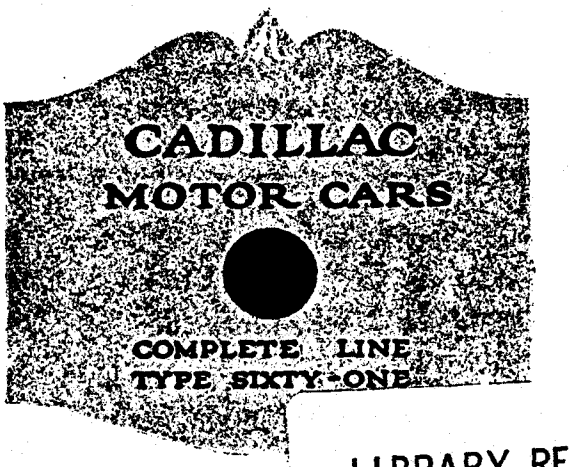
CADILLAC
Miscellaneous
General

~~nrd.~~ 1421 - Cadillac motor cars- complete line- type 61.



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EACH succeeding year sees a higher standard by which motor cars of quality are judged. Because it has led for many years in fixing this standard, the Cadillac is looked upon as the measure of progress in the automobile art.

Type 61, which is the latest Cadillac, offers numerous advantages which strengthen this position of leadership. It retains, of course, those sturdy qualities of dependability, durability, and safety on which Cadillac reputation is built.

The lines of the new car are increasingly attractive while retaining the characteristics which have made a long succession of types distinctively Cadillac.

A larger hood, conforming to a higher radiator of more graceful shape, gives the impression of reserve power which the Cadillac possesses. The center of gravity has been lowered by use of smaller wheels, bringing the car closer to the ground with a long, low effect which adds beauty and distinction. This change, however, has been accomplished without reducing road clearance. With the lowered center of gravity comes an important advance in riding comfort and roadability. The new seats are of improved design in cars seating five passengers or less and these cars have the full length of wheelbase which is 132 inches.

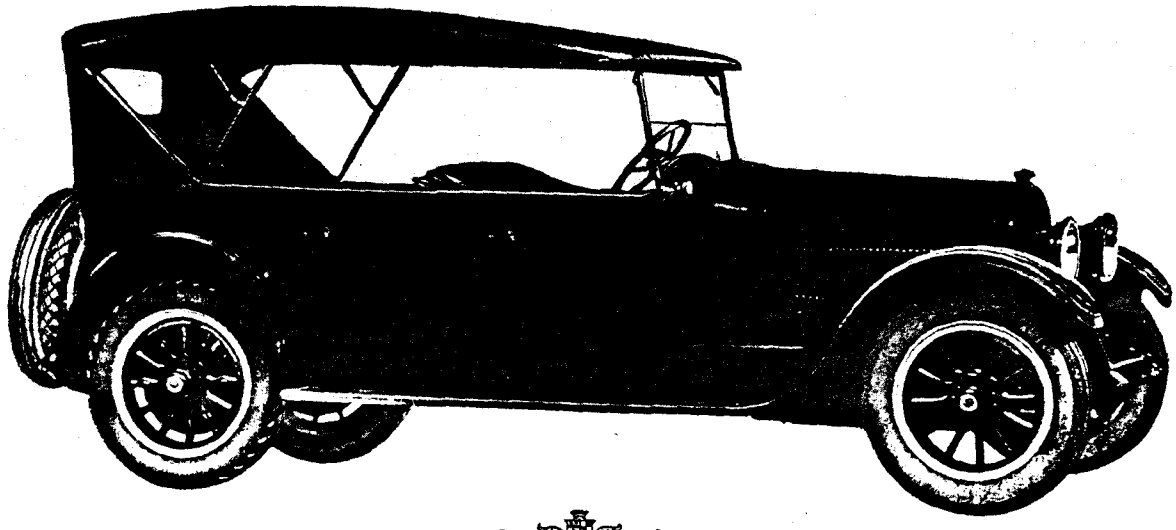
The Cadillac engine, long recognized as the finest example of multi-cylinder design, is now even more fully developed and matured. It provides more efficient starting in cold weather, more power for stiff grades, greater responsiveness in traffic and better economy for average driving conditions.

Contributing to this result is the new Cadillac carburetor with two-inch intake. Thermostatic controls, governing the auxiliary air valve spring and throttle pump, automatically enrich the mixture when the engine is cold.

Space does not permit of describing in detail the numerous refinements which distinguish Type 61. The steering wheel may be taken as a symbol of the craftsmanship which governs every detail of construction. It is made entirely of selected walnut even to the spokes. The rim is gracefully moulded to fit the driver's hands, which are free from contact with metal at any point.

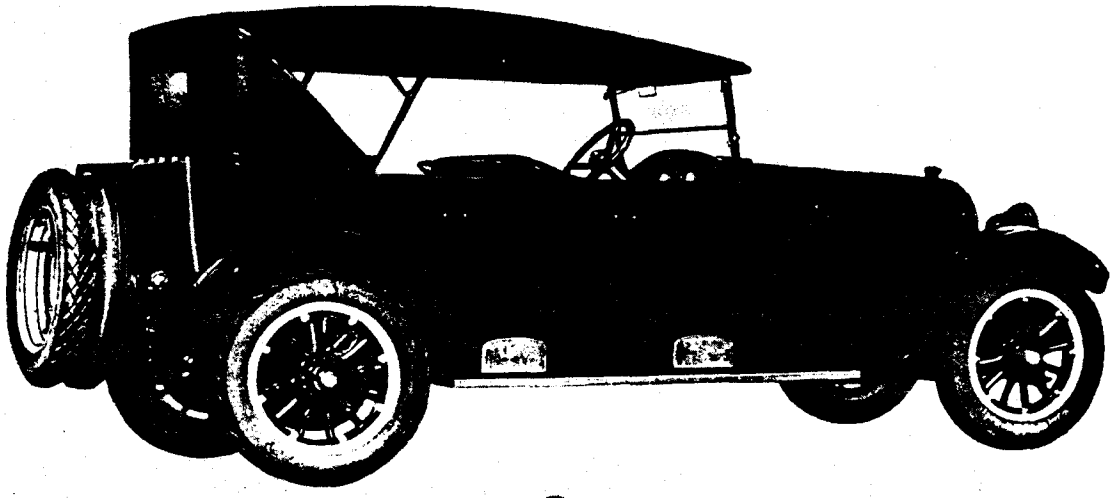
Two new and distinctive body styles have been added—the Landau Sedan, which resembles the sedan in arrangement of seats, and the five-passenger coupe, which is equally attractive and has a wide range of utility.

The complete line of Cadillac body styles is pictured and described on the ensuing pages.



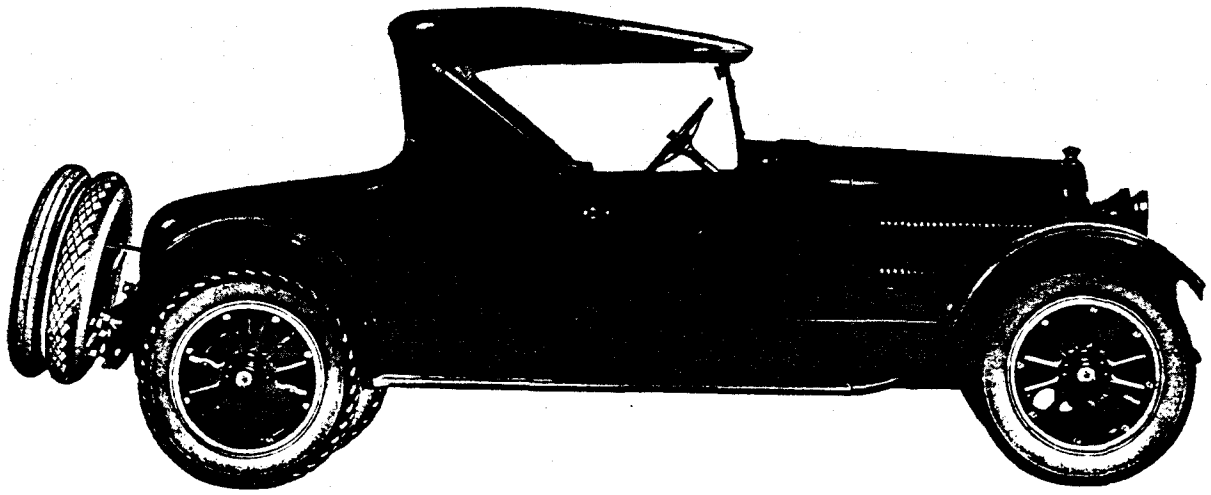
TOURING CAR • SEVEN PASSENGERS

The Touring is a handsome and roomy car suitable for town use, week-end trips and cross-country motoring. Like other Cadillac open cars, it is provided with snugly fitted storm curtains easily attached to swing with the doors. It provides complete riding comfort for seven passengers.



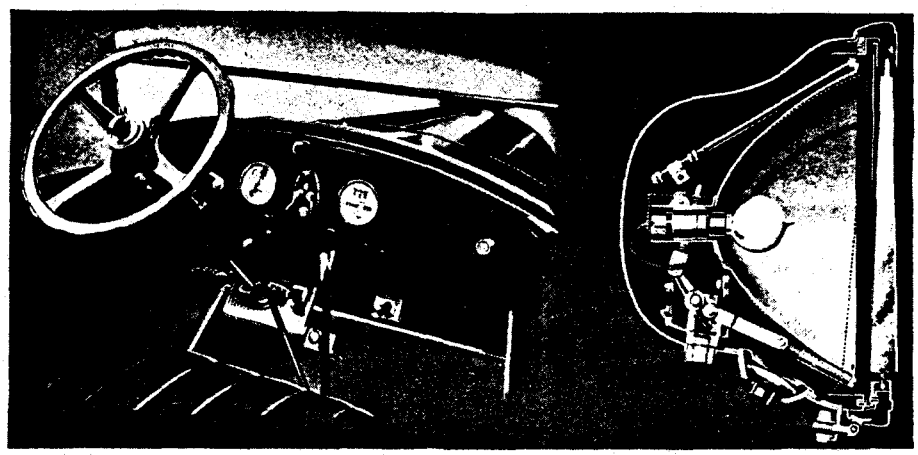
PHAETON • FOUR PASSENGERS

The Phaeton is a close-coupled open car especially designed for the small family group or club foursome. Trim and compact, it has exceptional roadability and there is a touch of raciness in its graceful lines. While nominally for four passengers, it contains ample room for five.



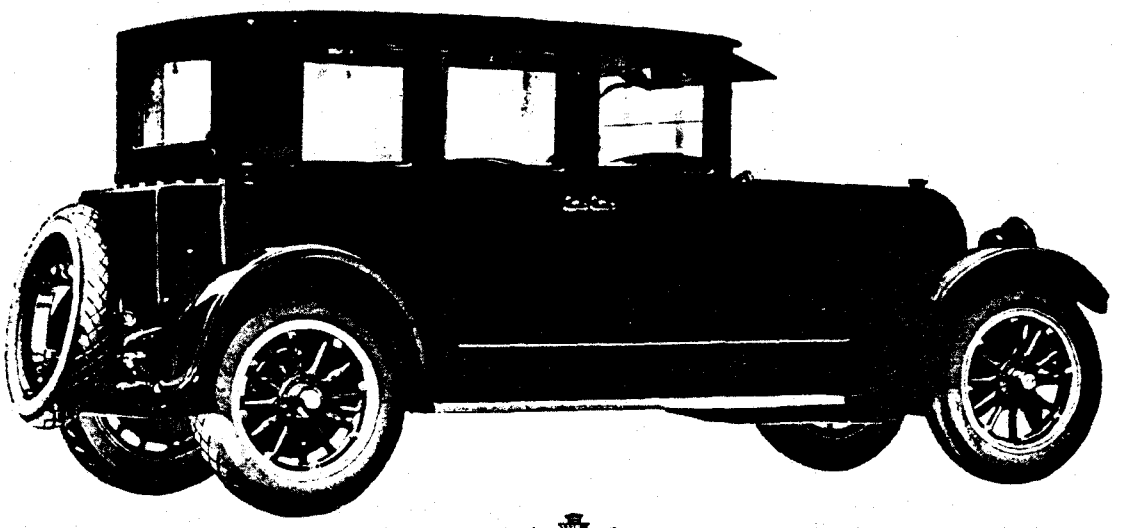
ROADSTER • TWO PASSENGERS

The Roadster ranks high in professional use. It appeals also to the business man who likes a fast drive to country club or suburban home. Its speed possibilities are indicated by its rakish lines. The roadster has a large luggage compartment under the rear deck. It will accommodate an extra passenger when desired.



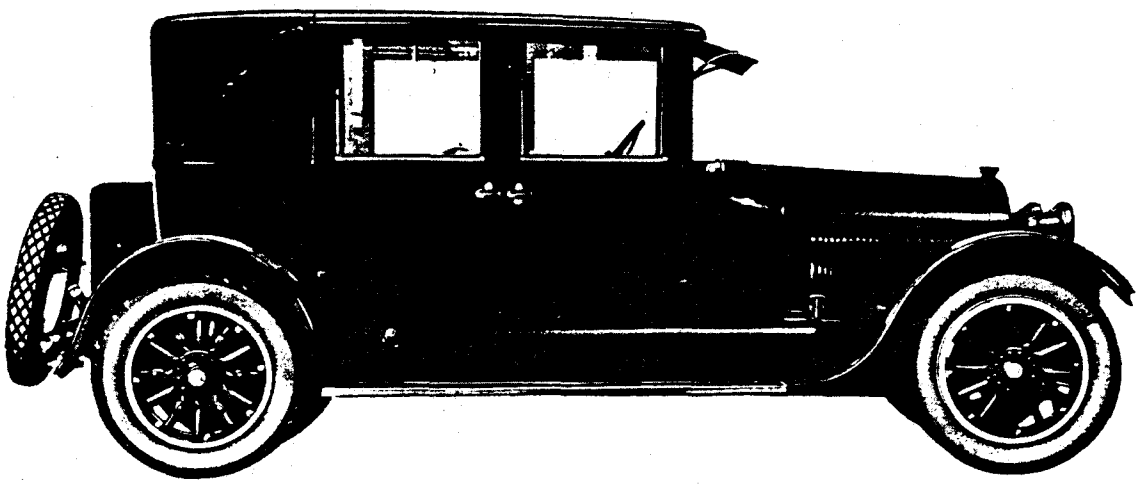
INSTRUMENT BOARD AND HEADLAMPS

The instrument board is one of the highly artistic and beautiful features of the new Cadillac. The oval center disc is jet black with the monogram finished in gold. The new headlamps, which are equipped with anti-glare lenses, are conveniently adjustable from the instrument board.



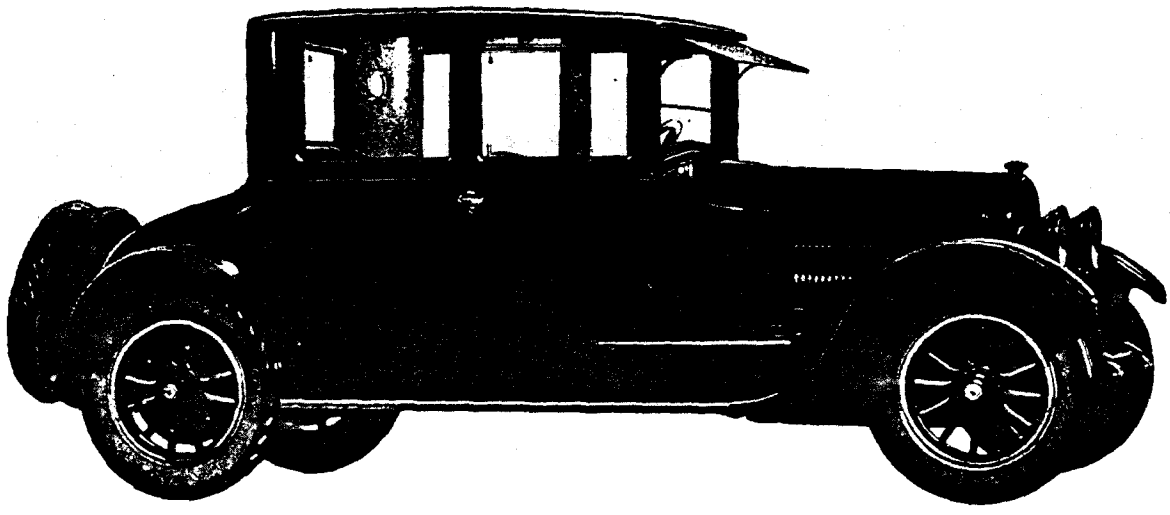
SEDAN • FIVE PASSENGERS

The Sedan is a single-compartment car seating five persons in complete comfort. It is suitable for general use which includes cross-country touring. At the rear is a small platform designed to carry either a trunk or two suitcases.



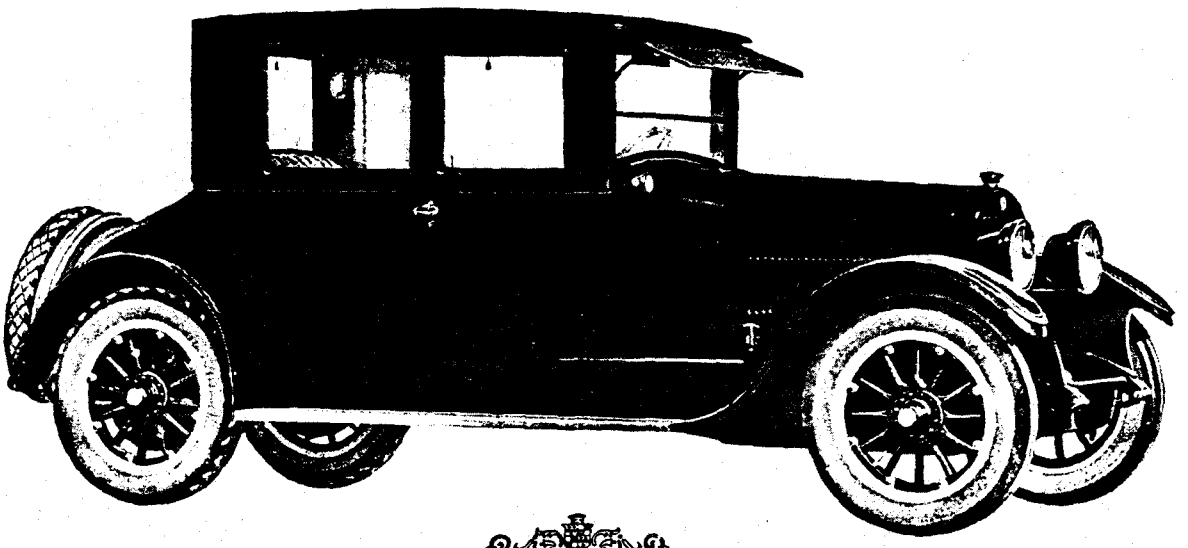
LANDAU ~ FIVE PASSENGERS

The Cadillac Landau is a recent addition to the Cadillac line. One of its distinguishing features is the landau construction of the rear section of the body, which is covered with straight grained leather of the highest quality. Interior furnishings and seating arrangement resemble those of the Sedan.



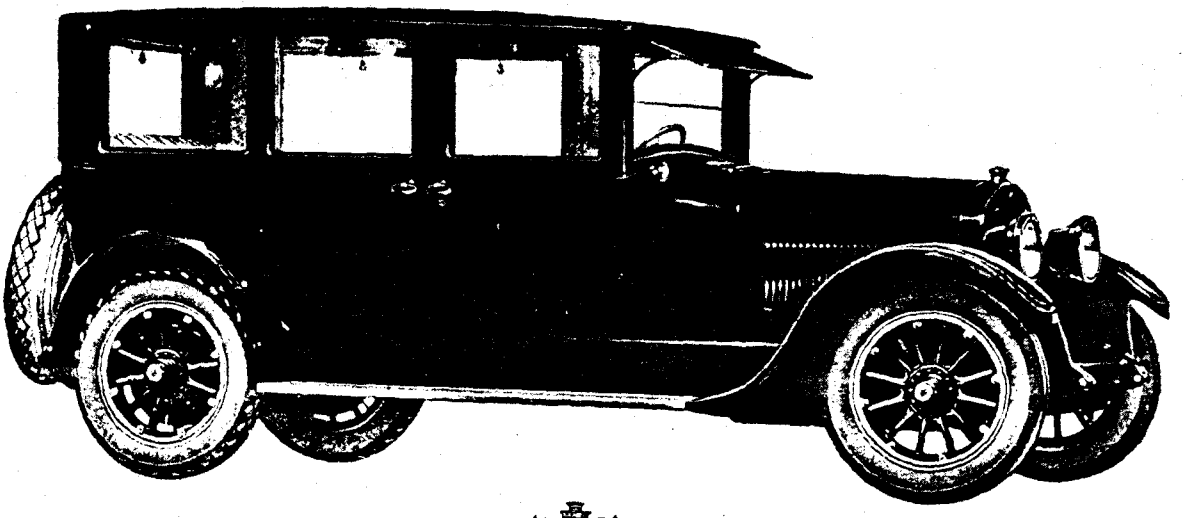
VICTORIA - FOUR PASSENGERS

The Victoria, in addition to other uses, is much admired as a town car for women. For social usage and shopping tours, the small group finds it unsurpassed. The extra folding chair is heavily upholstered and designed for comfort. The Victoria is equipped with rear corner reading lamps, and extra parcel compartment.



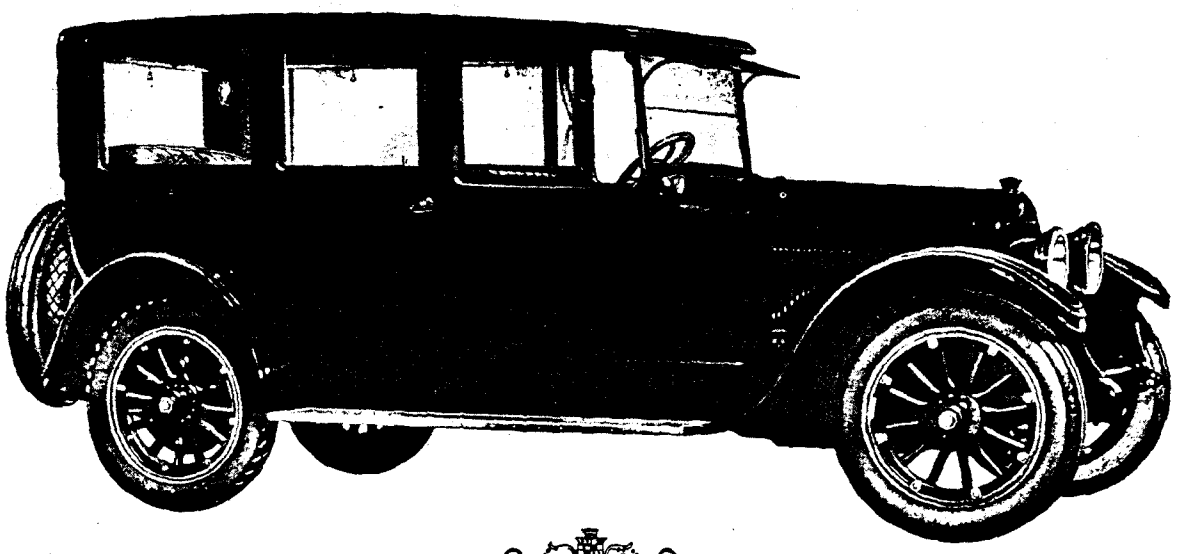
COUPE - FIVE PASSENGERS

An increasingly popular model is the Five-Passenger Coupe, another recent addition to the Cadillac line of enclosed cars. It is well suited to the use of professional men and is likewise an appropriate vehicle for women who drive. Entrance is facilitated by a movable front seat.



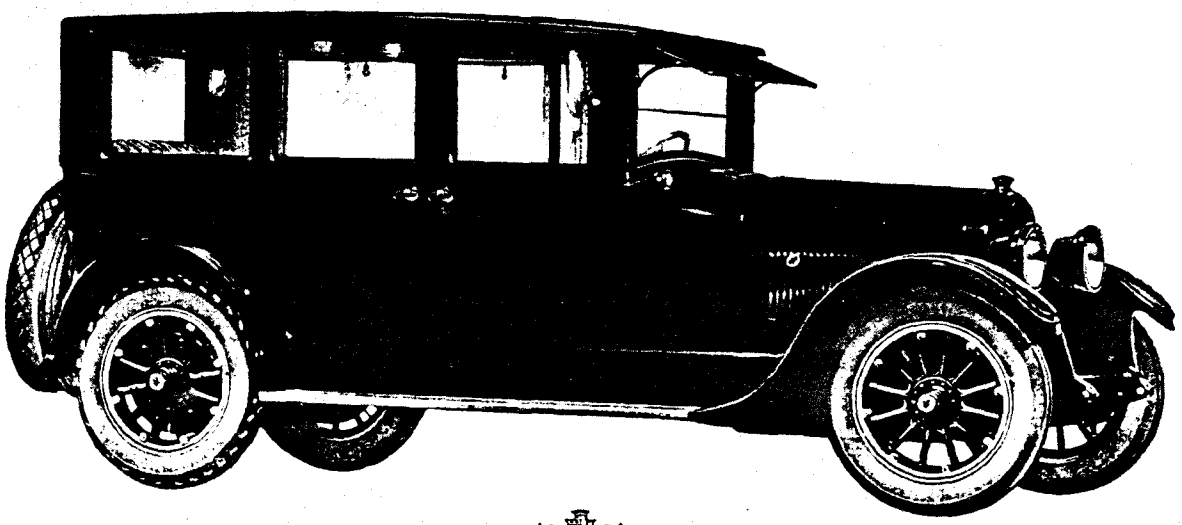
SUBURBAN • SEVEN PASSENGERS

The Suburban is a luxurious enclosed car designed primarily for the owner-driver who wishes to carry the maximum number of passengers. All occupants are seated in a companionable group. This model is notable for its riding comfort and the fine character of its coach work.



LIMOUSINE • SEVEN PASSENGERS

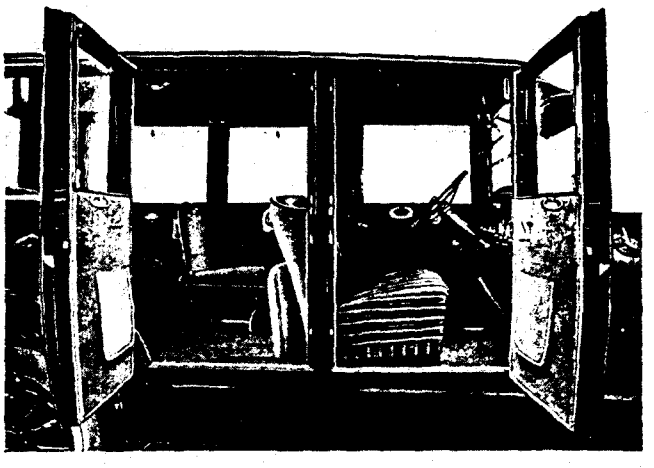
The Limousine is a chauffeur-driven vehicle of fine proportions and generally dignified appearance. The front compartment is open but in bad weather the driver is protected by storm curtains.



IMPERIAL LIMOUSINE - SEVEN PASSENGERS

The Imperial Limousine is a completely enclosed car of commanding appearance and luxurious riding quality. A glass partition in back of driver can be lowered, making it convenient either when the owner or when the chauffeur is at the wheel.





INTERIOR VIEWS

The magnificence, superb comfort, and good taste of interiors are shown by the above glimpses of the sedan (left) and suburban (right).

Specifications
of TYPE 61 CADILLAC

ENGINE—Eight-cylinder V-type, high speed, high efficiency. Engine and transmission built in unit, three-point suspension. Cylinders cast in two blocks of four cylinders each, with water-jackets integral; detachable heads. Three and one-eighth inch bore by five and one-eighth inch stroke. Piston displacement, 314 cubic inches. Crankcase, aluminum, copper alloy. Tungsten steel valves. Valve mechanism enclosed. Three-bearing crankshaft, all main bearings, two inches diameter, of chrome nickel alloy steel, special heat-treated. Main and connecting rod bearings of liberal dimensions; Cadillac special bearing metal, with bronze reinforcement. Single camshaft, six bearings. Camshaft and generator shaft driven by silent chains from crankshaft; chains adjustable.

HORSEPOWER—N. A. C. C. rating 31.25.

COOLING—Water, forced circulation. Jackets cast integral with cylinders, liberal water circulating space. Two centrifugal pumps, one for each block of cylinders, insuring proper water circulation. Radiator, Cadillac tubular and plate type. Fan driven by silent chain from camshaft. Water temperature governed by sylphon thermostats.

IGNITION—Cadillac-Delco, improved system. Current supplied by generator and battery.

LUBRICATION—Automatic pressure fed by gear pump. Oil forced to crankshaft and connecting rod bearings.

CARBURETOR—Cadillac, designed especially for this engine, insuring uniform gas distribution and maximum efficiency. Auxiliary air control to facilitate starting. Intake pipe, exhaust heated. Correct mixture controlled by thermostats.

CLUTCH—Multiple disc, dry plate type; seventeen high-carbon steel plates, seven and three-quarter inches in diameter. Driving plates are faced with a friction material composed largely of asbestos. Exceptionally soft and velvety in operation.

TRANSMISSION—Selective type sliding gear, three speeds forward and reverse. Chrome nickel steel gears and shafts. Aluminum case.

CRANKING DEVICE—Cadillac-Delco, improved, patented.

STORAGE BATTERY—Exide manufacture, designed especially for Cadillac.

DRIVE—Tubular shaft. Two universal joints.

BRAKES—One internal and one external brake direct on wheels, seventeen inch by two and one-half inch drums. Exceptionally easy of operation. Both equipped with equalizers.

STEERING GEAR—Cadillac patented worm gear sector type, adjustable, with ball thrust bearings. Eighteen inch steering wheel with walnut rim and spokes.

FRAME—Channel section, carbon steel, maximum depth seven inches; width thirty inches in front, thirty-three inches in rear; three tubular and two pressed steel cross members.

WHEELS—Wood, artillery type, with steel felloe, rotating on Timken bearings, fitted with demountable rims for straight side tires; special large steel hub flanges and substantial spokes.

CONTROL—Center control. Gear change lever and hand brake in center, set well forward, yet within easy reach. Service brake, foot lever. Clutch, foot lever. Accelerator, pedal button with foot rest. Throttle and spark levers at steering wheel. Auxiliary air control button, on instrument board.

FUEL SYSTEM—Twenty-gallon tank with gauge, at rear of chassis. Fuel forced by air pressure to carburetor.

AXLES—Rear, full-floating type; adjustable taper roller bearings; special alloy steel, live axle shafts. Spiral type bevel driving gears, machined with accuracy. Front axle, drop forged, special alloy steel, I-beam section with integral yokes and spring perches; drop forged tie rod ends and steering spindles, the latter fitted with adjustable taper roller bearings at the upper ends.

TREAD—Fifty-six inches.

SPRINGS—Front, semi-elliptic, forty-two inches long by two inches wide; rear, three-quarter platform; sides, fifty-four inches long by two inches wide. Rear cross, thirty-nine and one-half inches long by two inches wide.

OPEN BODIES—Roadster, two passengers; Phaeton, four passengers; Touring, seven passengers.

ENCLOSED BODIES—Coupe, five passengers; Victoria, four passengers; Sedan, five passengers; Landau Sedan, five passengers; Suburban, seven passengers; Limousine, seven passengers; Imperial Limousine, seven passengers.

FINISH—All open cars are finished in Cadillac green with standard black parts in black enamel. Enclosed cars have black upper panels and Brewster green lower panels with standard black parts in black enamel.

UPHOLSTERY—Touring car upholstered in extra heavy, dull finish, long grain leather. Phaeton and Roadster upholstered in heavy bright enameled black leather. Purchasers of enclosed cars have choice of finest mohair velours as upholstering material.

PRICES—On automobiles and parts are net, f. o. b. Detroit. No allowance will be made for any part of standard equipment if ordered omitted.

NOTE—The Cadillac Motor Car Company reserves the right to make changes or improvements at any time without incurring any obligations to install same on cars previously sold.

CADILLAC MOTOR CAR COMPANY

DETROIT

EVANS-WINTER-HEBB DETROIT

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CADILLAC 1921
Miscellaneous
General
~~3rd~~ 1921. Cadillac details of construction, type 61.



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CADILLAC

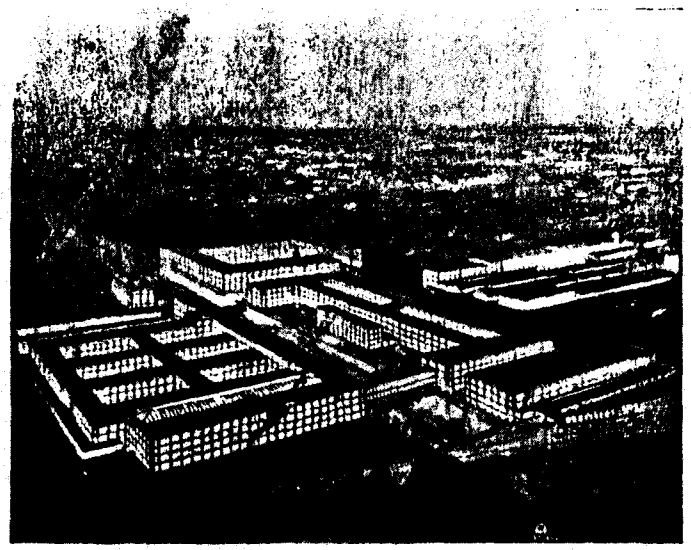
DETAILS OF CONSTRUCTION

Type 61



Edited by the Engineering Department of the

CADILLAC MOTOR CAR COMPANY
Division of General Motors Corporation
DETROIT, MICHIGAN, U. S. A.



Main Plant of Cadillac Motor Car Company, Detroit

PLANT site, 49 acres. Total floor area, 55 acres, or more than 2,250,000 square feet. Buildings, reinforced concrete, four stories with 14-foot ceilings. In addition, the Company operates two other plants in Detroit.

These vast new Cadillac works have been termed the most wonderful in the world devoted to the manufacture of high grade motor cars.

Such a plant is the just due of the Cadillac; and of the loyal craftsmanship which has labored long to bring it to its present high estate.

Visitors to Detroit are invited to see for themselves how the perpetuation of Cadillac standards is assured, and Cadillac reputation safeguarded, by the marvelously precise and efficient equipment of this remarkable plant.

Cadillac Details of Construction

EXPERT opinion in this country and in Europe has been unstinted in its praise of Cadillac's engineering. During the Great War Cadillac was made the official military and diplomatic car of several governments. Three times has it been awarded the coveted Dewar trophy. The honors that have been conferred upon it are numerous and signal. But, to our own mind, the finest of all the tributes that the years have brought to Cadillac is the frank admiration of motorists themselves.

For twenty years now, Cadillac has been built to serve. Its steadfast ideal has been to produce a mechanism so simple and easy in its operation, so faithful in its functioning, that it can be used in tranquil comfort by a clientele unversed in mechanical things.

This is an ideal not easy of accomplishment. Certainly it is not within the compass of any small group of men, nor to be achieved in a few months or years. Time alone can furnish the experience necessary to such perfection; many minds and countless hands must toil over the mass of detail involved.

So Cadillac's mechanical development is a long history; and Cadillac's endorsement by those it serves is a precious thing. The two are inseparable, for the one begot the other, slowly and surely as the years went by.

Now each Cadillac car, as it leaves the maker's hands, bears the impress of this patient diligence and of this cumulative experience. It is beautiful. It is luxurious. But best of all, it is a fine mechanism with tremendous capacity to serve.

What steels to use, what processes to follow, what precision to exercise, what designs to retain or to change, what new conditions to face in order to keep in the van of automotive progress—all these were problems for the Cadillac pioneers. And they are still problems calling for unceasing vigilance and resource, solved today only to be solved again next year, that Cadillac may maintain its leadership and its owners be better served.

Cadillac was the first manufacturer of motor cars to adopt the famous Johansson system of gauges, accurate to the one hundred-thousandth part of an inch. Cadillac was the first to produce a truly standardized car, winning the Dewar trophy three times as a result.

Cadillac was first to perfect the electrical system of starting and lighting; first to develop the V-type, high speed motor, and first to utilize thermostatic control of the circulation of the engine cooling medium.

And now Cadillac is first to introduce thermostatic control of carburetion, as exemplified in the new Type 61.

The vast amount of research occasioned by these developments still goes on, a hidden guaranty of Cadillac excellence always. The Cadillac of today is largely its product, replete indeed with many striking characteristics, but most remarkable for the uniform fitness of every part to render lasting service.

Each of these parts has been designed and built for Cadillac alone. Each functions perfectly as a unit, and harmoniously as a part of an intricate mechanism. In these pages is described each part to emphasize its individual quality, and to show that Cadillac is fine because its parts are fine.

Cadillac Type 61 Power Plant

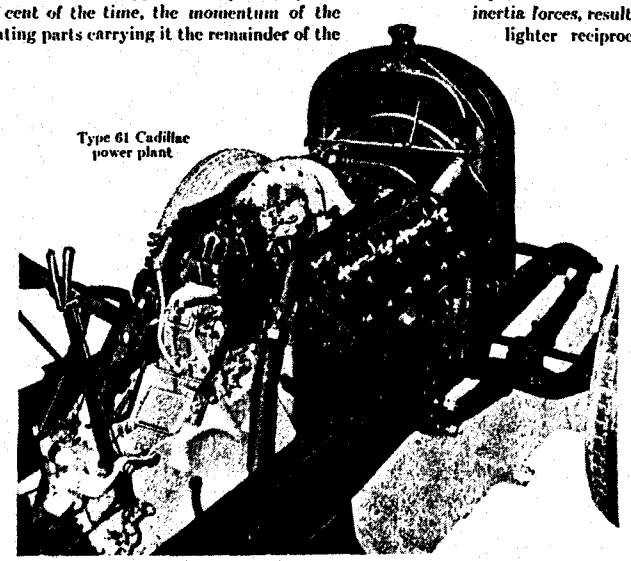
CONSTANT development year after year has resulted in the new Cadillac Type 61. A little over 125,000 Cadillac eight-cylinder engines are demonstrating their efficiency as automotive power plants. Numerous advantages are recognized as accruing from the Cadillac V-type eight-cylinder engine and show definite superiority as a method of automobile propulsion.

Impulses Frequent

1. More even turning movement, resulting from more frequent power strokes. In a four-cylinder engine turning force is being exerted on the crankshaft approximately seventy-five per cent of the time, the momentum of the rotating parts carrying it the remainder of the cycle. In the eight-cylinder engine the impulses overlap, so that not only is turning effort exerted on the crankshaft continuously, but for approximately fifty per cent of the time two or more cylinders are delivering power simultaneously. The result is a very flexible power plant which meets the slow speed requirements of modern city traffic without gear shifting, and which has fluent power for rapid acceleration to extreme speeds.

Light Reciprocating Parts

2. Low rate of wear and tear because of the less severe impulses and the reduction of inertia forces, resulting from the lighter reciprocating parts.



Type 61 Cadillac power plant

Higher Engine Speed

3. Higher engine speed, also made possible by the lighter reciprocating parts, and resulting in the development of a greater amount of power for the same displacement.

High Compression—High Efficiency

4. A greater efficiency made possible by carrying higher compression. One of the important efficiency factors is the compression pressure, which is, however, limited in practice by pre-ignition. The easier cooling of the smaller pistons of the eight-cylinder engine allows an increase in the compression pressure, without the rise in temperature from which pre-ignition results.

Short Engine, Roomy Body

5. Shortest possible engine of any of four or more cylinders with equal stroke and piston displacement—an advantage accentuated in the Cadillac by the use of opposite rather than staggered cylinders.

Crankshaft and Camshafts Four-Cylinder Construction

6. Most simple crankshaft and camshaft construction of any engine of more than four cylinders, all the throws of the crankshaft being in one plane.

Clean Valve Channel Very Accessible

7. Very clean valve channel, making for easy accessibility of the valves, and providing room for the carburetor, motor generator and distributor without crowding. It has a ninety-degree angle, since the angle between the cylinder blocks in a V-type motor with equally spaced impulses is dictated by the number of cylinders, the angle and accessibility decreasing with an increase in the number of cylinders.

These seven outstanding advantages have been accomplished in the Cadillac eight-cylinder V-type engine with a maximum of simplicity and a minimum of parts. It is reassuring to note the complete absence of any tendency toward unnecessary mechanical complication for the sake of freshening sales arguments by the appeal of the unique. With the benefit of a large experience in the building of more than 125,000 eight-cylinder automobiles, the remarkable degree of refinement in design and manufacture is logical and most marked.

The bore and stroke of the Cadillac eight-cylinder engine are 3⅛ by 5⅛ inches. The piston displacement is 314 cubic inches.

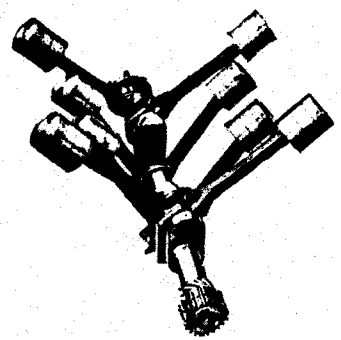
The engine design is such that very nearly maximum turning power is delivered over a wide range of speeds, resulting in a torque curve with an unusually flat peak.

Crankshaft

THE Cadillac crankshaft is a chrome nickel steel forging machined all over. Careful design, a fine choice of materials and careful machine work give it strength, accuracy and balance.

Short Shaft—Large Bearings

One of the principal determinants of its rigidity and strength is the favorable relation of bearing surface to unsupported length, made possible by the eight-cylinder V-type design. The length of the crankshaft between the outer ends of the forward and rear main bearings is only twenty-six and one-sixteenth inches, nine and three-quarters of



Crankshaft assembly with pistons

which comprise the three main bearings. The maximum length between bearings is only eight and one-fourth inches.

No other known type of automobile engine of four or more cylinders having equal piston displacement and stroke, will permit so short and rigid a crankshaft construction. In fact the crankshaft design in four and eight-cylinder engines is identical in number of throws, but the smaller cylinder bore of the latter makes possible a shorter shaft. By placing the cylinders in the two cylinder blocks directly opposite each other and using the forked connecting rod design, this advantage has been realized in the fullest possible measure.

Notwithstanding the fact that the chrome nickel steel of the crankshaft has a tensile and shearing strength double that of the usual carbon steel, the shaft has been given the large diameter of two inches. Its ample diameter and length of its bearing area eliminate noticeable engine vibration even at high speeds.

The forged steel flywheel is bolted and dowel-pinned to the flange on the rear end of the crankshaft. Gear teeth, with which the starter gear meshes, are cut on its circumference. Unnecessary weight is eliminated by six holes cut in its web.

The crankshaft, the flywheel and the clutch ring, which bolts to the flywheel, are accurately balanced.

The three main bearings, on which the crankshaft is supported, are of phosphor bronze, lined with special Cadillac bearing metal. In boring the inside of the bronze bearings, the tool leaves a grooved surface which effects an intimate union between the bearing metal and the bronze backing when the former is cast.

Connecting Rods

THE connecting rods, which transform a maximum thrust of approximately one and one-fourth tons per explosion on each piston, into the power of a smoothly rotating crankshaft, are drop-forged from special formula steel, and finished over their entire surface, reducing weight to a minimum, and insuring uniformity.

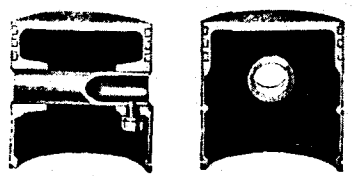
The connecting rods from cylinder blocks on each side of the valve channel connect with the four-throw crankshaft, the bearings of each throw taking care of the ends of connecting rods from opposite cylinders. To make it possible for opposite connecting rods to use the same bushing, one rod has a forked end, the end of the straight rod from the opposite cylinder fitting within the fork arms.

The bushing clamped in the forked rod has its bearing on the crankshaft, and the end of the straight rod has its bearing on the center portion of this bushing, upon which it oscillates. The angle of oscillation of the straight

connecting rod on the bushing is only between thirty-two and thirty-three degrees. The piston end of each rod is bushed with a phosphor bronze bearing, pressed into it.

The rods have I-sections with the web of the "I" in the plane of lateral motion. Where stress consistently remains in one plane, as in the case of the connecting rod, this shape is the lightest and strongest possible.

The ratio of rod length to stroke is especially great. Obviously the thrust of a long



Sectional view of piston

rod is more nearly direct than that of a short one, the angle of a long connecting rod with the line of centers being less at all points in the stroke. In thus reducing angularity by the use of a long rod, the thrust against the cylinder walls is appreciably less than with a shorter connecting rod design.

The connecting rods exemplify Cadillac manufacturing precision. The machining and finishing of one pair of connecting rods and pistons involve three hundred thirty-six operations. Two dimensions are held within the limits of three ten-thousandths of an inch; four within one-half thousandth of an inch; thirty-nine within one one-thousandth of an inch; twenty-eight within two one-thousandths of an inch and more than fifty within ten one-thousandths of an inch. More than 200 gauges and micrometers are used to insure that the pistons and connecting rods conform to the dimensions specified on the drawings.

Pistons

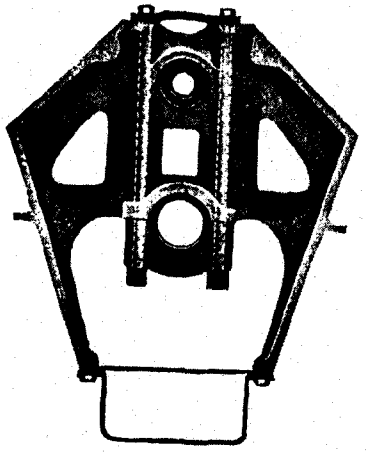
THE high speed and smooth running of the Cadillac eight-cylinder V-type engine are due principally to the reduction of inertia forces accomplished by the use of lighter reciprocating parts. In the pistons especially is evidenced the elimination of unnecessary weight, made possible by the less severe impulses and smaller cylinders which accompany the multi-cylinder design.

When one considers that in the modern multi-cylinder engine at high speed each piston travels at a tremendously high velocity and stops and starts more than eighty times per second, the relationship between speed and weight of the reciprocating parts becomes clear.

The pistons are of unusually light design, the entire eight pistons weighing no more than two pistons of the average four-cylinder engine with equal piston displacement. It is worth noting that in effecting this remarkably light design Cadillac engineers have adhered strictly to the use of the metals which have been scientifically demonstrated to be best adapted to the requirements. Gray cast iron alloy of Cadillac special formula is used. An interesting step is the annealing process, by which any internal strains which may have been left in the casting are relieved. The bearing surface of the pistons is ground to a limit of the one-thousandth part of an inch.

Three concentric piston rings are carried above the wrist-pin. Each ring has two small grooves cut in its circumference which entrap lubricating oil, rendering the seal against compression leakage more effective.

The wrist-pin is supported by bosses. A locking screw in one boss securely holds the wrist-pin from turning in the piston or moving



Sectional view of crankcase

longitudinally. The pin is of nickel steel, case hardened and ground to the limit of three ten-thousandths of an inch.

Crankcase

THE most striking characteristic of the Cadillac crankcase, or engine base, is its weight efficiency, with ample strength, rigidity and stability, and but a fraction of the size and weight which might be expected for an engine of the power of the Cadillac.

The material employed is a special copper alloy aluminum, with a strength-to-weight ratio more than twice that of an iron casting.

The design is such that "lazy weight" is reduced to a minimum, the same metal efficiently serving to resist stress and to enclose the crankshaft and camshaft.

Seven ribs brace the deep walls of the crankcase and support the crankshaft and camshaft bearings. The center and rear crankshaft bearings are supported by two ribs each.

The crankshaft bearing caps are not simply bolted to the supporting ribs, but are held in place over the bearings by through-bolts, eleven inches long, which pass between the ribs to the very top of the crankcase and share with it the tensile stress imposed by both the dead and live load of the crankshaft.

The crankcase is closed at the top by the coverplate which also serves to support the valve rocker arms; at the front by a coverplate, which also acts as one point of support for the engine; and at the bottom by a pressed steel oil pan. The rear end of the crankcase is closed by a coverplate, just forward of the flywheel. Ventilation is provided by breathers attached to underside of cylinder blocks.

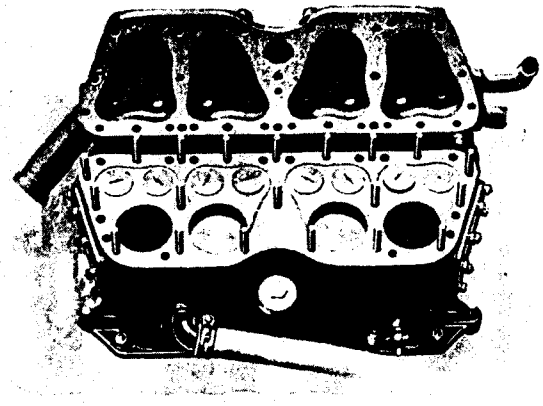
The Cadillac engine is supported at three points—two points at the rear of the crankcase, and the ball and socket joint on the front coverplate.

Cylinder Blocks

CADILLAC cylinders are cast en bloc, in fours, with detachable heads. Both inlet and exhaust valves are on the same side of the combustion chamber—commonly known as the L-head arrangement.

Each cylinder block includes water jacketing, intake manifolds and valve spring compartments.

This construction has distinct merits. It is compact; the L-head arrangement permits all of the valve mechanism to be placed on the same side of the cylinder block. It is simple; the exposed water and gas connections are few; it is light and permits great accuracy in the alignment of cylinders.



Side view of engine, showing detachable head removed from right hand cylinder block

Detachable Heads

The separately cast head members permit the accurate profiling of the combustion chambers. This results in more uniform compression, and the smoothly machined surface reduces the tendency of carbon to adhere. Every part of the cylinder or combustion chamber with which the exploding gas comes in contact is machined.

Valve caps for access to the valves being unnecessary, the spark plugs are set directly in the head and surrounded immediately by the water jacketing.

The accessibility to combustion chambers and valves, made possible by the detachable head construction, is highly appreciated from the standpoint of engine service.

Casting of the cylinder heads separately renders it possible in manufacturing to have access to both ends of the cylinder bore, permitting use of the plug gauge in both ends of the cylinder. Greater accuracy is the result.

Each cylinder head is secured to the block by twenty studs. The surfaces of the block and the head are ground, and between them is a copper-covered asbestos gasket, which prevents the leakage of gas or water. Openings in the gasket permit the free passage of water from the cylinder block to the cylinder head.

A gray cast iron alloy of Cadillac special formula gives the proper even distribution of carbon particles necessary for the glass-like surface of the cylinder walls.

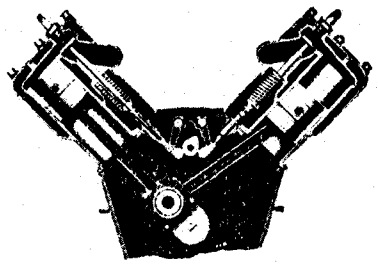
The cylinder block casting itself is an ingenious piece of work, made possible by advanced foundry methods. The ends of the

blocks have large openings, closed by coverplates. These openings make it possible to rigidly support the core at each end when casting, thereby insuring uniformity in the thickness of the cylinder walls.

Constant precautions are taken to insure that the cored water passages are cast clean and without obstructing projections.

Both left and right blocks are cast from the same patterns, and with the exception of the water connections are interchangeable.

Each cylinder block is bolted to the aluminum crankcase with ten studs, dowel-pins insuring the accurate location of the blocks.



Sectional view through intake valves, showing details of valve system

Valve System

THE Cadillac eight-cylinder V-type design permits a simple and unusually quiet valve mechanism. The single camshaft has but eight cams, each operating two of the sixteen valves. It is positioned directly above the crankshaft, and driven from it by a silent chain. Its six bearings constitute more than one-third of its overall length.

The camshaft is a drop forging with integral cams. To eliminate weight as far as consistent with required strength, the shaft is hollowed. Each valve is actuated by a rocker arm, carrying a hardened steel roller which rides upon the cam. The rocker arms are pendant from shafts, supported from the underside of the crankcase top coverplate. They are bushed with replaceable bronze bearings.

The motion of the valve rocker arms is transmitted to hardened steel pushrods with adjustable tappets, and passed on to the valve stems.

The Cadillac poppet valves are forged from high quality tungsten steel. They are of integral design, as contrasted with the built-up construction with a separate stem.

The diameter of the valve opening is approximately one and eleven-sixteenths inches.

The valve stems have their bearings in guides four and a half inches long, pressed into the cylinder blocks. This length prohibits even the possibility of destructive wear at this point.

The valve springs are of the highest quality tempered spring steel. They exert their pressure upon valve feet which are held in place by split tapered collars, that fit into grooves cut in the lower end of the valve stems. This refinement facilitates the removal of valves or valve springs.

The valve springs and push rods are protected by four coverplates, which are readily accessible from the ninety-degree valve channel.

The valves are easily timed by reference marks stamped on the rim of the flywheel and an indicator attached to the crankcase.

Fuel System

FAVORABLE location of the storage tank and positive transfer of the fuel to the carburetor, at the rate required, are the principal reasons behind the adoption and continued use of the pressure feed system of Cadillac cars.

Gasoline Tank

By placing the tank at the rear of the frame the supply of fuel may be more easily replenished, greater freedom of body design is possible, the factor of safety is greater and the passengers are relieved of fuel odor usually attendant upon the forward location of the tank.

Tank Holds 20 Gallons

The 20-gallon tank is of Terne plate steel, rectangular in section. Its interior is trisected by two partitions, which minimize splashing of the contents. Its size gives an ample carrying radius; gauge registers the contents in gallons. The tank is filled conveniently through a large inlet, covered by a filler cap, which may be easily applied and removed by hand. A thumb screw of convenient size at the top of the cap easily makes possible an air-tight joint.

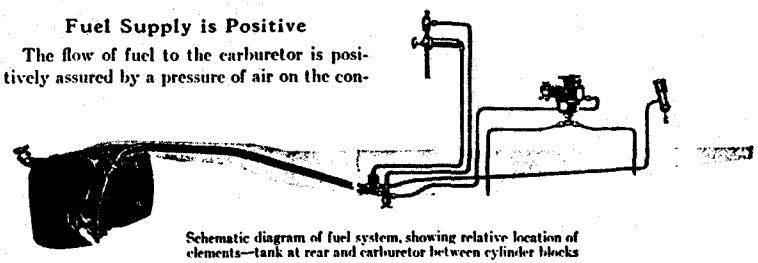
Fuel Supply is Positive

The flow of fuel to the carburetor is positively assured by a pressure of air on the contents of the tank, which is automatically maintained between one and two pounds per square inch above atmospheric pressure. There is no dependence upon pressure below atmospheric, or upon an auxiliary tank.

The air pressure which forces the gasoline from the tank to the carburetor is furnished by an air compressor, supported on the front coverplate of the engine and driven by an eccentric on the camshaft. The pressure relief in the air line prevents the pressure from rising above a predetermined point. This precaution is especially valuable to users of the volatile casing-head gasoline. An auxiliary air pump and gauge which indicates the pressure in the gasoline line are located on the instrument board.

Fuel Strained

Thorough cleansing of the fuel affords maximum protection against the admission of impurities or water into the carburetor. Two settling chambers and three strainers between tank and carburetor purify the engine fuel before it enters the mixing chamber. This is especially appreciated when one is at the mercy of some roadside fuel stations.



Schematic diagram of fuel system, showing relative location of elements—tank at rear and carburetor between cylinder blocks

Carburetor

Cadillac Designed and Built

IN ITS design, the Cadillac carburetor has been properly considered as functionally an integral part of the power plant. It is designed by Cadillac engineers to meet every requirement of the Cadillac eight-cylinder V-type engine, and is manufactured in the Cadillac factory.

Engine flexibility is due not only to the continuous torque made possible by the eight-cylinder design, but to the quick responsiveness of the carburetor in supplying the correct fuel mixture for varying loads and speeds.

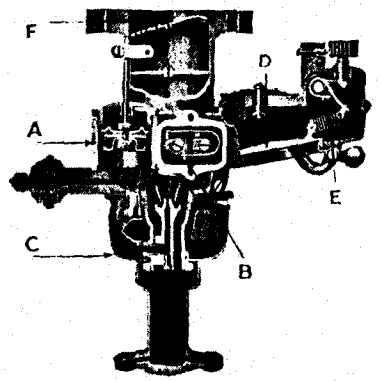
The use of fuel in the Cadillac carburetor is surprisingly efficient, the practical limit of economy being *in-built* as an element of the design, eliminating so-called "vaporizers," and "gas-saver" accessories.

The carburetor, located between the cylinder blocks, is of the air-valve, single jet type, but with a number of exclusive features.

The float bowl is directly under and concentric with the mixing chamber. With this construction the float maintains the fuel in the spraying nozzle at the proper level, no matter at what angle the car is driven. Consequently the mixture is not affected as it is liable to be when the float bowl is located at one side of the mixing chamber.

The auxiliary air supply, by which the correct mixture is automatically maintained at all speeds and throttle openings, is controlled by a leather-seated swing valve, governed by an adjustable spring, under light tension.

Two thermostatic elements are embodied in the Type 61 carburetor. One thermostatic device controls the action of the auxiliary air valve. The second thermostatic element regulates the action of the throttle pump to compensate for the changes in temperature.



Sectional View of Carburetor
A—Throttle pump. B—Throttle pump control and vent control thermostats. C—Concentric float chamber. D—Swinging air valve. E—Swinging air valve spring control thermostat. F—Automatic throttle

Throttle Pump for Quick Acceleration

The requirement for a mixture of additional richness at the moment of acceleration is met by a plunger pump, operated from the throttle shaft, forcing the necessary extra fuel through the spraying nozzle. When the throttle is opened slowly this device has no effect on the amount of fuel fed into the mixing chamber, but when the accelerator pedal is depressed quickly the pump operates in the manner described. A larger spraying nozzle would admit sufficient fuel at the moment of acceleration, but provides too large an opening for other conditions.

Besides the usual butterfly throttle valve, a second valve under spring tension is placed just above the main throttle to prevent the fluttering of the auxiliary air valve when running slowly with the throttle wide open.

Exhaust Heated Intake

COMPLETE vaporization of the present low grade gasoline is provided for in the Cadillac engine by an exhaust heated intake manifold.

The gasoline now obtainable does not vaporize readily, having a tendency to condense and cling in drops on the walls of an intake manifold and leak past the pistons, destroying the lubricating qualities of the oil in the crankcase. The practice of supplying hot air to the carburetor serves to vaporize the gasoline more thoroughly. Heated air, however, is thin, and lacks the power contained in unheated air.



Intake header is heated direct from exhaust manifolds

The Cadillac intake manifold is jacketed immediately above and beyond the carburetor. By the application of heat at this point that part of the mixture which normally would condense and lodge as vapor on the walls of the intake manifold comes in contact with a warm surface and remains a part of the explosive mixture which enters the cylinders. Moving swiftly through this heated area the volume of mixture as it comes from the carburetor is not affected in temperature.

The method of applying exhaust heat to the intake manifold walls is efficient and direct. The outward passage of gases sets up in the exhaust manifolds an alternate condition of high and low pressure. Successive explosions in the Cadillac engine occur in opposite cylinder blocks so that when the pressure is high in one manifold it is low in the manifold opposite.

A passage connecting the two manifolds also incloses the intake header. The difference in pressure sets up a surging action between the two manifolds which draws the hot exhaust gases through the passageway as soon as the engine is started. This immediate application of heat at the vital point in the fuel system gives good carburetion in a cold motor almost instantly.

The Exhaust System

Two Manifolds—Two Mufflers

EACH block of four cylinders has its individual system, insuring the rapid conduction of the spent gases away from the cylinders.

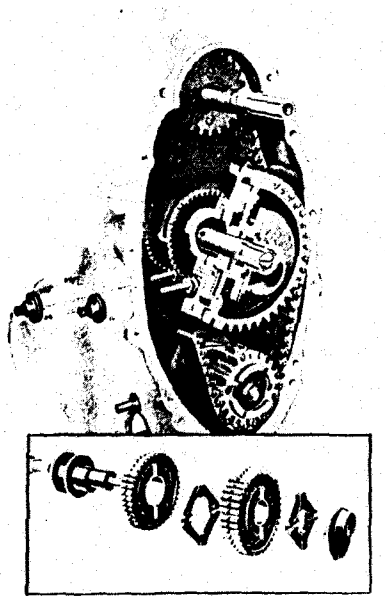
The hot gases released by the exhaust valves enter the exhaust manifolds, one of which is bolted to each cylinder block, and pass through asbestos-covered pipes to the mufflers.

The two mufflers, one suspended from each sidebar, effectively silence the explosions of the eight cylinders. Through a patented design, back pressure is reduced to a minimum. Their construction is such that they may be easily disassembled.

Tail pipes conduct the exhaust gases from the mufflers to the extreme rear of the car.

Timing Chain Adjustment

SILENT timing chains have been used on Cadillac engines since the 1912 season. They have the advantage of being quieter than the gears which they replace, and they retain this quietness throughout their life. The chain adjustment provided on the Type 61 engine adds to the life and efficiency of Cadillac timing chains.



Timing chain adjustment showing parts and how they function

Operation

The two camshaft sprockets rotate on two cylindrical surfaces mounted eccentrically on a hollow support, which projects from the front of the crankcase. This support is clamped in position by means of a toothed clamping collar on the rear side of the crankcase wall.

A toothed adjusting flange provided on the hollow support just in front of the crankcase wall, makes it possible to turn the support, after the clamping collar is loosened. The clamping collar and the adjusting flange are each operated and controlled from the outside of the crankcase by means of a shaft and a worm gear.

The front end of the camshaft passes through and has its bearing in the hollow support for the camshaft sprockets.

Universal Drive

The forward camshaft sprockets are driven by a silent chain from the crankshaft sprocket. The camshaft is driven from the forward camshaft sprockets through a universal cross and a driver splined and pinned to the front end of the camshaft. Another universal cross drives the rear camshaft sprockets which in turn drive, through a silent chain, the fan and generator shaft.

Since the camshaft gears are set eccentrically on their support, the center distances between crankshaft and camshaft sprockets, also between camshaft and fanshaft sprockets may be changed, within limits, to take up slack in the chain. By means of this mechanism, it is possible to compensate for chain wear which would naturally result after a long period of service.

The Ignition System

NO matter how precise the results of carburetion, power cannot be developed from a correct fuel mixture unless ignited in the cylinders without fail and at the proper instant. For this reason, no other part of the automobile has been the subject of so much research as the ignition system, and none has so bewildered and mystified the driver of a car.

Simple—Reliable

The Cadillac engine has a single ignition system of the Delco high tension type, a simple high grade and reliable design embodying the following elements:

A source of current, the generator, or, at low speeds, the storage battery.

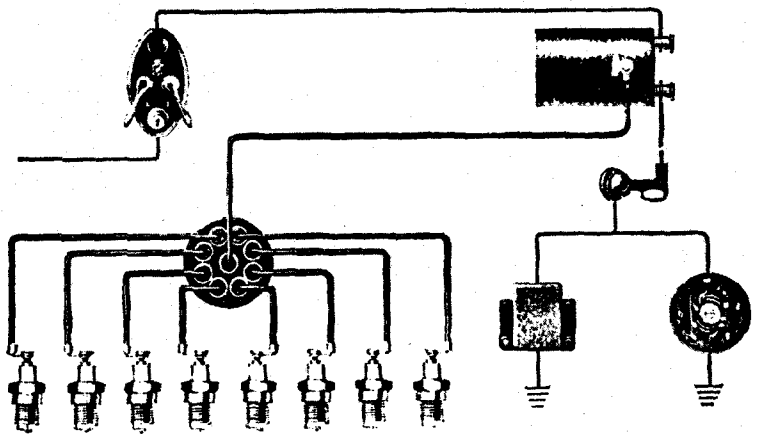
An ignition timer, which interrupts the low tension current at the proper instant to produce a spark in the high tension circuit.

An induction coil, transforming the primary current of six volts into one of sufficient voltage to jump between the points of the spark plugs.

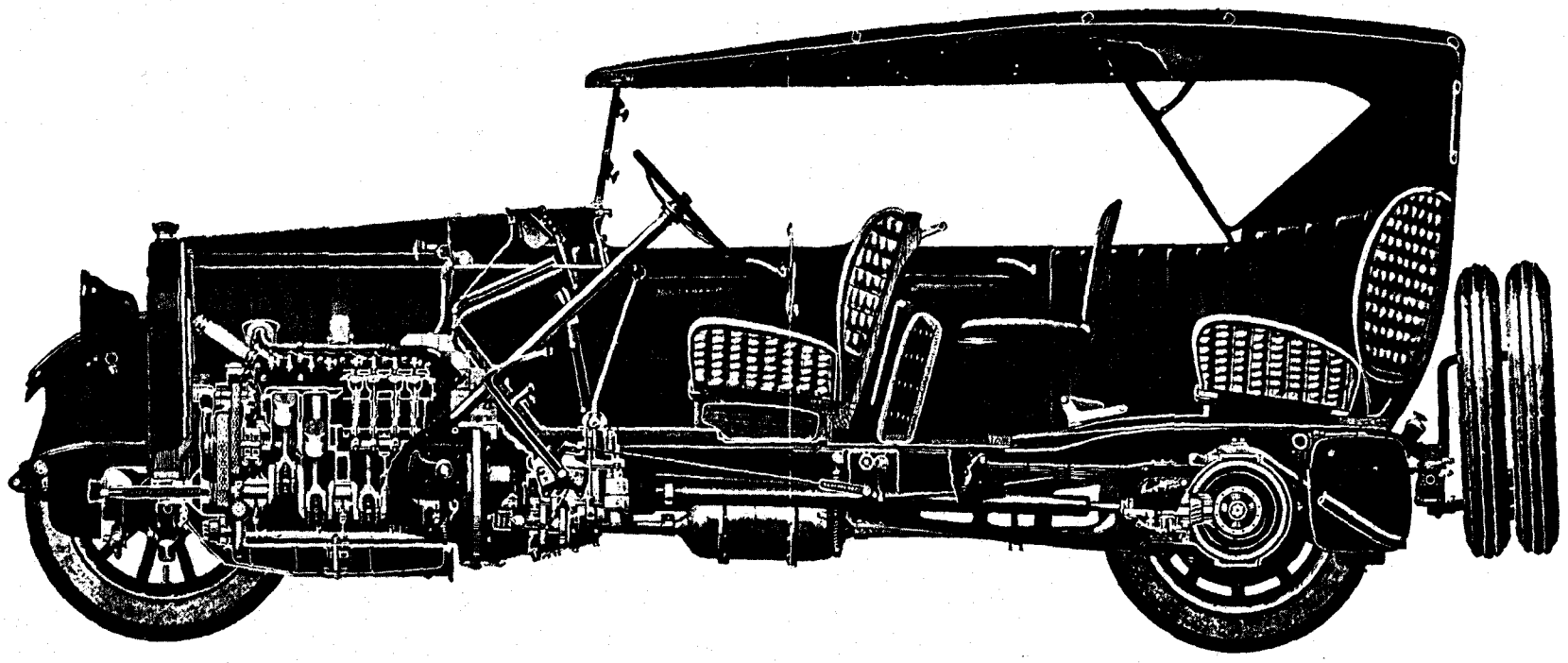
A condenser, which assists the induction coil to raise the voltage, and which protects the contact points of the ignition timer against burning.

A high tension distributor, which directs the distribution of the high tension current to the spark plugs in the respective cylinders.

A resistance unit, which protects the ignition coil and timer contacts from injury should the ignition circuit remain closed for any considerable length of time with the engine not running.



Elements of ignition system, showing its simplicity. Source of current: storage battery and motor generator



Type 61 is a thing of joy to those who appreciate the fine points of design and construction. If the car is dissected in such a way as to show the interior, it would look like this picture. The motor has been cut in two ways: the first, through the center of the cylinder block, to show the pistons; the second, cut deeper in the cylinder block, to show the valves. The clutch, transmission, and differential are shown in detail.

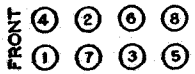
Structurally, the ignition timer, the distributor, the condenser and the resistance unit constitute a single assembly, which is bolted to the rear of the fanshaft housing.

Double Set of Contact Points

The ignition timer, which is driven by a vertical shaft through spiral gears from the fanshaft, has two sets of contact points. These share between them the current which would otherwise pass through one. The tendency to spark and corrode the points is ordinarily proportional to the amount of current passing through them. Thus, the use of two sets greatly adds to the life of each.

The *primary current* is interrupted by the timer contacts four times for each revolution of the engine, producing at each break of the primary current a high tension current, which is directed by the distributor to spark plugs in the respective cylinders. The distributor is located directly above the timer, and on the same shaft.

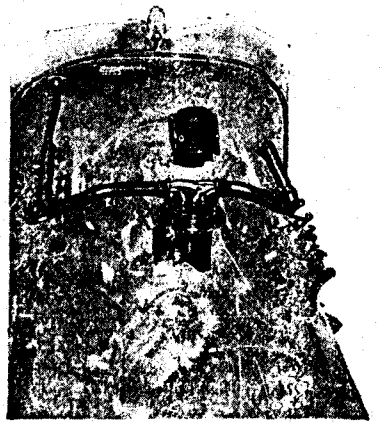
The firing order of the cylinders is as follows.



Automatic Spark Control

One of the many steps taken by the Cadillac to make driving entirely pleasurable, free from constant attention to details, is the automatic spark control, which relieves the operator of practically all spark lever manipulation. A ring type centrifugal governor is a part of the timer assembly. The ring changes its angle with the speed of the engine, advancing or retarding the position of the timer cam relative to its driving shaft.

The wiring of a car, if not thoroughly protected, even beyond all apparent need, will



Timer, distributor, condenser and resistance form one easily accessible unit

prove a source of constant annoyance and expense through current leakage. The wiring which, in the Cadillac, carries the high tension current to the spark plugs, is housed in brass tube conduits, with black nickel finish. The ignition cables are visible only at points of connection to the spark plugs. Cores of the cables are concentrically stranded copper wires tinned, and built up with a wall of extra grade insulating rubber, to the diameter of three-eighths of an inch.

The Cooling System

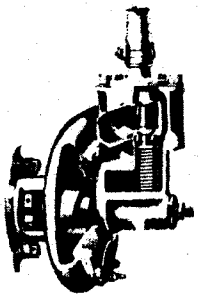
THE temperature of the Cadillac engine is maintained at the point of maximum efficiency and smooth running by forced water circulation, thermostatically controlled. The cooling system is thus considered not alone with respect to the prevention of over-heating, but with a view to obtaining uniformity of temperature for all conditions. Cooling efficiency and reliability have been a determining factor in the sale of many Cadillac cars.

The water jackets are cast integral with the cylinder blocks, and with the detachable cylinder heads. The construction also provides for an unrestricted waterway around the combustion chambers and valves. Removable plates at the ends of the cylinder blocks permit the flushing out of the passage for any possible sediment.

Two Pumps

Circulation of water through the radiator and water jackets is maintained by two centrifugal pumps, one for each block of cylinders, located at the front end of the engine.

The impellers are connected by a cross shaft, driven from the crankshaft by helical gears just forward of the front main bearing. The flow of water in the jackets follows the natural convection currents. The hottest water, which surrounds the combus



Water pump assembly showing pump impeller, thermostat and the valve which it controls.

tion chambers in the head, is thus the first to be removed to the radiator, and cooled.

Thermostatic Control

Thermostatic control of motor temperature was developed and first employed by the Cadillac Company.

A balanced valve and a thermostatic member are housed and mounted on each pump. The thermostat itself is a bellows-like container, partly filled with a liquid which, when heated, is transformed into a gas. The resulting pressure elongates the thermostat, forcing the valve from its seat.

Connections to the thermostat housing allow the pumps to draw water from the radiator and the cylinder blocks.

When the engine is cold, the thermostat valves are closed, and the supply from the radiator is cut off. The water then is circulated only through the water jackets of the cylinders and heads. Because of the fact that the amount of water to be heated is relatively small, the temperature of the cylinders quickly rises to the point at which the engine operates best.

As soon as the temperature of the water in the water jackets reaches the predetermined point, the thermostats force open the valves and allow only sufficient cooled water from the radiator to enter to keep the temperature down to the predetermined point.

Chilling of the engine by cold air from underneath is prevented by the long splash pan, which extends from the radiator the entire length of the engine.

Radiator Construction

The copper tubular and plate radiator embodies but four elements—the upper and

lower tanks, the vertical tubes, and the horizontal plates. The construction is such that there is a positive metallic connection between each tube and each plate, insuring the rapid conduction of heat away from the tubes.

Two heavy spiral springs absorb any strains which might be transmitted to the radiator from the frame. The strainer in the filler cap is easily removable for cleaning.

A six-bladed fan is driven at engine speed from the camshaft, by a silent chain. A friction clutch, under spring tension, allows the fan to slip at high speeds.

The capacity of the system is approximately six gallons.

Condenser Holds Winter Solution

A condensing device, protected by patent rights, renders it possible to use with safety the inexpensive alcohol solution as an anti-freezing cooling medium. A condenser of simple construction is attached to the frame, and is connected by a tube to the overflow which runs from the upper tank of the radiator.

Alcohol vapor driven out of the solution by heat, as well as any water vapor, is restored to liquid form in the condenser. When the radiator cools, the vacuum produced by the contraction of its contents automatically causes surplus liquid in the condenser to return under atmospheric pressure to the radiator

Another result, a by-product, but nevertheless appreciated, is the conservation of the contents of the cooling system when simply water is used. It is not an unusual occurrence for condenser-equipped Cadillacs to be driven very long distances in warm weather and under heavy loads without appreciable diminution of the water supply

The Engine Lubricating System

Pressure Circulating System

THE engine is lubricated by the pressure circulation system, employing a gear pump. As contrasted with delivering oil in measured quantities at the bare rate of consumption, the principle is that of a continuous circulation between the moving surfaces in contact.

The oil supply is carried in the pressed steel reservoir, which closes the under side of the crankcase. Baffle plates divide the reservoir space into four compartments to prevent splashing.

Gear Pump

The gear pump is driven from the water pump shaft through helical gears. The pump draws its supply from the central and deepest compartment of the oil pan, insuring that the suction pipe is immersed in oil, regardless of the angle of the car.

Leads to All Bearings

The oil is forced by the pump to a manifold fitting, which runs the length of the crankcase, above the oil pan, and at the left. Leads to each of the main bearings from this manifold circulate oil to all crankshaft bearings.

Hollow Crankshaft

Oil passages drilled through the crankshaft conduct the oil from the main bearings to the connecting rod bearings. Oil forced from the connecting rod bearings is thrown by centrifugal force onto the cylinder walls and pistons, lubricating the cylinders and wrist pins.

Pressure Regulated

The pressure under which the oil is forced to the main and connecting rod bearings is controlled by a ball valve pressure regulator, located just behind the right hand block of cylinders. This regulator prevents the oil pressure from becoming excessive at high engine speeds, a condition which would cause oil to be thrown onto the cylinder walls in unnecessary quantities. It also insures positive lubrication at low speeds.

A gauge on the instrument board, connected to the pressure regulator housing, indicates the oil pressure.

Overflow oil from the regulating valve, forced into the hollow camshaft, is a source of supply for the camshaft bearings, the engine chains, chain adjusting mechanism and the gasoline system air pump.

The oil is delivered to the front end chains through holes in the rim. Lubrication is also supplied to the camshaft driving chain through a hole in the crankshaft sprocket. This hole connects with an oil duct in the crankshaft.

The helical gear on the pump shaft receives lubrication from the end of the crankshaft.

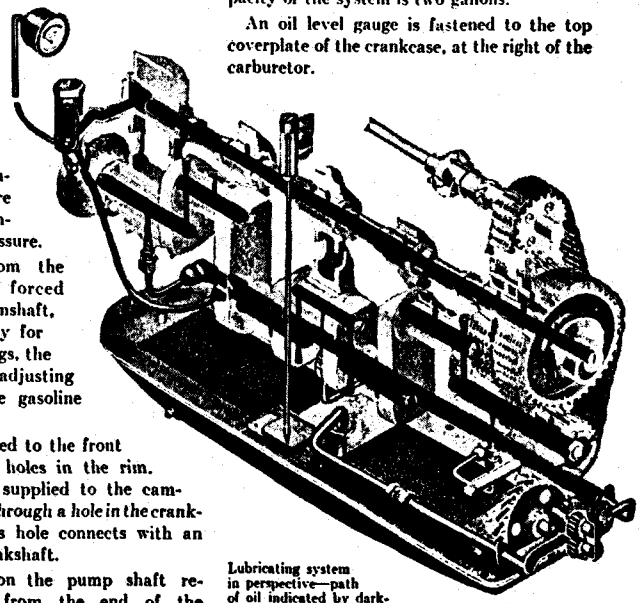
Valve Lubrication

The valve rocker arms are lubricated by oil entrained in cup-like depressions at upper ends.

All oil drains back into the reservoir through a fine wire gauze, interposed between the crankcase and the reservoir space.

Oil may be added conveniently through a filling well in the housing enclosing the fan-shaft driving chain, accessible by raising the right hood panel. The well is provided with a strainer, and closed with a threaded cap. Capacity of the system is two gallons.

An oil level gauge is fastened to the top coverplate of the crankcase, at the right of the carburetor.

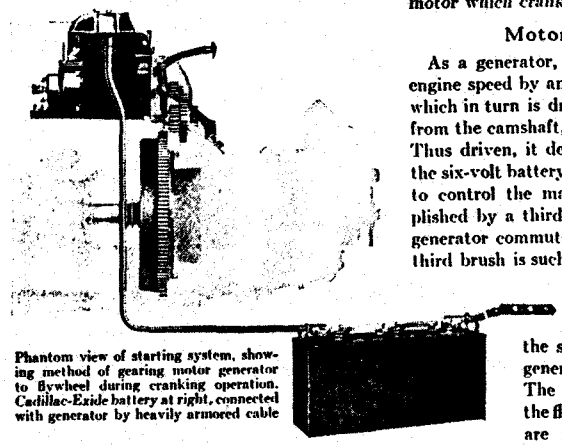


Lubricating system in perspective—path of oil indicated by darkened portions—oil level indicator and pressure gauge shown

The Starting and Lighting System

Starting, Lighting and Ignition, Cadillac-Delco

THE Cadillac-Delco starting and lighting system is the result of many years of effective co-operation between the Dayton Engineering Laboratories Company and the Cadillac. The single unit system, first installed on the 1912 Cadillac as standard equipment, is continued in the current model car as the most efficient type, lending itself most readily to compact design.



Phantom view of starting system, showing method of gearing motor generator to flywheel during cranking operation. Cadillac-Exide battery at right, connected with generator by heavily armored cable

Single Unit, Single Wire System

The units of the starting system include a source of current supply—a generator; a means of storing the current generated—a storage battery; and a method of applying the current to crank the engine—a motor. The motor and generator functions are combined in one unit—a motor generator.

A single wire system connects the different units, the circuit being completed through the frame. The principal components of the motor generator are the field and the armature. There are two windings on the armature and four field coils. One winding of the armature and two of the field coils are connected so as to form a shunt wound generator which furnishes current for charging the battery and for lighting, ignition, horn, etc. The other windings are connected so as to form a series wound motor which cranks the engine.

Motor Generator

As a generator, the armature is driven at engine speed by an extension of the fanshaft, which in turn is driven through a silent chain from the camshaft, at the front of the engine. Thus driven, it delivers current for charging the six-volt battery. The necessary regulation to control the maximum current is accomplished by a third or auxiliary brush on the generator commutator. The position of the third brush is such that the maximum charging rate is delivered at average driving speeds.

When acting as a motor, the sole function of the motor generator is to crank the engine. The armature is then geared to the flywheel by idler gears, which are meshed upon pressing the conveniently located starter button. Through the reduction gears the motor cranks the engine at eighty to ninety revolutions per minute under normal conditions. The hub of the larger idler gear contains an overrunning clutch, which prevents the armature from being driven at an excessively high speed the instant after the engine is running under its own power, and before the starter button is released.

The starter button also breaks the circuit between the generator windings and the storage battery, and completes the motor circuit by lowering the motor brushes onto the commutator. Meshing of the starter gears is facilitated by the slow rotation of the armature of the motor generator, which begins as soon as the ignition lever on the switch is turned to the "on" position.

The Storage Battery

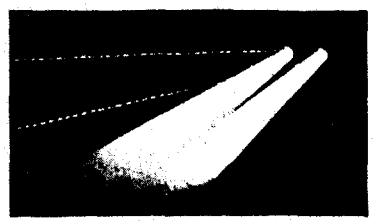
The Cadillac-Exide storage battery will give reliable and uninterrupted service and long life, having an overload capacity enabling it to perform without strain the sudden and severe task repeatedly imposed upon it in cranking an engine. Design and construction are particularly stout, heavy plate wood and rubber separators giving it a life, when properly cared for, that is equal to that of any other part of the car.

Cadillac Headlamps

ELECTRIC lighting was adopted first as standard equipment on the 1912 Cadillac which was announced in 1911. It follows naturally that Cadillac should lead in eliminating headlight glare which is objectionable.

Three principles of eliminating glare are in common use. The first of these, commonly known as "dimmers," eliminates glare by reducing the quantity of light at its source.

The second, known as diffusion, breaks up the parallel pencil rays from the parabolic reflector and spreads them in all directions.



With the reflectors tilted down the light hits the road directly ahead of the car. Dotted line shows the direction of the light when the tilters are up. The light then illuminates the road ahead of car

The third, the principle of deflection, bends the parallel rays toward the ground by means of prisms in the lenses.

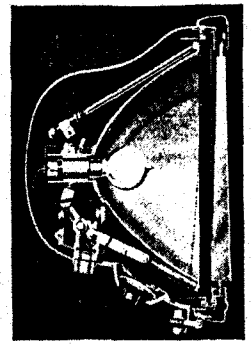
Dimming devices eliminate glare but reduce the amount of light at the very moment, when passing another car, the driver needs to see the road before him and the ditch. Diffusing lenses break up the light and spread it in all directions, accentuating rather than eliminating the quality they wish to correct.

Ideal road lighting must satisfy two distinct and separate sets of conditions. For passing other cars lights should be bright enough to show the road immediately in front and the right hand ditch, yet be so directed as to keep out of the eyes of the approaching driver. At other times they would be out ahead, picking up the road well in front of the car.

Cadillac headlights meet these two conditions, not by changing the quantity or quality of the headlight needed for night driving, but by tilting the headlight reflectors when approaching another vehicle so that all the light is directed down on the road, well out of the eyes of the approaching driver.

In normal position Cadillac headlights satisfy the legal requirements in all states where the law specifies definite candle power at a distance of a hundred feet ahead of the car.

The tilting reflector is a feature which enables the driver to easily extend a courtesy of the road. The approaching driver's car may not be equipped with powerful lights, therefore chance of accident is eliminated. Cadillac headlamps are also equipped with special optical lenses.



Sectional view of headlamp—dotted lines show tilted position of reflector, which is pivoted

A supplemental advantage, resulting from the tilting of the reflectors, is the illumination of the road immediately in front of the car when rounding a turn or topping a hill.

In the judgment of engineers this device is the most satisfactory and practical solution of the glare difficulty.

The Lamps and Horn

A SINGLE wire system supplies current to the lamps, one side of each lamp socket being grounded.

The headlamps, sidelamps, tail and speedometer lamps are controlled by a single lever from the ignition and lighting switch on the instrument board. The tail and speedometer lamps are connected in series, conveniently enabling the operator to tell from the speedometer lamp whether or not the tail lamp is lighted. They are operated by both the lighting switch and separate push button for illuminating the front compartment when entering the car. Inspection lamp with fourteen feet of cord and reel is located under hood.

Open and closed bodies, in addition, are provided with full lamp equipment.

Protection is afforded to the ignition, lighting and horn circuits by circuit breakers, which have well known and distinct advantages over fuses, commonly used. One, protecting the horn, portable lamp and tonneau lamp circuits, is known as a lock-out circuit breaker. In case of a "ground" in any of these circuits the breaker opens and remains open until the "ground" is removed. The ignition and remaining lamp circuits are protected by a vibrating circuit breaker which produces a vibrating sound, should a "ground" occur in any of these circuits.

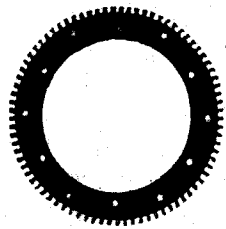
A Weston ammeter indicates the rate of charge or discharge of the storage battery.

The electric horn is located under the hood on front of left hand cylinder block. The horn is motor driven with large end type commutator to assure long life of motor brushes.

The Power Transmission System

Clutch

THE clutch has seventeen steel plates: nine plain driven discs and eight driving discs faced on both sides with an asbestos friction fabric. The advantage of attaching the friction material to the driving discs rather than the driven discs, is that unnecessary and undesirable weight is thereby avoided in the latter, thus decreasing their tendency to spin under their own momentum when the clutch is disengaged.



One of the eight clutch driving discs—eighty-one driving teeth

The periphery of each driving disc is serrated in the form of gear teeth, of ten pitch, which mesh with similar teeth on the inner surface of the clutch driving ring, bolted to the flywheel. The effect produced by this method of driving the clutch is that of eighty-one driving keys and as many keyways, greatly reducing the load on each key

The thrust of a three hundred pound coil clutch spring, which forces driving and driven discs tightly together, is taken by a ball-thrust bearing.

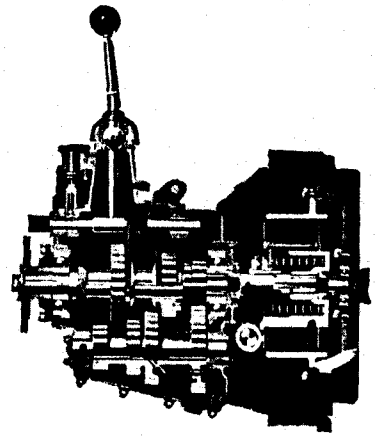
Careful compounding of leverage has made the clutch pedal release astonishingly smooth and easy

Gearset

THE Cadillac selective gearset provides for three speeds forward and one reverse. The gears and shafts are chrome nickel steel forgings, heat-treated. The gears are accurately machined to the proper tooth forms, and the ends of the teeth are backed off, permitting easy and quiet gear-shifting. Wide gear faces distribute tooth pressure over an ample area to minimize frictional wear.

The meshing of the gears is controlled by a centrally located control lever. The ball handle is well up under the driver's right hand. First and second gears are very quiet. Third or high speed is direct from engine to rear axle.

The clutch shaft and main transmission shaft revolve on ball bearings. To allow differential motion between the clutch shaft and the transmission shaft, when other than direct drive is in use, the front end of the transmission shaft revolves on a Hyatt flexible roller bearing, housed in the rear end of the clutch shaft.



Sectional view of clutch and gearset

The countershaft revolves on two roller bearings on a stationary tubular shaft.

Positive lubrication for the countershaft roller bearings is uniquely provided by the rotation of a metal spoon on the intermediate gear, impelling the lubricant through a tube to the bearings.

A spiral gear mounted on the main transmission shaft drives a gear keyed to the end of the shaft which drives the flexible speedometer drive shaft. In this position the speedometer drive receives constant lubrication and is protected, as well, from roadside dust and dirt.

Propeller Shaft

THE propeller shaft between the transmission and the rear axle is of seamless drawn steel tubing. Universal joints fitted at each end provide for the flexible drive, which is made necessary by constantly changing alignment, due to play of the springs. The forward joint is telescopic, being provided with a sliding connection to accommodate longitudinal play.



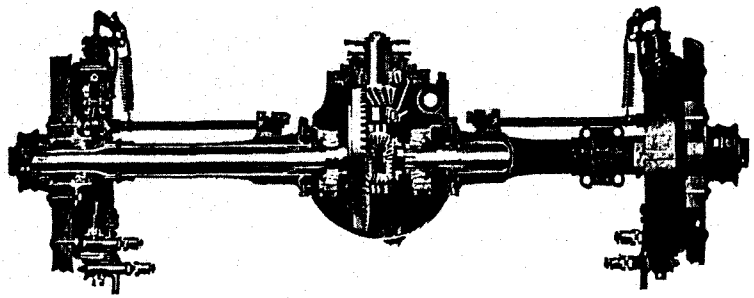
Forward universal joint is telescopic

Both universal joints are housed in pressed steel casings, to exclude dust and retain the lubricant.

The Rear Axle

THE rear axle carries the weight of the car independently of its transmission of power to the rear wheels, a construction usually designated as full-floating. The load is taken by the pressed steel, tube-shaped housing. Into the ends of this pressing, chrome nickel steel sleeves are riveted and welded. The wheel bearings are mounted upon these sleeves.

The transmission of power and the gear reduction are accomplished by the helical bevel gear and pinion, and the two live axle shafts. The pinion gear is a nickel steel forging.



Full-floating rear axle with helical bevel driving gears and adjustable taper roller bearings

Helical bevel gears insure a degree of quietness impossible with straight-tooth gears. They are cut and fitted to each other in pairs in the Cadillac factory. Pinion gear and shaft are integral, being supported on each side of the gear by taper roller bearings. The differential is of the bevel gear type. Both gears and pinion bearings are mounted in a carrier, which forms the front cover of the rear axle housing.

The two shafts, which drive the wheels from the differential, are chrome nickel steel, with the integral driving clutches at the outer ends. The clutches consist of six lugs machined on the outer ends of the shafts, fitting into corresponding slots machined in the hubs of the rear wheels.

A spring locking ring in an annular groove prevents lateral motion between each wheel hub and the driving lugs.

The spring seats, by which the load of the car is carried on the rear axle, are free to oscillate on the axle housing.

The torque is absorbed, not by the springs, but by the sturdy torque arm fastened to the central cross member of the frame.

Frame and Running Gear

CADILLAC engineers have not been content to allow only an ample factor of safety in the frame. They have designed a foundation on the basis of rigidity. Body and chassis, as a result, have an increased length of life.

The sidebars have a long deep channel section through the center, where the stress is most severe, and a wide top flange. There is a gradual reduction in the section toward each end with a moderate kick-up at the rear.

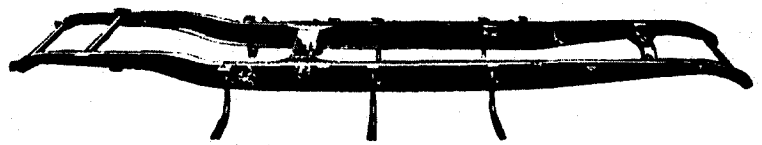
The sidebars are rigidly tied together by five cross members: a central cross member of channel section; the cross member for the front engine support; and three additional cross members of steel tubing. The central cross member, to which the forward end of the torsion arm is attached, is riveted securely to the sidebars by both web and flanges, the joints at the sidebars being reinforced by gusset plates.

The tubular cross members are located, one between the front outriggers, another just forward of the gasoline tank, and the third at the extreme rear end of the frame. It is axiomatic among engineers that a tubular member is the lightest possible for resisting torsional and indeterminate bending strains.

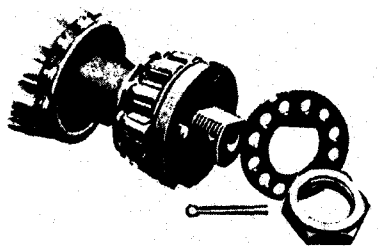
The holes in the sidebars for the brackets and other attachments are drilled on giant multiple-spindle drill presses, with fixtures which insure correct location.

The Wheels

SAFETY will impress the purchaser or prospective purchaser as the primary consideration in the design and construction of Cadillac wheels.



Frame with five cross members and sidebars with maximum depth of seven inches



Locking-on device for front wheel and bearing adjustment

They are of the artillery type, with twelve spokes in each wheel. The best selected hickory, thoroughly seasoned, composes the spokes.

The spokes are of especially large elliptical section, being one and one-fourth by one and three-fourths inches at the smallest point, which is at the felloe.

The felloe is of steel, hollow in section and the spokes are anchored in felloe by hydraulic pressure, forming a practically indestructible unit.

Each hub comprises two pressed steel flanges, the inner flange being integral with the hub core. Bolts through the wood spider at each joint between the abutting ends of the spokes hold the flanges firmly in place. The wheels revolve upon adjustable roller bearings.

The consideration of safety has been given unusual attention in the device used for locking-on the front wheels. An adjusting nut for the bearings carries a stud which keys it to a lockwasher. This lockwasher has a D-shaped hole, which fits the spindle and positively prevents the turning of the adjusting nut. A locknut holds the lockwasher firmly against the adjusting nut.

The Front Axle

THE front axle is a one-piece drop forging of chrome nickel steel. It is of I-beam section, heavily ribbed at the yoked ends, where the spindles are pivoted.

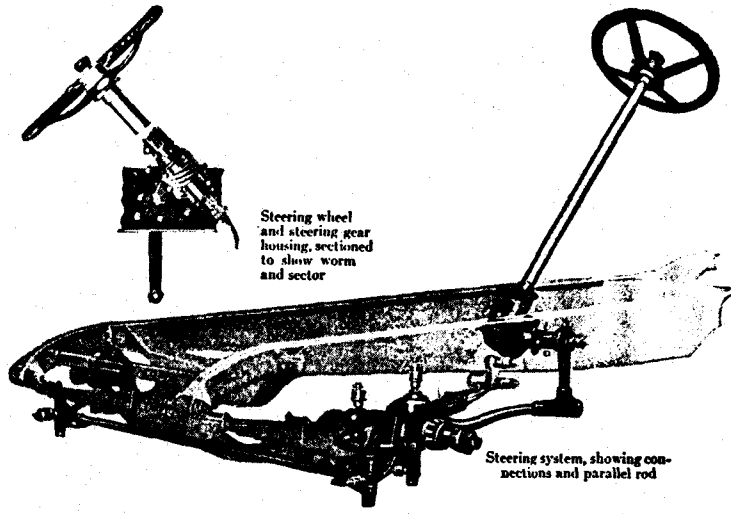
The spindles are also drop forgings of chrome nickel steel. They taper toward the outer end, where the strain is least. Next to the knuckle, where the cantilever action brings the most severe strain, the spindle has an especially large section.

The Steering System

THE first surprise of driving a Cadillac is the unusual pliancy with which it is maneuvered in traffic; the second comes after the first day of continuous touring, when the operator finds himself unexpectedly unfatigued. The acquisition of a Cadillac car has revived interest in touring in many people for whom automobiling may have lost some of its fascination, or who had resigned the driver's seat to a chauffeur.

The steering gear is of the worm and sector type. The worm is machined from a solid bar of steel and is keyed to the steering staff, which is a length of seamless steel tubing. The worm is supported in the steering gear housing by plain bearings, which take the radial load, and adjustable ball bearings, which take the thrust.

The sector is machined from a single drop forging of nickel steel. The sector teeth do not follow the true arc of a circle, the center teeth being at a slightly greater radius than those at the ends. The center teeth perform the greater service, inasmuch as the car is



Steering wheel and steering gear housing, sectioned to show worm and sector

Steering system, showing connections and parallel rod

normally in an approximate straight-ahead position. Adjustment of the position of the sector relative to the worm is easily made.

The sector shaft has the unusual diameter of one and three-eighths inches, and bearing length of more than five inches. End play may be taken up by an adjustment on the inner coverplate of the housing.

The steering gear housing is bolted to the web of the sidebar, supporting the worm and sector, and serving as a container for lubricant.

The sector shaft is tapered and serrated at the outer end to receive the steering arm, which carries at its lower end the ball for the rear joint of the steering connecting rod. This ball is not forged integrally with the arm; for safety, the construction is that of a separate ball anchored in a tapered socket; forged separately this part is given a fibre structure of more uniform texture.

The tubular steering connecting rod, between the steering gear arm and the front axle, has a ball and socket joint at each end. One-half of each bronze socket is fixed, and the other half is held in position by a spring, which automatically compensates for wear.

The spindle arms, of generous dimensions, are forged of chrome nickel steel. As a check on their correct composition and heat treatment, a small nipple is forged on the arms, later to be removed and examined.

The tubular parallel rod is located in front of the axle, and is threaded at each end into the steering arm yokes, permitting adjustment for aligning the front wheels.

Roller bearings are used at the upper end

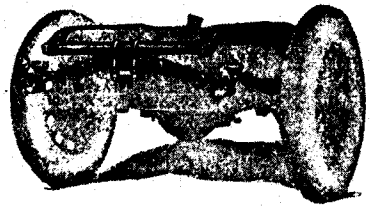
of the spindles. A slight caster effect, in which the reaction of the road on the wheels tends to keep them in the straight-ahead position, contributes to safe and easy steering.

The eighteen-inch steering wheel and spokes are of walnut and carry short levers for throttle and spark control without quadrant. Horn control button of walnut with metal core matches the steering wheel.

The turning radius is forty-four feet.

The Spring System

THE three-quarter platform construction is a distinguishing Cadillac mark to the eye of the man on the street. It is visual evidence of the consideration and care which has been given to Cadillac riding comfort



Semi-elliptic spring construction in front and three-quarter platform suspension at rear

The front springs are semi-elliptical, and three semi-elliptical units, arranged on the platform principle, comprise the rear suspension system The combined length of all five units is more than nineteen feet.

Rear axle driving torque is transmitted by a substantial torque arm to the chassis frame Relieved of this function the rear springs are left free to cushion the body against road shocks.

Unusual precautions have been taken against spring breakage The spring leaves are silico-manganese steel, heat-treated to give maximum life in service. The length of the springs, and the width and thickness of the plates composing the spring leaves have been accurately determined by a careful consideration of the work to be done, and the deflections required. Springs periodically taken from stock are completely deflected hundreds of thousands of times.

The inside surfaces of spring perches and clamping blocks are machined to the normal curvature of the springs.

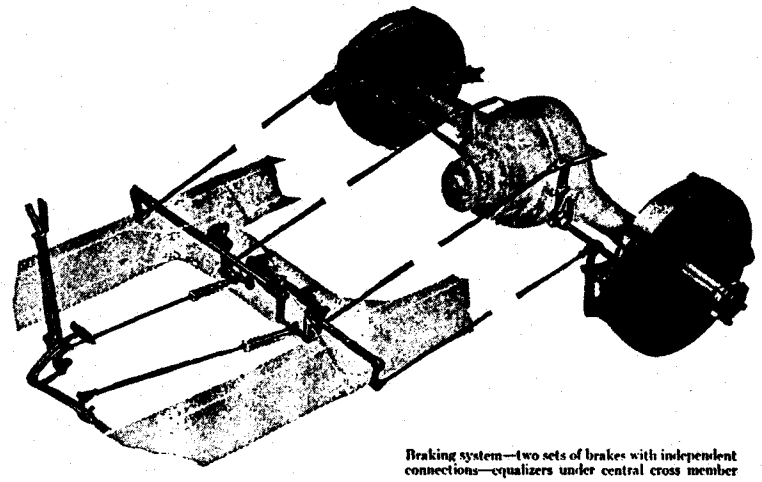
The spring eyes are lined with phosphor bronze bushings, bearing on shackle bolts with the unusually large diameter of three-fourths of an inch. The shackles, in which these bolts are journaled, have uncommonly large bearing surfaces.

The shackles, which permit the free elongation of the springs, are steel forgings. The connections at the rear ends of the rear side spring permit a universality of action between these and the rear cross spring.

Cadillac Bodies

SEPARATE Cadillac plants are devoted to the building and finishing of Cadillac bodies. The same sort of thought and care which enters into the building of the Cadillac chassis is here given to the construction of bodies.

Characteristic qualities of sturdiness and long life are built into the framing and joining of Cadillac bodies. Selected hardwoods, heavy gauge steel and aluminum paneling, more than fourteen coats of varnish and enamel and the finest coach fittings are used to make bodies that will outlast the long life of the Cadillac chassis.



Braking system—two sets of brakes with independent connections—equalizers under central cross member

The Braking System

CADILLAC braking should be considered as a phase of control rather than simply a means of bringing the car to a stop. Either hand or foot brakes may be applied easily with sufficient pressure to lock both wheels, but this characteristic in no way compromises the smoothness with which the car decelerates when the brakes are lightly applied.

There are in the Cadillac two independent sets of brakes. The foot, or service, brake-bands contract on the external surface of a brake drum bolted to each rear wheel. The hand brakes expand within the drums.

Compensating links equalize the tension on the brake pull rods in both systems. The drums are gripped with practically the same pressure, reducing the tendency to skid on slippery roads. The equalizing rocker shafts are located under the central cross member of the frame, and are journaled in self-lubricating bushings. The pull rods actuating the external brakes are outside of the frame, and connect the equalizing rocker shafts directly to the levers on the brake-bands.

Brake-band lining is replaceable, heat resisting friction fabric. The pressed steel brake drums are seventeen inches in diameter, and two and one-half inches wide. The total braking surface is more than five hundred square inches.

Specifications in Brief

Type 61 Cadillac Eight-Cylinder Chassis

Details of the standard Cadillac body types are contained in a general catalog

ENGINE—Eight-cylinder V-type, high speed, high efficiency. Unit engine and transmission, three-point suspension. Cylinders cast in two blocks of four cylinders each, with integral water jackets and valve chambers; detachable heads. Three and one-eighth inch bore by five and one-eighth inch stroke. Piston displacement, 314 cubic inches. Crankcase, aluminum copper alloy. Tungsten steel valves. Valve mechanism enclosed. Three-bearing crankshaft, two inches diameter, of chrome nickel alloy steel, special heat-treated. Main and connecting rod bearings of liberal dimensions, Cadillac special bearing metal, with bronze reinforcement. Single camshaft, six bearings. Camshaft and generator shaft driven by silent chains.

HORSEPOWER—N. A. C. C. rating 31.25

COOLING—Water, forced circulation. Jackets cast integral with cylinders, liberal water circulating space. Two centrifugal pumps, one for each block of cylinders, insuring proper water distribution. Radiator, Cadillac tubular and plate type. Fan driven by silent chain from camshaft. Water temperature governed by Sylphon thermostats.

IGNITION—Cadillac-Delco, improved system. Current supplied by generator and battery.

LUBRICATION—Automatic pressure fed by gear pump. Oil forced to crankshaft, camshaft and connecting rod bearings.

CARBURETOR—Cadillac, designed especially for this engine, insuring uniform gas distribution and maximum efficiency. Correct proportion of mixture controlled by thermostat. Auxiliary air control to facilitate starting. Intake pipe, exhaust jacketed.

CLUTCH—Multiple disc, dry plate type; seventeen high carbon steel plates, 7¾ inches diameter. Driving plates are faced with wire mesh asbestos. Exceptionally soft and velvety in operation.

TRANSMISSION—Copper alloy aluminum case. Selective type sliding gear, three speeds forward and reverse. Chrome nickel steel gears and shafts.

CRANKING DEVICE—Cadillac-Delco, improved, patented.

STORAGE BATTERY—Exide manufacture, designed especially for Cadillac; heavy plates.

DRIVE—Tubular shaft. Two universal joints, the forward telescopic, each enclosed in housing and running in lubricant.

BRAKES—One internal and one external brake direct on wheels, 17-inch x 2½-inch drums. Exceptionally easy of operation. Both equipped with equalizers.

STEERING GEAR—Cadillac patented worm and worm gear sector type, adjustable, with ball thrust bearings. 18-inch steering wheel with corrugated walnut rim, and spider.

FRAME—Channel section, carbon steel, maximum depth, 7 inches; width 30 inches in front, 33 inches in rear; three tubular and two pressed steel cross members.

WHEELS—Wood, artillery type, with steel felloe, rotating on Timken bearings, fitted with demountable rims for straight side tires, special large steel hub flanges and substantial spokes.

CONTROL—Center control. Gear change lever and hand brake in center, set well forward, yet within easy reach. Service brake, foot lever. Clutch, foot lever. Throttle accelerator, pedal button with foot rest. Throttle and spark levers at steering wheel. Throttle auxiliary air control, hand button on instrument board.

FUEL SYSTEM—Twenty-gallon tank with gauge, at rear of chassis. Fuel forced by air pressure to carburetor.

AXLES—Rear, Cadillac-Timken full-floating type; Timken bearings; special alloy steel live axle shafts. Spiral type bevel driving gears, machined with accuracy. Front axle, drop-forged, special alloy steel, I-beam section with integral yokes and spring perches; drop-forged tie rod ends and steering spindles, the latter fitted with Timken bearings at the upper ends.

TREAD—56 inches.

SPRINGS—Front, semi-elliptic, 42 inches long by 2 inches wide; rear, three-quarter platform; sides, 54 inches long by 2 inches wide. Rear cross, 30½ inches long by 2 inches wide.

PRICES—On automobiles and parts are net, f. o. b. Detroit. No allowance will be made for any part of standard equipment if ordered omitted.

The Cadillac general catalog tells, in detail, the story of Cadillac body building and describes, in text and pictures, the fittings and appointments of the current Cadillac models. The nearest Cadillac distributor will be glad to furnish you a copy of the catalog.

CADILLAC MOTOR CAR COMPANY

DETROIT, MICHIGAN

MANUAL

OF

CARE AND OPERATION

FOR OPERATOR'S USE

Type 61

CONTENTS

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Price, 35 Cents

Cadillac Motor Car Company

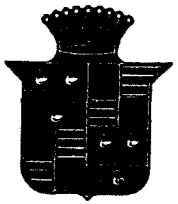
Detroit, Michigan, U. S. A.

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Detroit, Mich.

SEVENTH EDITION

CADILLAC
OPERATORS' MANUAL



TYPE 61

PRICE 35 CENTS

CADILLAC MOTOR CAR COMPANY
DETROIT, MICH., U. S. A.

OPERATION

Part I

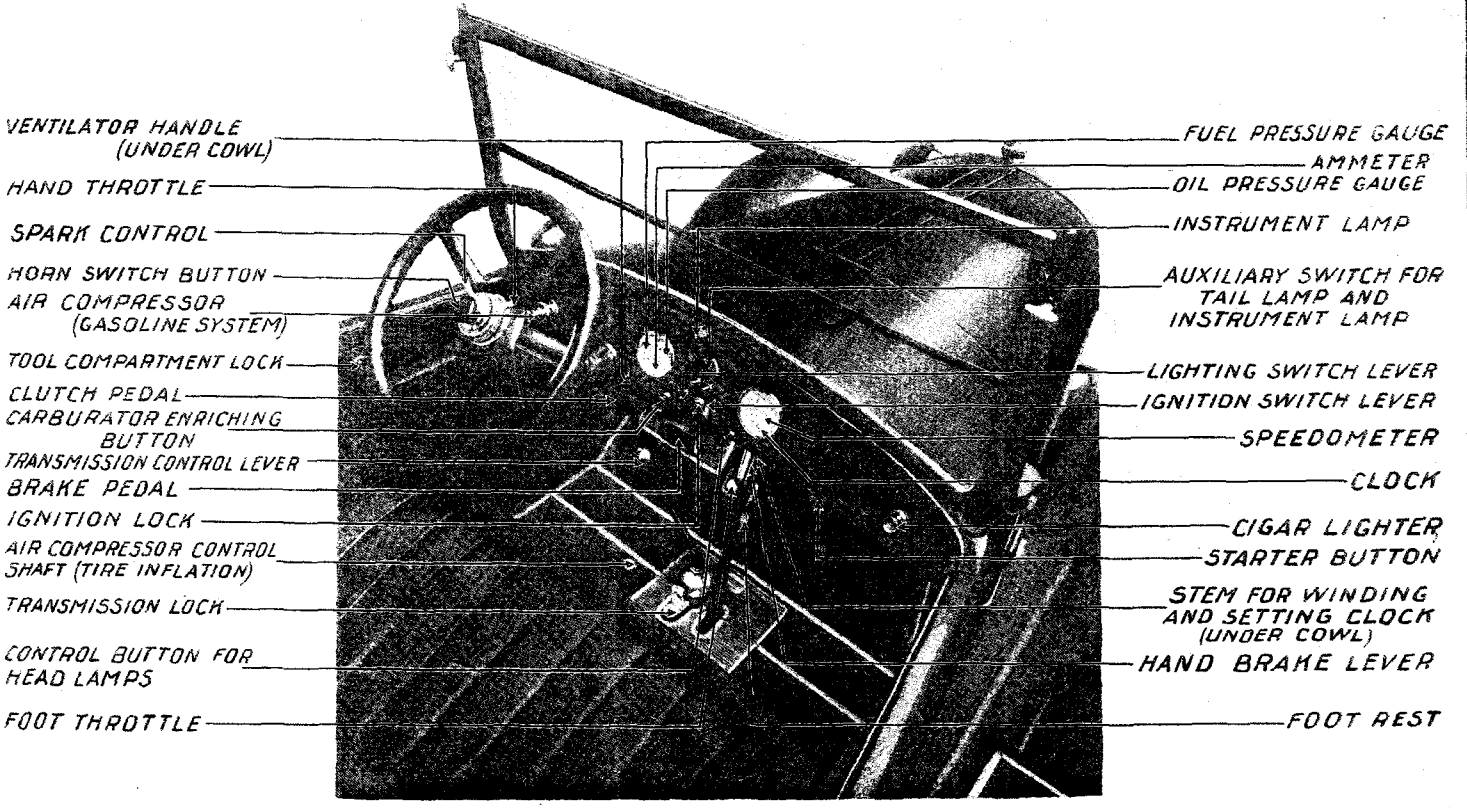


Fig. 1. Instruments, Control Levers and Pedals.

LICENSE DATA

The following information may be found useful in making license application:

Number of cylinders....8

Cylinder bore....3⅛ in.

Piston displacement....314 cubic in.

Stroke....5⅛ in.

Horsepower (N. A. C. C. rating)....31.25

Engine number:

The engine number is stamped on the crank case just back of the right-hand block of cylinders, and on the name plate attached to the forward face of the dash.

The number of each Type "61" engine begins with the figures "61."

Wheelbase:....132 in.

Tread....56 in.

THE THREE MOST IMPORTANT THINGS IN CONNECTION WITH THE CARE OF THE ENGINE

1. Use of Suitable Oil

The use of Cadillac Engine Oil is recommended (see under "Lubricants" page 31.)

2. Replacement of Oil

Replace the engine oil at the end of each 500 miles of travel during warm weather and at the end of each 350 miles of travel or once a week during cold weather. (See under "Replace Engine Oil" page 33 and "Replace Engine Oil Frequently During Cold Weather," page 34.)

3. Manipulation of Carburetor Enriching Button

After starting the engine, do not run it with the carburetor enriching button pulled back any longer than is absolutely necessary. (See under "Starting the Engine," page 9.)

THE USER'S RESPONSIBILITY

The information, advice and instruction contained in this Manual are furnished because the user of a motor car needs them. But if the user fails to heed the advice, the loss is not wholly his but partly ours as well.

A Cadillac car in the hands of an operator who will give it the reasonable consideration to which it is entitled, and which every car requires, will run as smoothly and as quietly as is possible for any motor car to run. No car will give greater satisfaction nor will any car stand more abuse. But no car can be expected to stand continued abuse without showing the results of it sooner or later.

We are interested that Cadillac cars render unfailing service and satisfaction. They are built for that purpose but the user must do his part after the car comes into his possession. The Cadillac is capable of rendering the best of service and directions are furnished which will guide the user toward obtaining that service. But if he persists in ignoring these directions, there is no one but himself upon whom he can rightfully place the responsibility for difficulties which may result.

DRIVING AND CARING FOR A MOTOR CAR

Driving an automobile means more than simply starting, steering and stopping. To drive an automobile properly requires an understanding of the principles involved and the exercise of intelligence and judgment.

With well designed and correctly built automobiles, probably 95 per cent of the so-called "troubles" are directly traceable to lack of lubrication, abuse, carelessness, and a lack of an understanding of the principles involved.

To begin with, the driver should study the construction of his car and thoroughly acquaint himself with its mechanism, the functions of its various parts and the "why" of everything connected with it. If he understands these he is better able to realize why certain things must be done and why certain other things must not be done, if he is to obtain the most satisfactory results, the greatest efficiency and the greatest economy, together with durability and long life of the engine and car. Remember that the difference between a comprehensive understanding of your car and the superficial knowledge possessed by many drivers is the difference between having "troubles" and not having them.

On the other hand is frequently found the user who is constantly tinkering with his car when there is no necessity for it. Avoid both extremes. If, after seeing that all parts are lubricated properly and that all bolts, nuts and screws are tight, the car is running well, let it alone. Many users drive their Cadillacs for months without finding an adjustment necessary. If ad-

justment seems necessary and you are not sufficiently acquainted with the construction of the car to know what adjustment is necessary or how to make it, *don't experiment* but take the car to a Cadillac service station.

The most important thing in the care of an automobile is proper lubrication. Part Two of this Manual gives detailed directions regarding lubrication.

PLACING A NEW CAR IN RUNNING CONDITION

Before the cars are shipped, the fuel and cooling systems are drained. When the car is received and before it is placed in use, the supply of gasoline and water must be replenished. During freezing weather an anti-freezing solution should be used instead of water. (See under "Anti-Freezing Solutions," page 22.)

The car should be lubricated thoroughly in accordance with directions contained in this Manual. (See under "Lubrication," Part II.)

Filling the Cooling System

Fill the cooling system with water during warm weather and with a suitable anti-freezing solution during freezing weather (see under "Anti-Freezing Solutions," page 22.) To fill the cooling system proceed as follows:

Close the drain cock "D" (Fig. 20) on each cylinder block and the drain cock "C" on each water pump. If the indicator on the end of each pump shaft "B" does not point up turn the shaft so that it does. The shaft may be turned in either direction.

Remove the filler cap "A" and fill the cooling system. Screw the cap down tightly after replacing it This is important since the operation of the radiator condensor depends upon a tight joint at the radiator cap.

Turn each pump shaft "B" so that the indicator points down. To fill the radiator condensor (see under "Condensor" page 50) take out the floor board just forward of the transmission control lever and replace the drain plug "F" (Fig. 20.) Remove the condensor filler cap "E" and fill the condensor one half full using the same liquid as in the radiator. Replace the filler cap.

Type 61 cars carrying engine numbered 61-U-47 or a lower engine number are filled in the following manner:

Close the cylinder drain cocks "D", (Fig 20) and turn the valves "G" to the "Fill" position. If a water pump drain cock does not turn easily force

down on the screw driver. In extreme cases it may be necessary to strike the end of the screw driver with the hand to unseat the drain cock.

There is a drain cock "D" in each cylinder block and a valve "G" at each water pump.

Remove the filler cap "A" and fill the cooling system. Screw down the cap firmly after replacing it.

Turn the valves "G" to the "Close" position.

Caution:—Do not use water in the cooling system during freezing weather. Use a good anti-freezing solution. Water will freeze even though the engine be run continuously.

Filling the Gasoline Tank

The gasoline tank is at the rear of the car. (See Figure 19.) The filler cap can be removed after loosening the thumb screw.

Gasoline should be strained through a wire cloth of very fine mesh before it is poured into the tank. If dirt or water enters the gasoline system it may cause trouble.

After filling the tank and screwing on the filler cap, tighten the thumb screw. This is necessary to prevent leakage of the air pressure by which gasoline is forced to the carburetor.

Operating a New Car

It is recommended that the operator of a new car refrain from driving it at its maximum capacity and speed until the car has been driven at least five hundred miles.

Although the parts of a Cadillac car are machined and ground with the greatest possible accuracy and fineness of finish, manufacturing processes cannot give to bearing surfaces the fine polish which results from actual operation at moderate speed and under light loads.

For this reason, it is advised that a car be driven no faster than twenty miles per hour for the first two hundred and fifty miles, and no faster than twenty-five miles per hour for the second two hundred and fifty miles.

STARTING THE ENGINE

1. First make certain that the transmission control lever is in the neutral position and that the hand brake is applied, (see Figure 1.)

2. If the fuel pressure gauge on the instrument board indicates a pressure of less than one pound, increase the pressure by means of the hand air compressor. The handle of the compressor is screwed into place. Loosen it by unscrewing it a few turns in the counter-clockwise direction. After the pressure has been increased to at least one pound, lock the plunger in place by holding it in and turning it in the clockwise direction.

3. Place the spark lever about one-third the way down from the "Advance" position, except in cold winter weather, when it should be at the "Advance" position. If the engine should be cranked by hand, always place the spark lever at the "Retard" position. If this precaution is not observed, a back kick will occur, resulting in personal injury.

4. In extremely cold winter weather, prime the carburetor by placing the throttle lever at the "Close" position, then pushing the accelerator button down to the floor and permitting it to return. Twice repeat this operation. Do not prime the carburetor except in extremely cold weather.

5. Place the throttle lever approximately one-fourth the way down from the "Close" position.

6. In cold weather, or in warm weather, if the engine has been standing for some time, pull back the carburetor enriching button.

7. Switch on ignition by moving the ignition switch lever up.

8. Push down on the starter button. This will bring the starter into operation and will cause the engine to "turn over." (See under "Caution.") In extremely cold weather, when the car has been standing long enough to have become thoroughly chilled, it is a good plan to release the clutch before pressing down on the starter button, and to hold the clutch pedal down during the cranking operation.

9. Immediately the engine commences to run under its own power, which should be in a few seconds, permit the starter button to return to the normal position. If the carburetor enriching button is back, push it as far forward as possible without causing the engine to stop, or a material reduction in engine speed, as soon as the engine commences to run under its own power and as far forward as it goes as soon as the engine is warm enough to permit it. *It is important that the button be left back no longer than is absolutely necessary.*

If the engine does not start within thirty seconds, do not continue to operate the starter, but permit the starter pedal to return to the normal position and determine the cause. Be certain that the ignition is on, that there is gasoline in the tank, and sufficient pressure to force it to the carburetor. The starter will crank the engine only; ignition and gasoline must be present before it will run.

Caution:—The action which causes the engine to "turn over" is produced by a gear of the electric starting motor sliding into mesh with teeth on the fly wheel of the engine. When pushing down on the starter button to throw these gears into mesh, if it should so happen that they are in just such positions that the ends of the teeth of the starter gear come against the ends of the teeth of the fly wheel, instead of the teeth of one sliding between the teeth of the other, do not use force. Simply permit the starter button to return to the normal position and then push it down again. In the meantime, the gears will probably have changed their relative positions sufficiently to permit the teeth to mesh.

Oil Pressure

Lubricating oil is fed under pressure to the main and connecting rod bearings of the engine (see under "Engine Lubrication," page 32.) The pressure of the oil is indicated by the pressure gauge on the instrument board. (See Fig. 1.)

When the engine is not running, the hand of the oil pressure gauge should remain at zero, but immediately the engine is started and while it is in operation, pressure should be indicated. The pressure indicated depends upon the speed of the engine and the viscosity of the oil.

If at any time while the engine is in operation, the hand of the oil pressure gauge remains at zero, stop the engine at once and determine the cause. Serious engine trouble is a result of continuing to run the engine without oil pressure.

GEAR SHIFTING

Caution: Do not attempt to shift from neutral to any gear, or from one gear to any other without first disengaging the main engine clutch by pushing and holding down the clutch pedal (see Figure 1.)

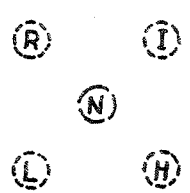


Fig. 2. Control Lever Positions.

As the transmission is of the selective type, the operator may shift from any gear to any other gear without shifting through a third gear.

Referring to Fig. 2, the ball at the top of the transmission control or gear shifting lever is shown at "N" in the neutral position, at "L" in the low gear position, at "I" in the intermediate gear position, at "H" in the high gear position, and at "R" in the reverse gear position.

Starting the Car

To start the car, after starting the engine and unlocking the transmission lock, push down on the left pedal, which is the clutch pedal, thereby releasing the main engine clutch. Then disengage the hand brake by means of the hand lever—still holding the clutch pedal down. (If the car is standing on a grade it will be necessary to hold it with the foot brake until ready to start.) Next shift into low gear.

To do so, move the control lever as far to the left as possible and then pull it back as far as it will go (Fig. 3.) Open the throttle slightly by means of the accelerator pedal or throttle lever and permit the main clutch to engage gradually, by allowing the pedal to come towards you slowly.

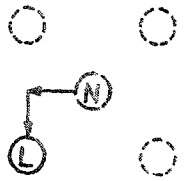


Fig. 3.
Neutral to Low Gear.

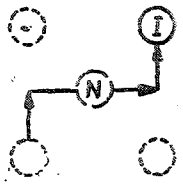


Fig. 4.
Low Gear to Intermediate Gear.

If it should so happen that the gears which mesh to make low gear are in positions such that the ends of the teeth of one gear come against the ends of the teeth of the other gear instead of the teeth of one sliding between the teeth of the other, do not force them but return the transmission control lever to the neutral position, engage the clutch by allowing the clutch pedal to come towards you, again release the clutch, then shift into low gear as directed above.

After the car is under way in low gear, release the clutch and shift into intermediate gear. To do this move the control lever back to the neutral position, then to the right and push it forward as far as it will go (Fig. 4.) Then permit the clutch to engage. In shifting from low to intermediate gear, it is advisable to pause for a moment in the neutral position if there is a tendency of the gears to clash.

After the car is under way in intermediate gear, shift into high gear. To do this, simply release the clutch and then pull the control lever straight back (Fig. 5.) Then permit the clutch to engage.

It is possible when starting the car on level ground to shift from low gear to intermediate gear and from intermediate to high gear at low speeds, and shifting can be done more quietly than at higher speeds. In starting on an incline a higher rate of speed must be attained before shifting gears.

Reversing

To start the car backwards, with the control lever in the neutral position, release the clutch, move the control lever to the left and push it forward as far as it will go. Open the throttle slightly by means of the accelerator pedal or throttle lever and engage the main clutch gradually.

If it should so happen that the transmission gears which mesh to make reverse are in just such positions that the ends of the teeth of one gear come against the ends of the teeth of the other gear, do not force them, but return the transmission control lever to the neutral position, engage the clutch, again release the clutch and shift into reverse gear as directed.

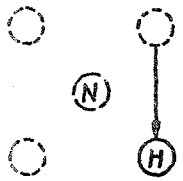


Fig. 5.
Intermediate Gear to High Gear.

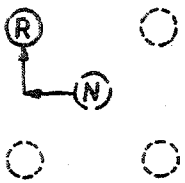


Fig. 6.
Neutral to Reverse Gear.

Shifting into Lower Gear

If, when ascending steep grades or pulling through soft mud roads or deep sand in high gear, the speed of the car is reduced until the engine labors, shift into intermediate gear. To do this, release the clutch, then push the control lever forward as far as it will go. Then engage the clutch. It is best to allow the car to slow down before making the shift and then, after releasing the clutch, to shift quickly. An experienced driver may find it more satisfactory to shift from high into intermediate gear in the following manner:

Release the clutch, return the control lever to the neutral position, engage the clutch, at the same time slightly accelerating the engine; then release the clutch again, and *instantly* shift into intermediate gear. Engage the clutch.

This entire change may be made in less time than it takes to read these directions by one who becomes familiar with this method. Shifting in this manner may be accomplished satisfactorily at higher speeds than is possible

when shifting in the usual manner. It is not recommended, however, that the operator attempt to shift from high to intermediate gear in this manner until he has considerable experience in shifting in the ordinary way.

Stopping the Car

First close the throttle and then release the engine clutch. Next return the transmission control lever to the neutral position. The clutch may then be re-engaged. Stop the car by pushing forward on the brake pedal. After the car has been brought to a stop, apply the hand brake by means of the hand brake lever.

Stopping the Engine

After stopping the car and applying the hand brake, move the ignition switch lever down.

TILTING HEAD LAMP REFLECTORS

The reflectors in the head lamps are pivoted so that they can be tilted and are controlled by a button on the instrument board (see Figure 1.) When the road is clear and illumination of the distant road is desired, the reflectors direct the rays ahead. When a vehicle traveling in the opposite direction approaches, rays from the headlamps can be deflected further than already deflected by the lenses, increasing illumination directly in front of the car, by simply pushing forward the button and thereby tilting down the reflectors.

DRIVING SUGGESTIONS

Rules of the Road

Road and traffic laws vary greatly in different localities. It is, therefore, impossible to set down a complete list of rules which may be followed in all parts of the country. The following are some of the rules which are universal in practically all parts of the United States.

In meeting a vehicle going in the opposite direction *pass to the right.*

In passing a vehicle going in the same direction *pass to the left.*

Always stop with the right hand side of the car next to the curb. If it is necessary to turn the car around to do this, it should be done.

Never turn around or turn off onto another road without making absolutely certain that there is no other vehicle directly behind you.

Never enter upon street car tracks without making sure that there is no car directly behind you—*no matter how sure you feel, look and see.*

Do not cross street car or steam railroad tracks without making certain that it is absolutely safe to do so.

In crowded traffic do not apply the brakes suddenly unless it is absolutely necessary. It may be that a following vehicle cannot stop as quickly as you can.

On wet asphalt streets or slippery roads do not apply the brakes suddenly unless it is absolutely necessary. If the brakes are applied suddenly under these conditions disastrous skidding is apt to occur.

Always signal vehicles at the rear, before turning, slowing down or stopping.

Slow down in passing vehicles going in the opposite direction.

One of the most essential things to remember is that you should *never "take a chance."*

Coasting

To coast on the level, close the throttle and then release the main engine clutch by pushing forward on the left pedal.

When descending grades a good method is to close the throttle and, with the clutch engaged, allow the engine to do the holding back as much as possible. This saves much wear on the brake band linings. The resistance offered by causing the car to drive the engine when "high gear" or "direct drive" is engaged is usually sufficient to control the speed. When the engine does not offer sufficient resistance the speed may be checked further by applying the foot brakes.

When it is necessary to descend a very steep grade it is best to engage the intermediate or possibly the low speed gear *before commencing the descent*, and if the resistance thus obtained is not sufficient, to supplement it by the foot brakes. Bear in mind that the more the resistance of the engine is used in coasting the longer the brake band linings will last and the longer the brakes will retain their adjustment.

DONT'S FOR GENERAL OPERATION

Don't fail to change the engine oil frequently.

Don't fail to push forward the carburetor enriching button as soon after starting as possible.

Don't fill the lubricating system in the engine only and neglect to lubricate all other parts of the car.

Don't neglect the lubrication of any part of the car.

Don't run the car at sustained high speed when it is new.

Don't put oil in the engine without first straining it through cheese cloth or fine wire mesh and making sure that it is free from dirt and lint.

Don't allow the clutch to engage suddenly.

Don't prime the carburetor too much.

Don't attempt to shift from neutral to any gear, or from one gear to another gear without first releasing the clutch.

Don't attempt to shift from the reverse gear to any other gear when the car is moving.

Don't attempt to shift from any forward gear to the reverse gear when the car is moving.

Don't attempt to shift from the high gear to the low gear when the car is moving.

Don't attempt to shift from the intermediate gear to the low gear when the car is moving, unless it is moving very slowly. Ordinarily it is best to stop the car altogether.

Don't push the starter button when the engine is running.

Don't turn the steering gear when the car is standing. This is not only unnecessary but is also bad practice.

Don't fail to investigate any unusual sound which may develop in the car. The car should be inspected at the service station of a Cadillac distributor or dealer.

Don't neglect to inspect the level of the acid in the storage battery every 500 miles.

Don't turn corners at high speed.

Don't neglect to keep the cooling system filled.

Don't drive fast or attempt to stop suddenly on wet pavements.

Don't attempt to start the engine with the switch turned off, without air pressure or without gasoline in the tank.

Don't neglect to keep the tires inflated properly.

Don't race the engine when it is not driving the car. There is no worse abuse.

CURTAINS

Storage of Curtains

The side curtains for open cars are carried in an envelope provided with cloth partitions to prevent the curtains from rubbing and chafing. All curtains are tagged to facilitate attaching.

In the touring car the curtains are stowed under the front seat. In the phaeton the curtains are stowed in a compartment provided in the back of the front seat and which opens in the tonneau. The roadster has a parcel-compartment just back of the seat in which the curtains are stowed.

Before the curtains are stowed away they should be dry and clean.

Curtain Fasteners

The curtains are held in place with fasteners which become locked on three sides when snapped into place and must be lifted on the side which is not locked in order to release them. This side is indicated by a small projection on the fastener as shown by the arrow (Figure 7). This type of fastener cannot be released by lifting it at any other side.

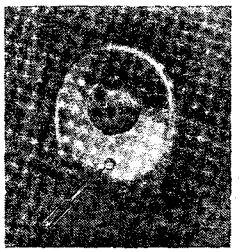


Fig. 7.
Curtain Fastener

SPEEDOMETER

The speedometer registers the speed at which the car is traveling, the total number of miles traveled, and the trip mileage. The total mileage cannot be reset but the trip mileage can be reset to zero.

An automobile repairman should never be permitted to attempt to adjust or repair the speedometer head or to replace the glass. This work can be done only by men experienced in speedometer work and only with special machinery and tools.

If the speedometer head is removed, handle it with the same care that you would a fine watch. The speedometer head may easily be damaged by rough handling.

CLOCK

The clock is in combination with the speedometer. It has an eight day movement and is wound and set in the same manner as any stem winding watch. The winding and setting stem is on the under side of the speedometer just back of the instrument board.

DEMOUNTABLE RIMS

Demounting Rim with Tire

Jack up the axle until the wheel is free from the ground. Then remove the valve cap; loosen the eight clamping nuts with the brace wrench furnished with the tool kit, and turn each clamp to the left until it strikes the stop pin in the fellow band. Turn the wheel so that the valve is at the top and pull the bottom of the rim towards you until it clears the wheel. The rim with tire can then be removed by lifting it straight up.

Mounting Rim with Tire

If the rim you are mounting has no split clamping ring, take the one from the rim removed. Turn the wheel so that the hole for the valve stem is at the top. Hold the rim so that the valve stem is at the top and so that the rim latch and the clamping ring are towards you. Insert the valve stem and then push the bottom of the rim into place.

Turn each clamp to its original position and turn the clamping ring so that the split in the ring comes directly under one of the clamps. Tighten each clamping nut slightly. Then continue around the wheel, tightening each nut firmly. Screw on the valve cap.

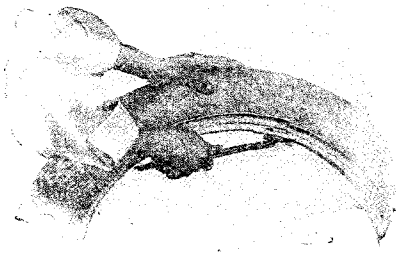


Fig. 8.

Removing Tire from Rim First Position.

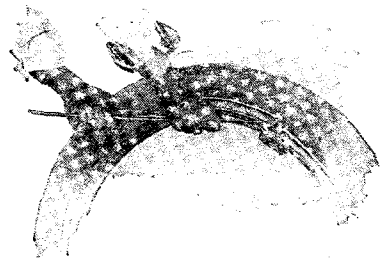


Fig. 9.

Removing Tire from Rim, Second Position.

If the rim does not run true, mark the part that runs "out" from the face of the wheel. Then slightly loosen the nuts diametrically opposite this part and tighten the nuts at the marked part. Proceed in this manner until the rim does run true.

Removing Tire from Rim

The tire may be removed without removing the rim from the wheel.

Deflate the tire. Then open the lock with the pointed end of the tire tool or with a screw-driver.

Raise one end of the ring with the tool as shown (Figure 8) until the lug is clear of the slot in the rim.

Raise the end of the ring further and force the lug out over the edge of the rim. (Figure 9.)

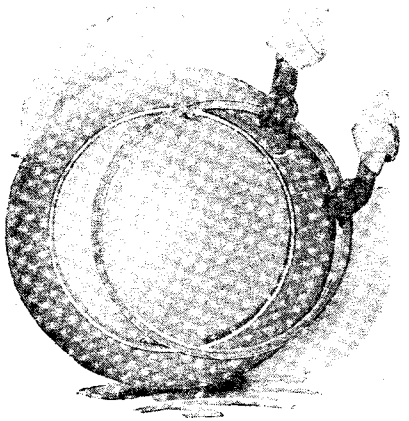


Fig. 10.
Removing Tire from Rim, Third Position.

Start at the end of the ring, which is out of the groove, and remove the entire ring from the rim. (Figure 10.) (See note.)

Turn the wheel until the valve stem is at the top, and pull the lower part of the tire towards you until it is clear of the rim. The tire may then be removed from the rim by lifting it straight up.

Note—In removing the ring from the rim, care should be taken to avoid opening the ring beyond its elastic limit. When the ring is free from the rim, the ends should overlap from ½ to 1½ inches, which they will not do if the ring has been stretched in removal.

If the ends of the ring do not overlap they should be closed together before replacing. If this is not done there is a possibility of the lock failing to engage the lugs on the ends of the ring. This might later be the cause of an accident.

Caution—Do not attempt to remove a tire from a demountable rim without first completely deflating the tire. Serious personal injury may result if this is attempted.

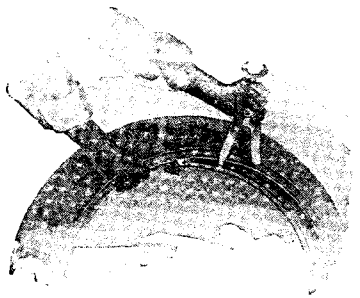


Fig. 11.
Placing Tire on Rim, First Position.

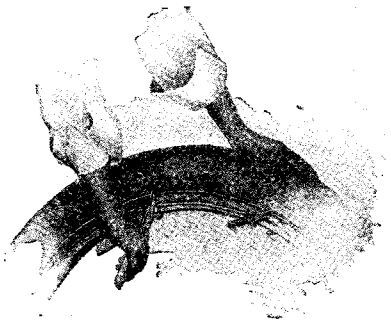


Fig. 12.
Placing Tire on Rim, Second Position.

Placing Tire on Rim

If the demountable rim is on the wheel, jack up the axle and turn the wheel until the hole for the valve is at the top.

Hold the tire so that the valve stem is at the top and insert the valve stem in the valve stem hole in the rim and wheel. Then push the bottom of the tire into place.

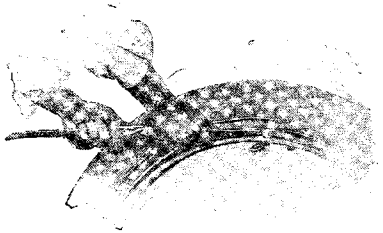


Fig. 13.

Placing Tire on Rim. Third Position.

Insert one end of the locking ring in the slot in the rim. Then with the tool as a lever, force the tire back far enough to allow the ring to go on easily. (Figure 11.)

Starting at the end of the ring which is inserted in the slot in the rim, force the remainder of the ring into place by using the tire tool as pliers. (Figure 12.)

Insert the flat end of the tool between the rim and the ring and turn the tool up edgewise. (Figure 13.) This will lift the loose end of the ring and force it into place.

Draw the ends of the locking ring together with the tool. (Figure 14.) Then swing the lock into place.

Then inflate the tire. (See under "Tire Air Compressor," page 20.)

If the demountable rim is not attached to a wheel, lay the rim with the tire flat on the ground when removing or replacing a tire.

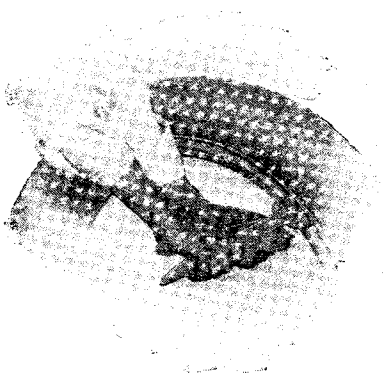


Fig. 14.

Placing Tire on Rim, Fourth Position.

TIRE HOLDER

The tire holder is designed to carry two standard size tires inflated on rims.

To remove the tire with rim, remove the cap from the lock at the center of the clamp and unlock it. Then unscrew the clamp as far as it will go. The tire then may be removed.

To put a tire on the holder proceed in the reverse manner.

When mounting two tires on the tire holder, the clamping or locking rings should face each other to prevent theft of the tires by removing them from the rims. If mounting one tire on the tire holder, the clamping or locking ring should face to the front or toward the body.

Care should be exercised not to permit the inner tire to strike the body of the car when removing or replacing it.

TIRE AIR COMPRESSOR

Using the Compressor

To inflate a tire, first attach the air hose to the connection projecting from the left hand dust shield just back of the battery box cover, then connect the other end to the tire valve. Do not connect the hose to the tire first, if there is air pressure in the tire.

If the engine is running, release the clutch by pushing the left pedal down. Hold the pedal down until you are certain the transmission gears have ceased to revolve, and then turn the slotted head of the compressor control shaft in the clockwise direction (see Figure 1). If the engine is not running, it is unnecessary to disengage the clutch before bringing the compressor into operation.

Run the engine at a speed of approximately 1,000 revolutions per minute. With all lights turned off, the ammeter on the instrument board should register approximately thirteen at 1,000 revolutions per minute of the engine. The compressor operates at its most efficient speed at 1,000 revolutions per minute of the engine. Do not race the engine in operating the compressor, or at any other time, when it is not driving the car.

To stop the compressor, turn the slotted head of the control shaft in the counter-clockwise direction.

Caution:—Do not turn the compressor control shaft to bring the compressor into operation when the engine is running and the clutch is engaged.

COLD WEATHER SUGGESTIONS

STARTING THE ENGINE

Manipulation of Carburetor Enriching Button

Pull back the carburetor enriching button before attempting to start the engine in cold weather, but immediately the engine commences to run under its own power push the button as far forward as possible without causing the engine to stop, or a material reduction in engine speed, and as far forward as it goes as soon as the engine is warm enough to permit it.

Priming the Carburetor

In *extremely* cold weather, if the engine is not started in 30 seconds with the carburetor enriching button pulled back, remove the foot from the starter button. This will stop the cranking operation. Now open and close the throttle once or twice with the hand throttle or the foot accelerator. *Do*

not open and close the throttle more than twice. Opening and closing the throttle operates the throttle pump of the carburetor. This raises the level of the gasoline in the carburetor, thereby priming it. If the throttle is opened and closed more than twice, gasoline is forced out of the carburetor.

Position for Spark Lever

Except in extremely cold weather the spark lever should be placed about one-third the way down from the "Advance" position when starting. In extremely cold weather, it should be in the "Advance" position when starting. (If the engine is to be cranked by hand, the spark lever should be placed at the "Retard" position.)

It is the practice of some drivers to place the spark lever at the "Retard" position when starting the engine. While this is the proper position for the spark lever if the engine is to be hand cranked, there is no reason for retarding the spark when the engine is electrically cranked and starting is facilitated if the spark lever is advanced. In extremely cold weather there is no reason why the spark lever cannot be placed in the "Advance" position if the engine be electrically cranked and a quicker start is assured if this is done. The following will explain why it is possible to fully advance the spark lever at such times:

The mixture in a cold engine does not burn as rapidly, nor is there so much energy in it, as when the engine is warmer and the fuel is better vaporized. When the engine is cold a large percentage of the heat of each explosion is instantly dissipated by reason of the cold combustion chambers and cylinder walls, the result being that an explosion which in a hot engine would occur early enough and have energy enough to produce a "spark knock" or "back kick," occurs so much later and is so much less intense, that neither of these results is produced.

It is best to have the spark lever in the fully advanced position for cold weather starting for the following reasons:

As explained before, a cold mixture ignites much more slowly than a hot mixture. A cold, slow-burning mixture, if ignited on top dead center on account of the spark being in the retarded position, may burn through the power stroke, through the exhaust stroke and may be still burning in the combustion chamber when the inlet valve is opened to draw in another charge. When this happens, the flame sets fire to the incoming charge, igniting the mixture in the intake pipe and carburetor, producing a "pop back" in the carburetor. The possibility of this happening is very much less if ignition is started earlier by placing the spark lever in the fully advanced position.

Position for Throttle Lever

In winter weather the throttle lever should be opened only slightly for starting. Many drivers make a practice of opening the throttle wide or nearly so immediately the engine is started and after shifting the transmission into gear. The full suction of each piston through the carburetor under these conditions causes the auxiliary air valve in the carburetor to open wide, allowing a large volume of cold air to rush into the carburetor.

The proportion of air to gasoline drawn in under these conditions is practically the same as when the engine is hotter, but as only a portion of the gasoline drawn in is vaporized, and as only the vaporized portion burns, the proportion of air to gasoline burned is greater than when the engine is warmer, thus producing a "lean" mixture. A "lean" mixture is slow burning, whether it is warm or hot, and a cold "lean" mixture is particularly slow burning. Thus if the throttle is opened suddenly before the engine is thoroughly warm, the cold "lean" mixture resulting, burns so slowly that a "pop back" in the carburetor is almost sure to occur.

Use of Starter Button

Do not press the starter button while the engine is running.

In extremely cold weather, when the car has been standing long enough to become thoroughly chilled, it is a good plan to release the clutch before pressing down the starter button and to hold the clutch pedal down during the cranking operation. If this is not done, the starter is called upon to turn the jackshaft in the transmission in addition to cranking the engine. While at ordinary temperatures the additional energy required is almost negligible, in extremely cold weather the lubricant in the transmission may offer enough resistance to the transmission gears to increase considerably the demand upon the battery.

ANTI-FREEZING SOLUTIONS

In cold weather a good anti-freezing solution should be used. A solution of commercial glycerine and water is recommended of the correct proportion for the temperature experienced. The following are the freezing temperatures of glycerine and water solutions:

Glycerine (% by volume)	Water (% by volume)	Freezing Temperature (degrees Fahr.)
35%	65%	+10°
40%	60%	+6°
45%	55%	+3°
50%	50%	0°
55%	45%	—2°
60%	40%	—4°

Do not use a solution containing calcium chloride, as it is injurious to the metal parts of the cooling system.

The radiator condenser also makes it possible to use with safety an anti-freezing solution of denatured or wood alcohol and water. The following are the freezing temperatures of denatured alcohol and water solutions.

Denatured Alcohol (% by volume)	Water (% by volume)	Freezing Temperature (degrees Fahr.)	Specific Gravity (Hydrometer reading)
20%	80%	+13°	.974
30%	70%	— 3°	.964
40%	60%	—20°	.953
50%	50%	—34°	.936

It is a good plan to draw out a sample of the solution occasionally and to test its specific gravity with a hydrometer graduated between the limits of the above table.

The capacity of the cooling system is five and one-quarter gallons. The condenser should contain an additional three quarts, making a total of six gallons.

Caution—Do not use water in the cooling system during freezing weather. Use a good anti-freezing solution. Water will freeze even though the engine be run continuously.

ADDITIONAL COLD WEATHER SUGGESTIONS

Starting in Intermediate or High Gear

Starting in intermediate or high gear should not be done at any time, but this is particularly unfair to a cold engine, as it necessitates a further opening of the throttle than is necessary when starting on low gear, with the probability of a "pop back" in the carburetor.

Cold Test of Engine Oil

Use oil having a low cold test. In other words, use oil which flows freely at low temperature. (See under "Lubricants," page 31.)

Frequent Changing of Oil

Water and gasoline may accumulate in the crank case of the engine during cold weather. It is necessary, therefore, to drain the oil frequently and replace it. (See under "Replace Engine Oil Frequently During Cold Weather," page 34.) If water and gasoline are permitted to accumulate in the crank case, serious damage to the engine may result.

Strainers in Gasoline System

It may be found necessary to remove the strainers in the gasoline line more frequently during cold weather in order to prevent an accumulation of water at these points which would freeze and prevent the gasoline from flowing to the carburetor. (See under "Settling Chambers and Strainers," page 48.)

OPERATION OF ENGINE

General Principle

The production of power by the engine may be described briefly as follows:

Gasoline is forced by air pressure from the tank to the carburetor. At the carburetor the gasoline is mixed with air in the proper proportion, forming an explosive vapor or gas. The gas is drawn through the intake manifold and inlet valves into the cylinders of the engine, where it is compressed and ignited by electric sparks, the pressure of the resulting explosions producing the power.

The quantity of gas supplied to the engine is regulated by a throttle valve at the carburetor which is operated by means of the throttle lever at the steering wheel or by the accelerator button at the right of the brake pedal.

Four-Cycle Engine

The engine is of the four-cycle type, that is, there are four movements or strokes of each piston and two revolutions of the flywheel to complete each power producing stroke. The four strokes of the cycle each have a different function and follow one another in the same order as follows:

Suction Stroke. The suction stroke commences with the piston at its highest point in the cylinder and with the inlet and exhaust valves closed. Immediately the piston starts to descend the inlet valve opens and through this valve a charge of gas from the carburetor is drawn into the space above the piston.

Compression Stroke. As the piston starts upward again after completing the suction stroke, the inlet valve closes. As there is then no escape for the gas in the cylinder, it is compressed, the maximum compression being reached when the piston is at the top of its stroke.

Power Stroke. At the completion of the compression stroke, the spark takes place at the spark plug, igniting the compressed charge of gas. The heat resulting from the rapid combustion causes the pressure of the confined gas to rise almost instantaneously to several times its pressure

before the explosion. This pressure exerted on the piston forces down the piston and produces the impulse which is transmitted by the connecting rod to the crankshaft, causing it to rotate.

Exhaust Stroke. Just before the piston reaches the end of the power stroke, the exhaust valve opens. It remains open as the piston travels upward again on the exhaust stroke, driving the burned gas out from the cylinders. By the time the piston has reached its highest point it has forced out the burned gas and the exhaust valve closes. Having completed the four strokes, the piston is now ready to draw in a new charge and to repeat the cycle.

The same cycle of events takes place in all of the cylinders but no two pistons are at the same point in the cycle at the same time. In the Cadillac eight cylinder V-type engine, the impulses in the eight cylinders are so timed that a power stroke is begun every quarter turn of the crankshaft. In other words, the crankshaft receives four overlapping impulses every revolution. The order in which the impulses take place is shown in Figure 15.

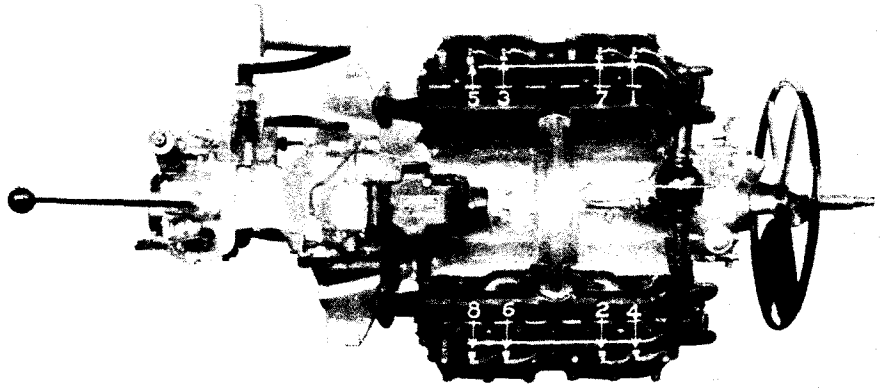


Fig. 15. Firing Order

Automatic Spark Control

When each piston is at its highest position in the cylinder is, of course, the time when the charge is at its greatest compression, or, in other words, when the gas is "jammed in the tightest." Ignition occurring exactly at this instant produces a much more forceful explosion than if it occurred at a time when the charge was not so tightly compressed.

If the charge were ignited the instant the contact is made in the ignition timer, regardless of the speed of the engine, the spark could be set permanently in one position and would not require changing. But a certain amount of time elapses from the instant the circuit is closed at the ignition timer until the charge is ignited in the cylinder. While this time is but the

merest fraction of a second, in fact, almost infinitesimal, yet it is time just the same and must be taken into account when dealing with such a rapidly acting mechanism as an automobile engine.

The lapse of time required to ignite the charge is always the same regardless of the speed of the engine and pistons. You will realize that when the engine is running, say 3000 R. P. M., the pistons are traveling many times as fast as they do when it is running only 300 R. P. M. When the engine is running 3000 R. P. M., it is necessary therefore to start the ignition process earlier.

In the Cadillac this is accomplished by means of a ring governor located directly under the ignition timer. As the speed of the engine increases, the ring in the governor assumes a position more nearly horizontal, forcing the timer cam slightly ahead on the shaft by which it is driven. This causes the timer contact points to break earlier, thereby starting the ignition process earlier in relation to the positions of the pistons. When the engine slows down, the ring in the governor assumes a position more nearly vertical, forcing the cam back on the shaft by which it is driven, causing the contact points to break later and thereby starting the ignition process later in the strokes of the pistons.

Manual Spark Control

The automatic control takes care of the spark position for all ordinary driving. A spark lever is provided, however, by which the ignition timing may be still further advanced or retarded.

Ordinarily the spark lever should be carried about one-third the way down from the "Advance" position. To get the best results, however, it should be retarded further for extremely low speeds and advanced further for extremely high speeds. The car should be driven at all times with the greatest possible spark advance permitted by the speed of the engine.

Advancing the spark too far for given engine speeds will usually cause a slight pounding noise, which is sometimes not noticed by the beginner, as it is usually but slight owing to the substantial character of the crankshaft and bearings.

When starting the engine, place the spark about one-third the way down from the "Advance" position, except during extremely cold weather when it should be placed at the "Advance" position. If the engine should be cranked by hand, the lever should be placed at the "Retard" position. If this caution is not observed a "back kick" may occur, probably resulting in personal injury.

WINDSHIELD POSITIONS.

For inclement weather

The normal position of the windshield for inclement weather is with the upper and lower sections closed and with the removable rubber strip between the glasses. If rain or snow should freeze on the glass making it impossible to clean it with the windshield wiper, the upper section may be tilted out at a slight angle. This is known as the rain vision position. The driver may then look between the sections of the shield, at the same time being protected to some extent. The clamping nuts at the top of the windshield standards must be loosened before the upper section can be moved and should be tightened after it is in the desired position.

For ventilation

When greater ventilation in the front compartment is desired than provided by the cowl ventilator, the lower section of the windshield should be tilted in. The clamping nuts, half way up the windshield standards, must be loosened before the lower section can be moved and should be tightend afterwards.

If still greater ventilation is desired the upper section may be tilted toward the driver.

The rubber strip between the windshield glasses must be removed before either the upper or lower section of the shield is tilted inward.

LUBRICATION

Part II

NO PAGE 28

IMPORTANCE OF LUBRICATION

There is no one thing which is the primary cause of more trouble and the cause of more expense in maintenance to the mechanism of an automobile than insufficient lubrication.

All moving parts of the Cadillac car are manufactured with an unusual degree of accuracy. In order to maintain the splendid running qualities of the car, it becomes necessary systematically to introduce suitable lubricants between surfaces which move in contact with one another.

It should be borne in mind constantly that where one part moves upon or in contact with another friction is created. Friction means wear, and the wear will be of the metal itself unless there is oil. The use of too much oil is better than too little, but just enough is best.

Proper lubrication not only largely prevents the wearing of the parts, but it makes the car run more easily, consequently with less expense for fuel and makes its operation easier in every way.

The oiling diagram shown on page 36 indicates the more important points which require attention. But do not stop at these. Notice the numerous little places where there are moving parts, such as the yokes on the ends of various brake rod connections, etc. A few drops of oil on these occasionally will make them work more smoothly.

Judicious lubrication is one of the greatest essentials to the satisfactory running and the long life of the motor car. Therefore, lubricate, and lubricate judiciously.

LUBRICANTS

There are many grades of oils. There are none too good. Naturally, we have experimented a great deal with numerous lubricants to determine which are best adapted for the various parts of the Cadillac car. It is not always an easy matter for users to obtain suitable lubricants. The constant demand made upon us by Cadillac users has induced us to provide suitable lubricants which may be obtained from Cadillac distributors or dealers.

Engine Oil

Cadillac Engine Oil is recommended and may be used both summer and winter. If you prefer to use some other oil and will write our Technical Department, a complete up-to-date list of tested and approved oils will be mailed to you.

The oil used should be a filtered one and not an acid or alkali treated oil.

We cannot hold ourselves responsible for damage resulting from the use of oil not suited to the Cadillac engine.

Engine oil should be strained through cheese cloth or fine mesh wire cloth before using.

Rear Axle and Transmission Lubricant

Cadillac Rear Axle and Transmission Lubricant is recommended for the the rear axle and transmission or in its absence a mixture of steam cylinder oil and a small amount of cup grease mixed to such a consistency that the mixture flows easily at temperatures from 60° to 70° Fahrenheit.

Gun Grease

Cadillac Gun Grease is recommended for use in the grease gun or, in its absence, number three cup grease.

Distributor Grease

Cadillac Distributor Grease is recommended for the Distributor.

Universal Joint Grease

Cadillac Universal Joint Grease is recommended for the universal joints on the drive shaft or, in its absence, number three fibre grease.

Steering Gear Lubricant

A mixture consisting of seventy-five per cent of Cadillac Rear Axle and Transmission Lubricant and twenty-five per cent Cadillac Gun Grease or or number one cup grease is recommended for the steering gear.

ENGINE LUBRICATION

Lubricating System

The lubrication of the engine is by oil under pressure. A supply of oil is carried in the oil pan. Oil is drawn from the oil pan by an oil pump and forced to the main engine bearings.

The connecting rod bearings on the crank shaft are lubricated by oil from the main bearings forced through holes drilled in the crank shaft. A hole drilled in the forward end of the crankshaft communicates with a hole drilled in the crankshaft sprocket through which oil is supplied to the camshaft driving chain. The cylinders are lubricated by oil thrown from the lower ends of the connecting rods.

The pressure of the oil is regulated by pressure regulator (Figure 16), containing a valve under spring tension. When the pressure is reached for which the valve is set, the valve is forced open and the oil overflows past the valve. A small hole drilled in the regulator housing allows oil to by-pass the valve when the valve is seated. Oil flowing through the by-pass and oil forced past the valve is carried to the camshaft bearings, power pressure pump in the gasoline system and the camshaft sprockets and chains through a hole drilled in the camshaft.

There is one gauge and one indicator in the lubricating system. The pressure gauge is located on the instrument board and indicates the pressure of the oil. The indicator is attached to the upper cover of the crank case near the carburetor and indicates the level of the oil in the engine.

Filling Lubricating System

An oil level indicator on the engine is for the purpose of indicating when the supply of engine oil is low and when a sufficient amount has been added. The indicator is between the cylinder blocks and is under the intake manifold, on the right hand side.

Oil should be added whenever the red ball of the indicator is down to the line marked "Fill." Do not risk running the engine after the red ball has reached the line marked "Fill." If, through oversight, the red ball should reach the line marked "empty" the engine should be stopped immediately and supplied with oil. The oil filler is just forward of the oil level indicator. (See Figure 16.)

Use only oil which is suitable (see under "Lubricants," page 31), and be certain that the oil is free from dirt or lint before pouring it into the

engine. It is a good practice to strain the oil through cheese cloth or fine mesh wire cloth.

When the red ball of the indicator is at "Full" the engine should contain seven quarts of oil.

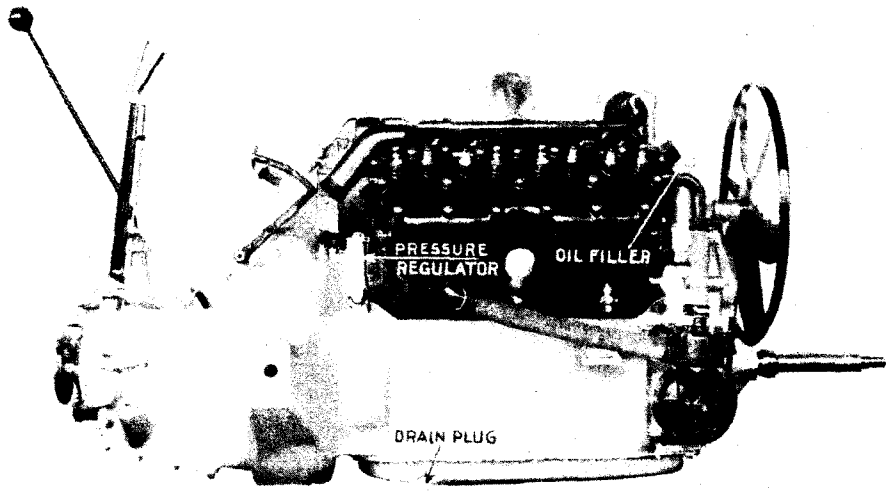


Fig. 16.

Oil Filler, Pressure Regulator and Drain Plug.

Replace Engine Oil

At the end of each 500 miles of travel remove the drain plug from the engine oil pan (see Figure 16). After the oil has drained out replace the plug and through the oil filler on the housing just back of the fan, add seven quarts of fresh engine oil (see under "Replace Engine Oil Frequently During Cold Weather," page 34). A socket wrench with a long handle is supplied with the tool equipment to facilitate the removal and replacement of the drain plug.

At the end of the first 1,000 miles of travel, at the end of the next 4,000 miles of travel and at the end of every 5,000 miles of travel, thereafter drain the oil pan as directed in the preceding paragraph, replace the plug and through the filler add a mixture consisting of three quarts of kerosene oil and one quart of engine oil. The mixture must be free from dirt and lint. Run the engine at a speed of between 600 and 1,000 revolutions per minute for the period of one minute. Then drain the oil pan, remove it and the screen from the engine and thoroughly clean the oil pan and screen. Do not fail to add seven quarts of fresh engine oil after replacing the oil pan

After cleaning the lubricating system with a mixture of kerosene and engine oil it is a good plan to clean the valve and seat of the pressure regulator. The regulator is located just back of the right hand block of cylinders. The valve can be removed after removing the regulator cover by unscrewing it. It is important also to make certain that the small by-pass hole by which oil is permitted to escape when the regulator valve is closed, is clean and free from any obstruction.

Do not use waste in cleaning the regulator valve or its seat. Use cloth free from lint.

Caution:—Do not fail to replace the engine oil as frequently as suggested.

Replace Engine Oil Frequently During Cold Weather

The mileages given under "Replace Engine Oil" at which engine oil should be replaced and the oil pan and screen cleaned are those at which this work should be done during warm weather.

During cold weather water and gasoline may accumulate in the crankcase of the engine. It is necessary, therefore, to drain the oil pan and clean the oil pan and screen much more frequently than during warm weather.

The frequency with which it is necessary to do this depends very largely upon the manner in which the car is driven. In cases where the car is driven short distances only and frequent stops are made so that the engine base and the oil remain cold it will be necessary to drain the oil pan and to clean the oil pan and screen much more frequently than in cases where the car is driven for longer distances with fewer stops, so that the engine base becomes thoroughly warmed.

If the car is constantly making short trips in cold weather the oil should be drained every 350 miles of travel or once a week and the oil pan and screen cleaned once a month.

Unless the oil is drained out and the oil pan and screen are cleaned frequently in cold weather, serious damage to the engine may result, particularly on cars in short trip service.

Oil Pressure

The pressure indicated by the oil gauge on the instrument board varies with the speed and temperature of the engine and the viscosity of the oil.

When the engine is warm and supplied with fresh Cadillac Engine Oil or oil of approximately the same viscosity, the pressure as indicated by the gauge should be from five to seven pounds when the engine is idling. (When idling the engine should run at approximately 300 revolutions per minute, if the

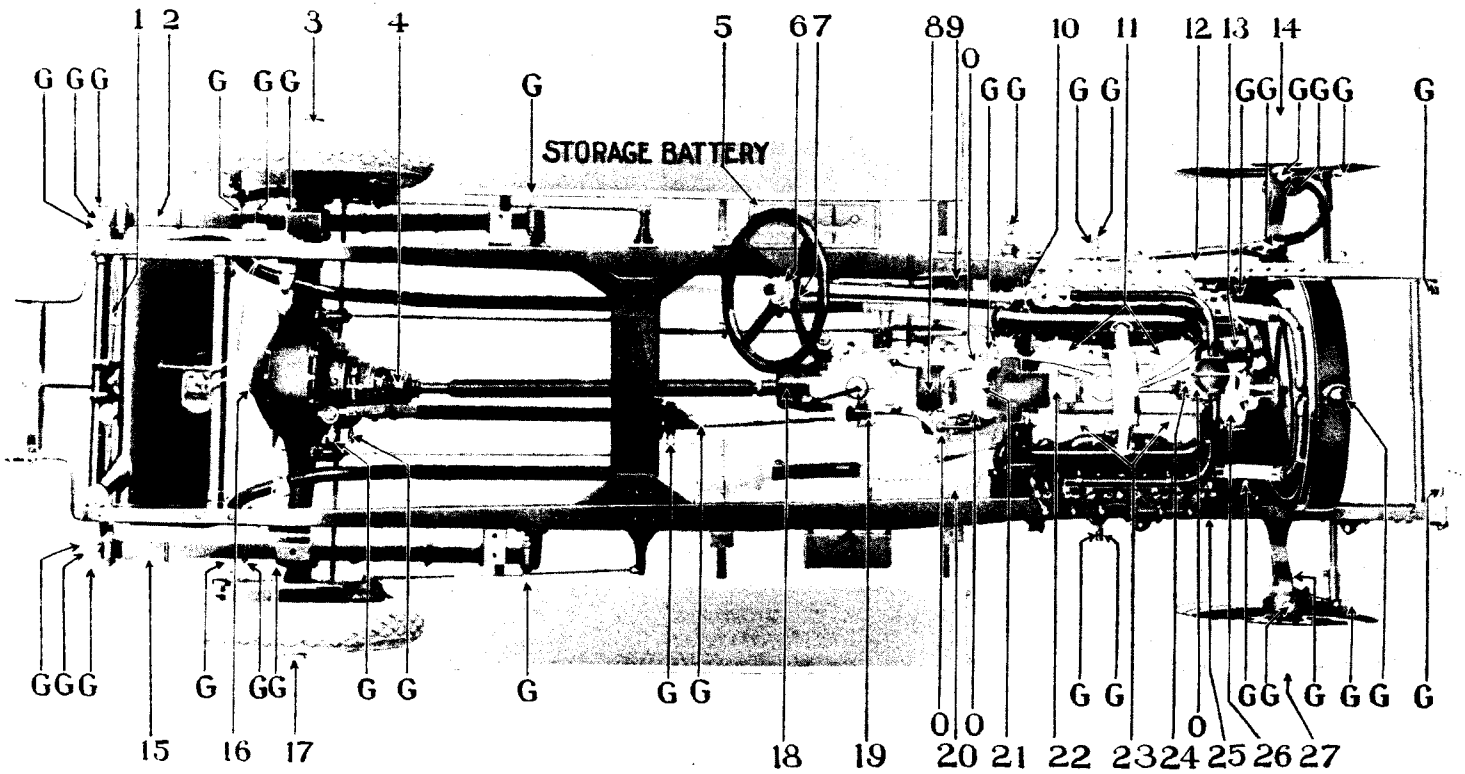
throttle stop-screw at the carburetor is properly adjusted.) At higher speeds a higher pressure should be indicated and at lower speeds, a lower pressure. Before the engine has become warm, higher pressures will be indicated at given speeds. In other words, maximum pressures will be indicated at given speeds when the engine is cold and the oil is fresh; minimum pressures, when the engine is hot and the oil becomes thin from use.

Practically all engine lubricating oils become less viscous from use even under normal conditions. Running the engine too long with the auxiliary air control lever pulled back will cause the oil to be thinned more rapidly due to the condensation of gasoline from the rich mixture.

Caution

If when starting the engine after replacing the oil it is found that the pressure gauge does not register pressure, stop the engine immediately and prime the oil pump. This may be done by disconnecting, at its upper end, the oil pipe running from the engine around the right hand side of the dash, and forcing clean engine oil into the pipe with the oil gun furnished in the tool kit. Connect the pipe and tighten the union before starting the engine.

Do not continue to run the engine if, as a result of low viscosity of the oil, or other cause, pressure is not indicated on the gauge when the engine is running. *(See under "Replace Engine Oil," page 33.)*


1 2 3 4 5 6 7 8 9 10 11 12 13 14
G G G

GENERAL LUBRICATION

It is manifestly impossible to give exact directions in every instance as to just how frequently each individual point should be oiled or exactly how much lubricant should be applied. In the following directions this is given approximately, based on average use.

With the tool equipment of each car is packed a lubrication chart, with a schedule for the lubrication of the car. This is intended to be hung in the garage to serve as a reminder.

EVERY 125 MILES

Engine: 26

At every 125 miles, or oftener, determine the quantity of oil in the engine and add oil if required (see under "Filling Lubricating System," page 32, and under "Replace Engine Oil," page 33).

EVERY 500 MILES

Grease Gun Connections: G

Points "G" should be lubricated with the grease gun at every 500 miles of travel.

Grease gun connections at all shackle bolts are fitted to grease cups. This makes it possible to lubricate shackle bolts while the car is on the road by simply screwing down the cups.

Grease cups should be screwed all the way back before refilling them with the grease gun. A reservoir of grease is thus provided.

Springs: 1, 2, 12, 15, 25

It is recommended that the springs be lubricated every 500 miles by painting the edges and ends of the leaves with engine oil. A small, stiff brush should be used. After applying the oil, the car should not be washed until it has been driven far enough to allow the lubricant to work in between the leaves. Do not open the leaves and insert lubricant.

Replace Engine Oil

Replace the engine oil at the end of every 500 miles of travel. (See under "Replace Engine Oil" Page 33 and "Replace Engine Oil Frequently During Cold Weather," page 34.)

Water in Storage Battery: 5

Every five hundred miles or at least every two weeks inspect the level of the acid in the storage battery and add *distilled* water if the level is low. (See under "Adding Water to Storage Battery," page 57.)

EVERY 1000 MILES

Oil Cups: O

A few drops of engine oil should be applied at points "O" every 1,000 miles.

Universal Joints: 4, 18

Fill the forward and rear universal joints on the drive shaft between the transmission and rear axle, with Cadillac Universal Joint Grease every 1,000 miles. A connection is furnished with the grease gun which fits the filling holes.

The forward joint is covered by a cylindrical shield to prevent grease from being thrown onto the under side of the floor. To fill the joint it is necessary first to detach the shield from the transmission case and to slide it back over the drive shaft. This may be done after loosening the two screws which hold the shield and turning the shield through a small arc in a counter-clockwise direction.

Generator Oil Cups: 21, 22

These oil cups conduct lubricant to the forward and rear bearings on the armature shaft of the motor generator. A few drops of engine oil should be applied every 1,000 miles.

Oil Holes at Steering Wheel: 6, 7

A few drops of engine oil should be applied every 1,000 miles.

Engine Rear Supports: 9, 20

There are felt wicks in the frame bracket to which the engine supports are bolted. Engine oil should be applied at these points every 1,000 miles of travel or oftener if necessary.

Clean Engine Lubricating System

At the end of the first 1,000 miles of travel, at the end of the next 4,000 miles of travel, and at the end of every 5,000 miles of travel thereafter, clean the lubricating system and the oil pan and screen. (See under "Replace Engine Oil" page 33 and "Replace Engine Oil Frequently During Cold Weather," page 34.)

EVERY 2500 MILES

Transmission: 19

The transmission should contain sufficient lubricant to bring it up to the level of the filling hole at the right hand side. The level should be inspected every 2,500 miles and lubricant added if necessary. Cadillac Rear Axle and Transmission Lubricant is recommended.

Rear Axle: 16

The rear axle should contain enough lubricant to bring it up to the level of the filling hole in the rear cover plate. The level should be inspected

every 2,500 miles and lubricant added if necessary. Cadillac Rear Axle and Transmission Lubricant is recommended.

Timer and Distributor: 24

Every 2,500 miles remove the small breather at the rear of the distributor housing by unscrewing it and pack distributor grease around the gears by which the timer and distributor are driven.

Valve Stems: 11, 23

Apply engine oil to the valve stems and cam slides every 2,500 miles. This may be done by lifting the valve compartment covers and inserting the spout of the oil gun.

Wheels: 3, 14, 17, 27

Every 2,500 miles, or every six months if the car is driven but little, all the wheels should be removed (see under "Wheels" page 62) and the bearings thoroughly cleaned in either gasoline or kerosene and examined. The bearings should be lubricated with a thin grease. Cadillac Gun Grease is recommended. Do not use heavy grease, as it will roll away from the path of the rolls and will not return.

Steering Gear: 10

The steering gear should be lubricated every 2,500 miles. Steering Gear Lubricant is recommended. (See page 31.)

Speedometer Flexible Drive Shaft

The flexible shaft by which the speedometer is driven is carried in a flexible casing. The shaft should be removed from the casing and lubricated at the end of every 2,500 miles of travel. Cadillac cup grease is recommended.

Do not under any circumstances attempt to lubricate the speedometer head. Any parts in the head which require lubrication are amply supplied when the head is assembled.

Clean and Lubricate Horn: 13

Clean and lubricate the horn at each 2,500 miles of travel. To do so it is first necessary to remove the horn from the engine and remove the motor shell. Pack the rear bearing with a light cup grease, and with an oil can put not more than two or three drops of engine oil in the front bearing. Care should be taken not to use an over supply of oil. Wipe off the commutator with a clean dry cloth.

EVERY 5000 MILES

Clutch Thrust Bearing: 8

Every 5,000 miles remove the cover plate shown at "8." With the engine not running reach in and turn the clutch thrust bearing so that the small filler screw is at the top. Remove the screw with a screw driver. Care must be exercised not to drop the screw into the clutch case.

A small connection for the grease gun is furnished with the tool kit. Screw this into the threaded hole from which the filler screw was removed and attach the grease gun.

Cadillac Rear Axle and Transmission Lubricant is recommended.

Clean Engine Lubricating System

At the end of every 5,000 miles of travel clean the engine lubricating system and the oil pan and screen. (See under "Replace Engine Oil" page 33 and "Replace Engine Oil Frequently During Cold Weather," page 34.)

Replace Transmission Lubricant: 19

At the end of every 5,000 miles of travel remove the drain plug from the under side of the transmission case and drain out all of the lubricant. Refill with two quarts of suitable lubricant. Cadillac Rear Axle and Transmission lubricant is recommended. The filler is shown at "19."

Replace Rear Axle Lubricant: 16

At the end of every 5,000 miles of travel remove the drain plug from the axle and drain out all of the lubricant. Refill with 5 quarts of suitable lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. The filler is shown at "16."

ADDITIONAL

In addition to the places specially mentioned, note carefully and oil all of the small connections and joints throughout the car, such as the various brake rod connections and joints in the brake mechanism.

Remember that wherever one part moves in contact with another, wear will be reduced to the minimum by lubrication.

GENERAL CARE

Part III

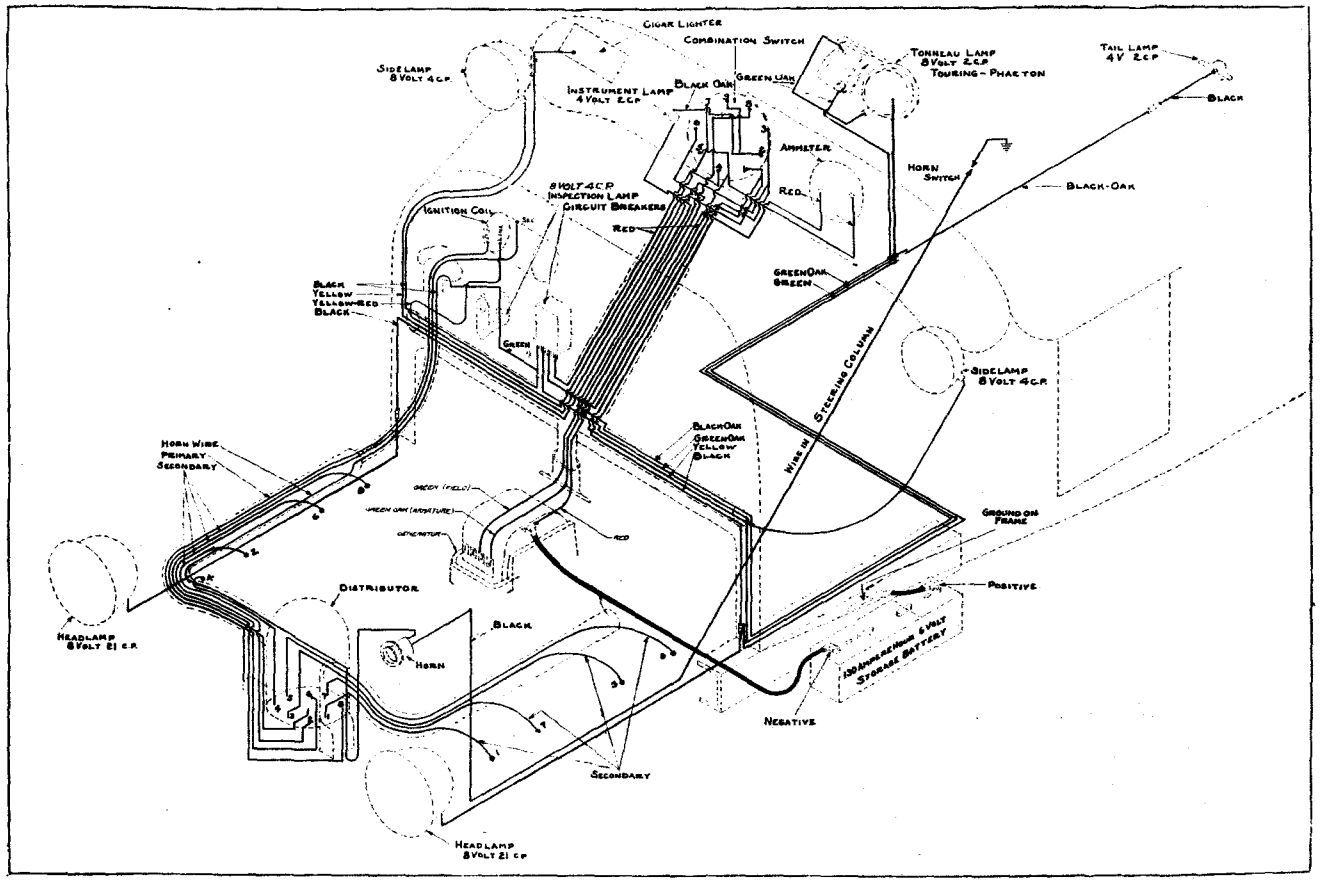


Fig. 18. Wiring Diagram

TIRES

Each tire maker publishes a booklet with instructions for care and repair of tires. Every motorist should provide himself with one of these and thoroughly familiarize himself with the contents. We give here suggestions that apply to pneumatic tires in general.

Probably 75% of so-called "tire trouble" is the result of misuse. In the following we have illustrated some of the more common causes of tire breakdown.

Result of Improperly Adjusted Tire Chains

Tires are sometimes badly damaged through the use of tire chains which are incorrectly adjusted or which are fastened to the spokes of the wheel holding the chains tightly in place.

The least injury results when chains are applied loosely leaving play enough to permit them to work around. The wear on the tire is thus distributed evenly. Probably the greatest amount of injury comes from using chains unnecessarily on paved streets.

Neglect of Small Cuts

If cuts extending to the cords of fabric are neglected deterioration and blistering of the tire tread is the result. It is unnecessary to remove a tire to treat small cuts of this nature. Tire companies furnish a plastic compound for filling cuts. This prevents moisture and dirt from getting in.

Result of Improperly Aligned Front Wheels

Running a car with the front wheels out of alignment causes rapid tread wear. This usually affects both tires similarly, although sometimes only one tire is affected. An incorrect adjustment of the parrallel rod in front of the axle or a bent steering arm is responsible for the condition. Unless the wheels are in proper alignment the treads of the front tires will wear away in a remarkably short time.

Result of Sudden Application of the Brakes

The sudden application of the brakes resulting in sliding the wheels causes the treads to wear away in spots. A tire will give away very rapidly under this severe treatment.

Result of Under Inflation

Under inflation causes a tire to flatten out under load. This causes the side walls to bend sharply as the tire revolves. The result is the breaking of the side walls.

Additional Suggestions

The tires are constructed for the purpose of carrying up to certain maximum loads and no more. It should be realized that overloading a car beyond the intended carrying capacity is sure to materially shorten the life of the tires.

Do not turn corners or run over sharp obstructions, like car tracks, at a high rate of speed. Such practice is sure to strain or possibly break the fabric, with the result that the further life of the tires will be limited. Remember that most tire troubles are the result of abuse.

Avoid scraping the tires against the curb and running in ruts. This kind of wear scrapes off the rubber side wall and exposes the fabric to dirt and moisture, which soon starts to rot the threads.

In turning in a narrow street, avoid striking the curb.

If a tire goes flat, see that the valve is not leaking. A little moisture on the tip will show bubbles if the air is escaping.

In case of puncture, the car should be stopped at once and the tube repaired or replaced, or the tire replaced by the extra one. The tire should also be examined carefully and the cause of the puncture ascertained and the nail, glass or whatever it may be, should be extracted. Before replacing the tire on the rim, examine the inside of the casing to see that the cause of the puncture is not still protruding. It is also advisable to look over the outside of the tires frequently and take out any pieces of glass or other particles which may have become imbedded in the casing.

Don't run in ruts or car tracks; the sides of a tire will soon wear out under such treatment. Avoid large stones or other obstructions in the road. To hit one of these may break the fabric even though no external injury be visible.

The garage floor should be kept free from oil or gasoline. The tires on a car left standing on a grease-covered floor deteriorate quickly, the natural enemies of rubber being oil and gasoline. These destroy the nature of the rubber, rendering it soft, so that it cuts and wears away quickly.

If the car is not used during the winter, it is better to remove the tires from the rims, keeping casings and tubes in a fairly warm atmosphere away from the light. It will be better to slightly inflate the tubes, as that keeps them very nearly in the position in which they will be used later on. If the tires are not removed and the car is stored in a light place, it will be well to cover the tires to protect them from the strong light, which has a deteriorating effect on rubber.

The greatest injury that can be done to tires on a car stored for the winter is to allow the weight of the car to rest on the tires. The car should be blocked up, so that no weight is borne by the tires, and the tires should then be deflated partially. This will relieve the tires of all strain, so that in the spring they should be practically no worse for the winter's storage.

STORAGE

Engine

To prepare the engine for storage proceed as follows: Start the engine, cover the radiator and run the engine until it is hot. (See under "Personal Danger in Running Engine in Closed Garage," page 50.) The engine should be run at a speed which will show an ammeter reading of about 10 with all lights switched off. It usually requires from two to ten minutes to heat up the engine.

After the engine is hot, stop the flow of gasoline to the carburetor by removing the gasoline tank filler cap, thus relieving the air pressure. Immediately the engine starts to slow down from a "lean mixture" inject from three to four tablespoonfuls of clean fresh engine oil into the carburetor. This may be done easily after lifting the large relief valve on the carburetor. This will stop the engine. Be certain there is no fire near when the filler cap is removed. Replace and tighten the cap after the engine stops.

Open the compression cocks. Inject from two to three tablespoonfuls of clean fresh engine oil into each cylinder and before closing the cocks crank the engine three or four revolutions with the ignition switched off. This will tend to distribute the oil over the cylinder walls.

If the engine is started again repeat the series of operations given in Paragraphs 1, 2 and 3.

Drain the cooling system. You will find complete directions in this book under "Draining the Cooling System," page 52.

Storage Battery

(*See under "Preparing Battery for Winter Storage," page 58*).

Tires

During winter storage it is best to remove the tires from the rims and keep the casings and tubes in a fairly warm atmosphere away from the light. It is best to inflate the tubes slightly after the tires have been removed to keep the tires in the position in which they are when inflated on the rim.

If the tires are not removed from the car, and the car is stored in a light place, it is best to cover the tires to protect them from strong light, which has a deteriorating effect on rubber.

The greatest injury that can be done to tires when the car is stored is to allow the weight of the car to rest on them. If the tires are not removed the car should be blocked up so that no weight is borne by the tires and the tires partly deflated.

Body and Top

It is best to put the top up and cover the entire car to protect it from dust.

Taking the Car Out of Storage

When the car is taken out of storage and before the engine is started, drain the oil from the oil pan, remove and clean the oil pan and baffle plate and replace the oil with fresh oil. (See under "Replace Engine Oil," page 33.)

The following instructions should be followed carefully in starting the engine:

Open the compression relief cocks and inject from two to three tablespoonfuls of clean fresh engine oil into each cylinder.

Close the cocks and with the ignition turned off turn the engine over a few revolutions by hand. This will tend to distribute the oil over the cylinder walls.

Start the engine in the usual manner.

Immediately the engine starts push the carburetor enriching button as far forward as possible without causing the engine to stop or a material reduction in engine speed and open the throttle to a point which causes an ammeter reading of approximately 10 with all lights switched off. With the engine running inject from two to three tablespoonfuls of clean fresh engine oil into the carburetor. This may be done after lifting the large relief valve on the carburetor.

Push the carburetor enriching button forward as far as it will go as soon as the engine is warm enough to permit it.

CARE OF THE FINISH

The finish of an automobile requires more careful and frequent attention when the car is new than when it is older and the varnish is harder. Particular care should be taken to keep mud from the body and hood of the car while new.

Never permit mud to remain on the finish over night or long enough to dry. If it is not possible to wash the car thoroughly before putting it away

for the night, flush it off and then thoroughly wash the car the next morning. Mud permitted to remain on the car until it has dried, is not only difficult to remove but stains and dulls the finish.

WASHING THE CAR

Use clean water and plenty of it. Do not use water containing alkali. In parts of the country where the regular water supply contains alkali use rain water. Do not use hot water, as it destroys the lustre. The temperature of the water should be between 40 and 60 degrees Fahrenheit. Do not wash the hood while it is hot. The effect on the finish is the same as washing it with hot water. Unless the hood is allowed to cool before washing, the lustre will soon disappear.

If a hose is used in washing, do not have water pressure greater than will carry the water 6″ beyond the end of the hose. Water under higher pressure drives the grit and dirt into the varnish. It is best not to use a nozzle.

Start at one of the front wheels, first going over the underside of the fender, the wheel and the chassis nearby, with water flowing gently from the hose. This will flush off most of the mud and dirt.

If it is necessary to use soap to remove road oil from the underside of the fenders or machine oil or grease from the chassis, use a little good automobile soap dissolved in a pail of water and apply the soapy solution with a sponge. Do not let this soapy solution remain on the finish more than two or three minutes but immediately wash it off thoroughly with a good soft carriage sponge. Then proceed to wash the under surfaces of the remaining fenders, the wheels and the remainder of the chassis in a similiar manner.

When the washing of the chassis is completed begin at the front of the car and with the water running gently from the hose, flow on the body, hood and upper surfaces of the fenders. This will soften the accumulation of road dirt and remove most of it. Then go over the car again and remove all dirt by rubbing lightly with a soft wool sponge, which is used exclusively for the body, hood and upper surfaces of the fenders. At the same time, apply gently from a hose an abundance of water. Rinse the sponge frequently in clean water to remove any grit. After the washing is completed squeeze the sponge as dry as possible and pick up all water from crevices.

Then thoroughly wet a clean soft chamois, wring it as dry as possible, and dry the finish. Rinse the chamois and wring it out frequently. Do not rub the finish or apply more pressure than is necessary to dry off the water. Water evaporates quickly and leaves the finish in good condition.

If it is desired to chamois the wheels and chassis, wet the parts with clean water if they have become dry, and then wipe them. Use a separate

chamois for the chassis. Do not use on the body a chamois that has been used on the chassis or wheels.

Do not use soap, gasoline, kerosene or anything of this nature on the finish. Such ingredients attack the varnish.

Do not clean the glass with preparations which may contain harmful ingredients. Use only cleaning compounds which are known to have no destructive effects on highly polished glass.

GASOLINE SYSTEM

General Description

The supply of gasoline is carried in a tank at the rear of the car and is forced to the carburetor by air under a pressure of one to two pounds. A float controlled needle valve in the carburetor maintains the gasoline at the correct level in the carburetor bowl.

The gasoline pressure is indicated by a gauge on the instrument board (see Figure 1). A hand air compressor on the instrument board is provided, by which pressure for starting may be obtained when the car has been standing long enough to make this necessary. When the engine is running, pressure is automatically maintained by an air compressor on the engine, driven by an eccentric on the front end of the cam shaft. An air pressure relief valve connected in the air line prevents the pressure rising above that for which the valve is set.

The pipe extending almost to the bottom of the gasoline tank is a continuation of the gasoline line. The air line simply enters the tank at the top and does not extend into the gasoline.

Filling the Gasoline Tank

The gasoline tank is at the rear of the car. (See Figure 19.) The filler cap may be removed after loosening the thumb screw.

Gasoline should be strained through a wire cloth of very fine mesh before it is poured into the tank. If dirt or water is allowed to enter the gasoline system it may cause great annoyance by getting under the carburetor inlet needle and causing the carburetor to flood.

After filling the tank, screw on the filler cap and tighten the thumb screw. This is necessary to prevent leakage of the air pressure by which the gasoline is forced to the carburetor.

Settling Chambers and Strainers

There are two settling chambers in the gasoline system, one at the under side of the gasoline tank and the other attached to the left hand side of the [illegible] of the car just under the front floor boards.

There is a drain plug at the bottom of each of these settling chambers. Every one thousand miles or oftener the plug in the settling chamber under the floor boards and the plug in the settling chamber underneath the gasoline tank should be removed to drain the settling chambers of any dirt or water which has accumulated. Before unscrewing either of the plugs, the car should be driven out of the garage into the open and the gasoline system relieved of all air pressure by removing the gasoline filler cap on the tank. Be sure there is no fire near the car when these plugs are removed.

There are two strainers in the gasoline system which require cleaning periodically—one at the point where the gasoline feed pipe is attached to the carburetor, and the other attached to the drain plug in the settling chamber under the front floor boards. (See Figure 19.)

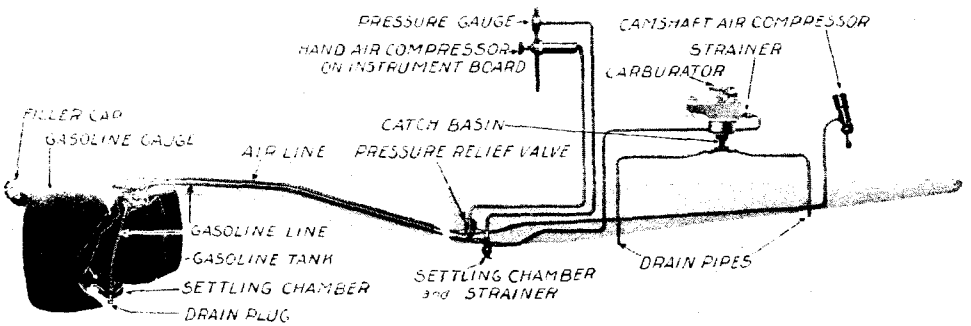


Fig. 19. Gasoline System.

The strainers should be removed and cleaned every one thousand miles or oftener. Remove the filler cap to relieve the air pressure before removing either strainer. In cold weather it may be found necessary to remove the strainers more frequently, to prevent an accumulation of water at these points which would freeze and prevent gasoline from flowing to the carburetor.

CARBURETOR

The carburetor is correctly adjusted when the car is assembled and unless tampered with should not require readjustment. It is unnecessary to change the adjustment for changes in season and weather.

Good carburetor action cannot be expected until the engine is thoroughly warmed up. Imperfect carburetor action while the engine is cold does not indicate that the carburetor requires adjustment.

If adjustment of the carburetor seems to be necessary have it made by a Cadillac distributor or dealer. The adjustment should not be attempted by one unfamiliar with it.

Personal Danger of Running Engine in Closed Garage

Carbon monoxide, a deadly poisonous gas, is present in the exhaust of gasoline engines. Increasing the proportion of gasoline to air in the mixture fed to the engine, in other words, enriching it, increases the amount of carbon monoxide given off.

The presence of carbon monoxide makes it very dangerous to run the engine while the car is in a small, closed garage. If the doors and windows are open the danger is lessened, but it is far safer, particularly if an adjustment of the carburetor is being made, to run the car into the open.

Serious personal injury may be caused by the presence of carbon monoxide in a garage if the percentage of it in the air is greater than a very small fraction of one per cent. Unconsciousness may result without warning. It is reported that no indication of danger is given by personal discomfort until too late. Deaths resulting from the presence of carbon monoxide in garages have been reported.

COOLING SYSTEM

General Description

The cooling system is of the forced circulation type. Circulation through each cylinder block is independent of that through the other, two pumps being provided.

The temperature of the liquid circulated by the pumps is under thermostatic control, the purpose of which is to permit liquid circulated through the water jackets of the cylinders to warm up to the temperature at which the engine operates best, very soon after the engine is started and to prevent the temperature dropping below this point while the engine is running.

Condenser

A condenser, the purpose of which is to prevent the loss of the cooling medium by evaporation, is attached to the right hand side of the car frame.

The operation of the condenser requires an air tight seal at the radiator filler cap. To make it possible to screw down and tighten the cap without injury to the rubber gasket, two metal washers are interposed between the head of the cap and the gasket. It is important that nothing be installed on the radiator cap which may cause an air leak or which makes necessary the elimination of the washers or cutting a hole through the gasket.

Refilling the Cooling System

Fill the cooling system with water during warm weather and with a suitable anti-freezing solution during freezing weather (see under "Anti-Freezing Solutions" page 22). To fill the cooling system proceed as follows:

Close the drain cock "D" (Fig. 20) on each cylinder block and the drain cock "C" on each water pump. If the indicator on the end of each pump shaft "B" does not point up turn the shaft so that it does. The shaft may be turned in either direction.

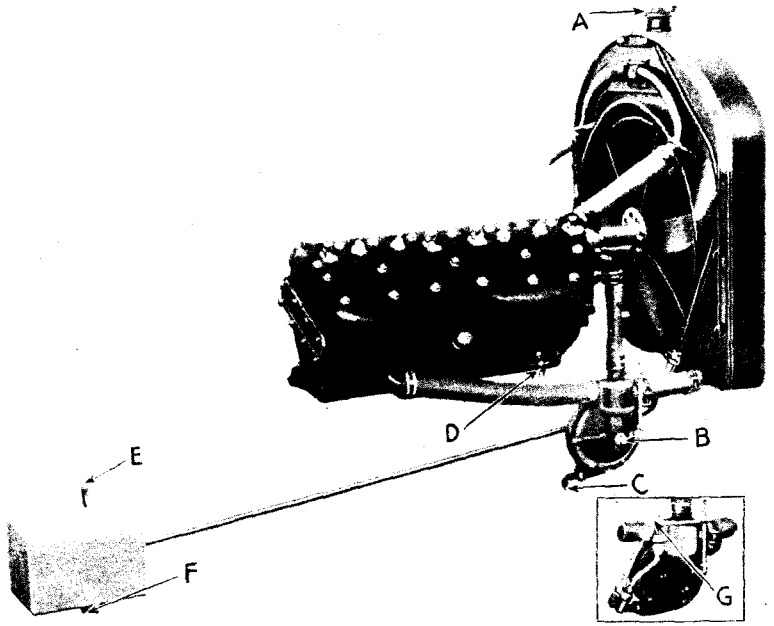


Fig. 20. Cooling System

Remove the filler cap "A" and fill the cooling system. Screw the cap down tightly after replacing it. This is important since the operation of the radiator condenser depends upon a tight joint at the radiator cap.

Turn each pump shaft "B" so that the indicator points down.

To fill the radiator condenser (see under condenser page 50) take out the floor board just forward of the transmission control lever and replace the drain plug "F" (Fig. 20.) Remove the condenser filler cap "E" and fill the condenser one half full using the same liquid as in the radiator. Replace the filler cap.

Type 61 cars carrying engine numbered 61-U-47 or a lower engine number are filled in the following manner.

Close the cylinder drain cock "D," (Fig. 20) and turn the valves "G," to the "Fill" position. If the water pump drain cock does not turn easily force down on the screw driver. In extreme cases it may be necessary to strike the end of the screw driver with the hand to unseat the drain cock.

There is a drain cock "D" in each cylinder block and a valve "G" at each water pump.

Remove the filler cap "A" and fill the cooling system. Screw down the cap firmly after replacing it.

Turn the valves "G" to the "Close" position.

Adding Cooling Solution

If only a small amount of cooling solution is necessary to fill the system, it is necessary only to remove the radiator filler cap and pour in the required amount.

Screw down the radiator filler cap firmly after replacing it. This is necessary to insure operation of the condenser.

Draining the Cooling System

To drain the cooling system turn the shaft "B," (Fig. 20) on each water pump so that the indicator on the end of the shaft points up. The shaft may be turned in either direction. Then open the drain cock "C" on each water pump and the drain cock "D" on each cylinder block.

To drain the condenser remove the drain plug "F."

A slight change was made in the design of the water pumps beginning with engine numbered 61-U-48. To drain the cooling system on a car numbered 61-U-47 or with a lower engine number, proceed as follows:

Open the drain cocks "D" (Fig. 20) and turn the water pump valves "G" to the "Drain" position. If a water pump drain cock does not turn easily, force down on the screw driver. In extreme cases it may be necessary to strike the end of the screw driver with the hand to unseat the drain cock.

The is a drain cock "D" in each cylinder block and a valve "G" at each water pump.

Cleaning the Cooling System

The cooling system should be drained and flushed out every two or three months. This can be done in the following manner:

Run the engine with the radiator covered until the liquid in the cooling system is boiling hot.

Shut off the engine and immediately drain the cooling system.

If an alcohol anti-freezing solution is drawn off part of it may be used again if the sediment is allowed to settle. In case it is used the specific gravity should be tested with a hydrometer, after it has cooled thoroughly.

After the liquid is drained off, refill the cooling system with hot water and repeat the operations outlined above.

If, in draining the second time, the water is very dirty, it may be desirable to repeat the flushing operation a third time, using a solution of sal-soda. If the sal-soda solution is used, be sure that it is drained out and the system flushed again with clear water.

The sal-soda solution should not be permitted to get onto the finish of the hood or radiator.

CADILLAC-DELCO ELECTRICAL SYSTEM

General Description

The Cadillac-Delco system is the single wire, single unit system. One side of the motor, generator, storage battery, lamps, horn and ignition apparatus is connected to some part of the frame of the car or the engine. The other connections are made with copper wires or cables.

The motor generator serves both as a generator of current and as an electric motor for cranking the engine when starting. The principal elements of the motor generator are an armature and a field. There are two windings on the armature and two in the field—one on the armature and one in the field are used when the motor generator is used as a generator and the other windings when it is used as a motor.

GENERATION OF CURRENT

When the engine is not running and the lights are turned on, the ammeter, located on the instrument board (see Figure 1) indicates on the "discharge" side of the dial, the amount of current drawn from the storage battery for the lights. When the ignition switch is turned on the ammeter indicates in addition the current used in slowly rotating the armature of the motor generator. When the starter button is pushed down, the current is no longer required for slowly rotating the armature of the motor generator. The ammeter then indicates only the current used for ignition and lights if turned on. The ammeter does not indicate the amount of current used in the cranking operation.

Before the engine is running fast enough to generate sufficient current to equal the current demand, the ammeter indicates on the "Discharge" side the amount of current being drawn from the storage battery. When the engine has attained a speed sufficient to generate current to more than

equal demand, the ammeter indicates on the "Charge" side the excess current. This passes to the storage battery and recharges it.

Ordinarily, with all lights switched off, sufficient current is generated to start recharging the battery when the car is operated in high gear at speeds from ten to twelve miles per hour and, of course, at much lower speeds when the car is operated in low or intermediate gear. With all lights turned on sufficient current is generated to take care of the requirements at speeds from ten to fifteen miles per hour. At speeds greater than this the surplus current passes through the storage battery and recharges it. In other words, the ammeter indicates the rate at which the storage battery is being charged or discharged.

To determine the total output of the generator turn off all the lights and add the amount of current used for ignition, i. e., two to three amperes, to the ammeter reading.

MOTOR GENERATOR COMMUTATORS

Do not put oil on the commutators of the motor generator.

IGNITION SYSTEM

The ignition system embodies the following elements: A source of current, the generator, or at low speeds, the storage battery; an ignition timer, which interrupts the low tension current at the proper instant to produce a spark in the high tension circuit; an induction coil, transforming the primary current of six volts into one of sufficient voltage to jump between the points of the spark plugs; a condenser, which assists the induction coil to raise the voltage, and which protects the contact points of the ignition timer from burning; and a high tension distributor which directs the distribution of the high tension current to the spark plugs in the respective cylinders.

Spark Plugs

Spark plugs should be clean. When carbon or soot is permitted to collect on them short circuiting of the current results and prevents the proper ignition of the charge in the cylinder. A good method of cleaning plugs is to wash them in alcohol. Use gasoline in the absence of alcohol.

In order to get the best results the points of the spark plugs should be .023 of an inch apart.

Cleaning Lamp Reflectors

The reflectors of the head and side lamps are plated with pure silver. In polishing, extreme care must be exercised in selecting materials which will not scratch it.

Powdered dry rouge and a chamois skin are recommended. If the reflectors are tarnished, moisten the rouge with alcohol, and apply with the chamois. Then polish with a dry chamois and rouge.

The chamois should be soft and must be free from dust. Do not use a chamois used for any other purpose.

Lamp Bulbs

It is recommended that bulbs for the lamps be purchased from a Cadillac distributor or dealer. In any event bulbs should have the correct voltage and candle power rating. The following is a table of correct voltages and candle powers:

Lamps	*Voltage*	*Candle Power*
Head	8	21
Side	8	4
Instrument	4	2
Tail	4	2
Tonneau	8	2
Portable	8	4
Dome, enclosed cars	8	4
Quarter, enclosed cars	8	2

Cigar Lighter

The wire to the Cigar Lighter (See Figure 1) is carried on a reel fastened to the front face of the instrument board. Pulling the cigar lighter out of its receptacle on the instrument board automatically operates a switch in the reel chamber by which current to the cigar lighter is controlled. Permitting the cigar lighter to return to its receptacle automatically switches off the current.

Portable Lamp

The portable lamp is attached to the right hand side of the front face of the dash. To use the lamp lift the right hand side of the engine hood and pull the lamp straight out from its socket. The wire to the lamp is wound upon a reel. To return the portable lamp to its socket, operate the small lever on the dash at the side of the lamp receptacle. This will throw a catch which holds the reel and permit it to rewind the wire. The lamp is lighted by the small switch near the lamp.

STORAGE BATTERY

General Description

The storage battery consists of three cells. It is carried in a compartment in the left hand dust shield. The cover of this compartment forms a

part of the dust shield and may be removed after unscrewing the two nickel-plated screws.

The battery is designed especially for the Cadillac-Delco electrical cranking, lighting and ignition system and is made by the Electric Storage Battery Co., Philadelphia, Pa., whose batteries are known as "Exide" batteries.

The specific gravity of the acid solution in the battery is an indication of the state of charge. (See under "Hydrometer Syringe," page 57.) In a fully charged battery the specific gravity should be from 1.270 to 1.290. If the specific gravity registers from 1.150 to 1.170 it indicates that the battery is practically discharged. A battery discharged below a specific gravity of 1.150 will not crank the engine nor will it burn the lights to full candle-power when the engine is not running.

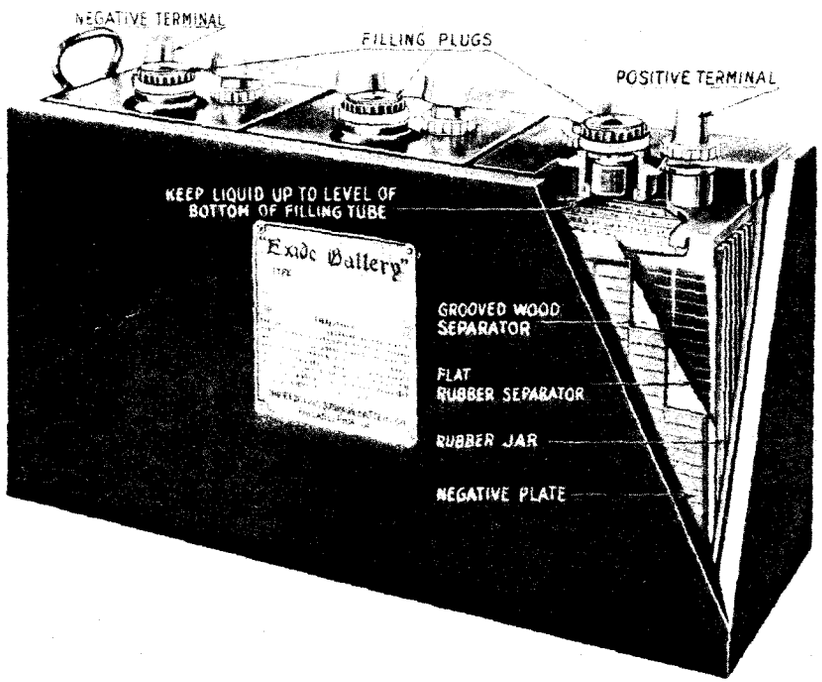


Fig. 21. Storage Battery, Sectional View.

Caution:—Never run the engine with the storage battery disconnected. Serious damage to the motor generator may result. Do not remove the motor generator or attempt any adjustment of the circuit breakers or remove any of the wires to the circuit breakers, without first disconnecting the storage battery.

Adding Water to Storage Battery

The acid solution in the battery must always cover the plates and the level of the acid solution should be kept even with the bottom of the filling tubes. Water should be added frequently enough to keep the level up to this point. *Do not* add *acid*. Ordinarily water should be added every 500 miles, but it should be added at least every two weeks and more frequently if found necessary Usually it will requre only a teaspoonful or so; in hot weather it may require more. Be sure to replace and tighten the filling plugs after adding water.

To remove a filling plug, turn it as far as possible in the counter-clockwise direction, then lift it straight up. To replace it, hold it so that the large arrow is perpendicular to the center line of the car, set the plug in place and turn it in the clockwise direction until tight.

If a plug is left out or is loose, acid solution will escape from the cell, especially when the battery is being charged. If a plug is lost or broken, obtain a new one and install it as soon as possible.

If one cell regularly requires more water than the others, thus lowering the specific gravity of the acid solution in that cell, a leaky jar is indicated. Even a very slow leak will in time result in the loss of all the acid solution in the cell. A leaky jar should be replaced immediately by a new one.

Water for filling the battery must be pure. Distilled water, melted artificial ice or fresh rain water are suitable for this purpose. If rain water is used, it should not be allowed to come in contact with any metal. It should not be caught from a metal roof or in a metal receptacle.

Never keep the water in a metal container, such as a metal bucket or can. It is best to get a bottle of distilled water from a druggist or from an ice plant. A quart will last a long time. The whole point is to keep metal particles out of the battery. Spring water, well water or hydrant water from iron pipes generally contains iron and other metals in solution, which will ultimately cause trouble if used.



Fig. 22. Hydrometer Syringe

Hydrometer Syringe

A hydrometer (Figure 22) is an instrument for testing the specific gravity of a liquid. A hydrometer syringe is a hydrometer specially designed for convenience in testing the specific gravity of the acid solution in storage batteries. Hydrometer syringes are not a part of the electrical system but can be purchased from any "Exide" service station.

To test the solution in the storage battery with a hydrometer syringe, proceed as follows:

Remove the filling plug from the cell to be tested, compress the rubber bulb of the syringe, and insert the pipette into the solution of the cell. Hold the syringe as nearly vertical as possible, and gradually lessen the pressure on the bulb until enough of the acid solution is drawn into the syringe to float the hydrometer. The specific gravity reading is taken on the hydrometer at the surface of the acid solution in the glass barrel.

If the acid solution is below the top of the battery plate, or so low that it is not possible to draw enough of the solution into the barrel to float the hydrometer, fill the cell to the proper level (see Figure 21), by adding pure water, run the engine until the water has become thoroughly mixed with the acid solution, and then take the reading as above described. The engine should run for several hours after water is added before an hydrometer reading is taken.

Preparing Battery for Winter Storage

When the car is stored for the winter the level of the acid solution should be even with the bottom of the filling tubes. (See under "Adding Water to Storage Battery," page 57.) If water is added it should be added just before the last time the car is used so that it will be thoroughly mixed with the acid solution. When the car is stored, the specific gravity of the acid should register from 1.270 to 1.290. In this condition there is no danger of the acid solution freezing. The specific gravity of water is 1.000 and water freezes at 32 degrees F. above zero.

Unless the battery is fully discharged or nearly so it is probable that the acid solution in the battery will freeze and cause extensive damage.

The following is a table of the freezing temperatures of sulphuric acid and water solutions of specific gravities from 1.050 to 1.300.

Specific Gravity (Hydrometer Reading)	Freezing Temperature (Degrees Fahr.)
1.050	+27°
1.100	+18°
1.150	+ 5°
1.164	0°
1.200	—17°
1.250	—61°
1.275 to 1.300	—90°

The battery should be charged every two months during the "out of service" period, by running the engine. If the above is impossible and there

is no garage equipped for charging batteries to which it may be conveniently sent, the battery may be allowed to stand without charging during the winter, provided the specific gravity of the acid solution registers from 1.270 to 1.290 at the time the car is laid up. Much better results and longer life from the battery will be obtained by giving the periodic charges.

The wires of the battery should be disconnected during the "out of service" period, as a slight leak in the wiring will discharge the battery.

Placing Battery in Service Again

If the battery has received periodic charges it will be unnecessary to give it any special attention, other than to fill it to the proper height with distilled water and connect the wires which were disconnected when the car was stored. After the car has been driven for a number of hours, the specific gravity of the acid solution should be taken with a hydrometer syringe. The solution should register from 1.270 to 1.290 if the battery is fully charged.

A greenish deposit sometimes exists on the terminals of a storage battery which has been stored. This deposit may be removed with a solution of bicarbonate of soda (common cooking soda) in water. Do not allow any of this solution to get into the cells of the battery.

If the battery has not been kept charged during the winter, it is advisable to remove it from the car and have a plant equipped to take care of the work, give it a fifty-hour charge at a 4-ampere rate, before putting it into service again.

Sediment

The sediment which gradually accumulates in the bottom of the jars, should be removed before it reaches the bottom of the plates. The need of cleaning may be determined by inspection. Its necessity is indicated by lack of capacity, excessive evaporation of the acid solution and excessive heating when charging. If a battery is in need of cleaning or repairs, it is best to communicate with a Cadillac distributor or dealer or with the nearest Exide depot, who will advise you where to ship the battery. *Do not ship batteries without receiving instructions.*

Exide Depots and Sales Offices

The Electric Storage Battery Company, whose general offices and works are at Alleghany Avenue and 19th Street, Philadelphia, Pa., has service stations in towns of any considerable size where battery repair work is done.

as well as sales offices and Exide battery depots in a number of the larger cities of the country, where complete assembled batteries and repair parts are carried in stock. For the location of the nearest Exide depot or service station, write the local Cadillac distributor or dealer, or, if preferred, the Electric Storage Battery Company, at Philadelphia.

TRANSMISSION AND CLUTCH

TRANSMISSION

General Description

The transmission is in unit with the engine, and is of the selective type of sliding gear. The gear changes are accomplished by the movement of a hand lever at the driver's right (see Figure 1, also under "Gear Shifting," page 10).

When traveling in high gear, power from the engine is transmitted through the transmission without passing through any of the transmission gears. Power is transmitted through transmission gears when the car is operated in intermediate, low, or reverse gear.

Changes of gear must never be attempted without first disengaging the clutch by holding down on the clutch pedal.

Lubrication

The transmission case should always contain lubricant enough to bring the level up to the filler plug in the right-hand side of the case. The level should be inspected at least every 2,500 miles, and lubricant added if necessary.

At the end of every 5,000 miles the transmission case should be thoroughly drained and refilled with fresh lubricant.

Cadillac Rear Axle and Transmission Lubricant is recommended for the transmission. In its absense steam cylinder oil mixed with gun grease may be used. The consistency of the mixture should be such that the mixture will flow easily at temperatures of from 60° to 70° Fahrenheit.

CLUTCH

General Description

The main clutch is of the multiple disc dry plate type. The driving discs are covered on both sides with a friction material composed largely of asbestos, and are driven by gear teeth in a clutch ring bolted to the fly wheel of the engine.

The driven discs are not covered. These discs are carried on a clutch hub and drive the clutch hub through keys. The clutch hub in turn drives the transmission shaft.

When the clutch is engaged by allowing the clutch pedal to come toward you, the clutch spring forces all of the discs together.

The resulting friction between the driving and driven discs drives the transmission shaft and the car when the transmission control lever is in other than neutral position.

The clutch pedal should be adjusted occasionally to compensate for wear on the facings of the clutch discs. This adjustment is explained below under "Adjustment of Clutch Pedal Clearance."

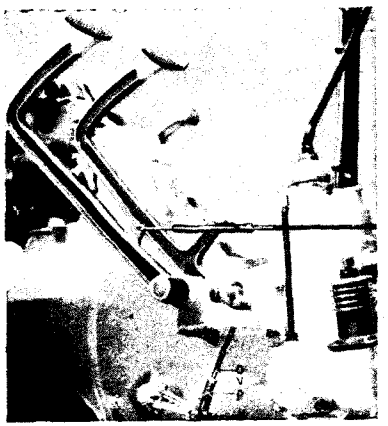


Fig. 23. Clutch Control.

Adjustment of Clutch Pedal Clearance

After the car has been run for some time it may be found that the facings on the clutch discs have become compressed or worn to some extent and that consequently the clutch pedal strikes the stop screw before the clutch is fully engaged. When this condition exists a readjustment may be made as follows:

Remove the pin "N," Figure 23, and unscrew the yoke "P," which is threaded on the rod "O," so that when the pin "N" is replaced the clutch pedal has a movement back and forth of one and one-quarter inches without starting to release the clutch. Secure the pin "N" with a cotter pin and tighten the lock nut "V."

STEERING GEAR

General Description

The steering gear is of the worm and sector type. Adjustments are provided in the steering gear for taking up play, which may result after long use.

The worm and sector are contained in a housing, which is bolted to the web of the side bar, and serves as a container for lubricant.



Fig. 24. Steering Gear.

Lubrication

The mechanism of the steering gear is lubricated through the gun connection "A," Figure 24.

Steering Gear Lubricant, made by mixing seventy-five per cent of Cadillac Rear Axle and Transmission Lubricant and twenty-five per cent of Cadillac Gun Grease or number one cup grease, should be used.

WHEELS

The adjustment of wheel bearings or the removal of wheels should not be attempted by one unfamiliar with work of this nature. It is recommended that the car be taken to a Cadillac distributor or dealer for this work.

Removing a Front Wheel

Jack up the axle until the wheel is free from the ground.

Remove the hub cap by unscrewing it.

Remove the cotter pin.

Remove the lock nut "A," Figure 25.

Remove the washer "B."

Remove the adjusting nut "C."

The wheel may now be removed.

Before replacing the wheel, see that the bearings are clean and that they are filled with a thin grease. Be sure that the grease is free from dirt and grit.

Replacing a Front Wheel and Adjusting Bearings

In replacing the wheel, adjust the nut "C" very carefully. (See under "Caution in Adjusting Wheel Bearings," page 64.) Replace washer "B," being sure that one of the holes in the washer fits over the stud "D." Replace the lock nut "A" and tighten carefully. Replace the cotter pin.

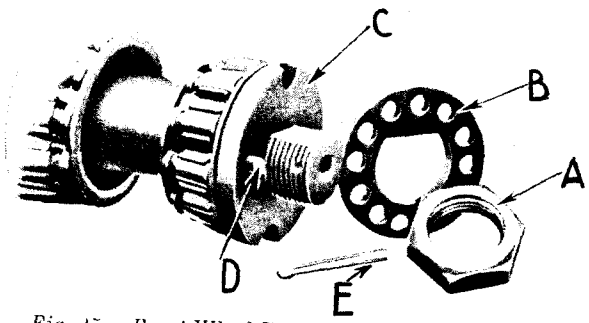


Fig. 25. Front Wheel Bearings and Adjusting Nuts.

It is better to adjust the wheel bearings a little too loose than tight. If after the adjustment is apparently correct, a hole in the washer "B" is not directly over the stud "D," it is best to loosen the adjustment rather than to tighten it.

Removing a Rear Wheel

Remove the lubricator "A," Figure 26. (The lubricator is not used on later Type 61 cars.)

Remove the hub cap "B" by unscrewing it.

Remove the spring locking ring "I."

Withdraw the axle shaft "K."

Jack up the axle so that the wheel will clear the floor.

Remove the lock nut "D," the washer "E" and the adjusting nut "F."

The wheel can then be taken off.

Replacing a Rear Wheel and Adjusting Bearings

Before putting the wheel on again, see that the bearings "G" and "H" are clean and filled with light grease which is free from dirt and grit.

In putting the wheel on again, set the adjusting nut "F" very carefully. (See

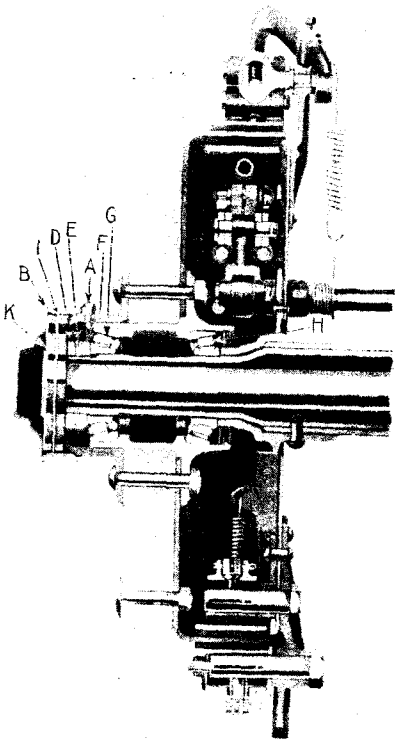


Fig. 26. Sectional View of Rear Hub, Showing Bearings

under "Caution in Adjusting Wheel Bearings.") Place the washer "E" in position. and tighten the lock nut "D."

CAUTION IN ADJUSTING WHEEL BEARINGS

When adjusting the wheel bearings, with which the wheels are equipped, great care must be exercised not to get them tight. These bearings will revolve even when adjusted very tightly, but that condition is sure to prove disastrous. They should be adjusted so that a very slight amount of play or looseness may be discerned.

If, after a bearing has been adjusted to a point that is apparently correct, the locking device cannot be placed in position without changing the adjustment, it is far better to *loosen* the adjustment until it can be secured with the locking device than to *tighten* the bearing adjustment.

REAR AXLE

General Description

The rear axle is of the full floating type. The wheels rotate on the axle housing. The axle shafts do not carry the weight of the car, but simply transmit power from the differential to rotate the wheels.

BRAKES

General Description

There are two pairs of brakes. The regular service brakes, which are operated by the right pedal, contract upon the outside of the drums. The hand brakes, operated by a hand lever, expand within the drums.

Connections from the right pedal and hand lever are made through equalizing bars so that each drum will be gripped with practically the same pressure. While these equalizing bars compensate for a certain amount of inequality in tension, it is desirable to adjust the brakes as nearly alike as possible.

The brake band linings can be renewed when necessary.

When the brake band linings are wet and muddy they are less effective than at other times. Hence more care must be exercised in driving at such times.

The brakes should be examined and tested occasionally to be sure that they are in serviceable condition.

All joints should be oiled occasionally.

Adjustment of Foot Brakes

Brake adjustment should not be attempted by one unfamiliar with it. It is recommended that the car be taken to a Cadillac distributor or dealer.

Provision is made in the brakes for adjustment. Do not attempt to adjust the brakes by the pull rods. The brakes cannot be adjusted properly in this manner. To adjust each foot brake, proceed as follows:

Remove the cotter pin in the adjusting screw "A," Figure 27, and turn the screw "A" until that part of the brake band lining opposite the screw just clears the drum. Adjust the two nuts "B" on the yoke bolt so that the lower part of the brake band lining just clears the drum.

Then adjust the nut "C" on the upper end of the yoke bolt so that the lever "D" is brought into the position shown in Figure 27, when the brake is fully applied—*i. e.*, so that the lower edge of the pin "T" and the upper edge of the pin "S" are tangent to an imaginary horizontal line shown at "X." Lock all adjustments.

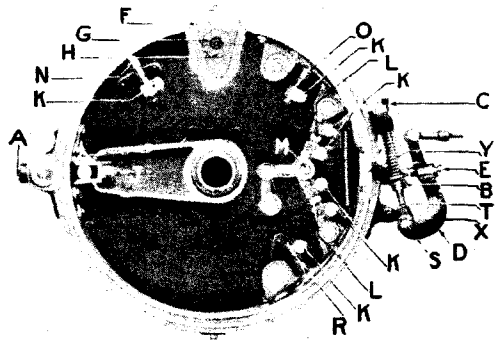


Fig. 27. Brakes (Wheel Removed.)

Adjustment of Hand Brakes

When adjustment of the brakes becomes necessary it is recommended that the car be taken to a Cadillac distributor or dealer.

Provision is made in each brake for its adjustment. Do not attempt to adjust the brakes by the pull rods. The brakes cannot be properly adjusted in this manner. To adjust each hand brake proceed as follows:

Place a jack under the rear axle housing and raise the axle so that the wheel can be turned by hand. Remove the cover "F," Figure 27; this may be done by loosening the lock nut "G" and turning the bolt to the left about one-quarter of a turn, which releases the clamping bar "H."

Rotate the wheel until the opening gives access to the screw "J." Turn the screw "J" until that part of the brake band lining opposite the screw just clears the drum.

Rotate the wheel and through the opening loosen the seven locking screws "K." Then turn the two adjusting screws "L," which have right-hand threads on one end and left-hand threads on the other, so that when the brake is fully applied the center of the pin "M" stands three and three-sixteenths inches to three and one-quarter inches away from the inside of the brake drum at "Y." The screws "L" should be turned equally and in the same direction.

Release the brakes and adjust the stop screws "R" so that the upper and lower parts of the brake band lining are equidistant from the brake drum. Adjust the stop screw "N" so that the head of the screw just touches the inside of the brake band. Tighten the seven locking screws "K" and replace the cover "F."

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REPAIR PARTS

Ordering New Parts

With many thousands of Cadillac automobiles in use, it is obviously impractical to deal directly with each Cadillac owner. We cannot open accounts with any except regular distributors with whom annual contracts are made.

To avoid unnecessary delay and correspondence new parts should, where possible, be ordered from the distributor or dealer from whom the car was purchased or from the nearest Cadillac distributor or dealer, who is generally in a position to supply it from his stock. If he cannot do so, he can order it for you.

Where, however, conditions are such as in our judgment to warrant it, we will fill orders for parts at current list prices, f. o. b. factory, provided the order is accompanied by cash. In ordering, send the engine number and type of the car with an accurate description of the part desired, preferably accompanied by a sketch with dimensions. If this cannot be done, return the part tagged properly and with transportation charges prepaid. (See below under "Returning Parts"). Otherwise, we cannot promise prompt service or to fill the order intelligently.

Our responsibility ceases in all cases, with delivery to the transportation company.

Returning Parts

In the event parts are returned, transportation charges must be prepaid or the parts will not be accepted. They should be tagged properly with the name of the owner and the engine number of the car. A letter should be sent, giving complete instructions regarding the disposition of the parts.

Tires, Speedometer and Clock

In cases of repairs to tires, speedometer, or clocks, correspondence should be opened with the manufacturers or one of their branches. If necessary the parts should be sent to them. Transportation charges should be prepaid.

Since this "Numerical List" was placed with the printer, change notices have been issued effecting symbols which should be corrected before the list is put into use.

Add to list:

Cadillac Symbols.

2085	Carburetor	J-194
2786	Tube	J-52
4346	Brass washer	Y-3169H
5022	Air pipe	J-243
5038	Brass washer	SS-165A
5154	Worm shaft	J-287
6007	Tube	J-1223
8884	Flange	C-441B
9548	Bracket	Y-364
17339	Magnet	BB-811
18908	Cover	A-6182
20162	Rod	B3-382
20169	Pump cover	BB-276
20282	Aux. disc	J-225
20292	Jackshaft	J-507B
24441	Dust shield	A-6171
24442	Dust shield	A-6174
24443	Dust shield	A-6177
24444	Dust shield	A-6180
25497	Conn. rod	E-2646A
32944	Support	A-4640
32945	Support	A-4644
33470	Clip	A-4626
33627	Bow socket	A-7001
34857	Front wheel	A-8037B
34858	Rear wheel	A-8037C
38252	Wood bow	A-7250
40452	Conn. rod	BB-2110
41319	Dust shield	BB-2248
41510	Dust shield	BB-2250
41960	Connection	A-3430
45904	Bow socket	A-7292
50010	Front wheel	E-3439A
50011	Rear wheel	E-3539C
50650	Rear wheel	E-3539D
50651	Front wheel	E-3539B
75368	Wrench	Tool-kit List

Dolco Symbols.

12140D	Core E-1226
31399D	Change serial to E-836
32812D	Change serial to E-788
On Page 125	
22781D	should be 22881D

Timken Symbols.

T-4122	Adj. ring	BB-2555
T-4315	Gasket	BB-2494
T-4518	Axle housing	Y-2631

National Gauge Symbols.

1204	Change to	1204US

Add to index, "Spicer Mfg. Co." Page 143.

Remove from list:

Cadillac Symbols.

3920	12675	17162	22617	34208
6029	13307	17163	23418	37232
7313	13308	17164	23419	37450
8225	13595	17546	23636	37507
8719	13756	17548	23637	37508
8720	13757	17549	23709	38327
8728	13857	17551	23896	38328
8729	13858	17614	24459	39043
9573	14081	18074	24460	40974
9574	14718	18077	24461	41682
9686	14719	19221	24462	41683
9687	16217	19222	24522	50470
10059	16705	19576	25836	56640
10596	16708	20217	30507	68422
11522	16991	20218	30571	
11642	16992	21436	30596	
12131	17014	21542	30597	
12132	17016	21690	30699	
12156	17017	21699	32598	
12167	17019	21856	33080	
12561	17160	21859	33518	

Dolco Symbols.

11189D
11369D
11864D
11865D
11866D
11867D
12283D
13086D

Timken Symbols

L-893
L-1391
T-3088
W-855
W-875

Kelsey Wheel Symbols.

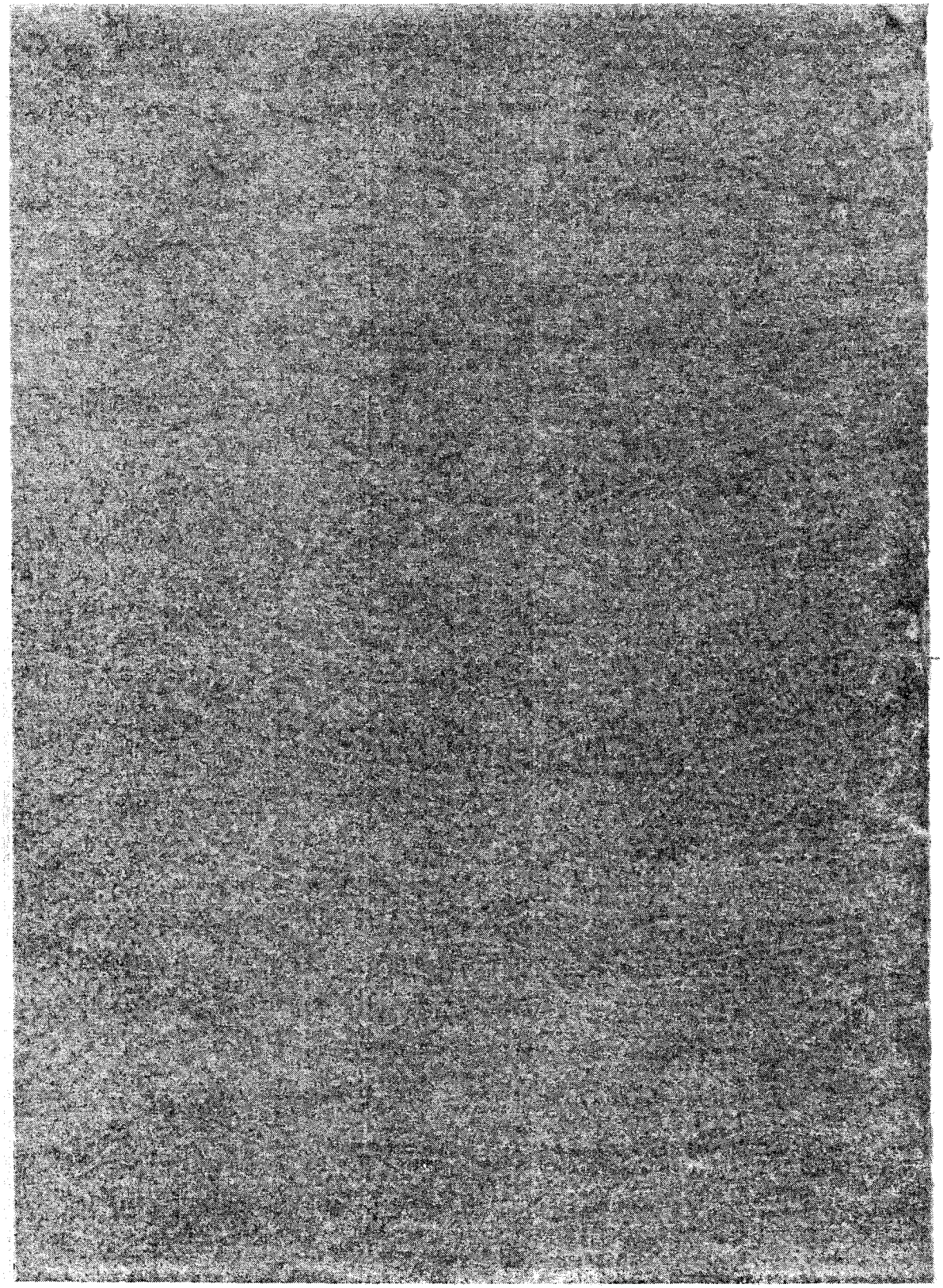
3674KW

Spicer Symbols.

4-3-17
4-5-1

National Gauge Symbols.

481
626



CADILLAC SHOP MANUAL



TYPE 61

CADILLAC MOTOR CAR COMPANY
Shop manuals

GENERAL DATA

Engine

Number of cylinders	8
Bore of cylinders	3⅛ inches
Stroke	5⅛ inches
Piston displacement	314 cu. inches
Horse power (N. A. C.C. rating)	31.25
Crankshaft diameter	2 inches
Valve size	1 11/16 inches
Valve lift	5/16 inch
Carburetor size	2 inches
Spark plug size	⅞ inch x 18

Engine revolutions per mile with transmission in direct drive and 33 x 5 tires.

Standard gear ratio	2620 to 2740*
Low gear ratio	2740 to 2980*
High gear ratio (special)	2420 to 2530*

*Varies with make of tire and tire inflation.

Engine Number

The number of the engine is stamped on the crankcase just back of the right-hand block of cylinders and on the name plate attached to the front face of the dash.

Gear Ratios

Axle

Standard	4.50 to 1
Low	4.91 to 1
High (special)	4.15 to 1

Transmission

High	Direct
Intermediate	58.65% of direct
Low	32.00% of direct
Reverse	26.70% of direct

Between Engine and Rear Wheels

Axle gear ratio 4.5 to 1:

Transmission gear	
High	4.50 to 1
Intermediate	7.673 to 1
Low	14.063 to 1
Reverse	16.854 to 1

Axle gear ratio, 4.91 to 1:

Transmission gear	
High	4.91 to 1
Intermediate	8.372 to 1
Low	15.344 to 1
Reverse	18.390 to 1

Axle gear ratio 4.15 to 1:

Transmission gear	
High	4.15 to 1
Intermediate	7.076 to 1
Low	12.969 to 1
Reverse	15.543 to 1

Wheel Base

All cars ..... 132 inches

Tread

All cars ..... 56 inches

Gasoline Tank Capacity

Gallons:	
United States	20
Imperial	16.67
Liters	75.70

1922

CADILLAC SHOP MANUAL

Diagnosis, Adjustment
Repair and Lubrication
of Cadillac Motor Cars

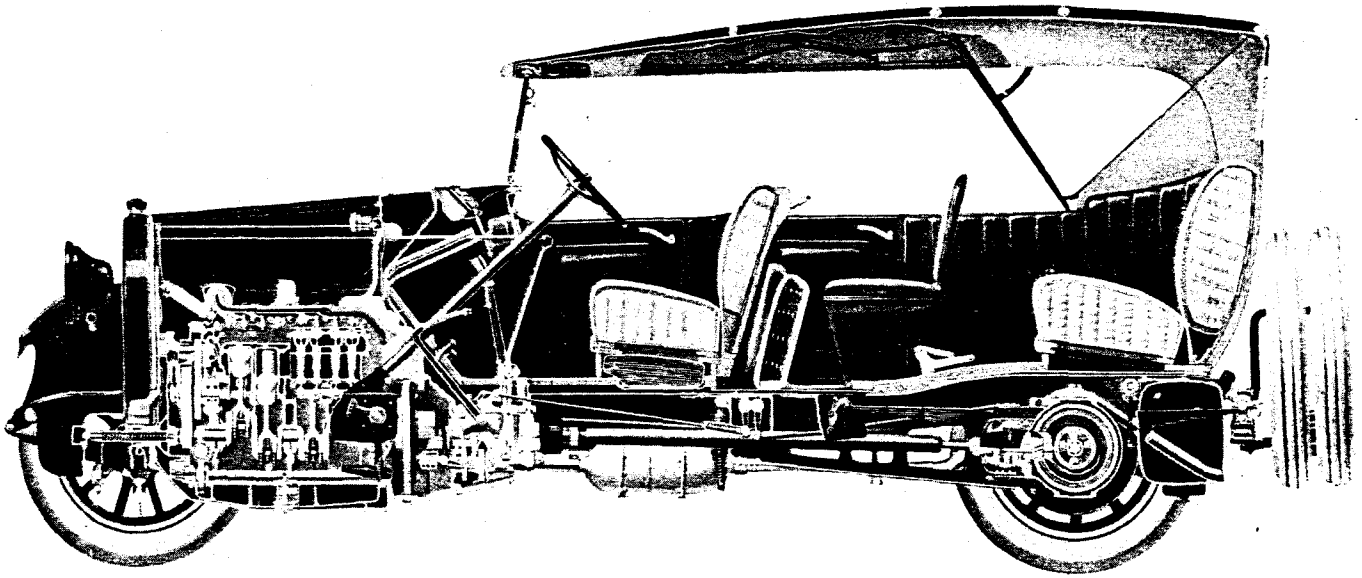


Type 61

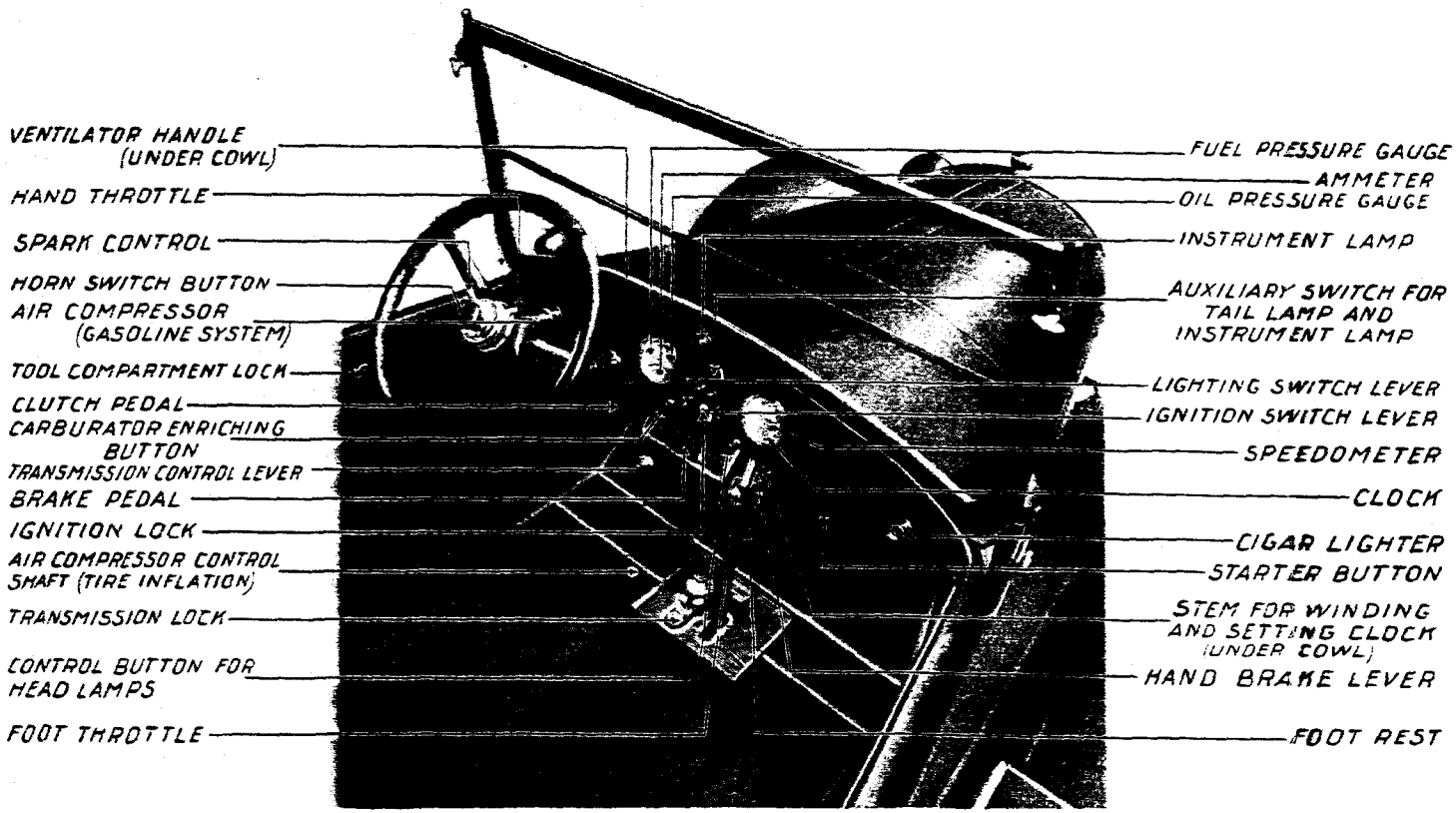
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Research
Laboratories

Cadillac Motor Car Company
Detroit, Michigan



Sectional View of Touring Car



Instruments, Control Levers and Pedals

PREFACE

The directions, suggestions and information contained in this manual represent actual experience in the shops of the Cadillac Motor Car Company. Part One deals with adjustments; Part Two with the removal, inspection and replacement of parts, and Part Three with lubrication. This manual is intended for shop use strictly, and has been compiled with this end in view.

It has always been the practice in the manufacture of Cadillac motor cars to machine parts to limits and to inspect parts before they are assembled into cars to make certain that they have been held to the established limits in manufacture. A result of this practice is that correct clearances between moving parts are assured.

One of the objects of this manual is to establish limits for use in the inspection of parts which have seen service. These limits are supplied in Part Two under headings "Inspection." The limits named are those beyond which it is inadvisable to continue to use parts, if quietness of operation and maximum efficiency are expected in the operation of the car, but not necessarily beyond which some service, in normal use, cannot be obtained.

Suitable micrometers and dial indicators are necessary in making these inspections.

This manual will not only assist the repair man schooled in Cadillac shops, but will make it possible for the trained mechanic without previous Cadillac shop experience to determine the causes for unsatisfactory operation and to adjust, repair and lubricate Cadillac cars correctly.

Our Technical Department invites correspondence with shop foremen and shop superintendents on matters pertaining to the care, adjustment and repair of Cadillac motor cars. Suggestions regarding these matters are appreciated.

CADILLAC MOTOR CAR COMPANY

Detroit, Michigan.

GENERAL SUGGESTIONS

Do not use shellac on gaskets or on hose connections. Its use is unnecessary and makes practically impossible the removal of parts without injury.

Before replacing gaskets make certain that they are in good condition and that the surfaces which press against them are clean and in good condition.

In removing sprockets, gears, collars, etc., do not tap them off, unless you have no suitable puller and are unable to procure one. If you are forced to tap off parts, do so carefully, using a lead hammer or a drift of soft brass.

Use well fitting wrenches and only enough force to tighten parts properly. The amount of force required depends upon the size of the stud or cap screw and the length of the wrench. Do not tighten a nut or cap screw sufficiently to strain the parts.

Select well fitting screwdrivers in removing and replacing screws.

The replacement of parts will be facilitated if a practice is made of observing the manner in which they are assembled, before taking them apart.

If parts do not disassemble readily do not injure or break them by using too much force. Parts will disassemble easily when correct methods are employed and proper tools are used.

Care should be exercised to prevent the loss or injury of parts removed.

In replacing cotter pins use new ones.

Lubricate parts which move upon one another with suitable lubricant before putting them together. This includes such parts as spring shackle bolts, brake rod pins and the like, as well as pistons, engine bearings, etc.

Do not use waste in cleaning cylinders, pistons, bearings, gears, etc. Use cloth free from lint.

PART I
DIAGNOSIS

The purpose of this section of the Shop Manual is to assist the Cadillac service man to locate readily the part which requires adjustment. The possible causes for various troubles are tabulated in chart form for convenience. A service man should not be content with a remedy for the immediate trouble but should find out what causes the difficulty. For example if timer contact points require frequent cleaning and adjusting, a diagnosis of the trouble should be made and the causes eliminated.

ENGINE

Engine Apparently Lacks Power

1. Engine fires irregularly. See under "Engine Fires Irregularly," page 11.
2. Incorrect spark timing.
   - A. Incorrectly timed ignition. See under "Timing Ignition," page 54.
   - B. Automatic spark control inoperative. See "Inspection" under "Distributor and Timer," page 147.
   - C. Driving with spark lever too far retarded or too far advanced.
3. Low compression. See under "Compression Low," page 10.
4. Carbon in cylinders. See under "Rapid Accumulation of Carbon in Cylinders," page 13.
5. Engine overheating. See under "Engine Overheats," page 12.
6. Imperfect fuel mixture.
   - A. Carburetor not correctly adjusted. See under "Adjustment of Carburetor," page 71.
   - B. Insufficient flow of gasoline into carburetor bowl. See under "Insufficient Flow of Gasoline into Carburetor Bowl," page 20.
   - C. High test gasoline used in summer.
   - D. Thermostats adjusted so they do not close. See under "Adjustment of Water Pump Valve," pages 68-69.
   - E. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.
7. High gear ratio which gives the impression of lack of power.
8. Large diameter tires which give the impression of lack of power.
9. Excessive frictional resistance.
   - A. Engine not properly lubricated. See under "Engine Lubrication," page 196.
   - B. Tight brakes. See under "Brakes Drag When Released," page 22.
10. Back pressure in mufflers—mufflers clogged with carbon.
11. Accelerator pedal does not open throttle wide—incorrect adjustment of control rods.
12. Automatic throttle valve remains closed or nearly so—automatic throttle valve shaft sticking in its bearings. See "Inspection" under "Carburetor," page 151.

Compression Low

1. Thin oil.
   - A. Oil used has insufficient viscosity. See under "Lubricants," page 194.
   - B. Oil thinned by gasoline. See under "Gasoline Accumulates in Oil Pan," page 28.
2. Valves not seating.
   - A. Valves timed incorrectly. See under "Adjustment of Cam Slide," page 39.
   - B. Valve stems or cam slides sticking in guides. See under "General Lubrication," page 200.
   - C. Weak or broken valve spring. See "Inspection" under "Valves and Valve Springs," page 137.
   - D. Warped valves.
3. Valves require regrinding. See under "Grinding Valves," page 39.
4. Worn or imperfectly fitting piston rings. See "Inspection" under "Piston and Piston Rings," page 120.
5. Loose fitting pistons, or scored cylinders or pistons. See "Inspection" under "Cylinder Blocks," page 111 and under "Piston and Piston Rings," page 120.

Excessive Gasoline Consumption

1. Habits of driver.
   - A. Failure to push enriching button forward as far as possible as soon as engine is warm enough to permit it.
   - B. Running the engine more than necessary with car standing.
   - C. Car making short trips with stops between long enough to allow engine to cool.
   - D. Driving with spark lever too far advanced or too far retarded.
2. Incorrect spark timing.
   - A. Spark timed incorrectly. See under "Timing Ignition," page 54.
   - B. Automatic spark control inoperative. See "Inspection" under "Distributor and Timer," page 147.
3. Soft tires.
4. Tight brakes. See under "Brakes Drag When Released," page 22.
5. Imperfect fuel mixture.
   - A. Carburetor not correctly adjusted. See under "Adjustment of Carburetor," page 71.
   - B. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.
   - C. Carburetor flooding. See under "Carburetor Floods," page 18.
   - D. Thermostat valves do not close.
6. Low compression. See under "Compression Low," page 10.

7. Engine firing irregularly. See under "Engine Fires Irregularly," page 11.
8. Carbon in cylinders. See under "Rapid Accumulation of Carbon in Cylinders," page 13.
9. Engine overheating. See under "Engine Overheats," page 12.

Continued Cranking Necessary to Start Engine

1. Habits of driver.
   - A. Attempting to start without air pressure.
   - B. Failure to prime carburetor (in cold weather).
   - C. Failure to pull back the carburetor enriching button when starting with cold engine.
   - D. Enriching button pulled too far back when starting with warm engine.
   - E. Throttle lever not in correct position.
   - F. Spark lever too far retarded (in cold weather).
   - G. High test gasoline used in summer.
2. Auxiliary air valve spring not fully compressed when enriching button is pulled back. Enriching rod not in proper adjustment. See under "Adjustment of Enriching Device," page 71.
3. Weak ignition. See under "No Spark or Weak Spark Between Spark Plug Points," page 15.
4. Carburetor flooding. See under "Carburetor Floods," page 18.
5. Insufficient flow of gasoline to carburetor bowl. See under "Insufficient Flow of Gasoline into Carburetor Bowl," page 20.
6. Slow cranking. See under "Starter Does Not Crank Engine," etc., page 14.
7. Incorrect adjustment of spark plug points. See under "Spark Plugs," page 56.
8. High test gasoline used, in summer weather.
9. Water or dirt in the gasoline.

Engine Fires Irregularly

1. Imperfect spark plugs.
   - A. Dirty spark plug cores. See under "Spark Plug Cores Require Frequent Cleaning," page 16.
   - B. Broken spark plug cores.
2. Spark plug points set incorrectly. See under "Spark Plugs," page 56.
3. Weak ignition. See under "No Spark or Weak Spark Between Spark Plug Points," page 15.
4. Dirty track in distributor. See under "Track in Distributor Head Requires Frequent Cleaning," page 16.

5. Imperfect fuel mixture.
   - A. Carburetor not correctly adjusted. See under "Adjustment of Carburetor," page 71.
   - B. Use of high test gasoline in summer.
   - C. Insufficient flow of gasoline into carburetor bowl. See under "Insufficient Flow of Gasoline Into Carburetor Bowl," page 20.
   - D. Thermostat valves held open.
   - E. Thermostats adjusted so they do not allow valves to close. See under "Adjustment of Water Pump Valve," pages 68 and 69.
   - F. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.
   - G. Leaking intake manifold gasket. See "Replacement" under "Intake Manifold," page 119.
   - H. Worn valve stem or valve guide. See "Inspection" under "Valves and Valve Springs," page 137.

6. Imperfect valve action.
   - A. Valves timed incorrectly. See under "Adjustment of Cam Slide," page 39.
   - B. Valve stems or cam slides sticking in guides. See under "General Lubrication," page 200.
   - C. Weak or broken valve spring. See "Inspection" under "Valves and Valve Springs," page 137.

Engine Overheats

1. Imperfect operation of cooling system.
   - A. Accumulation of sediment in water jackets of cylinders.
   - B. Thermostat valves do not open. See "Inspection" under "Water Pumps," page 126.
   - C. Cooling liquid frozen.
   - D. Not enough liquid in cooling system.
   - E. Accumulation of mud or dirt between radiator fins.
   - F. Too much of radiator covered.
   - G. Too much alcohol in cooling liquid. See under "Anti-Freezing Solution," page 63.

2. Late ignition.
   - A. Driving with spark too far retarded.
   - B. Timer incorrectly set. See under "Timing Ignition," page 54.
   - C. Automatic spark control inoperative. See "Inspection" under "Distributor and Timer," page 147.

3. Pistons not properly lubricated. See under "Not Enough Oil Thrown onto Cylinder Walls," page 27.

4. Carbon in cylinders. See under "Rapid Accumulation of Carbon in Cylinders," page 13.

Rapid Accumulation of Carbon in Cylinders

1. Use of oil which has low fire and flash test. See under "Lubricants," page 194.
2. Rich fuel mixture.
   - A. Air valve spring incorrectly adjusted. See under "Adjustment of Auxiliary Air Valve Spring," page 71.
   - B. Flooding Carburetor. See under "Carburetor Floods," page 18.
3. Driving longer than is necessary with enriching button pulled back.
4. Open thermostat.
   - A. Adjustment. See under "Adjustment of Water Pump Valve," pages 68 and 69.
   - B. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.
5. Excessive oil consumption. See under "Excessive Oil Consumption," page 26.
6. Late ignition.
   - A. Driving with retarded spark.
   - B. Incorrect ignition setting. See under "Timing Ignition," page 54.
   - C. Automatic spark control inoperative. See "Inspection" under "Distributor and Timer," page 147.

ELECTRICAL SYSTEM

Battery Does Not Keep in Charged Condition

1. Habits of driver.
   - A. More lights burning than are necessary when car is standing.
   - B. Car driven very little and left standing with lights burning large proportion of time.
   - C. Starter used more than is necessary.
2. Low charging rate. See under "Generator Charging Rate Too Low or Too High," page 14.
3. Low acid solution level in battery. See under "Adding Water to Storage Battery," page 58.
4. Sediment in battery jars. See "Sediment" under "Storage Battery," page 62.
5. Additional electrical appliances in circuit.
6. Continued cranking necessary to start engine. See under "Continued Cranking Necessary to Start Engine," page 11.

One Cell of Battery Regularly Requires More Water Than the Others, and Acid in That Cell Has Lower Specific Gravity

1. Leaking jar.
2. Short-circuited plates.
   - A. Sediment in battery jars. See "Sediment" under "Storage Battery," page 62.
   - B. Imperfect separators.

Addition of Water to All Battery Cells Frequently Necessary

1. Charging rate too high for service in which car is used. See under "Generator Charging Rate Too Low or Too High," page 14.
2. Excessive overcharging.
3. Short-circuited plates.
   - A. Sediment in battery jars. See "Sediment" under "Storage Battery," page 62.
   - B. Imperfect separators.

Generator Charging Rate Too Low or Too High

1. Incorrect adjustment of generator third brush arm. See under "Current Regulation," page 58.

Starter Does Not Crank Engine, or Cranks Engine Slowly

1. Grounded motor brush does not make contact when starter pedal is pushed down due to wire from front end of generator to generator switch being drawn too tight.
2. Generator circuit does not open when starter pedal is pushed down due to bent generator switch arm.
3. Loose or corroded connections at battery terminals.
4. Imperfect motor brush contact. See "Inspection" under "Motor Generator," page 143.
5. Battery nearly or completely discharged. See under "Battery Does Not Keep in Charged Condition," page 13.
6. Clutch pedal not disengaged when cranking (cold weather).
7. Starter gear hub tight on shaft as a result of lack of lubrication. See under "General Lubrication," page 200.
8. Incorrect adjustment of starter pedal stop.
9. Driver does not push starter pedal all the way down.
10. Grounded motor winding on armature.

Sparking at Generator Brushes

1. High mica on generator commutator. See "Inspection" under "Motor Generator," page 143.
2. Imperfect brush contact. See "Inspection" under "Motor Generator," page 143.
3. Insufficient spring tension on brushes. See "Inspection" under "Motor Generator," page 143.

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4. Grease or dirt on commutator.
5. Brush arms binding on posts.

Bulbs Short Lived

1. Low voltage bulbs used. See under "Lamp Bulbs," page 50.
2. Charging rate of generator too high. See under "Generator Charging Rate Too High or Too Low," page 14.
3. Low acid solution level. See under "Adding Water to Storage Battery," page 58.
4. Loose or corroded connections at battery terminals or in charging circuit.
5. Short-circuited plates.
   - A. Sediment in battery jars. See "Sediment" under "Storage Battery," page 62.
   - B. Imperfect separators.
6. Excessive overcharging of battery.

Bulbs Dim

1. High voltage bulbs used. See under "Lamp Bulbs," page 50.
2. Loose or corroded connections at battery terminals.
3. Battery nearly or completely discharged. See under "Battery Does Not Keep in Charged Condition," page 13.
4. Loose connection on circuit breaker.
5. Dirt or corrosion on circuit breaker contacts.

No Spark or Weak Spark Between Spark Plug Points

1. Imperfect ignition coil.
   - A. Short-circuited primary or secondary winding.
   - B. Open circuit in primary or secondary winding.
   - C. Grounded primary terminals caused by improper installation of coil in bracket.
2. Timer contact points incorrectly adjusted. See under "Adjustment of Timer Contact Points," page 52.
3. Timer contact points dirty or pitted.
   - A. Broken down condenser. See under "Ignition Condenser," page 56.
   - B. Short-circuited resistance coil.
   - C. Timer contacts too closely adjusted. See under "Adjustment of Timer Contact Points," page 52.
   - D. Oil in timer contact points.
4. Loose connections or open circuit at ignition switch or at vibrating circuit breaker.
5. Dirt or corrosion on contacts of vibrating circuit breaker.
6. Leaking secondary wires.

7. Broken down condenser. See under "Ignition Condenser," page 56.
8. Storage battery discharged. See under "Battery Does Not Keep in Charged Condition," page 13.
9. Dirty or cracked spark plug cores.
10. Dirty track in distributor head. See under "Track in Distributor Head Requires Frequent Cleaning," page 16.
11. Grounded rotor.

Track in Distributor Head Requires Frequent Cleaning

1. Rough surface on rotor contact button.
2. Track in head roughened by use of sandpaper in cleaning. See "Inspection" under "Distributor Head," page 144.

Non-Vibrating Circuit Breaker Opens

1. Short circuit in horn, portable and tonneau lamp or cigar lighter or in circuits to these parts. See under "Circuit Breakers," page 56.

Vibrating Circuit Breaker Operates

1. Short circuit in ignition apparatus, head, side, instrument, or tail lamp, or in circuits to these parts. See under "Circuit Breakers," page 56.

Spark Plug Cores Require Frequent Cleaning

1. Too much oil passes pistons. See under "Excessive Oil Consumption," page 26.
2. Rich fuel mixture.
   - A. Driving longer than necessary with enriching lever pulled back.
   - B. Rich carburetor adjustment. See under "Adjustment of Carburetor," page 71.
   - C. Carburetor flooding. See under "Carburetor Floods," page 18.
3. Open thermostat.
   - A. Adjustment. See under "Adjustment of Water Pump Valve," pages 68 and 69.
   - B. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.
4. Very low-grade gasoline used.
5. Flash and fire test of oil too low.

COOLING SYSTEM

Additional Cooling Liquid Frequently Necessary

1. Water pump glands leaking.
   - A. Gland nuts not tight enough. See under "Water Pump Packing Glands," page 68.
   - B. Glands require repacking. See under "Water Pump Packing Glands," page 68.

2. Engine overheating. See under "Engine Overheats," page 12.
3. Leaking hose connections.
4. Liquid in condenser does not return to radiator. See under "Liquid in Condenser Does Not Return to Radiator," page 17.

Alcohol Fumes Escape from Condenser

1. Engine overheating. See under "Engine Overheats," page 12.
2. Not enough liquid in condenser. See under "Anti-Freezing Solution," page 63.

Liquid in Condenser Does Not Return to Radiator

1. Air leak at radiator filler cap.
   - A. Radiator cap not tightneed.
   - B. Imperfect gasket in radiator cap.
   - C. Air leak around a temperature indicator or ornament in radiator cap.
   - D. Leaking connections between radiator and condenser.

GASOLINE SYSTEM

Gasoline Pressure Not Maintained After Engine is Started

1. Filler cap or thumb-screw on filler cap not tightened.
2. Imperfect filler cap gasket.
3. Leaking air connections.
4. Failure to screw in hand pump handle tightly after using.
5. Insufficient lubrication of air pressure pump on engine. See under "Insufficient Flow of Oil to Chains," etc., page 27.
6. Power air pump cylinder or piston worn or cut.
7. Incorrectly adjusted air pressure regulator. See under "Pressure Relief Valve," page 69.
8. Leaking air pressure regulator.
   - A. Imperfect needle valve or seat.
   - B. Dirt on needle valve or seat.
9. Leaking air pipe.
10. Sharp bend or dent in air or gasoline piping.
11. Pressure gauge inaccurate.
12. Leak at gasoline gauge.
13. Leak at filler joint on tank.
14. Improper seating of needle in check valve when pump cylinder or piston is worn or cut.

Low Gasoline Pressure Indicated When Engine is Running

See under "Gasoline Pressure Not Maintained After Engine is Started," page 17.

Gasoline Pressure Falls Off Rapidly After Engine Stops

1. Filler cap or thumb-screw on filler cap not tightened.
2. Imperfect filler cap gasket.

3. Leaking air connections.
4. Failure to screw in hand pump handle tightly after using.
5. Leaking check valve at pump.
6. Leaking air pressure regulator. {A. Imperfect needle valve or seat. B. Dirt on needle valve or seat.
7. Leaking air pipe.
8. Leak at gasoline gauge.
9. Leak at filler joint on tank.

High Gasoline Pressure Indicated

1. Incorrect adjustment of air pressure regulator. See under "Pressure Relief Valve," page 69.
2. Pressure gauge incorrect.

Insufficient Flow of Gasoline to Carburetor

1. Low gasoline pressure. See under "Low Gasoline Pressure Indicated When Engine is Running," page 17.
2. Strainer at top of tank, under front floor or at carburetor, clogged with dirt or ice. See under "Removal of Gasoline Strainer," page 153.
3. Dirt or ice in settling chamber at bottom of gasoline tank. See under "Settling Chambers and Strainers," page 70.
4. Sharp bend or dent in gasoline piping.

CARBURETOR

Carburetor Floods

1. Dirt on needle valve or valve seat.
2. Imperfect valve or seat. See "Inspection" under "Carburetor," page 151.
3. Valve sticking in guide.
4. Excessive gasoline pressure. See under "High Gasoline Pressure Indicated," page 18.
5. Float rubbing on carburetor bowl.
6. Incorrect float adjustment. See under "Adjustment of Float," page 75.
7. Bent pin in float arm.
8. Air vent hole closed between thermostat body and carburetor body.

Back-Firing in Carburetor

1. Very low-grade gasoline
2. Water in the gasoline.

3. Incorrect spark timing.
   - A. Incorrectly timed ignition. See under "Timing Ignition," page 54.
   - B. Automatic spark advance inoperative. See "Inspection" under "Distributor and Timer," page 147.
   - C. Driving with spark lever retarded too far.

4. Lean fuel mixture.
   - A. Incorrect adjustment of auxiliary air valve spring. See under "Adjustment of Auxiliary Air Valve Spring," page 71.
   - B. Weak air valve spring. See "Inspection" under "Adjustment of Carburetor," page 151.
   - C. Insufficient flow of gasoline into carburetor bowl. See under "Insufficient Flow of Gasoline into Carburetor Bowl," page 18.
   - D. Nozzle partly clogged.
   - E. Thermostat valves adjusted so they do not close. See under "Adjustment of Water Pump Valve," pages 68 and 69.
   - F. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.

5. One or more inlet valve stems or inlet cam slides sticking in guides. See under "General Lubrication," page 200.
6. One or more imperfect spark plug cores.
7. Valve timing incorrect as result of improper chain and sprocket assembly. See "Replacement" under "Engine Chains," page 116.
8. Throttle pump disconnected.
9. Dirty track in distributor head. See under "Track in Distributor Head Requires Frequent Cleaning," page 16.
10. Improper adjustment of valves.
11. Loose air vent nozzle on carburetor.
12. Accumulation of carbon in jacket of intake manifold.

Fuel Mixture Lean When Throttle is "Closed"

1. Incorrect adjustment of auxiliary air valve spring. See under "Adjustment of Auxiliary Air Valve Spring," page 71.
2. Weak air valve spring. See "Inspection" under "Carburetor," page 151.
3. Insufficient flow of gasoline into carburetor bowl. See under "Insufficient Flow of Gasoline Into Carburetor Bowl," page 18.
4. Nozzle partly clogged.
5. Leaking gasket between carburetor and inlet manifold or between inlet manifold and cylinder block. See "Replacement" under "Intake Manifold," page 119.
6. Incorrect adjustment of enriching lever on carburetor.

Fuel Mixture Lean When Throttle is Partly Open

1. Incorrect adjustment of auxiliary air valve spring. See under "Adjustment of Auxiliary Air Valve Spring," page 71.
2. Weak air valve spring. See "Inspection" under "Carburetor," page 151.
3. Insufficient flow of gasoline into carburetor bowl. See under "Insufficient Flow of Gasoline Into Carburetor Bowl," page 18.
4. Nozzle partly clogged.
5. Incorrect adjustment of enriching lever on carburetor.

Fuel Mixture Lean When Throttle is Fully Open

1. Incorrect adjustment of auxiliary air valve spring. See under "Adjustment of Auxiliary Air Valve Spring," page 71.
2. Weak air valve spring. See "Inspection" under "Carburetor," page 151.
3. Insufficient flow of gasoline into carburetor bowl. See under "Insufficient Flow of Gasoline Into Carburetor Bowl," page 18.
4. Nozzle partly clogged.
5. Incorrect adjustment of enriching lever on carburetor.

Carburetor Air Valve Flutters

1. Auxiliary throttle valve shaft sticking in bearings. See "Inspection" under "Carburetor," page 151.
2. Spring on auxiliary throttle valve broken or incorrectly adjusted. See under "Adjustment of Automatic Throttle," page 76.
3. Valve timing incorrect as result of improper chain and sprocket assembly. See "Replacement" under "Engine Chains," page 116.

Insufficient Flow of Gasoline Into Carburetor Bowl

1. Insufficient flow of gasoline to carburetor. See under "Insufficient Flow of Gasoline to Carburetor," page 18.
2. Carburetor inlet valve sticking in its guide.
3. Float rubbing on carburetor bowl due to bent float arm.
4. Bent pin in float arm.
5. Incorrect float adjustment. See under "Adjustment of Float," page 75.

CLUTCH AND TRANSMISSION

CLUTCH

Clutch Grabs When Engaging

1. Dry disc facings.
2. Gummy disc facings.
3. Warped plates.
4. Discs sticking in driver or on hub keys.

Clutch Slips

1. Incorrect adjustment of clutch pedal. See under "Adjustment of Clutch Pedal Clearance," page 79.
2. Driver allows foot to rest on pedal.
3. Oily disc facings.
4. Badly worn disc facings. See under "Relining Clutch Discs," page 79.
5. Bent or warped clutch plates.

Clutch Spins When Released

1. Incorrect adjustment of clutch pedal. See under "Adjustment of Clutch Pedal Clearance," page 79.
2. Driver does not release clutch fully.
3. Worn or dry bearing at front end of clutch connection. (In flywheel.) See "Inspection" under "Flywheel," page 138.
4. Gummy or sticky disc facings.
5. Discs do not slide freely on hub keys or in serrations in clutch driver. See "Inspection" under "Clutch," page 155.
6. Bent or warped clutch plates.
7. Thin oil in transmission. See under "Lubricants," page 195.

Clutch Plates Rattle

1. Too much freedom between clutch plates and serrations in clutch driver or keys on clutch hub. See "Inspection" under "Clutch", page 155.

Noisy Clutch Release Ball Race

1. Worn bearing.

Clutch Chatters When Engaging

1. Dry clutch disc facings.
2. Glazed clutch disc facings.

TRANSMISSION

Noisy Gear Shifting

1. Shifting incorrectly done.
2. Clutch spins when released.
   - A. Incorrect adjustment of clutch pedal. See under "Adjustment of Clutch Pedal Clearance," page 79.
   - B. Operator does not release clutch fully.
   - C. Worn or dry bearing at front end of clutch connection. See "Inspection" under "Flywheel," page 138.
   - D. Gummy or sticky disc facings.
   - E. Discs do not slide freely on hub keys or in serrations in clutch driver. See "Inspection" under "Clutch," page 155.
   - F. Bent or warped clutch plates.
   - G. Thin oil in transmission. See under "Lubricants," page 195.
   - H. Excessive wear of discs on hub keys or in serrations in clutch driver, allowing discs to fall together.

Noisy Transmission Gears

1. Insufficient lubricant in transmission. See under "General Lubrication," page 200.
2. Unsuitable lubricant used. See under "Lubricants," page 195.
3. Worn gear teeth.
4. Tire pump gears not fully disengaged.

Noisy Transmission Bearing

1. Insufficient lubricant in transmission. See under "General Lubrication," page 200.
2. Unsuitable lubricant used. See under "Lubricants," page 194.
3. Dirt in bearing.
4. Worn bearing.

REAR AXLE

Brakes Drag When Released

1. Incorrect adjustment of bands. See under "Brakes," page 86.
2. Bands out of true. See "Inspection" under "Brakes," page 170.
3. Anchor pins dry or rusty.
4. Drums on wheels out of true. See "Inspection" under "Wheels," page 186.
5. Rusty brake rod connections.
6. Rusty brake mechanism.
7. Releasing spring broken.
8. Yoke bolt pins tight or rusted.

Brakes Do Not Hold

1. Incorrect adjustment. See under "Brakes," page 86.
2. Wet linings.
3. Anchor pins dry or rusty.
4. Oily linings.
5. Lining worn down to rivets. See under "Relining Foot Brakes," page 88.
6. Yoke bolt pins tight or rusted.

Brakes Noisy When Applied

1. Anchor pins dry or rusty.
2. Dry brake bands.
3. Lining worn down to rivets. See under "Relining Foot Brakes," page 88.
4. Incorrect adjustment.

Brake Bands Rattle on Rough Roads

1. Incorrect adjustment. See under "Brakes," page 86.
2. Worn brake band guides.

Axle Driving Gears Noisy

1. Insufficient lubricant in axle. See under "General Lubrication," page 200.
2. Gears incorrectly adjusted. See under "Adjustment of Pinion" and "Adjustment of Ring Gear," page 83.
3. Use of unsuitable lubricant. See under "Lubricants," page 195.
4. Loose adjustment of bearings on gear mount or pinion shaft. See under "Adjustment of Pinion Bearings," page 81, and "Adjustment of Ring Gear Bearings," page 83.
5. Faces of gear teeth badly worn. See "Inspection" under "Differential and Large Driven Gear," page 171, and "Driving Pinion and Pinion Shaft," page 174.
6. Bearings badly worn.

Axle Noisy When Turning Corners Only

1. Noisy differential gears.
   - A. Insufficient lubricant in axle. See under "General Lubrication," page 200.
   - B. Use of unsuitable lubricant. See under "Lubricants," page 195.
   - C. Worn differential gears. See "Inspection" under "Differential and Large Driven Gear," page 171.

Noisy Axle Bearing

1. Bearing too tightly adjusted. See under "Adjustment of Pinion Bearings," page 81, and "Adjustment of Ring Gear Bearings, page 83.
2. Insufficient lubricant in axle. See under "General Lubrication," page 200.
3. Use of unsuitable lubricant. See under "Lubricants," page 195.
4. Bearing worn. See "Inspection" under "Differential and Large Driven Gear," page 171 and "Driving Pinion and Pinion Shaft," page 174.

Axle Shaft Noisy at Hub Flange

1. Rear wheel bearings loosely adjusted. See under "Replacing a Rear Wheel and Adjusting Bearings," page 94.
2. Bent axle shaft. See "Inspection" under "Axle Shafts," page 174.
3. Bent axle housing. See "Inspection" under "Rear Axle Housing," page 172.
4. Dry hub clutch.
5. Too much play at hub flange. See "Inspection" under "Axle Shafts," page 174.

Oil Leaking at Rear Hub Caps

1. Too much grease in wheel bearings. See under "General Lubrication," page 200.
2. Unsuitable lubricant used in axle. See under "Lubricants," page 195.
3. Oil level too high in axle. See under "General Lubrication," page 200.
4. Imperfect or worn felt oil retainers.

STEERING GEAR

Steering Gear Rattles

1. Too much end play in sector shaft. See under "Adjustment of Sector Shaft," page 92.
2. Too much end play in steering worm. See under "Adjustment of Worm Thrust Bearings," page 91.
3. Too much play between teeth of worm and sector. See under "Adjustment of Worm and Sector," page 92.
4. Steering connecting rod joints loosely adjusted. See "Replacement" under "Steering Connecting Rod," page 185.

Excessive Play in Steering Gear

1. Too much end play in sector shaft. See under "Adjustment of Sector Shaft," page 92.
2. Too much end play in steering worm. See under "Adjustment of Worm Thrust Bearings," page 91.
3. Too much play between teeth of worm and sector. See under "Adjustment of Worm and Sector," page 92.
4. Steering connecting rod joints loosely connected. See "Replacement" under "Steering Connecting Rod," page 185.

Steering Gear Turns Hard

1. Lack of lubrication. See under "General Lubrication," page 200.
2. Soft tires.
3. Steering gear too tightly adjusted. See under "Steering Gear," page 91.
4. Steering connecting rod joints too tightly adjusted. See "Replacement" under "Steering Connecting Rod," page 185.
5. Dry or cut taper bushings at upper end of housing tube. See under "General Lubrication," page 200.
6. Spindle bolts tight or rusted.
7. Eccentric bushing dry or cut.

TIRES

Tires Do Not Run True

1. Rims not trued up after placed on wheels.
2. Wheels out of true. See "Inspection" under "Wheels." page 186.

Front Tires Wear Out Rapidly

1. Incorrect alignment of front wheels. See under "Alignment of Front Wheels," page 94.
2. Loose steering connections or arms.

SPRINGS

Springs Squeak

1. Dry or rusty spring leaves. See "Replacement," under "Springs," page 190.
2. No lubricant between spring and bolted spring clamp.
3. Insufficient lubrication of spring shackles. See under "General Lubrication," page 200.

Spring Action Stiff

1. Dry or rusty spring leaves. See "Replacement" under "Springs," page 190.
2. Spring shackles adjusted too tight.

Springs Appear to Be Weak

1. Unusually fast driving over rough roads.
2. Heavier loads carried than car is designed for.
3. Springs weak.

LUBRICATING SYSTEM

No Oil Pressure Indicated on Gauge When Engine Is Running

1. Gauge incorrect. See "Inspection" under "Oil Pan and Baffle Plate," page 124.
2. Thick oil.
   - A. Cold test of oil too high. See under "Lubricants," page 194.
   - B. Emulsion in oil pan. See under "Emulsion Forms in Oil Pan," page 28.
   - C. Viscosity of oil too great. See under "Lubricants," page 194.
3. Oil pan empty. See under "Filling Lubricating System," page 197.
4. Ice in oil pan. See under "Water or Ice Accumulates in Oil Pan," page 28.
5. Oil pump requires priming. See "Caution" under "Adjustment of Oil Pressure Regulator," page 199.
6. Worn parts in oil pump. See "Inspection" under "Oil Pump," page 125.
7. Oil pressure regulator does not operate properly.
   - A. Dirt on valve or seat.
   - B. Broken or weak spring. See "Inspection," under "Oil Pressure Regulator," page 127.
   - C. Imperfect valve or seat. See "Inspection" under "Oil Pressure Regulator," page 127.

Low Oil Pressure Indicated

1. Thin oil.
   - A. Oil used has insufficient viscosity. See under "Lubricants," page 194.
   - B. Oil thinned by gasoline. See under "Gasoline Accumulates in Oil Pan," page 28.

2. Oil pressure regulator does not operate properly.
   - A. Dirt on valve seat or valve.
   - B. Broken or weak valve spring. See "Inspection" under "Oil Pressure Regulator," page 127.
   - C. Imperfect valve or seat. See "Inspection" under "Oil Pressure Regulator," page 127.
3. Incorrect adjustment of oil pressure regulator. See under "Adjustment of Oil Pressure Regulator," page 199.
4. Too much oil escapes through crankshaft bearings.
   - A. Loose main or connecting rod bearings. See under "Adjustment of Connecting Rod and Crankshaft Bearings," page 29.
   - B. Excessive end play in connecting rod bearings. See under "Adjustment of Connecting Rod Bearings," page 29.
   - C. Halves of main bearings not properly fitted. See under "Adjustment of Main Crankshaft Bearings," page 30.
5. Worn parts in oil pump. See "Inspection" under "Oil Pump," page 125.
6. Leaking oil connections in crankcase.
7. Gauge incorrect. See "Inspection" under "Oil Pan and Baffle Plate," page 124.

High Oil Pressure Indicated

1. Oil pressure regulator incorrectly adjusted. See under "Adjustment of Oil Pressure Regulator," page 199.
2. Viscosity of oil too great. See under "Lubricants," page 194.
3. Gauge incorrect. See "Inspection" under "Oil Pan and Baffle Plate," page 124.

Excessive Oil Consumption

1. Too much oil thrown onto cylinder walls.
   - A. Incorrect adjustment of oil pressure regulator. See under "Adjustment of Oil Pressure Regulator," page 199.
   - B. Loose connecting rod bearings. See under "Adjustment of Connecting Rod Bearings," page 29.
   - C. Too much end play in connecting rod bearings. See under "Adjustment of Connecting Rod Bearings," page 29.
   - D. Too much oil in oil pan. See under "Filling Lubricating System," page 197.
   - E. Oil used has insufficient viscosity. See under "Lubricants," page 194.
   - F. Oil thinned by gasoline. See under "Gasoline Accumulates in Oil Pan," page 28.

2. Worn or imperfectly fitting piston rings. See "Inspection" under "Piston and Piston Rings," page 120.
3. Loose fitting pistons or scored cylinders or pistons. See "Inspection" under "Cylinder Blocks," page 111, and under "Piston and Piston Rings," page 120.
4. Leakage of oil through air intake port at camshaft air pump.

Not Enough Oil Thrown Onto Cylinder Walls

1. Incorrect adjustment of oil pressure regulator. See under "Adjustment of Oil Pressure Regulator," page 199.
2. Too much oil escapes through crankshaft bearings.
   - A. Loose main bearings. See under "Adjustment of Main Crankshaft Bearings," page 30.
   - B. Halves of main bearings not properly fitted. See under "Adjustment of Main Crankshaft Bearings," page 30.
3. Worn parts in oil pump. See "Inspection" under "Oil Pump," page 125.
4. Leaky oil connection in crankcase.
5. Viscosity of oil too great. See under "Lubricants," page 194.

Insufficient Flow of Oil to Chains, Camshaft Bearings and Gasoline System Air Pump

1. High oil pressure. See under "High Oil Pressure Indicated," page 26.
2. Clogged by-pass in oil pressure regulator. See "Inspection" under "Oil Pressure Regulator," page 127.
3. Worn parts in oil pump. See "Inspection" under "Oil Pump," page 125.
4. Leaking oil connections in crankcase.
5. Too much oil escapes through main crankshaft bearings.
   - A. Loose main or connecting rod bearings. See under "Adjustment of Connecting Rod and Crankshaft Bearings," page 29.
   - B. Excessive end play in connecting rod bearings. See under "Adjustment of Connecting Rod Bearings," page 29.
   - C. Halves of main bearings not properly fitted. See under "Adjustment of Main Crankshaft Bearings," page 30.

Oil Indicator Does Not Operate

1. Vertical rod bent so that it does not slide freely in guide. See "Inspection" under "Oil Pan and Baffle Plate," page 124.
2. Emulsion in oil pan. See under "Emulsion Forms in Oil Pan," page 28.
3. Leaking float.

Water or Ice Accumulates in Oil Pan

1. Car used in short trip service. Trips not long enough to allow engine to become thoroughly warm.
2. Failure to replace engine oil at frequent intervals. See under "Replace Engine Oil," page 197.
3. Open thermostat.
   - A. Adjustment. See under "Adjustment of Water Pump Valve," pages 68 and 69.
   - B. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.
4. Loose fitting pistons or scored cylinders or pistons. See "Inspection" under "Cylinder Blocks," page 111, and under "Piston and Piston Rings," page 120.
5. Imperfectly fitting piston rings. See "Inspection" under "Piston and Piston Rings," page 120.
6. Unsuitable engine oil used. See under "Lubricants," page 194.

Gasoline Accumulates in Oil Pan

1. Car used in short trip service. Trips not long enough to allow engine to become thoroughly warm.
2. Failure to replace engine oil at frequent intervals. See under "Replace Engine Oil," page 197.
3. Driving longer than is necessary with enriching button pulled back.
4. Rich fuel mixture.
   - A. Incorrect adjustment of auxiliary air valve spring. See under "Adjustment of Auxiliary Air Valve Spring," page 71.
   - B. Flooding carburetor. See under "Carburetor Floods," page 18.
5. Open thermostat.
   - A. Adjustment. See under "Adjustment of Water Pump Valve," pages 68 and 69.
   - B. Punctured thermostatic member. See "Inspection" under "Water Pumps," page 126.
6. Loose-fitting pistons or scored cylinders or pistons. See "Inspection" under "Cylinder Blocks," page 111; and under "Pistons and Piston Rings," page 120.
7. Imperfectly fitting piston rings. See "Inspection" under "Pistons and Piston Rings," page 120.
8. Unsuitable engine oil used. See under "Lubricants," page 194.
9. Descending grades with transmission in gear, clutch engaged and ignition off.

Emulsion Forms in Oil Pan

1. Accumulation in oil pan of gasoline and water. See under "Water or Ice Accumulates in Oil Pan" and "Gasoline Accumulates in Oil Pan," page 28.

Oil Freezes in Oil Pan

1. Extreme cold.
2. Cold test of oil too high. See under "Lubricants," page 194.
3. Water mixed with oil. See under "Water or Ice Accumulates in Oil Pan," page 28.

PART II

ADJUSTMENTS

ENGINE

ADJUSTMENT OF CONNECTING ROD AND CRANKSHAFT BEARINGS

Adjustment of Connecting Rod Bearings

Remove the oil pan and baffle plate. (See "Removal" under "Oil Pan and Baffle Plate," page 124.)

The caps at the lower ends of the single connecting rods are adjustable. Liners varying in thickness from .002 inch to .006 inch are placed between the caps and the rods when the engine is assembled. To readjust, remove these liners and substitute thinner ones of the proper thickness. Liners must be of equal thickness under each cap.

To determine the clearance in a connecting rod bearing turn the engine over by hand to bring the throw of the crank-shaft to the lower center. Then place Cadillac indicator tool numbered 1963 in the holder numbered 67870 and clamp it to the forked connecting rod as shown in (Fig. 1.) With the bar, tool numbered 57736, in position as shown, force the rod up and set the dial on the indicator at zero. Then with the bar, over the head of the straight connecting rod bolt and under a nut on a forked rod bolt force the rod down. The clearance in the bearing will be indicated on the dial.

Caution:—Place the bar on the side opposite to that to which the indicator holder is fastened. Use as much care in handling the indicator as you would in handling a fine watch.

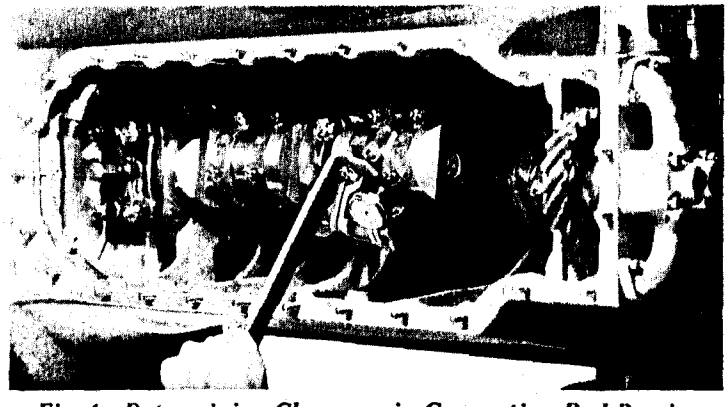


Fig. 1—Determining Clearance in Connecting Rod Bearing

These bearings should have from .0025 inch to .0035 inch play. Bearing trouble is probable if the clearance is less than .0025 inch.

The crank pin bearings in the forked connecting rods are not adjustable. If there is more than .006 inch clearance between a bearing

and the crank pin, or more than .015 inch end play in the bearing, a new bearing should be substituted. (See under "Fitting Crank Pin Bearings," page 31.

Adjustment of Main Crankshaft Bearings

Remove the oil pan and the baffle plate. See "Removal" under "Oil Pan and Baffle Plate," page 124.

The three main bearings are provided with liners which are clamped between the crankcase and the bearing caps.

To tighten a main bearing, proceed as follows: Remove the oil feed pipe connecting the bearing cap with the oil manifold. Remove the aluminum bearing cap with the lower half of the bearing and the liners.

Replace the liners with liners which are less and equal in thickness by an amount equal to the amount of "take-up" necessary. The clearance between the shaft and the bearings should be between .001 inch and .002 inch. Liners can be obtained from our Parts Department varying in thickness by .001 inch.

To determine this clearance screw the indicator holder, tool numbered 65530, on to the nipple screwed into the bearing cap and place the indicator, tool numbered 1961B, as shown in (Fig. 2.)

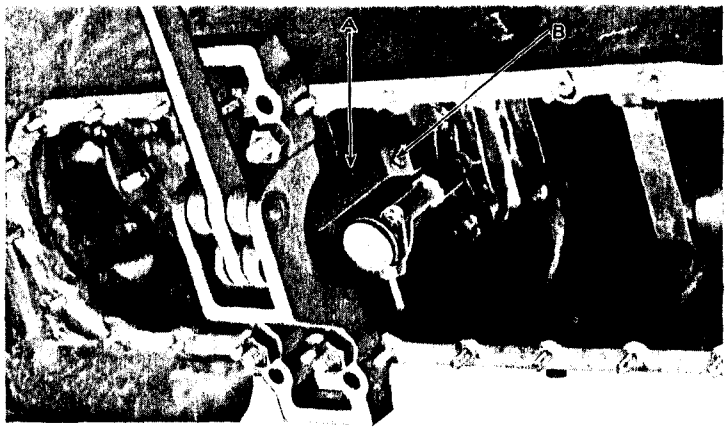


Fig. 2—Determining Clearance in Main Crankshaft Bearing

Turn the crankshaft so that the cheeks are in the horizontal plane. Place Cadillac puller, tool numbered 72631, up against the under face of the crankcase, turn the clamping screws outward and tighten the nut on each clamp. Place the arm "A" over the cheek of the crankshaft and tighten the set screw "B." Set the indicator to zero, then force the lever up and down watching the indicator hand. The bearing clearance can thus be determined. The clearance in each main bearing can be determined in like manner.

Caution:—Use as much care in handling the indicator as you would in handling a fine watch.

Carefully reduce the upper edges of the lower half of the bearing just enough to allow the aluminum bearing cap to clamp the new liners. This work must be done very accurately, as clearance between the halves of the bearing will cause an oil leak.

The upper edges of the lower half of the bearing may be reduced by rubbing the bearing on a piece of fine emery cloth stretched tightly over the face plate of Cadillac gauge numbered 71969, as shown in Fig. 3. After the clearance in the bearing has been determined place the lower half of the bearing under the gauge as shown in Fig. 3 and sliding it back and forth, set the indicator to zero. By making tests after reducing the edges of the bearing the actual amount taken off can be determined accurately. Main engine bearings should have between .001 inch and .002 inch clearance after adjustment. See under "Fitting Main Crankshaft Bearings," page 33.

Caution:—Use care in handling the arbors and in handling the gauge not to mar the finished surfaces. Use as much care in handling the indicator as you would in handling a fine watch.

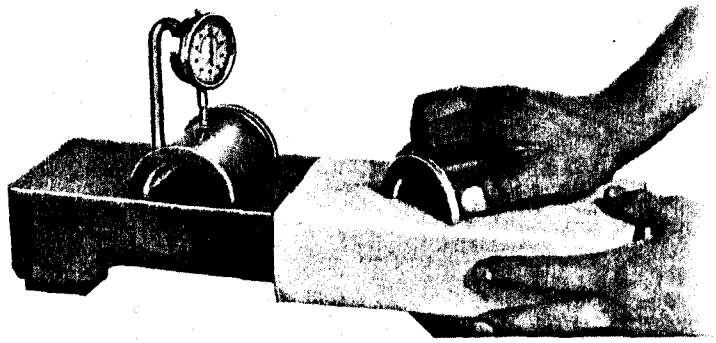


Fig. 3—Reducing Edges of Crankshaft Main Bearing

Thoroughly clean the bearing, bearing cap and liners and oil the bearing surface before replacing. Numbers on bearings and caps face to the front of the engine.

In replacing the bearing cap, tighten the bearing nuts firmly and lock with new cotter pins. Also make sure that the union nuts on the oil pipe are tightened sufficiently to prevent leakage.

If more than one bearing is removed at a time, care should be taken not to mix the liners, as they may not all be the same thickness.

After replacing the oil pan, refill it with seven quarts of suitable engine oil. Cadillac Engine Oil is recommended.

FITTING CRANK PIN BEARINGS

If the crank pins of the crankshaft are scored or out of round more than .003 inch they should be dressed down before used bearings are refitted, or new bearings are installed. See under "Dressing Down Crankshaft Bearing Surfaces," page 35.

Refitting a Used Bearing

If the babbitt is scored, rough, or shows only partial bearing on the crank pin, clean it up with a scraper. This work should be attempted only by workmen familiar with bearing scraping. The work must be done carefully to prevent an excessive flow of oil by the bearing.

If, after completing the work, the clearance between the bearing and the crank pin exceeds .006 inch, a new bearing should be substituted.

The end play in a crank pin bearing should not exceed .015 inch.

Fitting a New Standard Size Bearing

Crank pin bearings of standard size are reamed before shipment and should not be scraped unless the bearing surface becomes injured.

If there is more than .006 inch clearance between a new standard size bearing and the crank pin, an undersize bearing should be fitted. Unreamed bearings .005 inch and .020 inch undersize are furnished by our Parts Department.

The end play in a crank pin bearing should not exceed .015 inch.

Fitting a New Undersized Bearing

Unreamed crank pin bearings .005 inch and .020 inch undersize are furnished by our Parts Department for use where the clearance between a crank pin and a new standard size bearing exceeds .006 inch.

The desired clearance between the bearing and the crank pin is from .0015 inch to .003 inch. The clearance must in no case be less than .0015 inch or more than .006 inch.

Undersize bearings are unreamed and should be scraped or reamed. The work should be attempted only by workmen familiar with bearing scraping. Bearings can be reamed by use of the Martel reamer. See (Fig. 4) page 33.

Reaming Connecting Rod Bearings

To ream a connecting rod bearing, clamp the connecting rod into a vise protecting the rod with wood blocks or copper jaws. Set the reamer to the proper size, assemble it upon the short shaft and place the reamer with shaft and a centering bushing into the connecting rod as shown in (Fig. 4.)

Hold firmly together the two portions of the centering bushing and with the 6° cutting edge of the reamer held tightly against the opposite end of the connecting rod bearing to center that end of the reamer shaft, screw the centering bushing into place. Lubricate the reamer with a good quality of lard oil and ream the bearing until the reamer strikes the centering bushing. Then remove the bushing and continue with the reaming operation.

After this work is completed the connecting rods should be aligned in accordance with directions on page 129.

Caution:—Inaccurate work will result unless very great care is used in handling this tool, particularly the long bar which may be easily rendered inaccurate by rough handling. Keep all parts well oiled with a good quality of engine oil and packed in the box in which they are received.

FITTING MAIN CRANKSHAFT BEARINGS

If the bearing surface is rough, scored, or shows only a partial bearing on the shaft, it should be cleaned up with a scraper. This work should be attempted only by workmen who thoroughly understand bearing scraping. The work must be carefully done to prevent an excessive flow of oil by the bearing.

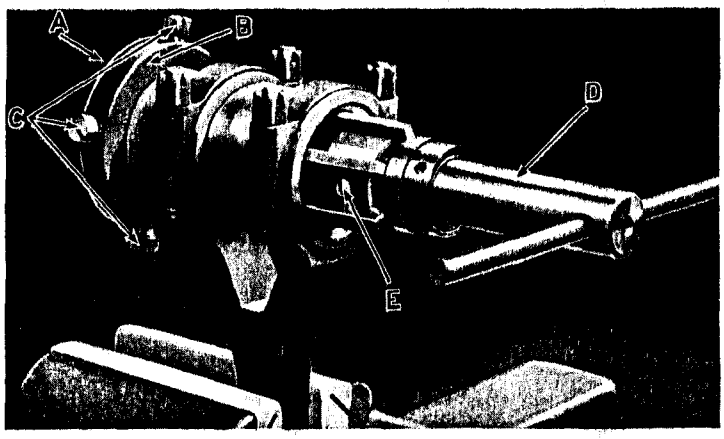


Fig. 4—Reaming Connecting Rod Bearing

When clamped in place the clearance between a main bearing and the shaft should be from .001 inch to .002 inch.

After scraping the bearing halves reduce the edges, which come together, sufficiently to give the proper clearance between the bearing and the shaft. This may be done by rubbing the halves of the bearing over fine emery cloth stretched tightly over a surface plate as shown in (Fig. 3.)

Replace the liners with liners of the proper thickness. See under "Adjustment of Main Crankshaft Bearings," page 30.

FITTING NEW MAIN CRANKSHAFT BEARINGS

Disassemble the engine (See "Removal and Disassembly" under "Engine" page 101) and place the crankcase upside down upon a suitable support. Assemble the main bearings into the crankcase with the proper size liners in place. Great care should be exercised in having each half of the bearing properly fitted to the crankcase and aluminum caps before tightening down the caps.

Caution:—Do not squeeze the bearings but have them just tight enough in the case to prevent moving them endwise with a lead hammer.

After main crankshaft bearings are properly fitted in place, they should be reamed. Main bearings can be reamed by using the Martell reamer, tool numbered 79255 furnished by our Parts Department, as shown in (Fig. 6.)

If the reamer is not fitted with cutters of the proper size replace them. To do so proceed as follows: Place the reamer upon the short shaft furnished with the tool and clamp the shaft in a vise as shown in (Fig. 5.) With a spanner wrench furnished loosen one of the clamping collars "A" or "B" and remove the cutters. Cutters of the correct size may be assembled into the reamer and the collar tightened. The cutters

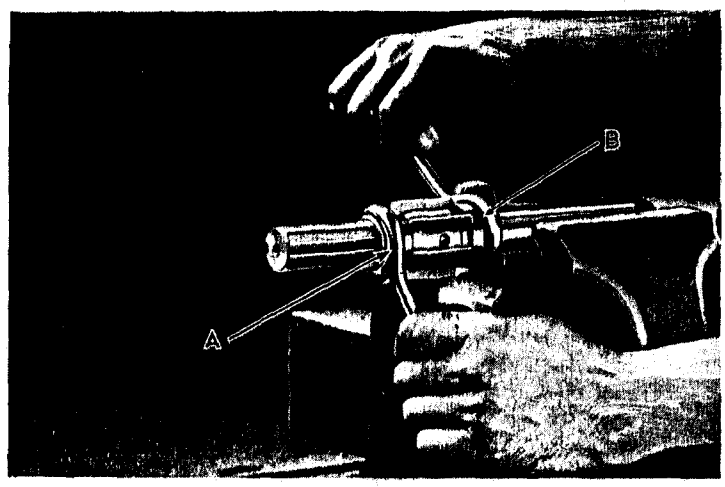


Fig. 5—Replacing Cutter in Martell Reamer

are stamped with figures from one to six. The grooves into which they fit are similarly marked. It is important that each cutter be placed in its proper groove.

After cutters of the correct size are assembled into the reamer, micrometer the crank shaft bearings and set the reamer .002 inch to .003 inch larger than the bearings. This will give them .001 inch to .002 inch clearance between the shaft and bearings after reaming is completed. To increase the size of the reamer loosen the collar "A" and tighten the collar "B." To decrease the size, loosen the collar "B" and tighten the collar "A."

With cutters of the correct size in place and the reamer set to the correct size, assemble the bar with centering bushings and reamer into the crankcase as shown in (Fig. 6.) Have the 6° cutting edge of the reamer face toward the forward bearing.

With the two parts of centering bushings "A," "B" and "C," fitted tightly together, screw the threaded portions tightly into the ends of

the bearings as shown in (Fig. 6.) Have two of the set screws of the centering bushings "B," in a horizontal plane, and the other two in the vertical plane. Move the center portion of centering bushing "B," in a horizontal plane, and the other two in the vertical plane. Move the center portion of centering bushing "B" back $\frac{1}{16}$ inch to $\frac{1}{8}$ inch and adjust the set screws so that they just touch the parallel surface of the conical center.

To determine if the centering bushings have been lined up correctly pull the bar back until it just leaves the forward support and then push it forward. The bar should enter the hole without clicking. If it does not, reset the set screws of centering bushing "B." After the bar is lined up correctly lubricate the reamer with a good quality of lard oil and ream the forward bearing, continuing the reaming operation until the reamer just touches the forward centering bushing. Then remove the bushing and continue the reaming operation. After completing the work pull the reamer about one half way out of the bearing just reamed and carefully replace the centering bushing by again screwing it into place. The bar should be lubricated with a good quality of light engine oil.

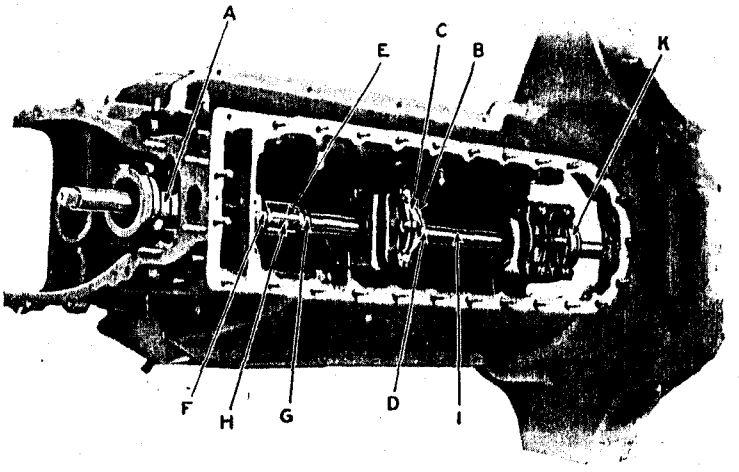


Fig. 6—Reaming Crankshaft Main Bearings

Carefully remove the bar just far enough to permit turning the reamer around and then replace it. The center bearing may then be reamed in similar manner. After completing this work place the reamer between the second and third bearings and ream the rear bearing.

DRESSING DOWN CRANKSHAFT BEARING SURFACES

Main Bearing Surfaces

Crankshaft bearing surfaces should be smooth, free from scores and round within .003 inch. If not they should be dressed down.

This work should be attempted only by workmen who thoroughly understand work of this kind. To get the best results the shaft should be removed from the engine and placed in a lathe or grinder.

After the shaft is in proper condition, refit the bearings in accordance with directions under "Fitting Main Crankshaft Bearings," page 33.

Crank Pin Surfaces

If the crank pin surfaces become scored, worn down or worn badly out of round they should be trued up and new undersize bearings be refitted, see under "Fitting a New Undersized Bearing" page 32.

Crank pins can be trued up by using the Weber crank pin returning tool numbered 79256 furnished by our Parts Department as shown in (Fig. 7.)

Remove the crank shaft from the engine, remove the plugs from the oil ways and clean the crank pins. Do not use emery cloth for this purpose. Then place the shaft upon lathe centers as shown in Fig. 7, being careful not to adjust the centers tightly enough to spring the shaft.

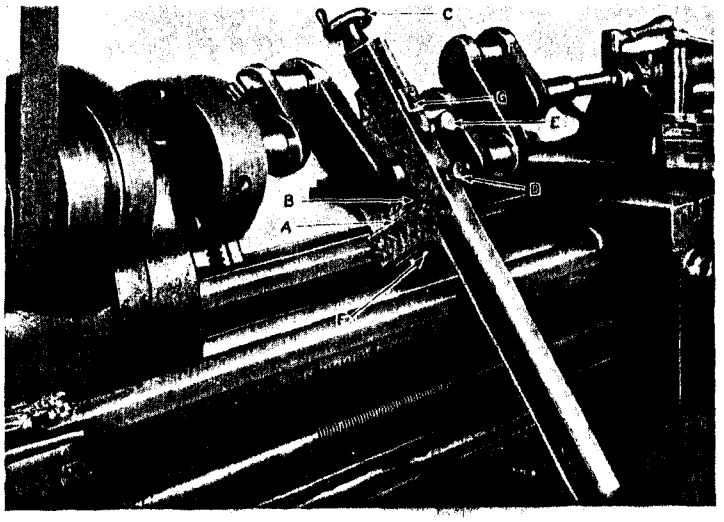


Fig. 7—Truing up Crank Pin

Using the scale "A" set the tool to the diameter of the crank pin. Three bronze shoes are furnished with each tool. Install the one marked "2" and place the tool over the crank pin as shown. Set the screw "E" bringing the shoe against the crank pin thereby holding the shaft firmly in place. Do not adjust the shoe too tightly.

Adjust the cutter by the hand wheel "C" so that it just clears the crank pin at its largest diameter. The lathe should be turned by hand to make certain the cutter is adjusted correctly.

Start the lathe on the lowest back gear speed. A speed of between eight and ten revolutions per minute is recommended. In no event should the speed exceed fifteen revolutions per minute. Start the cutting operation with a feed of not more than .0005 inch per revolution. Keep the bronze shoe screwed tightly against the crank pin while the work is being

done. An out of round crank pin will result if this is neglected. Remove only enough metal to true up the pin.

Use freely a cutting lubricant consisting of equal parts of lard oil and turpentine. Do not use a water compound.

Do not back off the cutter while the lathe is in operation. Injury to the hardened steel plates is the result if this is done. If through mistake the plates are injured in this manner, use a fine oil stone in dressing them up.

All crank pins should be turned to the same diameter. This can be done by using the graduation on the hand wheel as a scale.

If a crank pin is worn badly out of parallel with the main bearings the handle of the tool will oscillate on the ways of the lathe. This can be overcome by running the carriage lightly against the handle of the tool. When overcome run the carriage back.

After the work is completed, stop the lathe, remove the tool, place a piece of number 00 emery cloth in the wooden hand clamp and with the pin well lubricated polish it with this tool. Finish polish with crocus cloth and oil.

After completing the work, thoroughly clean out all oil passages and replace the plugs.

It is important that the cutter edge be sharp and free from nicks. It is recommended that you permit the tool manufacturers, The Sawyer-Weber Tool Manufacturing Company, 350 South Alameda Street, Los Angeles, California, or the Special Tool Co., 1141 Jefferson Ave., E., Detroit, Mich., to regrind them when necessary.

Fit new undersize bearings after completing the work. These may be obtained from our Parts Department. Complete directions covering the refitting of new bearings will be found on page 32.

Caution: Care should be used in handling this tool. Do not injure the surface of the steel plates or the cutting edge.

FIRING ORDER

The order in which the cylinders fire is indicated in (Fig. 8.)

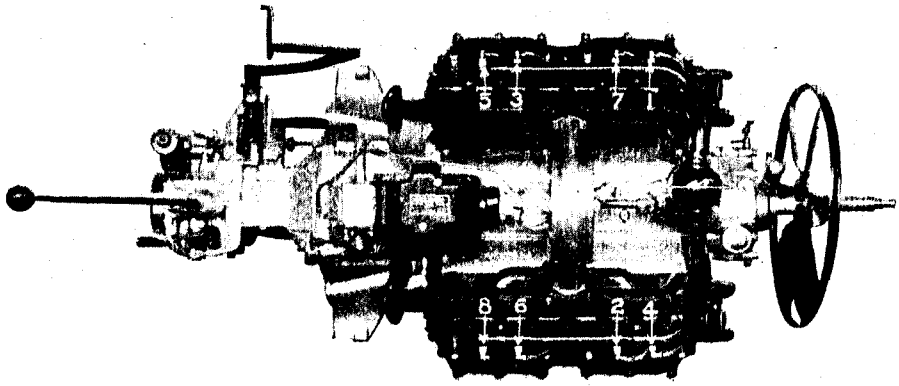


Fig. 8—Firing Order

TIMING MARKS ON FLYWHEEL

The flywheel marks (see Fig. 9) are arranged in four groups, each group consisting of the following marks in order:

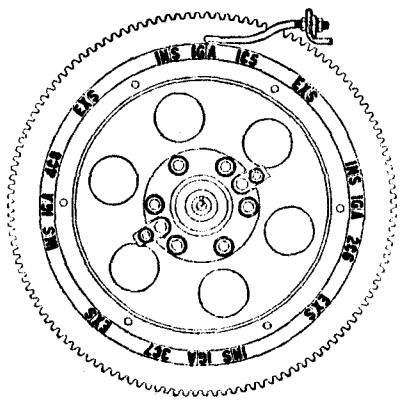


Fig. 9—Flywheel Showing Timing Marks

"IN|S"—"Inlet setting"
"IG|A"—"Ignition advance"
"C"—"Center"
"EXS"—"Exhaust setting"

Each group of marks refers to two cylinders, the numbers of which are stamped one on each side of the "C" in that group.

Complete instructions for using the "inlet setting" and "exhaust setting" marks are given below under "Positions of Cams for Adjustment of Cam Slides." The ignition timing is explained fully under "Timing Ignition," page 54.

ENGINE VALVES

Positions of Cams for Adjustment of Cam Slides

In poppet valve gasoline engines it is necessary for a cam roll to be on the circular surface of the cam when the cam slide operated by that cam is being adjusted. The shape of the circular portion of the cams in the Cadillac eight-cylinder engine is such that it is not sufficient for a cam roll simply to be on the circular surface of the cam. The cam roll must be on a certain small arc of the circular surface of the cam when the cam slide is being adjusted.

As no two cams on the camshaft are in the same position at the same time, it is necessary, before adjusting each cam slide, to place the corresponding cam in the proper position by cranking the engine by hand as described below. The cam slides cannot be properly adjusted with the cams in any but the correct positions.

Placing Cam in Position

To place a cam in position for properly adjusting the cam slide proceed as follows:

Open the compression relief cocks on the cylinder blocks and with the ignition switched off crank the engine slowly by hand in the direction in which it runs until the piston in the cylinder in which the valve is located is at the end of the compression stroke, or in other words, on firing center. This may be determined by placing a finger over the compression relief cock while cranking the engine. When the piston is exactly on firing center the pointer attached to the crankcase will then be directly over the mark on the flywheel indicating "center" for that cylinder.

INLET VALVE. If the valve operated by the cam slide is an inlet valve, select the first "IN|S" to the left of the center mark and mark it with a piece of chalk.

Crank the engine further by hand in the direction in which it runs until that "IN|S" is directly under the pointer. It will be necessary to crank the engine nearly a complete revolution.

The cam is then in the correct position for adjusting the cam slide operating that inlet valve. (See under "Adjustment of Cam Slide.")

EXHAUST VALVE. If the valve operated by the cam slide is an exhaust valve, after cranking the engine to the proper firing center, select the first "EX|S" to the right of the center mark and mark it with a piece of chalk.

Crank the engine further by hand in the direction in which it runs until this "EX|S" is under the pointer.

Then crank the engine further one complete revolution until this "EX|S" is again directly under the pointer.

The cam is then in the correct position for adjusting the cam slide operating that exhaust valve. (See under "Adjustment of Cam Slide," Page 39.)

Adjustment of Cam Slide

When the cam is in the proper position (See under "Positions of Cams for Adjustment of Cam Slides," page 38), the clearance between the end of the valve stem "A," (Fig. 10), and the adjusting screw "B" in the cam slide "D" should be from .002 inch to .003 inch when the engine is cold.

To adjust a cam slide, loosen the locking nut "C" and turn the adjusting screw "B."

Tighten the locking nut "C" when the proper clearance has been obtained, taking care that in so doing the adjustment of the screw "B" is not disturbed. The adjustment may be made by the use of Cadillac wrenches numbered 75368 and 72843.

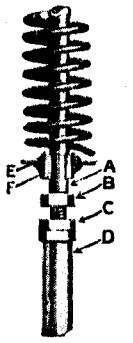


Fig. 10 Cam Slide and Adjusting Nut

Grinding Valves

Remove the valve. (See "Removal" under "Valves and Valve Springs," page 136).

Before grinding remove carbon or rust from the valve and valve stem bushing. Do not use a reamer for this purpose. Polish the valve stem.

It is a good plan to wrap soft string around the stem of the valve near the head. This will tend to prevent the grinding compound getting into the valve guide.

In the absence of a good prepared grinding compound, make a paste of powdered glass or flour of emery, mixed with thin oil.

Place the grinding compound on that portion of the valve which

bears on the valve seat. Then replace the valve, and with Cadillac tool, numbered 56330, a screw-driver, or other suitable tool, rotate it back and forth about one-third revolution, with only a slight pressure on the tool. Lift the valve occasionally and turn it to a new position. Continue the grinding operation only until the valve and its seat show perfect bearing when tested with Prussian blue or pencil marks on the valve seat.

Then thoroughly wash the valve, the valve chamber and the valve guide with kerosene or gasoline. Be very careful to leave none of the grinding compound in any part of the cylinder, as it will cause serious damage if it works into the cylinder bore or other parts of the engine; also remove the string from the valve stem. Replace the valve.

After replacing the valve, retime it. (See under "Adjustment of Cam Slide," page 39.) Retiming is necessary as the amount of clearance between the valve and the adjusting screw in the cam slide is necessarily reduced during the grinding operation.

All valve springs in one cylinder block may be lifted at once to facilitate grinding of valves by use of Cadillac valve lifter, tool numbered 69283.

ENGINE CHAINS

Frequency of Adjustment

The frequency with which chain adjustment is necessary depends upon four things:

Use of suitable lubricant
Manipulation of carburetor enriching lever
Replacement of engine oil
Washing out of oil pan of engine.

It is a good plan to readjust the chains at the end of the first two thousand miles of use.

Tests for Need of Adjustment

To determine if chain adjustment is necessary oscillate the fan as far as possible without slipping the fan clutch. If the movement at the periphery of the fan exceeds 1″ adjustment is recommended. Under no conditions should the car be driven until a readjustment is made if the fan movement exceeds 2″.

Method of Adjustment

Turn the shaft "B" (Fig. 55, page 114) *six comp'ete revolutions* in the clockwise direction. This will loosen the locking collar "A" screwed onto the inner end of the support "C." Turn the shaft "E" in the clockwise direction sufficiently to reduce the movement at the periphery of the fan to ⅜ inch without slipping the clutch at the fan hub. Then turn the shaft "B" in the counter-clockwise direction, thereby clamping the support "F" into place.

When chains become so badly worn that readjustment cannot be made, remove the offset link of each chain. Then loosen the locking collar "A" (Fig. 55) by turning the shaft "B" six complete revolutions. Turn the shaft "E" in the clockwise direction bringing the sprockets

"L" and "N" into positions such that the chains can be replaced. Then adjust the chains as directed under "Method of Adjustment."

Replacement of Chains

Chains must always be replaced in pairs. Do not replace one chain only.

RIVETING CHAINS

Each joint of the chain contains two pins, as shown in (Fig. 11;) a seat pin "A," which is ribbed, and a rocker pin "B," which is plain. If a chain is removed, be very sure in replacing it that the joint pins are inserted as shown.

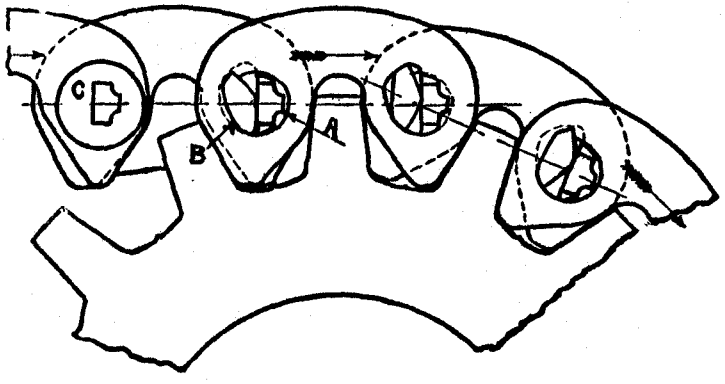


Fig. 11—Correct Positions for Rocker and Seat Pins

Bring the ends of the chain together on the upper side of the large sprocket. (See "Replacement" under "Engine Chains", page 116.) Insert the rocker pin and a used or extra seat pin to align the links.

Clamp the new seat pin in a vise and rivet the small washer "C" (Fig. 11) on one end. Turn the crank-shaft so that the connection is midway between the sprockets. Force the used seat pin out by inserting the new seat pin. Insert the new seat pin from the rear by use of Cadillac rivet inserter, tool numbered 56331. In doing so be careful not to force out the rocker pin. Be sure to recover the used seat pin so that it will not get into the mechanism of the engine. Then insert riveting block, tool numbered 56332 furnished by our Parts Department, between the crankcase wall and the inner end of seat pin to be riveted, place the small washer "C" on the end of the seat pin and force on with Cadillac rivet set, tool numbered 56322 and carefully peen over the end of the pin.

Remove the riveting block and try the pin to see that it is not broken, by applying a pair of pliers to the washer and, pulling endwise.

If, in installing a chain, the rocker pin is inserted backwards it will cause a knock on the small sprocket which will quickly destroy the chain. It is absolutely essential that the joint pins be assembled correctly if the chain is to live and give quiet and satisfactory service.

STORAGE

Engine

To prepare the engine for storage proceed as follows: Start the engine, cover the radiator and run the engine until it is hot. (See under "Personal Danger of Running Engine in Closed Garage," page 77.) The engine should be run at a speed which will show an ammeter reading of about 10 with all lights switched off. It usually requires from two to ten minutes to heat up the engine.

After the engine is hot, stop the flow of gasoline to the carburetor by removing the gasoline tank filler cap, thus relieving the air pressure. Immediately the engine starts to slow down from a "lean mixture" inject one-half can of clean fresh engine oil into the carburetor. This may be done easily by lifting up the cover over the air valve. This will stop the engine. Be certain there is no fire near when the filler cap is removed. Replace and tighten the cap after the engine stops and replace the screw.

Open the compression cocks. Inject from five to six tablespoonfuls of clean fresh engine oil into each cylinder and before closing the cocks crank the engine three or four revolutions with the ignition switched off. This will tend to distribute the oil over the cylinder walls.

Drain the cooling system. (See under "Draining the Cooling System," page 67.)

Storage Battery

(*See under "Preparing Battery for Storage," page 61*).

Tires

During winter storage it is best to remove the tires from the rims and keep the casings and tubes in a fairly warm atmosphere away from the light. It is best to inflate the tubes slightly after the tires have been removed to keep the tires in the position in which they are when inflated on the rim.

If the tires are not removed from the car, and the car is stored in a light place, it is best to cover the tires to protect them from strong light, which has a deteriorating effect on rubber.

The greatest injury that can be done to tires when the car is stored is to allow the weight of the car to rest on them. If the tires are not removed the car should be blocked up so that no weight is borne by the tires and then be deflated partially. This will relieve the tires of all strain, so that in the spring they should be practically no worse for the winter's storage.

Body and Top

It is best to put the top up and cover the entire car to protect it from dust.

Taking the Car Out of Storage

When the car is taken out of storage and before the engine is started, drain the oil from the oil pan, remove and clean the oil pan and baffle

plate and replace the oil with fresh oil. (See under "Replace Engine Oil," page 197.)

The following instructions should be followed carefully in starting the engine:

Open the compression relief cocks and inject from five to six tablespoonfuls of clean fresh engine oil into each cylinder.

Close the cocks and with the ignition turned off turn the engine over a few revolutions by hand. This will tend to distribute the oil over the cylinder walls.

Start the engine in the usual manner.

Immediately the engine starts push the carburetor enriching button as far forward as possible without causing the engine to stop or a material reduction in engine speed and open the throttle to a point which causes an ammeter reading of approximately 10 with all lights switched off. With the engine running inject a half canful of clean fresh engine oil into the carburetor under the cover, which is located over the auxiliary air valve.

Push the carburetor enriching button forward as far as it will go as soon as the engine is warm enough to permit it.

ELECTRICAL SYSTEM

GENERAL DESCRIPTION

The Cadillac-Delco system is the single wire, single unit system. One side of the motor generator, storage battery, lamps, horn and ignition apparatus is connected to some part of the frame of the car or engine. The other connections are made with copper wires or cables.

MOTOR GENERATOR

The motor generator serves both as a generator of current and as an electric motor for cranking the engine when starting. The principal elements of the motor generator are an armature and a field. There are two windings on the armature and two in the field—one on the armature and one on the field are used when the motor generator is used as a generator and the other windings when it is used as a motor.

Generator

The motor generator, when acting as a generator, is driven at engine speeds by the fanshaft which, in turn, is driven by a silent chain from the camshaft at the front end of the engine. Thus driven, it delivers electrical energy for charging the storage battery and for operating the lights, ignition apparatus and horn. To prevent the voltage of the current generated from rising too high when the engine is running at high speeds, the third brush system of current regulation is employed.

Motor

When acting as a motor, the sole function of the motor generator is to crank the engine. In starting, the first thing the operator does is

to push up the ignition lever on the combination switch. This closes the ignition circuit and the circuit between the storage battery and the generator windings on the motor generator, causing the armature to revolve slowly.

A ratchet clutch in the front end of the generator allows the armature to rotate ahead of the driving shaft. The clicking noise that is heard when the ignition switch is turned on comes from this clutch.

Next the operator pushes down the starter button. The first movement causes the starter gears to mesh with the teeth on the flywheel. The probability of the ends of the teeth striking and failing to mesh is overcome by the slow rotation of the armature which began as soon as the ignition was turned on.

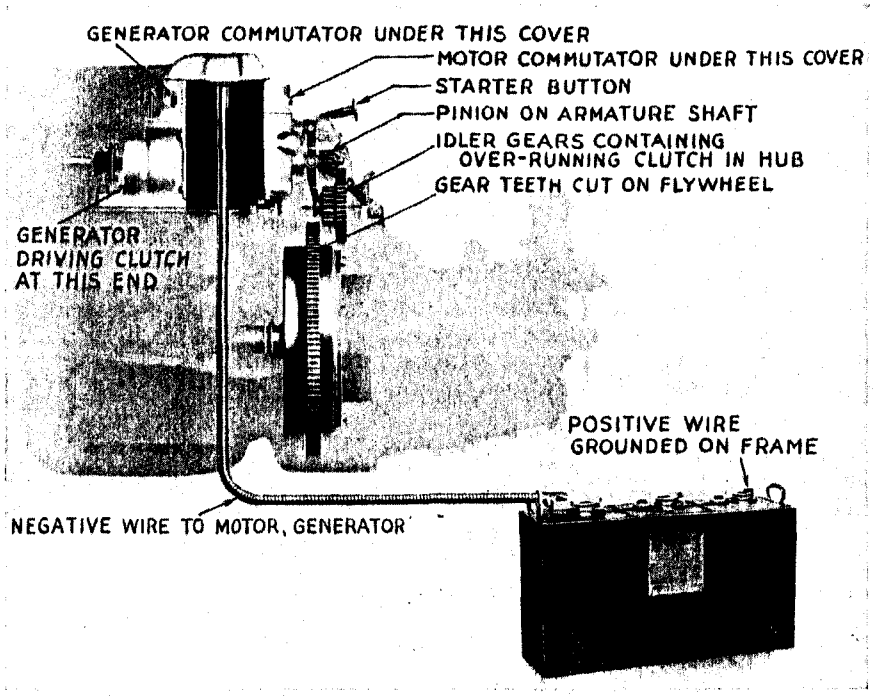


Fig. 12—Motor Generator and Starting Mechanism

As the starter button is pushed further down, the circuit between the storage battery and the generator windings of the motor generator is broken. Upon the last movement of the starter button the circuit is closed between the storage battery and the motor windings on the motor generator, causing it to act as a powerful electric motor which rapidly cranks the engine.

As the gear ratio between the armature shaft and the crankshaft is approximately 25 to 1, the armature would be driven at an excessively

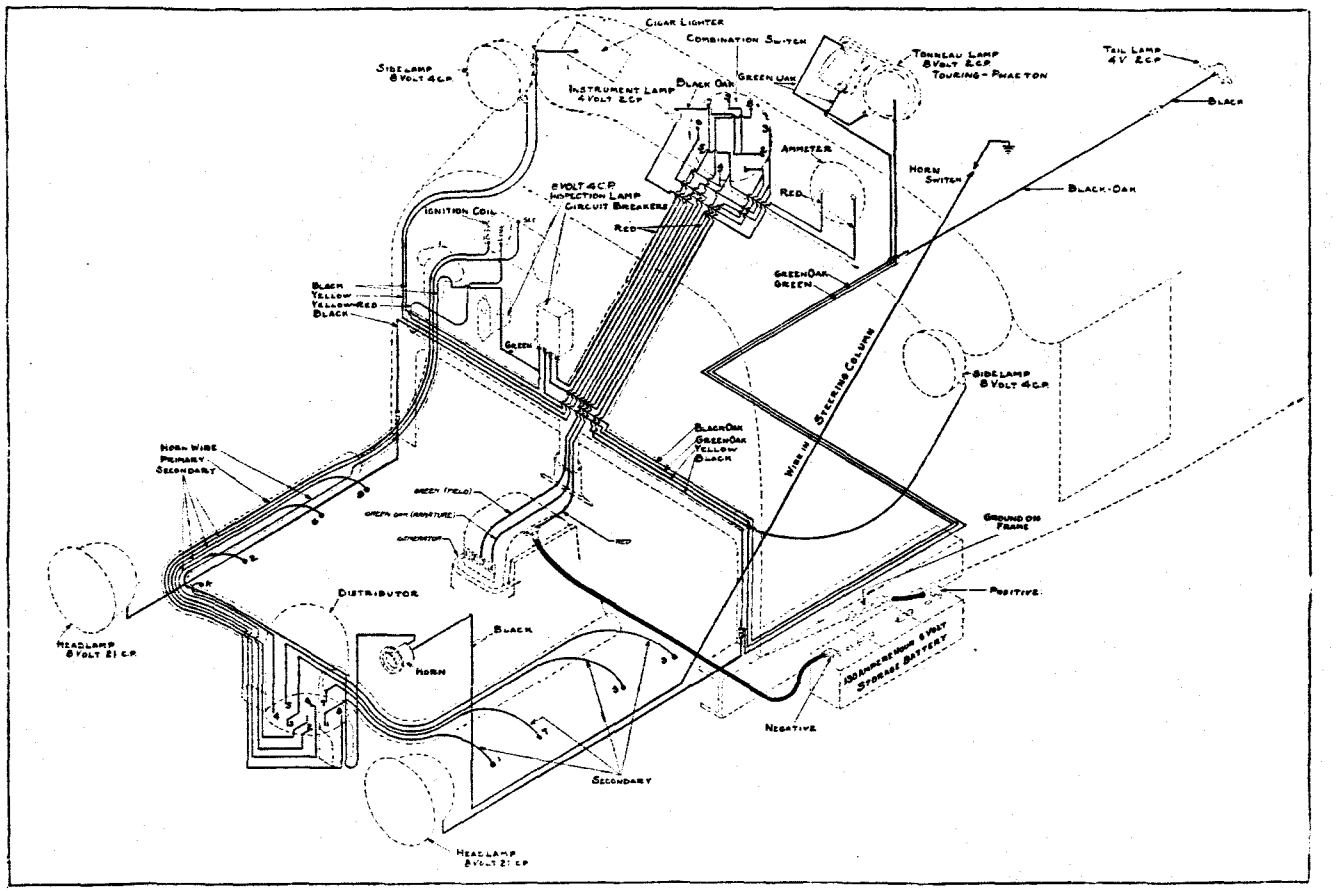


Fig. 13—Wiring Diagram

high rate of speed after starting the engine and before the operator let the starter button back if it were not for an over-running clutch in the hub of the idler gears between the flywheel and the armature shaft. The electric motor cranks the engine through this clutch, but after the engine has started and begins to run faster than the electric motor, the clutch slips.

When the starter button is let up, as soon as the engine is running under its own power, the first movement of the button breaks the circuit between the electric motor and the storage battery, a further movement causes the starter gears to slide out of mesh and the final movement completes the circuit between the generator and the storage battery, which was broken at the generator switch, (see Fig. 62 page 140,) when the starter button was pushed down. The engine running and the circuit being closed between the storage battery and the generator windings of the motor generator, the generation of current begins.

Caution:—The action which causes the engine to "turn over" is produced by a gear of the electric starting motor sliding into mesh with teeth on the fly-wheel of the engine. When pushing down on the starter button to throw these gears into mesh, if it should so happen that they are in just such positions that the ends of the teeth of the starter gear come against the ends of the teeth of the fly-wheel, instead of the teeth of one sliding between the teeth of the other, do not use force. Simply permit the starter button to return to the normal position and then push it down again. In the meantime, the gears will probably have changed their relative positions sufficiently to permit the teeth to mesh.

Fitting Motor Generator Brushes

If the brushes of the motor generator do not have a good full bearing on the commutators, the brushes should be refitted. To do so proceed as follows:

Cut a strip of number 00 sandpaper slightly wider than the brushes. Pass it between the brushes and the commutator and at least one-half way around the commutator. Draw the sandpaper back and forth with sanded side against the brushes.

Another method is by removing end frame and placing the sandpaper around the commutator with ends just butting.

The paper can be held intact by using LePage's glue at three or four places on commutator. Allow glue to dry before replacing brushes and end frame.

After end frame has been reassembled connect the motor end to a storage battery to revolve armature. Do not allow armature to revolve at high speed.

When fitting motor brushes use the generator end as a motor to revolve the armature.

Ordinarily the brushes seat very quickly.

Do not use emery cloth in fitting brushes.

Commutators

Do not under any condition put oil of any kind on the commutators of the motor generator.

HORN

The horn is mounted on a support which is attached to the fanshaft housing by two long screws. It is operated by a switch on the steering gear. The horns are motor driven and ordinarily require very little attention, or adjustment.

Before removing the horn or attempting to adjust it make sure the battery is well charged, the six collar screws are tightened properly, that the push button is making proper contact and that there are no loose or corroded connections in the circuit.

Adjustment

Remove the two wires from the horn terminals. Then remove the two long screws attaching the support to the fanshaft housing and remove horn. Remove the motor shell. Turn the two adjusting nuts "A" and "B" (Fig. 14) not more than one-eighth of a turn in a counter clockwise direction (looking at the horn from the front). Then turn the two nuts "E" and "F" likewise. All nuts should be turned the same amount and securely tightened. Should the adjustment be too close (this is indicated by the abrupt stopping of the motor when the current is turned off) reverse the adjustment of the nuts.

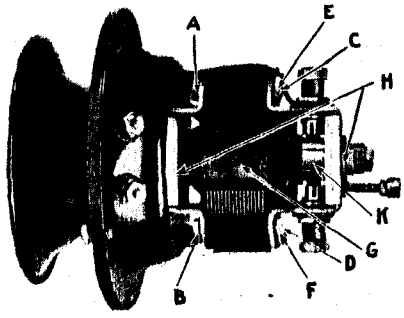


Fig. 14—Horn

Caution:—Do not use pliers on the knurled nut holding the motor shell in place on the Klaxon horn.

Cleaning and Lubricating the Horn

After each twenty-five hundred miles of car operation the horn should be cleaned and lubricated.

Remove the horn from the engine and take off the motor shell. Pack the rear bearing "H" (Fig. 14) with cup grease. Wipe the commutator "K" carefully with a clean cloth moistened with vasoline, at the same time turning the commutator so as to clean it on all sides. Finish wiping with a clean, dry cloth in the same manner. Do not lubricate the

commutator. Wipe the inside of the motor shell with a clean, dry cloth before replacing it.

TILTING HEAD LAMP REFLECTORS

The reflectors in the head lamps are pivoted so that they can be tilted and are controlled by a button on the instrument board. When the road is clear and illumination of the distant road is desired, the reflectors direct the rays ahead. When a vehicle traveling in the opposite direction approaches, rays from the headlamps can be deflected further than already deflected by the lenses, increasing illumination directly in front of the car, by simply pushing forward the button and thereby tilting down the reflectors.

LAMPS

Focusing Headlamps with Bausch and Lomb Lenses

Adjustment should be made with the car standing in a dark level place and with the light falling on a wall or the side of a building at a measured distance of 25 to 50 feet. Cover or disconnect one lamp while adjusting the other.

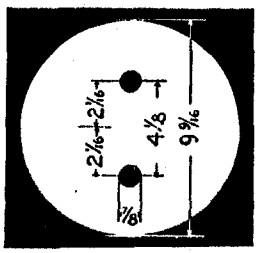


Fig. 15—Diagram of Card Used in Focusing Lamps

A card as shown (Fig. 15) is included in the tool kit with each car. The card is 9 $\frac{9}{16}$ inches in diameter. Two $\frac{7}{8}$ inch holes are cut in card $4\frac{1}{8}$ inches apart or $2\frac{1}{16}$ inches from center as shown in (Fig. 15.)

Open the lamp door and hold the card against the front of the lamp so that the centers of the two holes in the card lie in the vertical line. If the bulb is set properly the images of the lamp filament will appear in a solid spot of light as shown in (Fig. 16.) If the lamp bulb is too close or too far away from the reflector, two images will appear as shown in (Fig. 17.) In this event the bulb should be adjusted until a single spot of light is shown. This method of checking the lamp bulb setting is applicable for any type of lens.

Caution:—If only a single spot of light is shown, make certain that it is not because the lamp is so far out of focal adjustment that one spot strikes the ground.

Bulb adjustment is made by turning the adjusting screw at the edge of the reflector near the side. Turning the screw in the clockwise direction forces the bulb back. Turning it in the counter clockwise direction forces it out. After making the adjustment, repeat the test with the lamp doors closed in accordance with the following directions:

Checking Focal Adjustment of Headlamps

The focal adjustment should be checked and re-adjustment made if necessary each time the lamp bulbs are replaced. To determine if the headlamps are in correct adjustment proceed as follows:

Drive the car onto a level place with the light from the headlamps falling on a wall or the side of a building at a measured distance of 25 or 50 feet.

Cover or disconnect one lamp while adjusting the other. Hold the card (Fig. 15) against the lens of the lamp to be tested so that the centers of the two holes in the card lie in the vertical plane.

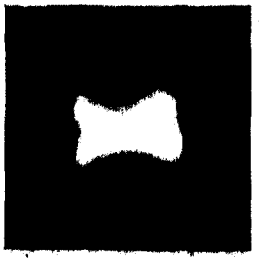


Fig. 16—Lamp In Focus (Door Open)

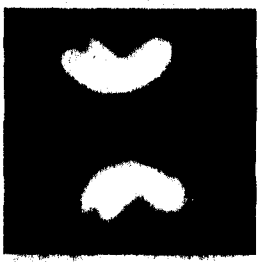


Fig. 17—Lamp Out of Focus (Door Open)

If the bulb is set properly the light will appear as one solid band as shown in (Fig. 18.) If the bulb is too close or too far away from the reflector, two bands of light will be shown as in (Fig. 19.) In this event, the bulbs should be readjusted until a single band of light is shown.

Caution:—If only one band of light is seen, make certain that it is not because the lamp is so far out of focal adjustment that one band falls upon the ground.

Directions for Setting the Tilting Reflectors

At a distance of 25 feet from the wall the center of the beam of light should be 9 inches below the level of the center of the headlamps with the reflectors in the normal position and the lamp doors closed. At 50 feet the deflection should be 18 inches. If the band of light is too high or too low, readjust the reflectors. To do so open the lamp doors and turn the adjusting screw at the bottom of each reflector. Turning the screw in the clockwise direction causes greater deflection of light. Turning it in the counter clockwise direction decreases the amount of deflection.

After completing the adjustment, close the lamp doors and check the adjustment.

Cleaning Reflectors

The reflectors in the head and side lamps are plated with pure silver. In polishing, extreme care must be used in selecting materials which will not scratch the silver.

Powdered dry rouge and a chamois skin are recommended. If the reflectors are tarnished, moisten the rouge with alcohol, and apply with the chamois. Then polish with a dry chamois and rouge.

The chamois should be soft and must be kept free from dust. Do not use chamois used for any other purpose.

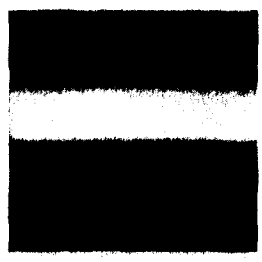


Fig. 18—Lamp In Focus (Door Closed)

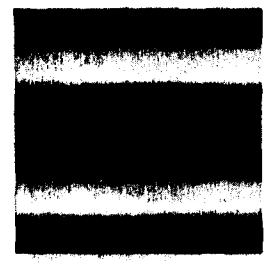


Fig. 19—Lamp Out of Focus (Door Closed)

Lamp Bulbs

Bulbs should have the correct voltage and candle power rating. The following is a table of correct voltages and candle powers:

Lamps	*Voltage*	*Candle Power*
Head	8	21
Side	8	4
Instrument	4	2
Tail	4	2
Tonneau	8	2
Inspection	8	4
Dome, enclosed cars	8	4
Quarter, enclosed cars	8	2

IGNITION SYSTEM

General Description

The ignition system embodies the following elements: A source of current, the generator, or at low speeds, the storage battery; an ignition timer, which interrupts the low tension current at the proper instant to produce a spark in the high tension circuit; an induction coil, transforming the primary current of six volts into one of sufficient voltage to jump between the points of the spark plugs; a condenser, which assists the induction coil to raise the voltage, and which protects the contact points of the ignition timer from burning; and a high tension distributor which directs the distribution of the high tension current to the spark plugs in the respective cylinders.

Distributor and Timer

The distributor and timer (Fig. 65 Page 147) are carried on the fanshaft housing and are driven by the fanshaft through spiral gears.

The distributor consists of a cap or stationary head of insulating

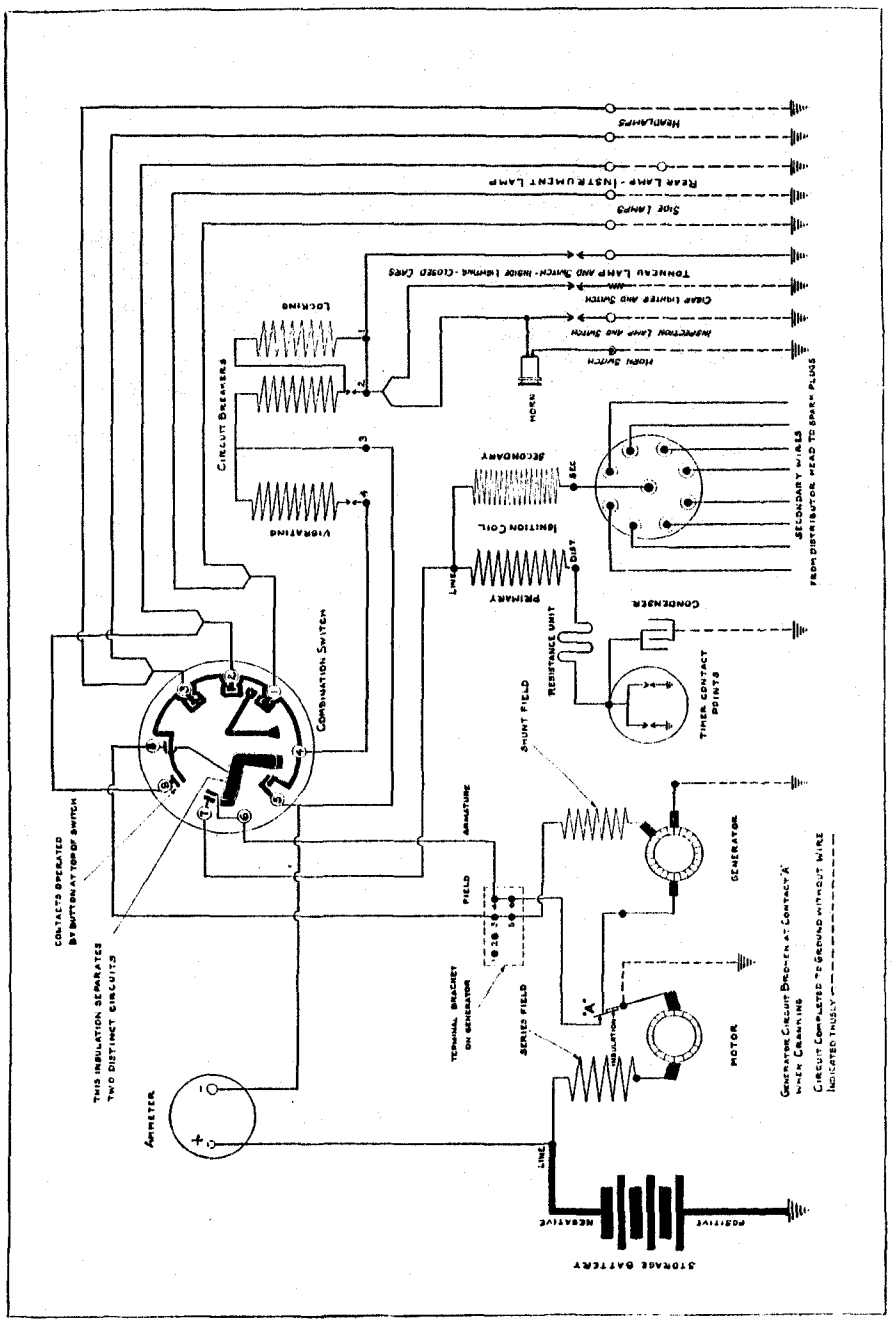


Fig. 20—Circuit Diagram, Starting, Lighting, Ignition and Horn

material and a rotor of the same material which turns with the timer shaft. The distributor head carries one contact in the center and eight additional contacts placed at equal distances about the center. (Only two of these contacts are shown in (Fig. 65.) The center contact is connected to the high tension terminal on the ignition coil. The eight remaining contacts are connected to the spark plugs in the cylinders. The center contact is provided with a spring plunger which is in constant contact with a plate on the rotor. This plate carries a contact button at its outer end. As the rotor revolves, the contact button slides over the eight outer contacts in the distributor head, consecutively completing the high tension circuit to each of the spark plugs from the ignition coil.

The timer, by which the low tension current is interrupted at the proper time to produce the spark, is beneath the rotor. An eight lobed cam "J" (Fig. 21, page 53) on the timer shaft, operates two contact arms "C" and "O." As the cam revolves, these arms alternately complete and break the primary circuit. The cam is held in place by the lock screw "I."

Two sets of timer contact points are provided. The object is to distribute over two sets the current which would otherwise pass through one. This greatly lessens wear and burning of the points.

The spark timing is automatically controlled by a centrifugal governor which advances or retards the position of the timer cam relative to the driving shaft, as the engine speed increases or decreases. A spark lever at the steering wheel is provided, however, by which the timing may be still further advanced or retarded. This spark lever is connected to the manual control lever at the left of the distributor housing.

Cleaning Distributor Rotor Button Track

If the track in the distributor head, against which the rotor button presses, requires cleaning, do not use sandpaper or emery cloth. Clean with a piece of cloth moistened with a good grade of vaseline, then polish with a dry cloth.

Adjustment of Timer Contact Points

The timer contact points should be adjusted so that both sets open simultaneously and are the same distance apart when open, that is, .020 inch, if the car is new, or .015 to .018 inch if the car has been driven more than 2,000 miles.

Adjustment of Contacts for Gap—To adjust the gaps between the contact points, remove the distributor rotor. (See "Removal" under "Distributor Rotor," page 144.) Crank the engine by hand until one of the contact arms is directly on top of a lobe of the cam "J" (Fig. 21). Then adjust the corresponding contact points so that they stand .020 inch apart if the car is new or .015 to .018 inch if the car has been driven more than 2,000 miles. Adjust the other contact points in the same manner with the other contact arm on top of a cam lobe. Be sure that both sets of contact points are adjusted exactly alike. If the

segment plate, "N," (Fig. 21,) is correctly adjusted, both contact arms "O" and "C" will be directly on top of lobes of the cam "J" at the same time. If they are not, adjust the contacts for gap as directed above and adjust the segment plate "N" as directed under "Adjustment of Segment Plate," page 54.

Do Not File or Grind the Contact Points. To clean the points, remove the contact arms after removing the cotter pins "H" and "G," remove the contact screws and simply rub the points over an oil stone a few times or until the points are clean and bright. Be sure the faces are at right angles to the screws and arms. Do not remove the segment plate nor loosen the screws "M," "K" and "L" in removing the contact points for this work.

It is a good plan after adjusting the timer contact points to check the ignition timing (see under "Timing Ignition," page 54), for the reason that changing the gap at the contact points also changes the timing.

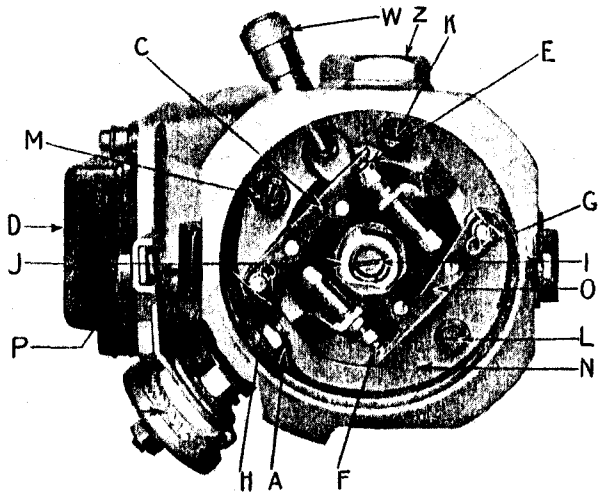


Fig. 21—Timer

Adjustment of Contacts for Simultaneous Opening—To determine whether the contact points open simultaneously proceed as follows: Remove the distributor rotor. (See "Removal" under "Distributor Rotor," page 144). Insulate the contact arm springs from the aluminum housing by inserting pieces of heavy paper or light cardboard no thicker than a common calling card between the springs and the housing. Disconnect the wire from the lower terminal on the end of the ignition coil on the dash and connect it to the upper terminal on the end of the coil.

Connect a six volt lamp to each contact arm, grounding the other terminal of each lamp.

Switch on the ignition and crank the engine slowly by hand. The two lights will be extinguished at the same instant if the contact points open simultaneously. If they do not open simultaneously and the gaps between the contact points are in correct adjustment (see under "Adjustment of Contacts for Gap," page 52), adjust the segment plate "N," (Fig. 21). (See below under "Adjustment of Segment Plate.")

Adjustment of Segment Plate

The holes in the segment plate "N" for the three screws "M," "L" and "K" are elongated in a direction parallel to the contact arms "O" and "C." This permits adjustment of the position of the contact arms relative to the cam "J." This adjustment is made at the factory and the plate "N" need not be readjusted unless it has been removed or the screws "M," "L" and "K" have been loosened. The plate "N" should not be removed in removing the contact points to clean them.

If the adjustment of the segment plate has been altered proceed as follows in readjusting: Test with lamps to determine which set of contact points open first. (See under "Adjustment of Contacts for Simultaneous Opening," page 53.) If the test shows that the contact points at "F" open before those at "E," loosen the three screws "M," "L" and "K" and the nut "A" and move the segment plate slightly towards the resistance unit. If the contact points at "E" open before those at "F" move the segment plate slightly away from the resistance unit. Move the segment plate only very slightly, as each change in position retards the opening on one side as much as it advances it on the other. After setting the segment plate tighten the screws and test again for simultaneous opening. Continue the adjustment of the segment plate until the test indicates simultaneous opening with both gaps correctly and equally set.

It is necessary to readjust the cam "J," as moving the segment plate affects the timing of the ignition. (See below, under "Timing Ignition.")

Timing Ignition

Unless the timer contact points are in proper adjustment they should be readjusted before proceeding to time the ignition. (See under "Adjustment of Timer Contact Points," page 52.)

To time the ignition proceed as follows:

Move the spark lever to the retard position; open the compression relief cocks on the cylinder blocks and crank the engine by hand until the piston in number one cylinder is on firing center. (Number one cylinder is the one nearest the radiator in the left-hand block of cylinders.)

Next remove the distributor head, also the rotor (see "Removal" under "Distributor Rotor," page 144) and loosen the lock screw "I," (Fig. 21), just enough to allow the cam "J" to be turned by hand after the rotor is fitted. (The lock screw should not be loosened enough to allow the cam to turn on the shaft when the engine is cranked by hand with the rotor in place.)

Then turn the cam with a suitable wrench until the cam is in the correct position for the terminal marked "1" on the distributer head.

Caution:—If the rotor is used instead of a wrench for turning the cam extreme care should be taken to have the cam pushed down fully after removing the rotor and before tightening the lock screw.

Move the spark lever, at the steering wheel to the "Advanced" position.

If the cam "J" is properly set, the contact points will just open when a point one and twenty-one thirty-seconds inches in advance of the center line for each cylinder is directly under the pointer attached to the crankcase of the engine. This point for each cylinder is marked on the fly-wheel by the letters "I G|A." (See Fig. 9, page 38.) (The letters "I G|A" stand for "Ignition Advance.")

Either of two methods may be used for indicating the instant the contact points open.

First Method: With the distributor head and rotor in place, switch on the ignition and hold a high tension spark plug wire about one-eighth of an inch away from the cylinder casting and crank the engine slowly by hand in the direction in which it runs. Stop cranking immediately a spark occurs between the wire and the casting. (It will be necessary to crank the engine nearly two complete revolutions before the spark occurs.)

Second Method: With the ignition switched off, connect a six volt test lamp in series between the number 3 terminal of the circuit breaker (see Fig. 20) and the terminal "P" on the timer (Fig. 21). *Stop cranking immediately the light is extinguished.*

If the contact points open early turn the cam "J" slightly in a counter-clockwise direction to correct the adjustment. If the contact points open late, turn the cam slightly in a clockwise direction. After turning the cam "J" test the timing again and readjust if necessary.

After the adjustment has been correctly made lock the cam securely to the distributor shaft by the lock screw "I."

After locking the adjustment it is a good plan to check the timing by fully retarding the spark lever—in other words moving it to the extreme left on the sector. If the ignition is set properly the contact points will open under these conditions when the center line of the fly wheel for each cylinder is directly under the pointer attached to the crankcase or has slightly passed the pointer.

Caution:—This work must be done accurately and under no condition should the ignition be set so that the contact points open before center with the spark lever at full retard position.

Resistance Unit

The resistance unit is a coil of resistance wire wound on a porcelain spool as shown in (Fig. 21.) Under ordinary conditions it remains cool and offers little resistance to the passage of current. If for any reason

the ignition circuit remains closed for any considerable length of time with the engine not running, the current passing through the coil heats the resistance wire, increasing its resistance to a point where very little current passes, and insuring against a waste of current from the battery and damage to the ignition coil and timer contacts.

Caution:—The resistance wire is of the proper length to allow not more than two or three amperes of current to flow and under no condition should it be shortened. If shortened or shorted out serious damage will result.

Ignition Condenser

The purpose of the condenser in the ignition system is to protect the timer contact points against the corrosive action of sparking and to utilize the tendency to spark to build up a higher voltage in the high tension circuit than would otherwise be obtained.

The ignition condenser is mounted on the right-hand side of the distributor housing in a waterproof casing "D." (See Fig. 21.) It consists of layers of tinfoil separated by sheets of paraffin paper. Alternate layers of tinfoil are connected to opposite terminals. The current does not pass through the condenser and on test the terminals should show open circuit.

There are no adjustments in connection with the condenser.

Ignition Coil

The ignition coil serves to transform the low voltage current in the primary circuit to a current of high voltage in the secondary circuit. The coil consists of a primary winding of coarse wire wound around an iron core in comparatively few turns, and a secondary winding of many turns of fine wire, also the necessary insulation and terminals for wiring connections. It is mounted on the inner face of the dash at right side.

Spark Plugs

In order to get the best results the porcelains of the spark plugs should be clean and the points should be .023 inch apart. If the points are too close, the engine will miss under a light load and when idling. If the points are too far apart, it will miss under heavy loads and when the throttle is opened quickly for acceleration.

CIRCUIT BREAKERS

The circuit breakers are mounted on the inner face of the dash. These are protective devices which take the place of fuses.

The circuit breakers prevent the discharging of the storage battery, damage to the wiring, horn, lights and the ignition apparatus, or to any of these parts in case any of the circuits to or in these parts become grounded.

As long as only a normal amount of current is used for horn, lights and ignition the circuit breakers will not open. In the event of a ground, an abnormally heavy current is conducted through one of the circuit breakers, thus producing strong magnetism which attracts the armature and opens the contact. This cuts the flow of current.

The circuit breaker protecting the horn, inspection, tonneau, dome and quarter lamps and cigar lighter circuit is known as a lockout circuit breaker. In case of a ground in any of these circuits, the breaker opens and remains open until the ground is removed.

The circuit to the ignition apparatus and remainder of the lights is protected by a vibrating circuit breaker. In case of a ground in any of the circuits protected by the vibrating circuit breaker, the breaker will start to vibrate and will continue to vibrate until the ground is removed.

GENERATION OF CURRENT

Ammeter

When the engine is not running and the lights are turned on, the ammeter, which is located on the instrument board, indicates on the "Discharge" side of the dial the amount of current being drawn from the storage battery for this purpose. When the ignition switch is turned on the ammeter indicates, in addition, the current used in slowly rotating the armature of the motor generator. When the starter button is pushed down current is no longer required for slowly rotating the armature of the motor generator. The ammeter then indicates only the current used for the ignition and lights (if turned on). The ammeter does not indicate the amount of current used in the cranking operation.

Before the engine is running fast enough to generate sufficient current to equal the current demand, the ammeter indicates on the "Discharge" side the amount of current being drawn from the storage battery. When the engine has attained a speed sufficient to generate current to more than equal the demand, the ammeter indicates on the "Charge" side the excess current which passes to the storage battery and recharges it.

Ordinarily, with all lights switched off, sufficient current is generated to start recharging the battery when the car is operated in high gear at speeds between four and six miles per hour and, of course, at much lower speeds when the car is operated in low or intermediate gear. With all lights turned on sufficient current is generated to take care of the requirements at a speed of ten to fifteen miles per hour and at speeds greater than this the surplus current passes through the storage battery and recharges it. In other words, the ammeter indicates the rate at which the storage battery is being charged or discharged.

To determine the total output of the generator, turn off all the lights and add the amount of current used for ignition, i. e., two to three amperes, to the ammeter reading.

Current Regulation

The generating capacity of the generator is regulated by means of a third brush on the generator commutator. (See Fig. 61, page 139.) The position of this brush relative to the other two generator brushes determines the maximum output of the generator, the length of the brush arm being adjustable. The brush arm is properly adjusted when the car is assembled and should not require readjustment unless its position is altered. To determine whether readjustment is necessary, proceed as follows:

Start the engine in the usual manner. With all the lights turned off slowly increase the speed of the engine by means of the hand throttle lever, meanwhile observing the hand of the ammeter on the instrument board. (*Do not race the engine.* There is no worse abuse, and it is unnecessary in this adjustment to run the engine faster than 1500 revolutions per minute.) The current indicated by the ammeter will increase with the speed of the engine to a point between 950 and 1200 revolutions per minute, and will then decrease. If the amount of current indicated by the ammeter at the maximum point is greater than 18 amperes, stop the engine and readjust the third brush as follows:

Remove the generator front end top cover. Loosen the two screws which hold together the two parts of the third brush arm and shorten the brush arm. After moving the third brush to an approximately correct position, press the brush down so that it makes even contact with the commutator, and hold it down while tightening the screws in the brush arm. The purpose of this is to have the curvature of the end of the brush conform as closely as possible to that of the commutator.

After setting the third brush, refit it to the commutator. (See "Fitting Motor Generator Brushes," page 46).

Start the engine. Again slowly accelerate the engine and check the maximum current. If it is still greater than 18 amperes, reset the third brush and sand it in again.

If the maximum current indicated by the ammeter is less than 18 amperes and the specific gravity of the battery repeatedly shows that the battery is not being properly charged, lengthen the brush arm. Do not, however, lengthen the brush arm unless the condition of the battery makes it necessary and under no circumstances adjust it so that the ammeter indicates a maximum current of more than 18 amperes with all lights turned off. A greater amount of current may result in serious injury to the motor generator.

STORAGE BATTERY

Adding Water to Storage Battery

The acid solution in the storage battery must cover the plates, and should be even with the bottom of the filling tubes. (See Fig. 22.) Add water to bring up the level. Do not add acid.

To remove a filling plug, turn it as far as possible in the counter-clockwise direction, then lift it straight up. To replace, hold it so that the large arrow is perpendicular to the center line of the car, set the plug in place and turn it in the clockwise direction until tight.

Water for filling the battery must be pure. Distilled water, melted artificial ice or fresh rain water are suitable for this purpose. If rain water is used, it should not be allowed to come in contact with any metal. It should not be caught from a metal roof or in a metal receptacle.

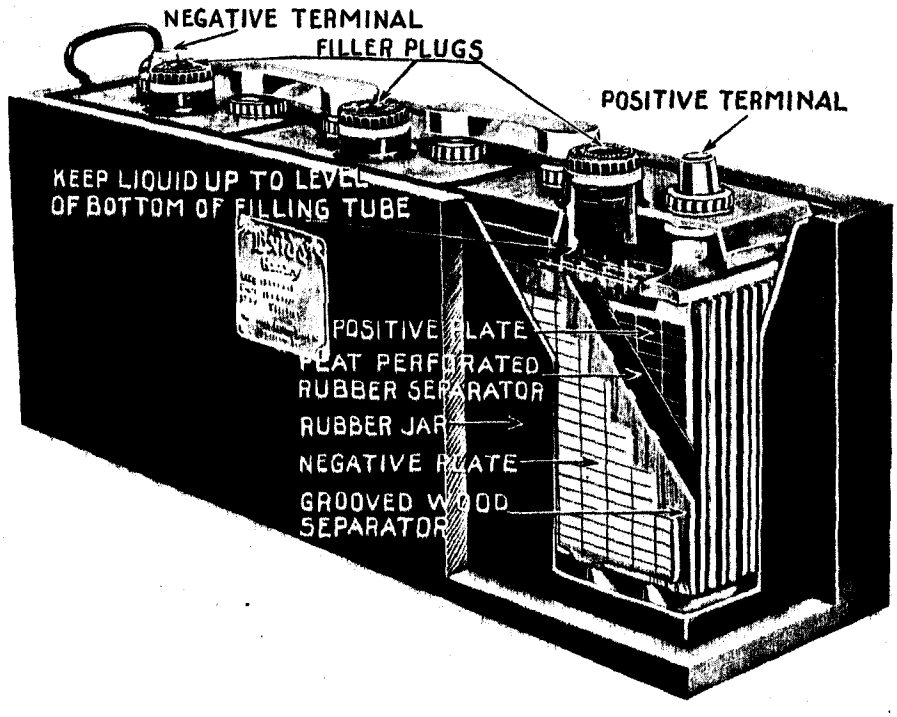


Fig. 22—Storage Battery, Sectional View

Never keep the water in a metal container, such as a metal bucket or can. It is best to get a bottle of distilled water from a druggist or from an ice plant. The whole point is to keep metal particles out of the battery. Spring water, well water or hydrant water from iron pipes generally contains iron and other metals in solution, which will ultimately cause trouble if used.

Replacing Acid Lost by Spilling

If any acid solution has been spilled or has leaked from a cell, replace the loss with freshly mixed solution and follow with an overcharge by running the engine for several hours or by charging the battery from an

outside source. (See Fig. 23. Also see under "Personal Danger of Running Engine in Closed Garage," page 77.)

The specific gravity of the acid solution used for replacing the loss should be the same as that of adjacent cells. This can be determined by the use of an hydrometer syringe.

The acid solution may be prepared by mixing chemically pure sulphuric acid, which has a specific gravity of 1.840, and distilled water. The proportion for an acid solution having a specific gravity of 1.280 is one part of chemically pure acid and three parts (by volume) of distilled water.

Caution:—The acid must always be poured slowly into the water. Do not pour the water into the chemically pure acid.

If, after mixing the acid solution as described above, a solution of a lower specific gravity is desired, it may be prepared by adding additional water to the mixture. But do not under any conditions pour water into the chemically pure acid.

Charging from an Outside Source

It is necessary that the charging be done with *direct current.* The simplest method when there is 110 or 120 volt direct current available, is to connect eight 110 volt, 32 candlepower, 100 watt carbon lamps in parallel with each other and in series with the battery to be charged, this combination giving approximately the proper charging rate—8 amperes. The positive terminal of the battery must be connected to the positive side of the charging circuit and the negative terminal to the negative side. *Very serious injury to the battery will result if connected in the reverse direction.* The terminals of the battery are stamped "Pos." and "Neg."

To determine the polarity of the charging circuit, if a suitable voltmeter is not at hand, dip the ends of the two wires "A" and "B" (Fig. 23) into a glass of water in which a teaspoonful of salt has been dissolved, care being taken to keep the wires at least an inch apart. When the current is turned on, fine bubbles of gas will be given off from the negative wire.

The diagram (Fig. 23) illustrates just how the connection should be made. The charge should be continued until all the cells have been "gassing" or bubbling freely for five hours, and there is no further rise in the voltage of the battery or specific gravity of the acid solution over the same period. A battery in good condition in a discharged state will require about ten hours of re-charging. If it has stood in a discharged condition for several weeks, it will require from twenty-five to fifty hours' charging—all depending upon the condition of the battery and the length of time it has stood discharged.

If only alternating current is available, a current rectifier must be used. Consult your city electrician regarding this matter.

Caution:—Never run the engine with the storage battery disconnected, or while it is off the car. Very serious damage to the motor generator may result from such action.

Preparing Battery for Storage

When a car is stored for some time the level of the acid solution should be even with the bottom of the filling tubes. (See under "Adding Water to Storage Battery," page 58.) If water is added it should be added just before the last time the car is used so that it will be thoroughly mixed with the acid solution. When the car is stored, the specific

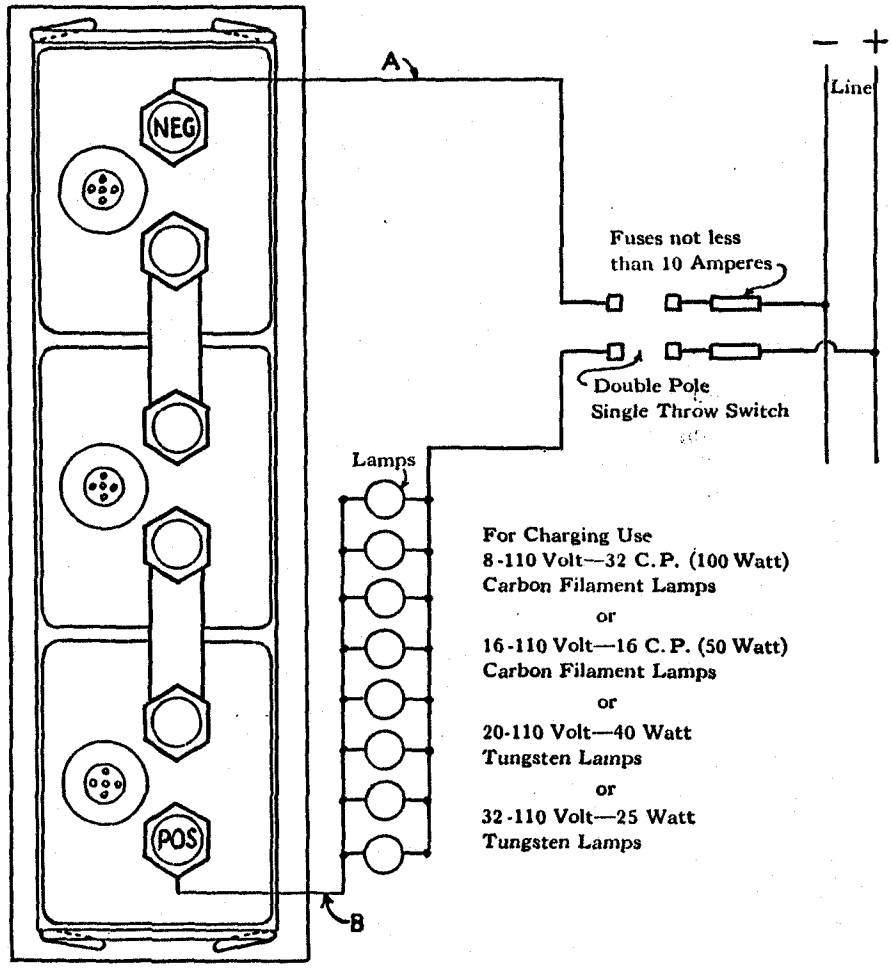


Fig. 23—Diagram of Connection for Charging Battery from 110 Volt D. C.

gravity of the acid solution should register from 1.270 to 1.290. In this condition there is no danger of the acid solution freezing during cold weather. The specific gravity of water is 1.000 and water freezes at 32 degrees F. above zero.

Unless the battery is fully charged, or nearly so, during freezing weather it is probable that the acid solution in the battery will freeze and cause extensive damage.

The following is a table of the freezing temperatures of sulphuric acid and water solutions of specific gravities from 1.050 to 1.300:

Specific Gravity (Hydrometer Reading)	Freezing Temperature (Degrees Fahr.)
1.050	+27°
1.100	+18°
1.150	+ 5°
1.164	0°
1.200	—17°
1.250	—61°
1.275 to 1.300	—90°

The battery should be charged at least once a month during the "out of service" period, either by running the engine or charging from an outside source (Fig. 23). If neither of the above is possible, the battery can be allowed to stand without charging during the winter provided the specific gravity of the acid solution registers from 1.270 to 1.290 at the time the car is laid up. Much better results and longer life from the battery will be obtained by giving the periodic charges.

The wires of the battery should be disconnected during the "out of service" period, as a slight leak in the wiring will discharge the battery.

Placing Battery in Service Again

Before putting the battery into service again, inspect it and add water, if necessary. In placing the battery on the car, care should be taken not to tighten the hold-down bolts too tight. If the battery has not been kept charged during the winter, it will be advisable to give it a fifty-hour charge at a four-ampere rate from an outside source before putting it into service again. Make sure that the terminals are free from corrosion and that good connections of the wires are made.

The corrosion, which is a greenish deposit, can be removed from the bolts and terminals by placing them in a solution of water and bicarbonate of soda (cooking soda).

The corrosion can be removed from the posts by saturating a piece of cloth with the solution and wiping them off. Do not allow any of the solution to get into the cells of the battery.

After the parts are free from corrosion they should be washed in warm water, and a light coat of heavy grease or vaseline applied.

If the battery has received periodic charges, it will not be necessary to give it any special attention other than to fill it to the proper height with distilled water. After the car has been driven for a number of hours, read the specific gravity of the acid solution with the hydrometer syringe. It should register from 1.270 to 1.290 if the battery is fully charged.

Sediment

The sediment which gradually accumulates in the bottom of the jars should be removed before it reaches the bottom of the plates, as it is very harmful to the battery. The need of cleaning may be determined by inspection. Its necessity is indicated by lack of capacity,

excessive evaporation of the acid solution and excessive heating when charging. When a battery requires removal of sediment, better results follow if the work is done at a place where they are thoroughly familiar with storage battery practice.

Cigar Lighter

The wire to the cigar lighter is carried on a reel fastened to the front face of the instrument board. Pulling the cigar lighter out of its receptacle on the instrument board automatically operates a switch in the reel chamber by which current to the cigar lighter is controlled. Permitting the cigar lighter to return to its receptacle automatically switches off the current.

Inspection Lamp

The inspection lamp is attached to the right hand side of the front face of the dash. To use the lamp lift the right hand side of the engine hood and pull the lamp straight out from its socket. The wire to the lamp is wound upon a reel. To return the inspection lamp to its socket, operate the small lever on the dash at the side of the lamp receptacle. This will throw a catch which holds the reel and permit it to rewind the wire. The lamp is lighted by the small pull switch near the lamp.

COOLING SYSTEM

General Description

The cooling system is of the forced circulation type. Circulation through each cylinder block is independent of that through the other, two pumps being provided.

The temperature of the liquid circulated by the pumps is under thermostatic control, the purpose of which is to permit liquid circulated through the water jackets of the cylinders to warm up to the temperature at which the engine operates best, very soon after the engine is started and to prevent the temperature dropping below this point while the engine is running.

Condenser

A condenser, the purpose of which is to prevent the loss of the cooling medium by evaporation, is attached at the outer right hand side of the car frame.

The operation of the condenser requires an air tight seal at the radiator filler cap. To make it possible to screw down and tighten the cap without injury to the rubber gasket, two metal washers are interposed between the head of the cap and the gasket. It is important that nothing be installed on the radiator cap which may cause an air leak or which makes necessary the elimination of the washers or cutting a hole through the gasket.

ANTI-FREEZING SOLUTION

In cold weather a good anti-freezing solution should be used. A solution of commercial glycerine and water is recommended of the

correct proportion for the temperature experienced. The following are the freezing temperatures of glycerine and water solutions of various proportions.

Glycerine (% by volume)	Water (% by volume)	Freezing Temp. (degrees Fahr.)
35%	65%	+10°
40%	60%	+6°
45%	55%	+3°
50%	50%	0°
55%	45%	—2°
60%	40%	—4°

Do not use a solution containing calcium chloride as this is injurious to the metal parts of the cooling system.

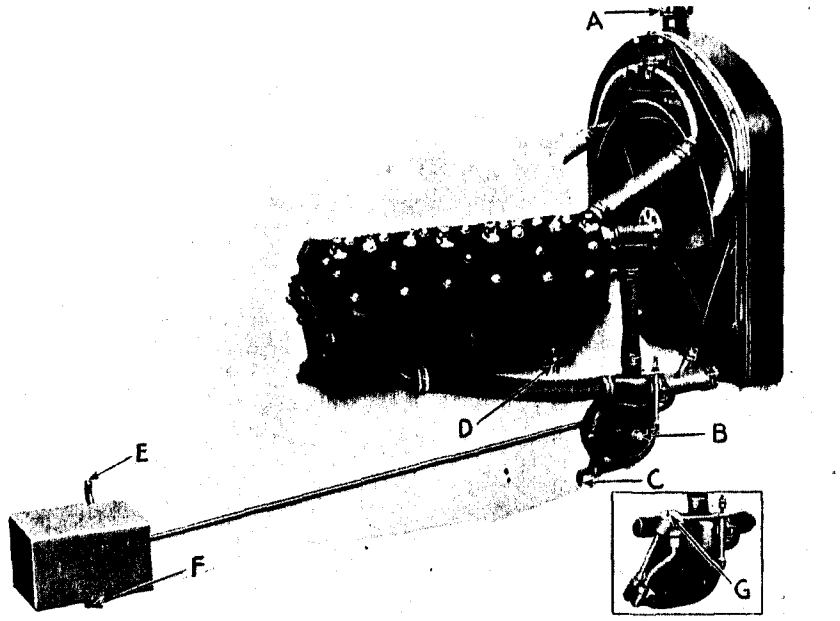


Fig. 24—Cooling System

(On later Type 61 cars screw plugs are used in place of the drain cocks at "D".)

The radiator condenser also makes it possible to use with safety an anti-freezing solution of denatured alcohol and water solutions of various proportions.

Denatured Alcohol (% by volume)	Water (% by volume)	Freezing Temperature (degrees Fahr.)	Specific Gravity (Hydrometer reading)
20%	80%	+13°	.974
30%	70%	— 3°	.964
40%	60%	—20°	.953
50%	50%	—34°	.936

It is a good plan occasionally to draw out a sample of the solution

in the radiator and to test its specific gravity with a hydrometer graduated between the limits of the above table.

The capacity of the cooling system is five and one-quarter gallons. The condenser should contain an additional three quarts, making a total of six gallons.

Caution:—Do not use water in the cooling system during freezing weather. Use a good anti-freezing solution. Water will freeze even though the engine be run continuously.

FILLING AND DRAINING THE COOLING SYSTEM

Fill the cooling system with water during warm weather and with a suitable anti-freezing solution during freezing weather. (See under "Anti-Freezing Solutions," page 63.) To fill the cooling system, proceed as follows:

Filling the Cooling System (First Type Water Pumps)

61-A-1 to 61-U-47 inclusive

With a screw driver close the cylinder drain cocks* "D" and turn the valves "G" (Figure 24) to the "Fill" position. If a water pump drain

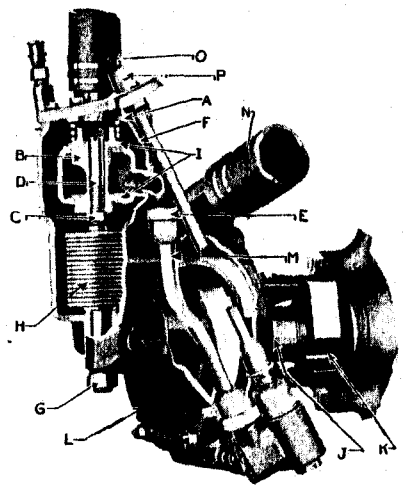


Fig. 25—Water Pump, First Type

does not turn easily force down on the screw driver. In extreme cases it may be necessary to strike the end of the screw driver with the hand to unseat the drain cock.

There is a drain cock* "D" in each cylinder block and a valve "G" at each water pump.

Remove the filler cap "A" and fill the system. Screw down the cap firmly after replacing it.

Turn the valves "G" to the "Close" position.

*On later Type 61 cars screw plugs are used in place of drain cocks.

To fill the radiator condenser (see under "Condenser," page 63), take out the floor board just forward of the transmission control lever and replace the drain plug "F" (Fig. 24). Remove the condenser filler cap "E" and fill the condenser one-half full, using the same liquid as in the radiator. Replace the filler cap.

Filling the Cooling System (Second Type Water Pumps)

61-U-48 and up

Fill the cooling system with clean water, during warm weather and with a suitable anti-freezing solution during freezing weather, (See under "Anti-Freezing Solutions" page 63).

To fill the cooling system, proceed as follows:

Close the drain valves "C" (Fig. 24) and the drain cocks* "D" (Fig. 24) and turn the shafts "B" on the water pumps so that the indicators on the ends of the shafts point up. The shafts may be turned in either direction. Then remove the filler cap "A" from the top of the radiator and fill the cooling system. Replace the filler cap and screw it down firmly. This is necessary, to insure the proper operation of the condenser. After the cooling system is filled, turn the shafts "B" so that the indicators on the ends of the shafts point down.

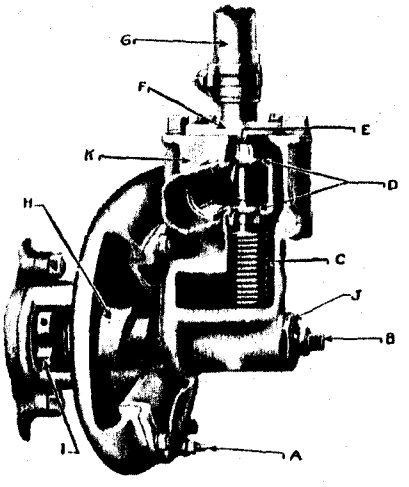


Fig. 26—Water Pump, Second Type

These indicators should point up when filling and down at all other times. The cooling system should be full or nearly so. When it is necessary to add only a small amount of liquid to bring up the level, it is not necessary to turn the shafts "B" but simply to remove the radiator filler cap.

When the cooling system is cold the condenser should be one-half full of the same liquid as used in the radiator.

To add liquid to the condenser, take up the removable floor board and remove the filler cap "E" at the top of the condenser.

*On later Type 61 cars screw plugs are used in place of drain cocks.

Any excess liquid which may accumulate in the condenser should be drained off at "F" and poured back into the radiator.

Draining the Cooling System (First Type Water Pumps)

61-A-1 to 61-U-47 inclusive

To drain the cooling system, open the cylinder drain cocks* "D" (Fig. 24) and turn the water pump valves "G" to the "Drain" position. (See Note page 67.)

There is a drain cock* "D" in each cylinder block and a valve "G" at each water pump.

To drain the condenser, remove the drain plug "F."

Draining the Cooling System (Second Type Water Pumps)

61-U-48 and up

To drain the cooling system, open the valves "C" (Fig. 24), then turn the shafts "B" on the water pumps so that the indicators on the ends of the shafts point up. The shafts may be turned in either direction. Then open the drain cocks* "D" in the cylinder blocks.

Cleaning the Cooling System (First Type Water Pumps)

61-A-1 to 61-U-47 inclusive

The cooling system should be drained and flushed out every two or three months. This can be done in the following manner:

Run the engine with the radiator covered until the liquid in the cooling system is boiling hot.

Shut off the engine and immediately open the cylinder drain cocks* "D" (Fig. 24) and turn the water pump valves "G" to the "Drain" position.

Remove the drain plug "F" from the bottom of the condenser.

There is a drain cock* "D" in each cylinder block and a valve "G" at each water pump.

If an alcohol anti-freezing solution is drawn off part of it may be used again if the sediment is allowed to settle. In case it is used the specific gravity should be tested with a hydrometer, after it has cooled thoroughly.

After the liquid is drained off, close the cylinder drain cocks* "D" and turn the valves "G" to the "Fill" position. Fill the cooling system with hot water and repeat the operations outlined above.

If, in draining the second time, the water is very dirty, it may be desirable to repeat the flushing operation a third time, using a solution of sal-soda. If the sal-soda solution is used, be sure that it is drained out and the system flushed again with clear water.

The sal-soda solution should not be permitted to get into the finish of the hood or radiator.

After the cooling system has been cleaned out and clear water or an anti-freezing solution (if during freezing weather) is replaced, turn the water pump valves to the "Close" position.

Note:—If a drain cock does not turn easily force down on the screw driver. In extreme cases it may be necessary to strike the end of the screw driver with the hand to unseat the drain cock.

*On later Type 61 cars screw plugs are used in place of drain cocks.

Cleaning the Cooling System (Second Type Water Pumps)

61-U-48 and up

The cooling system should be drained and flushed out every two or three months.

This can be done in the following manner:

Run the engine with the radiator covered until the liquid in the cooling system is boiling hot. Then turn the shafts "B" (Fig. 24) on the water pumps so that the indicators on the ends of the shafts point up.

Shut off the engine and immediately open the drain valves "C" and the drain cocks* "D" in the cylinder blocks.

Remove the drain plug "F" from the bottom of the condenser.

If an alcohol anti-freezing solution is drawn off, part of it may be used again if the sediment is allowed to settle. In case it is used again its specific gravity should be tested with a hydrometer, after it has thoroughly cooled.

When the liquid is drained off, close the drain cocks* "D" in the cylinder blocks and the drain valves "C" and fill the cooling system with clean, hot water. Then repeat the operations outlined above. If in draining the second time, the water is very dirty, it may be desirable to repeat the flushing operation a third time, using a solution of sal-soda. If the sal-soda solution is used be sure that it is drained out and the cooling system flushed again with clear water.

The sal-soda solution should not be allowed to get on the finish of the hood or radiator.

WATER PUMPS

Water Pump Packing Glands

To tighten the glands of the water pumps first remove the splash pan under the engine, then turn the packing glands in the direction in which the wheels rotate when the car is moving backward. Use Cadillac wrench numbered 83232. This applies to either the first type or the second type water pumps.

To repack water pumps it is necessary to first remove them. (See "Removal of Pump" under "Water Pumps," page 125). Repack with Cadillac packing.

In tightening the glands, tighten them only sufficiently to prevent leakage. Tightening them further causes unnecessary friction on the pump shaft.

Adjustment of Water Pump Valve (First Type)

61-A-1 to 61-U-47 inclusive

Disconnect at the water pump the hose between the pump and the cylinder head and remove the cap "A" (Fig. 25) over the valve.

Remove the spring and the valve "B." Loosen the lock nut "C." Replace the valve and screw down the adjusting screw "D" until it just touches the thermostat. Then unscrew the adjusting screw exactly three-quarters of a turn. This will give a clearance of 1/32" between the lower end of the adjusting screw at the top of the thermostat, which is the recommended clearance.

*On later Type 61 cars screw plugs are used in place of drain cocks.

Remove the valve again and set the lock nut "C," being careful not to alter the adjustment of the screw "D." Replace the valve, the valve spring and the cover plate "A." Be certain that the spring enters the groove in the cover plate.

Adjustment of Water Pump Valve (Second Type)

61-U-48 and up

The thermostat valves "D" (Fig. 26) are screwed onto the threaded stem of the thermostatic member "C" and are held in place by a slotted nut "E" in the center of the valve.

The valves are adjusted when the car is assembled and no further attention should be required. In the event that the adjustment has been altered, proceed as follows in making a readjustment.

Drain the cooling system. (See under "Draining the Cooling System" page 67). Disconnect the hose "G". Remove the four screws in the cap "F" and then remove the cap.

Turn the shaft "B" so that the indicator on the end of the shaft points in a horizontal direction.

With a screwdriver loosen the slotted locking nut "E". Then adjust the valve until it just seats without placing any tension on the thermostatic member "C." Hold the valve in this position and tighten the slotted locking nut.

Replace the cap "F" and connect the hose "G." Turn the shaft "B" so that the indicator points up and fill the cooling system.

After filling turn the indicator down regardless of weather conditions.

GASOLINE SYSTEM

PRESSURE RELIEF VALVE

A pressure relief valve is connected in the air line of the gasoline system for the purpose of preventing excessive pressure. It is attached to the left-hand side of the frame under the front floor boards and is adjusted to release if a pressure of four pounds should be reached. As the pump at the front of the engine is designed to furnish a pressure of considerably less than four pounds, it is evident that the relief valve is not intended to release under normal conditions. The relief valve is intended to operate only in case higher pressures result from the use of gasoline, such as "casing-head" gasoline, containing highly evaporative fractions.

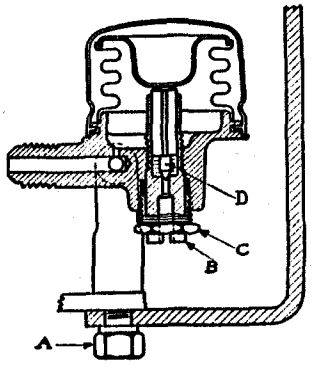


Fig. 27—Air Pressure Relief Valve, Sectional View.

If the pressure gauge on the instrument board shows a pressure of more than four pounds the relief valve should be readjusted. Or, if it is found impossible to maintain sufficient pressure to insure flow of fuel to the carburetor, this condition may indicate need for readjustment of the valve.

As low pressure may also be caused by leakage of air at the gasoline tank filler cap or at the piping connections, or by the presence of dirt

on the needle valve "D," (Fig. 27) or its seat, do not readjust the relief valve without making certain that the low pressure is due to the valve releasing and not to these other causes.

To readjust the pressure relief valve remove the cap screw "A" by which the relief valve is attached to the side bar and spring the piping so that access may be had to the nut "C" and screw "B" underneath the relief valve. Loosen the hexagonal gland nut "C." Then turn the hollow, slotted screw "B" in the clockwise direction if the pressure at which the valve releases is too low; or in the counter-clockwise direction if the valve releases at too high a pressure. Tighten the gland nut "C."

Check the results of the adjustment by raising the pressure with the hand pump. (Less pumping will be required if the tank is full or nearly so.) If it is found possible to raise the pressure above four pounds on the gauge, or if the maximum pressure obtainable is less than four pounds, the adjusting screw "B" should be adjusted again.

After the adjustment has been correctly made, make sure that the gland nut "C" is tight.

SETTLING CHAMBERS AND STRAINERS

The gasoline system is protected by a settling chamber at the bottom of the gasoline tank, a strainer at the top of the tank on early type 61 cars, a strainer and a settling chamber under the front floor boards, and a strainer at the carburetor. These settling chambers and strainers must be clean.

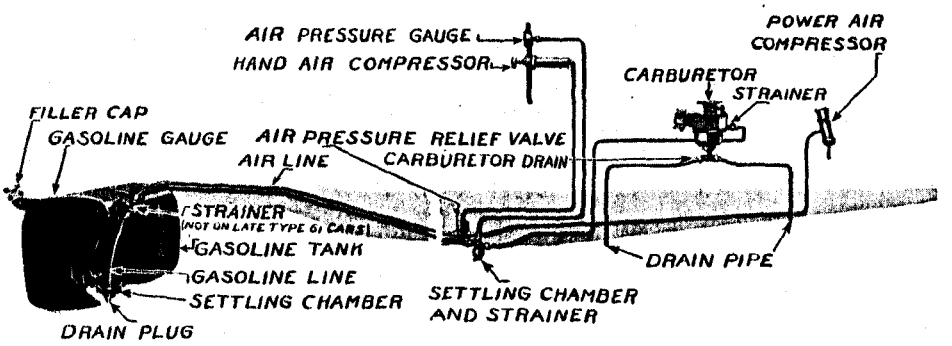


Fig. 28—Gasoline System

CARBURETOR

The carburetor should not be tampered with unless it needs adjustment. Good carburetor action cannot be expected before the engine is thoroughly warmed up. This is particularly true during cold weather. Imperfect carburetor action while the engine is cold does not indicate that the carburetor requires adjustment, and carburetor adjustment should not be made under these conditions.

Before changing any of the carburetor adjustments be sure it is the carburetor which requires attention.

In adjusting the carburetor select a quiet place, for correct adjustment depends largely upon being able to detect slight changes in engine speed.

ADJUSTMENT OF CARBURETOR

Adjustment of Enriching Device

When the lever "B" (Fig. 29) is held forward against the stop on the carburetor body, the tip of the air valve should, at a room temperature of 65° to 85° F., have an opening of $\frac{1}{16}$" to $\frac{1}{8}$" when held up lightly. In making this test do not apply enough pressure to the valve in holding it up to spring the thermostatic member to which the rear end of the air valve spring is attached and against which the valve strikes when the lever is held forward. If the opening under these conditions is more or less than the limits given a readjustment may be made after removing the cover "P" (Fig. 34) (see under "Caution") and loosening the two screws which hold the bracket carrying the thermostatic member. Tighten the screws after completing the adjustment.

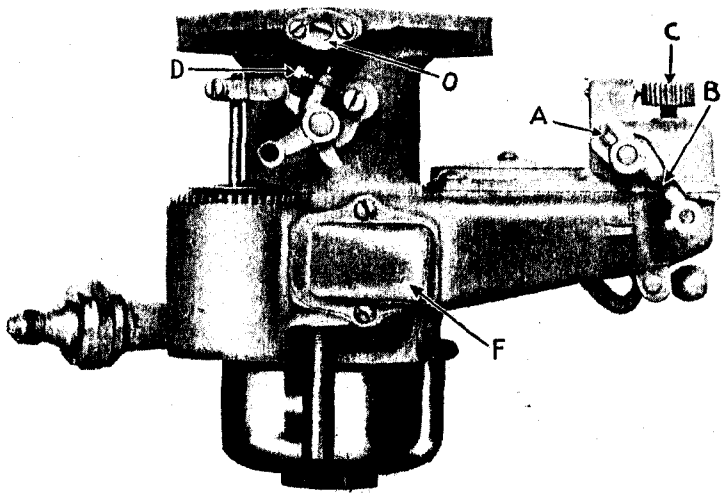


Fig. 29—Carburetor, Side View

The tongue "A" (Fig. 29) of the lever "B" should stand in the center of its slot when the carburetor enriching button on the instrument board is pushed forward as far as it goes. If the tongue does not stand in the center of the slot, a readjustment should be made.

Adjustment of Auxiliary Air Valve Spring

Before attempting to adjust the auxiliary air valve spring, make certain that the enriching device is in correct adjustment (See second

paragraph under "Adjustment of Enriching Device" page 71), also make certain that the relief valve over the air valve seats properly.

The rear end of the auxiliary air valve spring is attached to a thermostatic member which automatically adjusts the spring to compensate for changes in temperature. Auxiliary air valve spring readjustment is, therefore, very rarely required when once made.

The adjustment of the auxiliary air valve spring is made by the adjusting screw "C" (Fig. 29) and in the same manner as on earlier eight-cylinder carburetors. To determine whether the spring requires readjustment and to make the readjustment, proceed as follows:

Start the engine and run it until the intake manifold is up to normal driving temperature. Place the spark lever in the fully retarded position and move the throttle lever to the "CLOSE" position. The engine speed should then be about 300 revolutions per minute. If the engine runs faster than this, loosen clamp screw and unscrew the throttle stop screw "D" (Fig. 29) until the engine speed is reduced to 300 revolutions per minute. If unscrewing the stop screw "D" does not permit the throttle in the carburetor to close enough to reduce the engine speed to 300 revolutions per minute loosen the set screw in the small collar on the end of control rod running from the steering gear to the bell crank lever at the side of the starter housing. If the engine runs less than 300 revolutions per minute, move the throttle lever down until the engine speed is increased to about 300 revolutions per minute.

Then make the following test to determine the necessity for adjusting the auxiliary air valve spring:

Press down gently on the ball-shaped counterweight of the auxiliary air valve and note whether the immediate result is an increase or a decrease in engine speed. Release the counterweight and allow the engine to run a few seconds to regain its normal speed. Then press up gently on the counterweight and note the effect on the engine speed.

If the mixture is correct, the immediate result of gentle pressure up or down on the counterweight of the auxiliary air valve is a slight decrease in engine speed. If the immediate result of gentle upward pressure on the counterweight is a slight decrease in engine speed, while the result of downward pressure is an increase in engine speed, a rich mixture is indicated. If the immediate result of downward pressure is a decrease in engine speed, while the result of upward pressure is an increase of engine speed, a lean mixture is indicated.

If the above tests indicate an incorrect mixture adjust the auxiliary air valve screw "C" (Fig. 29) turning it clockwise to correct a lean mixture and counter-clockwise to correct a rich mixture. Continue to change the adjustment of the screw "C" and to test as above until a correct mixture is indicated. Do not turn the screw "C" more than a few notches at a time and not more than two notches at a time when nearing correct adjustment.

Move the throttle lever to the "CLOSE" position unless it is already in that position. The engine should now run at a speed of about 300 revolutions per minute. If it does not, change the adjustment of the throttle stop screw "D" until this speed is obtained. When the stop screw "D" has been adjusted correctly lock the adjustment and adjust

the collar on the control rod from the steering gear so that the throttle in the carburetor will start to open immediately the throttle lever is moved. Test the correctness of the mixture as before, and if necessary readjust the screw "C." When the test indicates the correct mixture with the throttle lever at the "CLOSE" position and the engine running 300 revolutions per minute, adjustment of the auxiliary air valve spring is correct. The enriching device should then be readjusted. (See "Adjustment of Enriching Device" page 71.)

Throttle Pump Control Thermostat

The piston of the throttle pump does not enter the gasoline as in earlier eight-cylinder carburetors, but when operated forces compressed air into the carburetor bowl above the gasoline, momentarily forcing additional gasoline through the spraying nozzle. Since good acceleration is obtained with a somewhat leaner mixture after the carburetor has become warm, a throttle pump control thermostat "E" (Fig. 30) covered by the cap "F" (Fig. 29) is provided to open a relief hole "G" (Fig. 30) when the temperature of the carburetor reaches a predetermined point, thus providing a release for a portion of the air compressed by the pump. The result is that a lesser amount of gasoline is forced through the spraying nozzle.

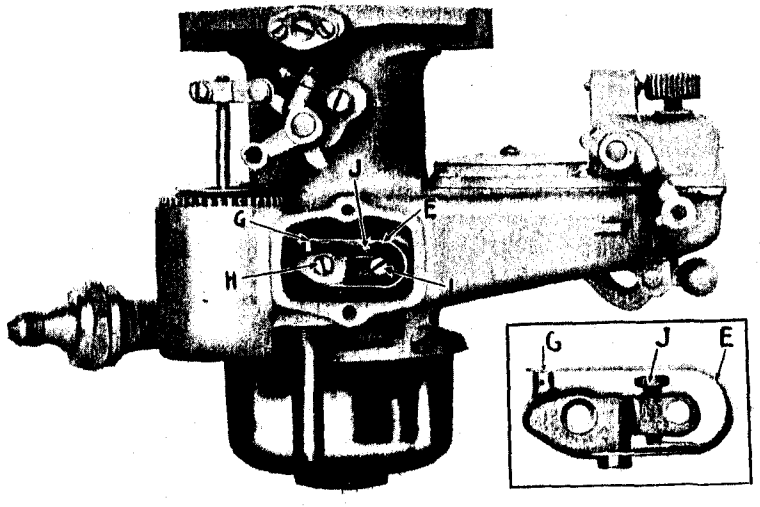


Fig. 30—Carburetor, Single Thermostat Type

Vent Control Thermostat

Carburetors on later Type 61 cars are fitted with two thermostats "G" and "F" (Fig. 31) attached to the thermostat block instead of one.

The object of the second or high temperature thermostat is to open a large vent from the carburetor bowl during hot weather which is desirable when very high test gasoline is used. Vent control thermostats are of two types. On carburetor with vent control thermostats of the first type, the high temperature thermostat, is the inner one. On car-

buretors with vent control thermostats of the second type, the high temperature thermostat, is the outer one. Vent control thermostats of the second type operate at a lower temperature and cover a larger vent than those of the first type.

Both thermostats are properly adjusted when the carburetor is assembled at the factory and require no further attention unless tampered with. If tampered with, thermostats may be readjusted in the following manner:

Adjustment of Throttle Pump Control Thermostat

Throttle pump control thermostats on all type 61 carburetors are adjusted in the same manner and to the same temperatures. To make this adjustment proceed as follows:

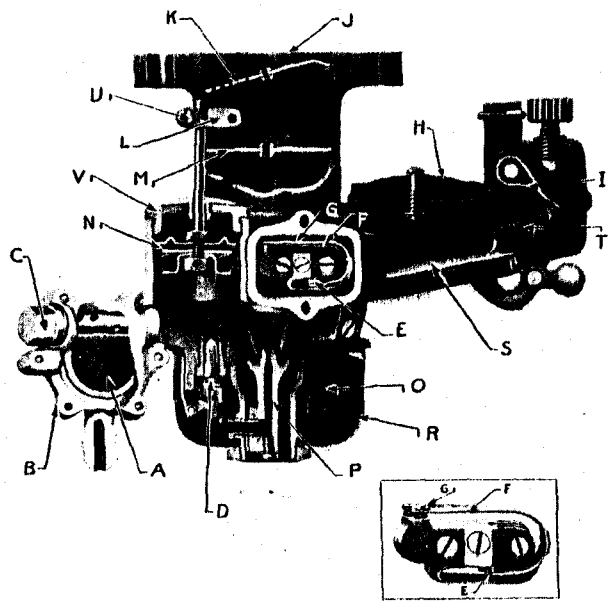


Fig. 31—Carburetor, Sectional View, Double Thermostat Type

Remove the thermostat with block from the carburetor body, being careful not to injure the gasket. This may be done after removng the attachment screws. The thermostat adjustment is made by turning screw "J" (Fig. 30) which should be so adjusted that the relief vent hole "G" is just closed at a temperature of 75° F. and just open at a temperature of 77° F. To test this, provide two dishes of water, one at a temperature of 75° F. and the other at a temperature of 77° F. First immerse the thermostat with block in the water at 75°. When removed, the vent hole "G" should just be closed. If it is not, readjust the screw "J" controlling the thermostat. Then immerse it in the water at 77°. The vent hole "G" should then be just open. If it is not, re-

adjust the screw "J." When the vent hole "G" is just closed at a temperature of 75° and just open at a temperature of 77°, the adjustment is correct and should be locked by tightening hexagonal nut.

Adjustment of Vent Control Thermostat

Vent control thermostats, should be adjusted in exactly the same manner as throttle pump control thermostats, but to different temperatures.

A vent control thermostat of the first type, this being the type in which the vent control thermostat is the inner one, should be so adjusted that the vent hole which it covers is closed at a temperature of 140° and open at a temperature of 145°. Vent control thermostats of the second type, being the type in which the vent control thermostat is the outer one, should be so adjusted that the vent hole is closed at a temperature of 130° F and open at a temperature of 135° F. If very high test gasoline is used during extremely hot summer weather it may be found desirable to change this setting to have the vent closed at 115° F and open at 120° F.

In making these adjustments, care must be exercised to make certain that the water used is exactly at the right temperature given. This work must be done carefully and should be entrusted only to a careful workman. The efficient operation of the carburetor depends considerably upon the skill used in making these adjustments.

If the gasket between the block and the carburetor is damaged in removal, replace it by a new one. There should be no possible chance for a leak around the vent passage.

Adjustment of Float

This adjustment is correctly made when the carburetor is assembled at the factory and should not soon require readjustment unless tampered with. The adjustment may be checked as follows:

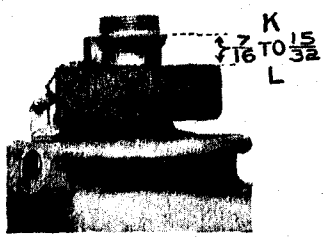


Fig. 32—Float Setting

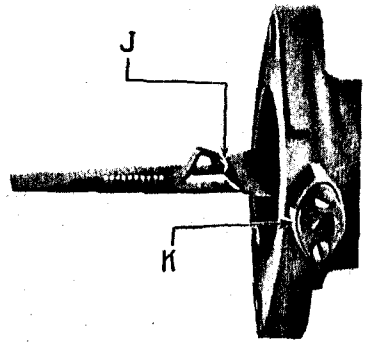


Fig. 33—Testing Spring of Carburetor Automatic Throttle

After removing the carburetor (see under "Removal of Carburetor" page 00), remove the carburetor bowl, invert the carburetor and remove the small cork gasket against which the carburetor bowl presses.

Take a measurement from the flange "K" (Fig. 32) to the top edge of the float "L." This measurement should be from 7/16″ to 15/32″.

Adjustment of Automatic Throttle

The adjustment of the automatic throttle is made in the same manner as with the earliest type of eight-cylinder carburetor. To determine if the spring which controls the automatic throttle is in proper adjustment and to make the adjustment, proceed as follows:

Remove the carburetor from the intake manifold. Cadillac tool, numbered 76037, should be used in making this adjustment.

Attach the tool "J" (Fig. 33) to the automatic throttle and hold the carburetor in the horizontal position as shown, note the position which the throttle disc assumes. The disc should assume the horizontal position, the weight of the tool opening the automatic throttle to within $\frac{1}{32}$″ of the stop pin. If it does not and you are sure that the throttle shaft is free in its bearings, slightly loosen the screws on the plate "O" (Fig. 29) and turn the large adjusting cap. Turning the cap in a

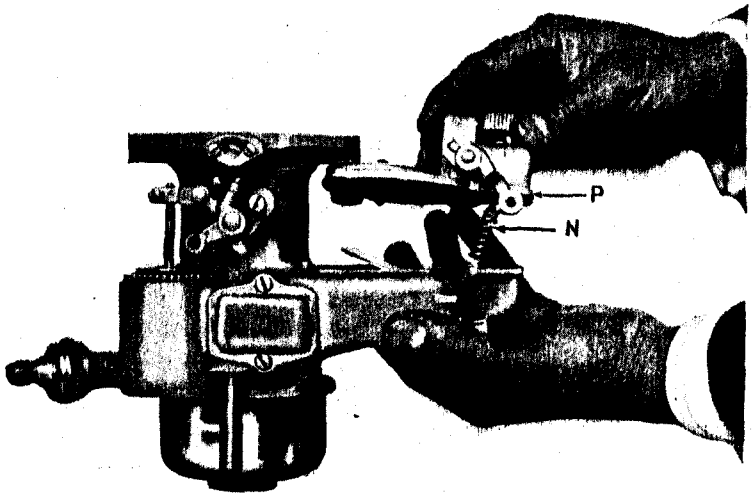


Fig. 34—Removing Auxiliary Air Valve Spring

clockwise direction increases the tension of the spring and turning it in a counter-clockwise direction decreases the tension. Retighten the screws holding the plate "O" after making the adjustment.

Caution:—Care must be used in removing the cap "P" (Fig. 34) over the auxiliary air valve not to ruin the air valve spring by stretching or twisting it, Remove the spring after lifting the cover just enough to permit this. If the spring is deformed by careless removal of the cover, do not attempt to repair it, but replace it by a new spring.

Throttle Pump Adjusting Screw

This adjustment is provided to make it possible to lessen the effect of the throttle pump which may sometimes be found desirable during

warm weather, also during cold weather if high test gasoline is used.

Unscrewing the adjusting screw "R" (Fig. 35) opens a by-pass in the passage between the throttle pump and the throttle pump control thermostat. At all temperatures with carburetors having the throttle pump control thermostat only and at ordinary temperatures with carburetors having the vent control thermostat the pressure of the air above the gasoline in the carburetor bowl is thus lessened at the moment of acceleration and less gasoline is forced through the spraying nozzle as a result. On carburetors with the vent control, pressure is relieved at high temperature by the operation of the high temperature thermostat.

Seven turns of the adjusting screw "R" in the counter-clockwise direction fully opens the by-pass. The amount of opening required depends upon the quality of the gasoline and atmospheric temperature. Ordinarily it is necessary to unscrew the adjustment not more than two or three turns if adjustment is required.

After making the adjustment, lock it with the lock nut "S."

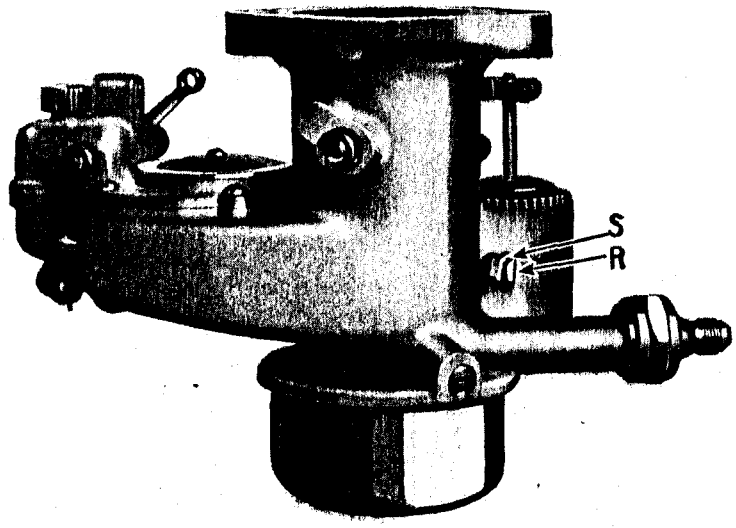


Fig. 35—Throttle Pump Adjusting Screw

Personal Danger of Running Engine in Closed Garage

Carbon monoxide, a deadly poisonous gas, is present in the exhaust of gasoline engines. Increasing the proportion of gasoline to air in the mixture fed to the engine, in other words, enriching it, increases the amount of carbon monoxide given off.

The presence of carbon monoxide makes it very dangerous to run the engine while the car is in a small, closed garage. If the doors and windows are open the danger is lessened, but it is far safer, particularly if an adjustment of the carburetor is being made, to run the car into the open.

Serious personal injury may be caused by the presence of carbon monoxide in a garage if the percentage of it in the air is greater than a very small fraction of one per cent. Unconsciousness may result without warning. It is reported that no indication of danger is given by personal discomfort until too late. Deaths resulting from the presence of carbon monoxide in garages have been reported.

CLUTCH AND TRANSMISSION

CLUTCH

General Description

The main clutch is of the multiple disc dry-plate type. The eight driving discs, (Fig. 67) are covered on both sides with a friction material, composed largely of asbestos, and are driven by gear teeth in the clutch ring which is bolted to the engine flywheel.

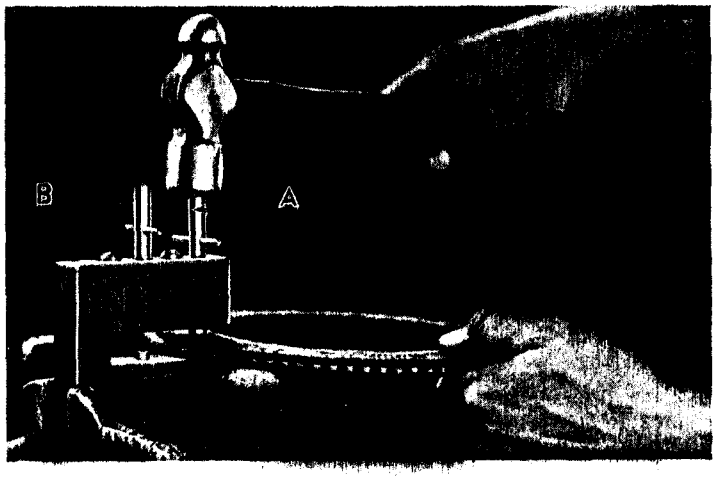


Fig. 36—Clutch Disc Relining Tool

The nine driven discs are not covered. These discs are carried on the clutch hub and drive it through six keys on the hub. The clutch hub is splined to the transmission shaft.

When the clutch is engaged by allowing the clutch pedal to come towards you, the spring forces all of the discs together. The resulting friction between the discs drives the transmission shaft and the car, when the transmission control lever is in other than the neutral position.

There are no adjustments on the clutch proper. The clutch pedal should be adjusted occasionally to compensate for wear on the facings of the clutch discs. This adjustment is explained under "Adjustment of Clutch Pedal Clearance," page 79.

Relining Clutch Discs

Remove the clutch discs in accordance with directions under "Removal of Clutch Discs," page 156.

Determine the amount of clearance between the teeth of the discs and the teeth of the clutch ring. If the clearance is .010 inch or more, new discs should be substituted.

With pliers or a sharp cold chisel and a hammer remove the used linings. Care must be exercised not to spring the discs in removing the linings.

After removing the lining determine if the discs are warped or sprung by laying them face down on a surface plate. If they are warped or sprung they should not be used again.

Cadillac clutch disc lining is supplied with the holes punched for the rivets. Suitable rivets are supplied. It is recommended that Cadillac lining and rivets be used.

Do not have the lining nearer than one-sixteenth of an inch from the bottom of the teeth on the periphery of the discs nor allow it to extend over the inner edge of the discs.

Do not have all rivet heads on one side of the disc. Alternate them. Rivets should be headed over and well drawn in so that they are at least one thirty-second of an inch below the surface of the lining.

The clutch rivets may be set by using Cadillac riveter, tool numbered 71975, as shown in (Fig. 36.)

When using this tool insert the brass tube rivets through the holes in the clutch discs and facings, alternating the rivet heads. Place the disc with facings into the tool as shown in (Fig. 36) so that the punch "A" enters one of the rivets. Tap the punch firmly then move the disc under the punch "B," and complete the riveting. Set each rivet in a similar manner. After completing the work, smooth down the new facings with a press or a steel block and hammer.

CLUTCH PEDAL

Adjustment of Clutch Pedal Clearance

If the clutch pedal strikes the stop screw before the clutch is fully engaged, readjustment should be made.

Remove the pin "N," (Fig. 37) and unscrew the yoke "P," which is threaded on the rod "J," so that when the pin "N" is replaced the clutch pedal has a movement back and forth of one and one-quarter inches without starting to release the clutch. Secure the pin "N" with a cotter pin and tighten the lock nut "V."

Adjustment of Clutch Pedal Stop

The clutch pedal stop screw "S," (Fig. 37) is adjusted when the car is assembled and requires no further attention. When in proper adjustment the stop screw "S," should hold the pedal arm "U" so that the distance "T" is approximately one-half inch on the Seven-Passenger,

Two-Passenger, Four-Passenger and Victoria and approximately one-quarter inch on all enclosed cars except the Victoria. If the adjustment has been changed, it may be readjusted in the following manner:

Remove the pin "N" from the yoke "P," loosen the lock nut "R" and adjust the stop screw "S" so that the pedal arm "U" is held the required distance from the under side of the toe board at "T" when the pin "Y" is against the stop screw. Tighten the lock nut "R."

Then adjust the yoke "P" so that when the pin "N" is replaced the clutch pedal has a movement back and forth of one and one-quarter inches without starting to release the clutch. Secure the pin "N" with a cotter pin and tighten the lock nut "V."

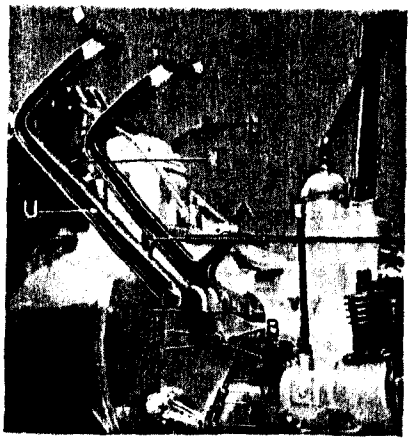


Fig. 37—Clutch Control

TRANSMISSION

General Construction

The transmission is of the selective type of sliding gear. It provides for three speeds forward and one reverse. The gear changes are accomplished by the movement of the control lever.

The teeth of the driving gear "A" (Fig. 69 page 161) are cut on the large end of the clutch connection shaft "B" which revolves on annular ball bearings "C" and "D," and which turns with the crankshaft of the engine when the clutch is engaged, at which time the bearing "D" is inoperative. The gear "A" is in constant mesh with the jackshaft gear "E." The jackshaft gears "E," "F", "G" and "H" revolve together on two Hyatt high-duty flexible roller bearings "I" on a stationary shaft "J." The roller bearings "I" are lubricated by oil forced through the tube "K" which revolves with the gear "F."

The main transmission shaft "L," which is coupled to the forward universal joint, is splined and carries two sliding gears "M" and "N." The shaft "L" is supported by an annular ball bearing "O" at the rear end, and at the front end by a roller bearing "P" which is housed in the rear end of the clutch connection shaft "B."

The high and intermediate shipper gear on Type 61 cars beginning with transmission numbered 11075 have a longer hub on the main transmission shaft. This necessitates a slightly shorter clutch connection and a somewhat narrower constant mesh gear on the jackshaft. As a result of these changes these parts from an early type transmission cannot be used in a late type transmission; neither can these late type transmission parts be used in the early type transmission.

There are no adjustments in the transmission.

UNIVERSAL JOINTS AND REAR AXLE

UNIVERSAL JOINTS

The tubular drive shaft that transmits the power of the engine from the transmission to the rear axle is fitted with a universal joint at each end.

The purpose of the joints is to provide a flexible drive, which is made necessary by the constantly changing alignment due to the play of the springs.

The general arrangement of the joints is shown in (Fig. 70 page 167). The joints differ only in that the forward joint, which is attached to the transmission shaft, is provided with a sliding connection, or slip sleeve, "K," while the rear joint is welded to the drive shaft. A sliding connection is necessary to take care of the endwise motion of the drive shaft due to variation in the distance between the transmission and the rear axle caused by the action of the springs.

The joints are protected by an inner housing "D" and an outer housing "C," both of pressed steel. The inner housing is bolted to the flange and the outer housing fits over the end of the inner housing and is held in place and kept tight by means of a spring. The packing "H" is for the purpose of preventing grease from working out and dirt from getting in.

REAR AXLE

In the design of the rear axle, provision is made for adjusting the pinion gear and ring gear so that the teeth may be meshed correctly, and for locking all adjusments securely.

The large bevel ring gear "A" (Fig. 38) on the gear mount "B", and the bevel pinion gear "C" on the pinion shaft "D", are correctly meshed when the car is assembled, but after it has been in use for several thousand miles it may be found that the bearings "E" and "F", which take the end thrust of the gears, have become more permanently seated, causing end play in the pinion shaft "D" and side play in the gear mount "B". When this condition exists, axle gear noise may result and bearings "E" and "F" should be adjusted.

Adjustment of Pinion Bearings.

If undue end play exists in the pinion shaft "D" (Fig. 38) the bearing "E" should be adjusted as follows:

Loosen the long clamping bolt on the pinion cage and remove the locking key holding shell "G" in place. Turn the shell "G" clockwise until all of the play in the bearings is taken up, then loosen the adjustment a minimum of two notches and a maximum of three notches. Cadillac spanner wrench, tool number 79249, is for use in making this adjustment.

Insert the locking key to hold the shell "G" in place and tighten the clamping bolt on the pinion cage.

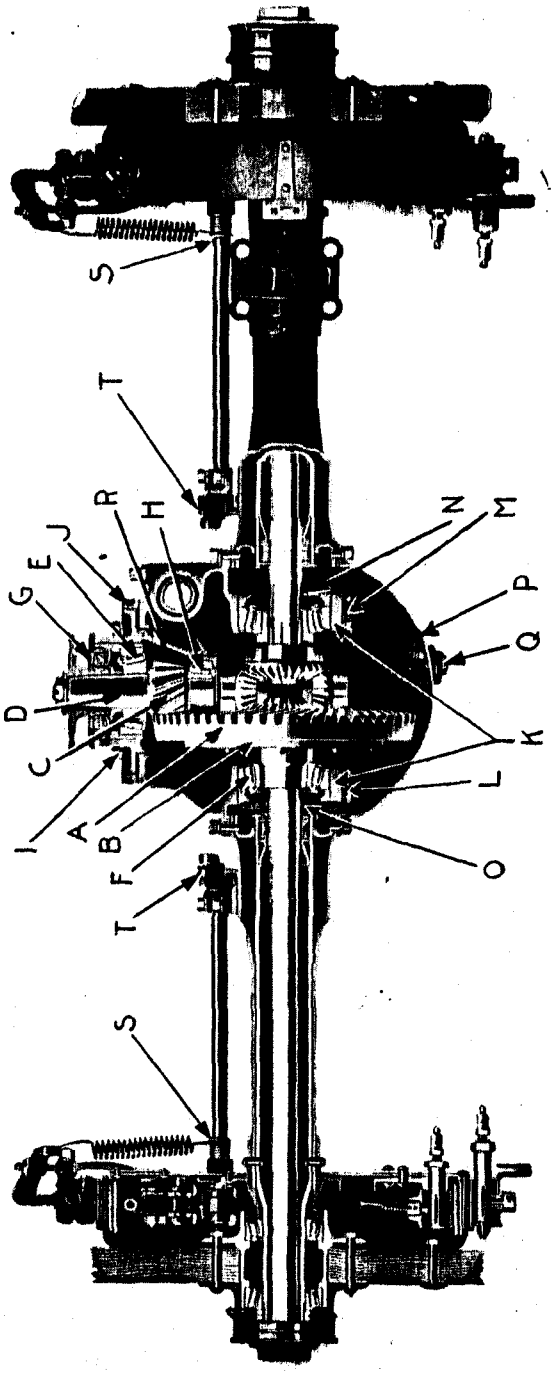


Fig. 38—Rear Axle, Sectional View

Adjustment of Pinion.

Before making a readjustment of the pinion, make certain that readjustment is necessary. Noisy bearings or noisy tire treads are frequently mistaken for axle gear noise even by expert gear men.

If the bearings "E" and "H" (Fig. 38) on the pinion shaft "D" are in proper adjustment, and it is found necessary to move the pinion "C" endwise (See "Testing Ring Gear for Proper Tooth Contact" page 84), proceed as follows:

Loosen the six screws "I". Turn adjusting ring "J" moving the pinion in either direction as required. A clockwise rotation of the locking ring moves the pinion away from the ring gear and a counter clockwise rotation moves the pinion toward the ring gear. Cadillac spanner wrench, tool numbered 79248, is for use in making this adjustment. Tighten the screws "I" in order to determine the proper position. When the proper position for the pinion has been found, make sure the screws are drawn up tightly.

Some of the Type 61 rear axles are provide with adjusting shims or washers under the flange of the pinion cage, instead of the adjusting ring "J". These washers come in various thicknesses. To adjust the pinion on these axles substitute washers of different thicknesses.

Adjustment of Ring Gear Bearings.

If, after removing the rear cover plate "P" (Fig. 38) undue side play is found in the gear mount "B", the bearing "F" shoud be adjusted as follows:

Move the key "L" entirely out of the slot in the adjusting nut "O", loosen the cap screws holding the cap "K" just enough to prevent turning the adjusting nut "O". Take up all play in the bearing and then loosen the adjustment a minimum of two notches and a maximum of three notches. After the adjustment has been made, make sure that the key "L" is replaced in one of the slots in adjusting nut "O" and that the cap screws holding the cap "K" are tightened and locked.

Adjustment of Ring Gear.

Before making a readjustment of the ring gear make certain that readjustment is necessary. Noisy bearings or noisy tire treads are frequently mistaken for noisy gears even by expert gear men.

If it is found necessary to move the ring gear sidewise (See "Testing Ring Gear for Proper Tooth Contact" page 84), proceed as follows:

First loosen the cap screws holding caps "K" (Fig. 38) just enough to prevent turning the adjusting nuts "N" and "O". Then move the keys "L" and "M" out of the slots in the adjusting nuts. These nuts can now be turned, moving the gear mount with the ring gear in either direction as required. Cadillac bar tool, numbered 72799, is for use in making this adjustment. Be careful not to adjust the bearings too tightly.

After the correct position for the ring gear has been found and the bearings have been adjusted by taking up all play and then loosening the adjustment not less than two or more than three notees, be sure

that the keys "L" and "M", are replaced in the slots in the adjusting nuts "N" and "O" and that the cap screws holding the caps "K" are tightened and locked.

Replace the cover "P", and refill the axle with Cadillac Rear Axle and Transmission Lubricant, bringing the level up to the filling hole "Q".

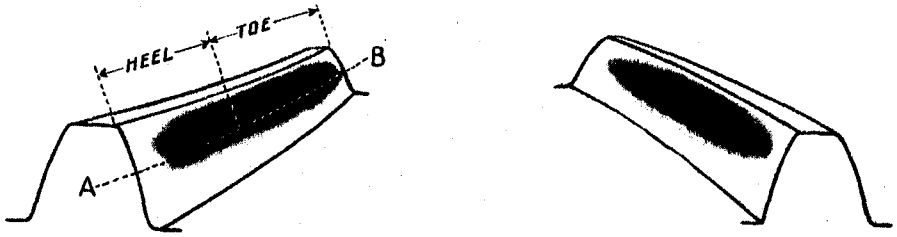
Testing Ring Gear for Proper Tooth Contact.

Axle gears are machined so that the large ends of the teeth of the ring gear are practically flush with the large ends of the teeth of the pinion gear and so that a certain amount of backlash is required between the teeth. Backlash is the play between the teeth and should not be less than .004 inch nor more than .012 inch when the gears are correctly meshed. When checking backlash pull the axle shafts and hold the pinion shaft. The amount of backlash may be measured by clamping a dial indicator to a bracket or arm fastened to the axle housing and having the indicator button in contact with a tooth on the ring gear.

Extreme care must be used in readjusting rear axle gears or adjusting new gears as the tooth forms may easily be ruined by running them when not correctly meshed.

Correct meshing of the gears can best be determined by painting the working surfaces of the ring gear teeth with red lead or Prussian blue and noting the tooth contact obtained on the ring gear under load. It will first be necessary to draw off the rear axle lubricant and clean the gears.

Jack up the rear wheels clear of the floor and drive them in both directions with the engine. The necessary load may be obtained by applying the brakes. Since the differential may operate under these conditions and noise from the differential gears may be confused with driving gear noise the axle shafts should be removed and the differential locked with Cadillac tool numbered 82865. If the bearings and gears are in proper adjustment the lengthwise tooth bearing on the ring gear, which is the bearing along the length of the tooth, and the profile tooth bearing on the ring gear, which is the bearing from top to bottom of the tooth, will appear as shown in Fig. 39 (a) for the forward speeds and as shown in (b) for the reverse speed.

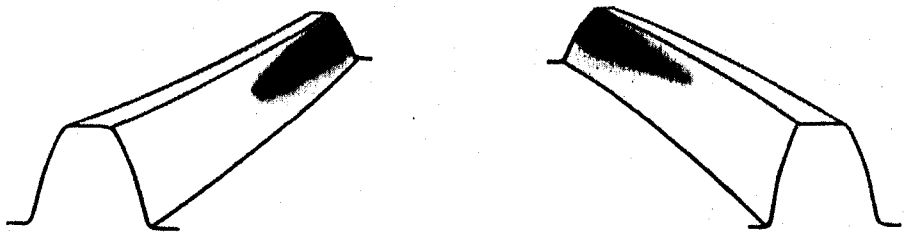


(a) *Driving* ***Fig. 39—Correct Ring Gear Tooth Bearing*** (b) *Reverse*

It will be noted that the tooth bearing for the forward speeds is heaviest toward the small end or "toe" of the tooth. Any suddenly applied load on the gears in forward speeds will cause the tooth bearing to

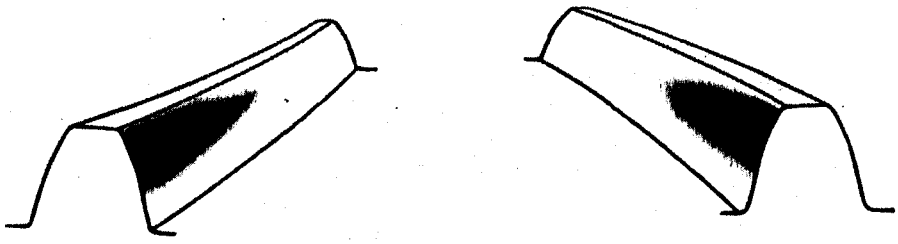
shift toward the large end or "heel" of the tooth. Under no conditions should the tooth bearing on the ring gear under operating load show heaviest at the large end of the tooth, as a suddenly applied load on the gears in any of the forward speeds would tend to concentrate the load on the "heel" of the tooth.

When in reverse any suddenly applied load on the gears will cause the tooth bearing to shift toward the small end or "toe" of the tooth. It is therefore desireable to have the bearing on the reverse side of the tooth slightly heavier towad the large end or "heel" of the tooth.



(a) *Driving* ***Fig. 40—Toe Bearing, Ring Gear Tooth*** (b) *Reverse*

To correct a "toe" bearing on both the driving and reverse sides of the tooth, as shown in Fig. 40 (a) and (b) respectively, move the ring gear away from the pinion. (See under "Adjustment of Ring Gear" page 83) This will increase the lenghwise bearing on the tooth but may also change the profile or top to bottom bearing slightly. It will increase the backlash and this should be checked to see if it is within the maximum limit of .012 inch.



(a) *Driving* ***Fig. 41—Heel Bearing, Ring Gear Tooth*** (b) *Reverse*

To correct a "heel" bearing on both the driving and reverse sides of the tooth, illustrated in Fig. 41 (a) and (b) respectively, move the ring gear toward the pinion. (See under "Adjustment of Ring Gear", page 83) This will increase the lengthwise bearing, but may also change the profile bearing slightly. It will decrease the backlash and this should be checked to see if it is within the minimum limit of .004 inch.

The profile bearing, or the bearing from top to bottom of the tooth, may appear at any position throughout the length of the tooth. For proper meshing of gears the greater part of the profile bearing on the ring gear should be above the middle of the tooth. Referring to Fig.

39, the dotted line "A" "B" represents the middle of the tooth, measuring from top to bottom. It will be noted that the bearing surface for the ideal condition extends only slightly below this line and almost to the top of the tooth. If the bearing surface favors a lower position on the ring gear tooth the profile bearing is too low. If, on the other hand, the bearing surface is totally above the middle line "A B" and also shows a decided bearing on the top or point of the tooth the profile bearing is too high.

To correct a low profile bearing move the pinion away from the ring gear. (See under "Adjustment of Pinion," page 83) This adjustment will increase the backlash and it may be necessary to move the ring gear toward the pinion to keep the backlash within the limits. Changing the position of the ring gear will alter the lengthwise bearing on the tooth and to obtain a correct tooth bearing, illustrated in Fig. 39 (a) and (b), several adjustments for lengthwise and profile bearing may be required.

To correct a high profile bearing move the pinion toward the ring gear. (See under "Adjustment of Pinion," page 83) This will decrease the backlash and it may be necessary to move the ring gear away from the pinion to maintain the proper amount of backlash. Changing the position of the ring gear will change the lengthwise bearing on the tooth and to obtain a correct tooth bearing, illustrated in Fig. 39 (a) and (b), several adjustments for lengthwise and profile bearing may be required. After obtaining the proper tooth contact under load check the backlash to see if it is within the limits.

If the tooth contact obtained under load varies widely from the tooth contact illustrated and described it would indicate that the gears are worn. In this event replacement of gears is usually necessary.

Adjustment of Torque Arm Support Bolt

The bolt at the front end of the torque arm, which connects the torque arm support to the cross member of the frame, is adjustable. Loosen the jamb nut with Cadillac wrench numbered 83236 and tighten up the bolt with Cadillac wrench numbered 83237. Tighten the jamb nut when adjustment of the bolt is completed.

BRAKES

FOOT BRAKES

(External Contracting)

Ordinary Adjustment

Provision is made in each brake for its adjustment. Do not attempt to adjust the brakes by the pull rods. The brakes cannot be properly adjusted in this manner. To adjust each foot brake, proceed as follows:

Remove the cotter pin in the adjusting screw "A," (Fig. 42) and turn the screw "A" until that part of the brake band lining opposite the screw just clears the drum. Adjust the two nuts "B" on the yoke bolt so that the lower part of the brake band lining just clears the drum.

Then adjust the nut "C" on the upper end of the yoke bolt so that the lever "D" is brought into the position shown in (Fig. 42); when the brake is fully applied—i. e., so that the lower edge of the pin "T" and the upper edge of the pin "S" are tangent to an imaginary horizontal line shown at "X." Cadillac drum, tool numbered 49839, is for use when making this adjustment with wheel removed.

Adjustment of Stop Screws

The position of the stop screw "E" (Fig. 43) is adjusted when the car is assembled and requires no further attention unless its adjustment is altered. Adjustment for wear on the lining should be made as described above by the nuts "A," "B," and "C" (Fig. 42); the stop screw "E" should not be adjusted to compensate for wear. If the stop screw "E" should be moved from its original position, it may be readjusted in the following manner:

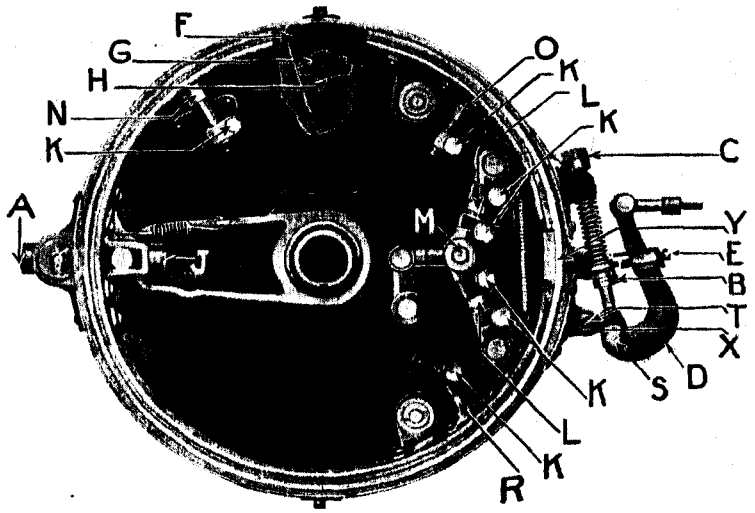


Fig. 42—Internal and External Brakes

First adjust the brake as explained above so that the lever "D" (Fig. 42) is in the correct position when fully applied. Then release the brake. Remove the pin "A" in the yoke "B" (Fig. 43). Then adjust the stop screw "E" and the nuts "B" (Fig. 42) so that the upper and lower parts of the brake band lining clear the drum by one thirty-second of an inch.

Then pull the rod "H" (Fig. 43) forward until the pin in the equalizing bar is $\frac{3}{16}$ inch from the rear end of the slot in the yoke on the end of the rod "H." Holding the rod "H" in this position, adjust the yoke "B" and the stop screw "C" so that when the pin "A" is replaced the brake pedal arm "U" is held three-eights of an inch away from the under side of the toe board and the pin in the equalizing bar is $\frac{3}{16}$ inch from the rear end of the slot in the yoke on the end of the rod "H."

After the adjustments are completed, be sure to lock all adjusting screws and nuts and to insert and spread all cotter pins.

Relining Foot Brakes

Raise the rear axle so that one wheel can be turned by hand, allowing the other wheel to rest on the floor.

Remove the wheel. (See under "Removal of Rear Wheel and Bearings," page 185.) Cut off the rivet heads and remove the lining.

Place Cadillac brake drum, tool numbered 49839, on the axle sleeve in place of the rear wheel.

Apply the internal brakes to hold drum in place.

Insert the new lining between the drum and brake band, making sure it is properly lined up with band.

It may be necessary to release the band slightly to allow new lining to be inserted.

Insert split rivet in Cadillac rivet set, with split in rivet crosswise of band to prevent danger of bulging of the outer edge of the lining. Rivet lining securely to band. See that band is properly formed and concentric before attempting to adjust it.

Before removing the drum adjust the brake band in accordance with directions in this book under "Brakes", page 86.

Remove the drum and replace the wheel in accordance with the directions under "Replacement" page 186.

The other external brake band may be relined and adjusted likewise.

HAND BRAKES

(Internal Expanding)

Ordinary Adjustment

Provision is made in each brake for its adjustment. Do not attempt to adjust the brakes by the pull rods. The brakes cannot be properly adjusted in this manner. To adjust each hand brake proceed as follows:

Place a jack under the rear axle housing and raise the axle so that the wheel can be turned by hand. Remove hub cap and draw out axle shaft free of wheel hub, allowing wheel to turn free. Remove the cover "F" (Fig. 42) this may be done by loosening the lock nut "G" and turning the bolt to the left about one-quarter of a turn, which releases the clamping bar "H."

Rotate the wheel until the opening gives access to the screw "J." Turn the screw "J" until that part of the brake band lining opposite the screw just clears the drum.

Rotate the wheel and through the opening loosen the seven locking screws "K." Then adjust the stop screw "N" and stop screw "O" until the upper part of the brake band lining clears the drum by one thirty-second of an inch.

Turn the two adjusting screws "L" which have right hand threads on one end and left hand threads on the other until the lower part of the brake band lining clears the drum by one thirty-second of an inch.

The screws "L" should be turned equally and in the same direction.

When the brake is fully applied the center of pin "M" should stand three and three-sixteenths inches to three and one-quarter inches away from the inside of the brake drum at "Y."

Adjust the stop screw "R" so that the head of the screw just touches the inside of the brake band. Tighten the seven locking screws "K" and replace the cover "F."

Replace axle shaft and hub cap.

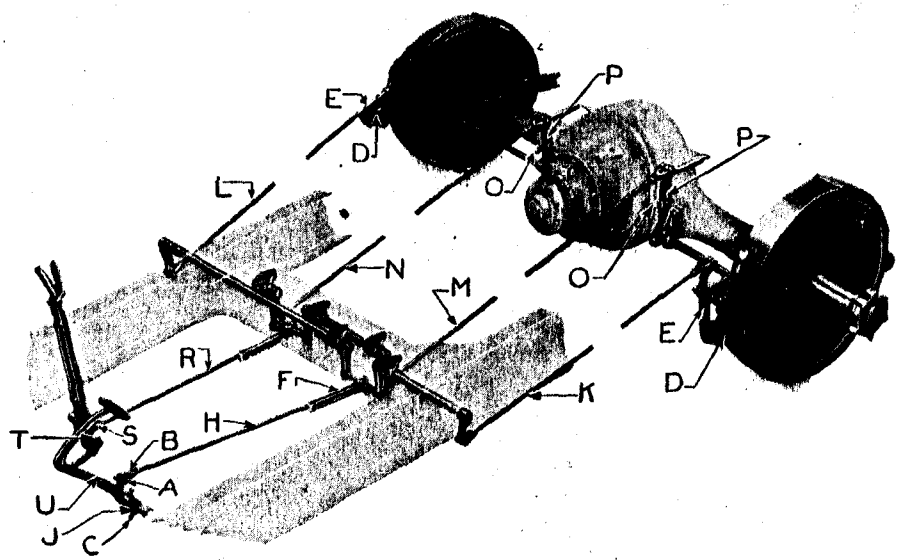


Fig. 43—Brake Rods

Adjustment of Stop Screws

The stop screw "O" (Fig. 43) is adjusted when the car is assembled, and requires no further attention unless its adjustment is altered. Adjustment for wear on the linings should be made, as described on page 88, by the screws "J," "L" and "R" (Fig. 42); the stop screw "O" (Fig. 43) should not be adjusted to compensate for wear. If the original adjustment of the stop screw "O" has been altered, it may be readjusted in the following manner:

First, adjust the brake, as described on page 88, by the screws "J" and "L" (Fig. 42) but screw the stop screws "O", "R" and "N" away from the brake band.

Then remove the pin "T" in the yoke "S" (Fig. 43) and adjust the stop screw "O" so that when the brake is released the center of the pin "M" (Fig. 42) stands three and three-sixteenths inches to three and one-quarter inches away from the inside of the brake drum.

Adjust the stop screws "R" and "O" so that the upper and lower parts of the brake band are equidistant from the brake drum. Adjust the stop screw "N" so that the head of the screw just touches the inside of the brake band. Tighten the seven locking screws "K" and replace the cover "F."

Then adjust the yoke "S" (Fig. 43) so that when the pin "T" is replaced the upper end of the handle on the hand brake lever may be moved back one and one-quarter inches from its extreme forward position without moving the rods "M" and "N."

After the adjustments are completed, be sure to lock all adjusting screws and nuts and to insert and spread all cotter pins.

Relining Hand Brakes.

Raise the rear axle so that one wheel can be turned by hand, allowing the other wheel to rest on the floor.

Remove the wheel. (See under "Removal of Rear Wheel and Bearings", page 185.)

Remove the brake band. (See under "Removal of Internal Brake Band", page 170.)

Cut off the rivet heads and remove the lining.

Place the new lining on the brake band, being sure that it fits the band snugly. Insert split rivet in Cadillac rivet set with split in rivet crosswise of band to prevent bulging of the outer edge of the lining. Rivet lining securely to band.

Replace brake band and place Cadillac brake drum, numbered 49839, on the axle sleeve. See that the band is properly formed and concentric and then adjust the brake.

Remove the drum and replace the wheel. (See "Replacement" under "Wheels," page 186).

The other internal brake band may be relined and adjusted in a similar manner.

FRONT AXLE AND STEERING GEAR

FRONT AXLE

Spindle Arm Stop Screws

The stop screws "H" (Fig. 78) are for the purpose of limiting the angle at which the front wheels can be turned. The stop screw at the left end of the axle limits the angle to which the wheels can be turned to the right. The stop screw at the right end of the axle limits the angle at which the wheels can be turned to the left.

The stop screws are adjustable and should be so set that the wheels are permitted to turn to as great an angle as possible, yet preventing the tires from rubbing on the side springs or the steering connecting rod on the left side.

Adjustment of Spindle Bearing

The bushing "G" (Fig. 78) is pressed into the axle forging. If there is too much end play in the bearing "D" draw up on the adjusting nut "B," pulling the bushing "G" up against the under side of the

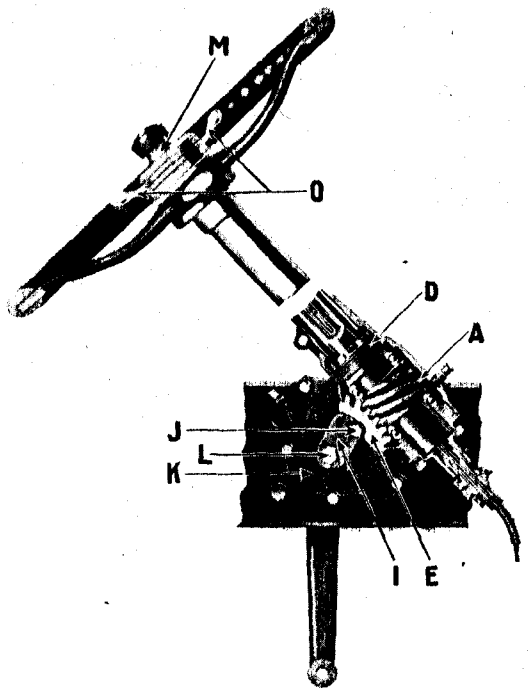


Fig. 44—Steering Gear, Sectional View

spindle. Then back off the adjusting nut "B" just enough to free the adjustment. (See under "Caution in Adjusting Timken Bearings," page 95.)

STEERING GEAR

Adjustment of Worm Thrust Bearings

To take up the end play in the worm "A" (Fig. 44) remove the two screws "B" and lock plate "C" (Fig. 45). Then with a screw-driver or something else suitable, screw down the adjusting collar "D" (Fig. 44) which can be seen through the hole from which the lock plate "C"

(Fig. 45) was removed, until the proper adjustment is made. Replace the lock plate "C" and the screws "B".

Adjustment of Worm and Sector

An adjustment is provided for taking up wear on the teeth of the worm "A" and sector "E" (Fig. 44). The sector "E" has its bearing in an eccentric steel bushing. Wear can be taken up by turning this bushing so that it throws the sector towards the worm.

To do this proceed as follows: First turn the steering wheel so that the front wheels point straight ahead. Remove the locking screw "F" (Fig. 45). As the bushing is assembled at the factory it is necessary to move the arm "G" down to tighten the adjustment.

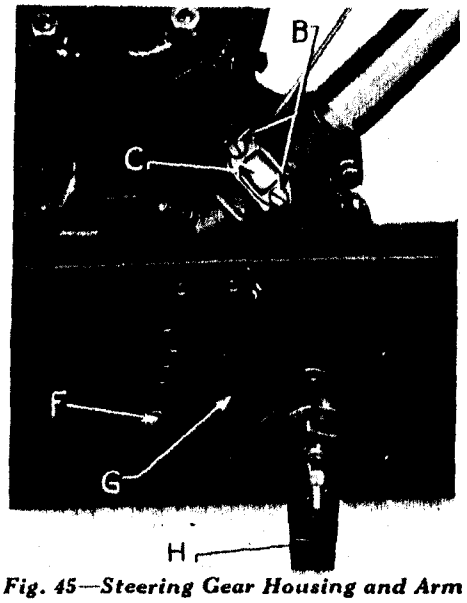


Fig. 45—Steering Gear Housing and Arm

If the wear on the teeth of the worm sector is very great, it will be necessary to remove the steering arm "H" and to place the arm "G" in a different position on the hexagonal end of the eccentric bushing in order to bring the arm "G" in position so that it can be locked by the screw "F."

After the adjustment is made properly be sure that the lock screw "F" is replaced and properly tightened.

Adjustment of Sector Shaft

An adjustment is provided on the inner face of the steering gear housing for taking up end-play in the sector shaft.

To make this adjustment remove the locking arm "I" (Fig. 44) and turn the adjusting screw "L" in until the proper adjustment is made,

after which the locking arm "I" should be replaced and the lock screw, "J," replaced and tightened.

Caution:—Do not turn the steering gear when the car is standing. This is not only unnecessary but is also bad practice.

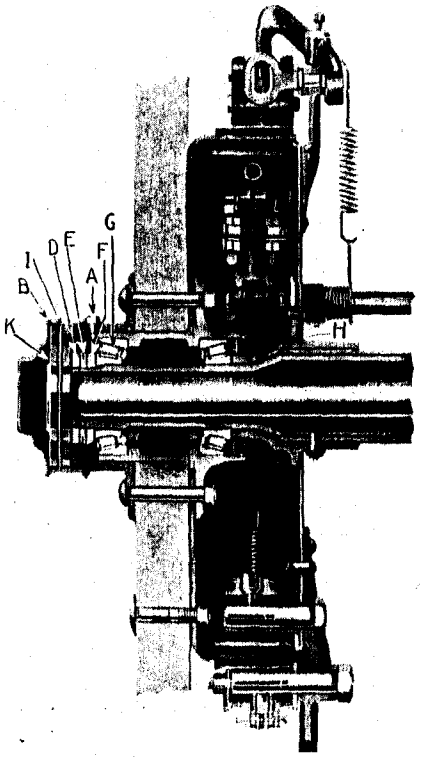


Fig. 46—Sectional View of Rear Hub, Showing Bearings.

WHEELS

REAR WHEEL

Removing a Rear Wheel

Jack up the axle so that the wheel will clear the floor.

Remove the lubricator "A" (Fig. 46) (Later cars are not provided with this lubricator).

Remove the hub cap "B" by unscrewing it.

Remove the spring locking ring "I."

Withdraw the axle shaft "K."

Remove the lock nut "D," the washer "E" and the adjusting nut "F."

The wheel can then be taken off.

Replacing a Rear Wheel and Adjusting Bearings

Before replacing the wheel, see that the bearings "G" and "H" are clean and filled with light grease which is free from dirt and grit.

In replacing the wheel, set the adjusting nut "F" very carefully. (See under "Caution in Adjusting Timken Bearings," page 95.) Place the washer "E" in position, and tighten the lock nut "D."

FRONT WHEEL

Removing a Front Wheel

Jack up the axle until the wheel is free from the ground.
Remove the hub cap by unscrewing it.
Remove the cotter pin "E" (Fig. 47).
Remove the lock nut "A".
Remove the washer "B."
Remove the adjusting nut "C."
The wheel may now be removed.

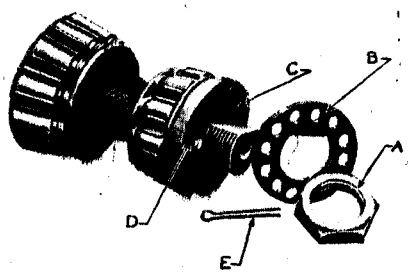


Fig. 47. Front Wheel Bearings and Adjusting Nuts

Before replacing the wheel, see that the bearings are clean and that they are filled with a thin grease. Be sure that the grease is free from dirt and grit.

Replacing a Front Wheel and Adjusting Bearings

In replacing the wheel, adjust the nut "C" very carefully. (See under "Caution in Adjusting Timken Bearings," page 95.) Replace washer "B," being sure that one of the holes in the washer fits over the stud "D." Replace the lock nut "A" and tighten carefully. Replace the cotter pin.

It is better to adjust the wheel bearings a little too loose than tight. If, after the adjustment is apparently correct, a hole in the washer "B" is not directly over the stud "D," it is best to loosen the adjustment rather than to tighten it.

ALIGNMENT OF FRONT WHEELS

The ideal condition is to have the front wheels parallel to each other on horizontal lines passing diametrically through their centers. Under

no condition should the wheels toe out. It is permissible to have them toe in, providing they do not toe in more than three-eights of an inch in the diameter of the wheel. Adjustment is provided in the parallel rod for aligning the front wheels.

The front wheels camber about one and one-half inches, that is, the measurement between the wheels at the top should be approximately one and one-half inches greater than the corresponding measurement diametrically opposite at the bottom of the wheels.

STRAIGHTENING BENT PARTS

Modern automobile construction demands the use of the highest grades of alloy steels. A great advantage of alloy steels is that by properly heating and cooling and re-heating such steels great strength and durability are obtained. However, heat treatment must be given with full and accurate knowledge of the contents of the steel, which cannot be obtained in the ordinary repair shop. Therefore, if any part is heated outside of this factory for the purpose of straightening or for other purposes, the part at once loses the advantage which the original heat treatment gave it.

CAUTION IN ADJUSTING TIMKEN BEARINGS

When adjusting Timken Bearings, great care must be exercised not to get them tight. These bearings will revolve even when adjusted very tightly, but that condition is sure to prove disastrous. They should be adjusted so that a very slight amount of play or looseness may be discerned.

If, after a bearing has been adjusted to a point that is apparently correct, the locking device cannot be placed in position without changing the adjustment, it is far better to loosen the adjustment until it can be secured with the locking device than to tighten the bearing adjustment.

CARE OF THE FINISH

The finish of an automobile requires more careful and frequent attention when the car is new than when it is older and the varnish is harder. Particular care should be taken to keep mud from the body and hood of the car while new.

Never permit mud to remain on the finish over night or long enough to dry. If it is not possible to wash the car thoroughly before putting it away for the night, flush it off and then thoroughly wash the car the next morning. Mud permitted to remain on the car until it has dried, is not only difficult to remove but stains and dulls the finish.

WASHING THE CAR

Use clean water and plenty of it. Do not use water containing alkali. In parts of the country where the regular water supply contains alkali use rain water. Do not use hot water, as it destroys the lustre. The temperature of the water should be between 40 and 60 degrees Fahrenheit. Do not wash the hood while it is hot. The effect on the finish is the same as

washing it with hot water. Unless the hood is allowed to cool before washing, the lustre will soon disappear.

If a hose is used in washing, do not have water pressure greater than will carry the water 6″ beyond the end of the hose. Water under higher pressure drives the grit and dirt into the varnish. It is best not to use a nozzle.

Start at one of the front wheels, first going over the underside of the fender, the wheel and the chassis nearby, with water flowing gently from the hose. This will flush off most of the mud and dirt.

If it is necessary to use soap to remove road oil from the underside of the fenders or machine oil or grease from the chassis, use a little good automobile soap dissolved in a pail of water and apply the soapy solution with a sponge. Do not let this soapy solution remain on the finish more that two or three minutes but immediately wash it off thoroughly with a good soft carriage sponge. Then proceed to wash the under surfaces of the remaining fenders, the wheels and the remainder of the chassis in a similar manner.

When the washing of the chassis is completed begin at the front of the car and with the water running gently from the hose, flow on the body, hood and upper surfaces of the fenders. This will soften the accumulation of road dirt and remove most of it. Then go over the car again and remove all dirt by rubbing lightly with a soft wool sponge, which is used exclusively for the body, hood and upper surfaces of the fenders. At the same time, apply gently from a hose an abundance of water. Rinse the sponge frequently in clean water to remove any grit. After the washing is completed squeeze the sponge as dry as possible and pick up all water from crevices.

Then thoroughly wet a clean soft chamois, wring it as dry as possible, and dry the finish. Rinse the chamois and wring it out frequently. Do not rub the finish or apply more pressure than is necessary to dry off the water. Water evaporates quickly and leaves the finish in good condition.

If it is desired to chamois the wheels and chassis, wet the parts with clean water if they have become dry, and then wipe them. Use a separate chamois for the chassis. Do not use on the body a chamois that has been used on the chassis or wheels.

Do not use soap, gasoline, kerosene or anything of this nature on the finish. Such ingredients attack the varnish.

Do not clean the glass with preparations which may contain harmful ingredients. Use only cleaning compounds which are known to have no destructive effects on highly polished glass.

DOOR BUMPERS

The upper rubber bumper on the doors of the Touring Car and all the bumpers on the enclosed car doors are self-adjusting. The lower bumper on each Touring Car, Phaeton or Roadster door is adjustable. To make the adjustment loosen the wood screw fastening the bumper to the door frame and pull the rubber out part way. The rubber is slotted where the screw passes through to permit this.

Close the door slowly until the latch just catches. As it closes, the door will force the rubber into place and at the instant the latch catches, the rubber will be exactly in the proper position. Open the door and tighten the wood screw until the rubber is clamped firmly.

TIRE AIR COMPRESSOR

Using the Compressor

To inflate a tire, first attach the air hose to the connection projecting from the left hand dust shield just back of the battery box cover, then connect the other end to the tire valve. Do not connect the hose to the tire first, if there is air pressure in the tire.

If the engine is running, release the clutch by pushing the left pedal down. Hold the pedal down until you are certain the transmission gears have ceased to revolve, and then turn the slotted head of the compressor control shaft, which projects through the floor board, in the clockwise direction. If the engine is not running, it is unnecessary to disengage the clutch before bringing the compressor into operation.

Run the engine at a speed of approximately 1,000 revolutions per minute. With all lights turned off, the ammeter on the instrument board should register approximately thirteen at 1,000 revolutions per minute of the engine. The compressor operates at its most efficient speed at 1,000 revolutions per minute of the engine. Do not race the engine in operating the compressor, or at any other time, when it is not driving the car.

To stop the compressor, turn the slotted head of the control shaft in the counter-clockwise direction.

Caution:—Do not turn the compressor control shaft to bring the compressor into operation when the engine is running and the clutch is engaged.

TIRE HOLDER

The tire holder is designed to carry two standard size tires inflated on rims.

To remove the tire with rim, remove the cap from the lock at the center of the clamp and unlock it. Then unscrew the clamp as far as it will go. The tire then may be removed.

To put a tire on the holder proceed in the reverse manner.

When mounting two tires on the tire holder, the clamping or locking rings should face each other to prevent theft of the tires by removing them from the rims. If mounting one tire on the tire holder, the clamping or locking ring should face to the front or toward the body.

Care should be exercised not to permit the inner tire to strike the body of the car when removing or replacing it.

CURTAINS

Storage of Curtains

The side curtains for open cars are carried in an envelope provided with cloth partitions to prevent the curtains from rubbing and chafing. All curtains are tagged to facilitate attaching.

In the touring car the curtains are stowed under the front seat. In the phaeton the curtains are stowed in a compartment provided in the back of the front seat and which opens in the tonneau. The roadster has a parcel compartment just back of the seat in which the curtains are stowed.

Before the curtains are stowed away they should be dry and clean.

Curtain Fasteners

The curtains are held in place with fasteners which become locked on three sides when snapped into place and must be lifted on the side which is not locked in order to release them. This side is indicated by a small projection on the fastener as shown by the arrow (Fig. 48). This type of fastener cannot be released by lifting it at any other side.



Fig. 48
Curtain Fastener

SPEEDOMETER

The speedometer registers the speed at which the car is traveling, the total number of miles traveled, and the trip mileage. The total mileage cannot be reset but the trip mileage can be reset to zero.

An automobile repairman should never be permitted to attempt to adjust or repair the speedometer head or to replace the glass. This work can be done only by men experienced in speedometer work and only with special machinery and tools.

If the speedometer head is removed, handle it with the same care that you would a fine watch. The speedometer head may easily be damaged by rough handling.

CLOCK

The clock is in combination with the speedometer. It has an eight-day movement and is wound and set in the same manner as any stem-winding watch. The winding and setting stem is on the under side of the speedometer just back of the instrument board.

COLD WEATHER SUGGESTIONS

Starting in Intermediate or High Gear

Starting in intermediate or high gear should not be done at any time, but this is particularly unfair to a cold engine, as it necessitates a further opening of the throttle than is necessary when starting on low gear, with the probability of a "pop back" in the carburetor.

Cold Test of Engine Oil

Use oil having a low cold test. In other words, use oil which flows freely at low temperature. (See under "Lubricants," page 194.)

Frequent Changing of Oil

Water and gasoline may accumulate in the crank case of the engine during cold weather. It is necessary, therefore, to drain the oil frequently and replace it. (See under "Replace Engine Oil Frequently During Cold Weather," page 198.) If water and gasoline are permitted to accumulate in the crank case, serious damage to the engine may result.

Strainers in Gasoline System

It may be found necessary to remove the strainers in the gasoline line more frequently during cold weather in order to prevent an accumulation of water at these points which would freeze and prevent the gasoline from flowing to the carburetor. (See under "Settling Chambers and Strainers," page 70.)

WINDSHIELD POSITIONS

For Inclement Weather

The normal position of the windshield for inclement weather is with the upper and lower sections closed and with the removable rubber strip between the glasses. If rain or snow should freeze on the glass making it impossible to clean it with the windshield wiper, the upper section may be tilted out at a slight angle. This is known as the rain vision position. The driver may then look between the sections of the shield, at the same time being protected to some extent. The clamping nuts at the top of the windshield standards must be loosened before the upper section can be moved and should be tightened after it is in the desired position.

For Ventilation

When greater ventilation in the front compartment is desired than provided by the cowl ventilator, the lower section of the windshield should be tilted in. The clamping nuts, half way up the windshield standards, must be loosened before the lower section can be moved and should be tightened afterwards.

If still greater ventilation is desired the upper section may be tilted toward the driver.

The rubber strip between the windshield glasses should be removed before either the upper or lower section of the shield is tilted inward.

OPERATION OF ENGINE

General Principle

The production of power by the engine may be described briefly as follows:

Gasoline is forced by air pressure from the tank to the carburetor. At the carburetor the gasoline is mixed with air in the proper proportion, forming an explosive vapor or gas. The gas is drawn through the intake

manifold and inlet valves into the cylinders of the engine, where it is compressed and ignited by electric sparks, the pressure of the resulting explosions producing the power.

The quantity of gas supplied to the engine is regulated by a throttle valve at the carburetor which is operated by means of the throttle lever at the steering wheel or by the accelerator button at the right of the brake pedal.

Four-Cycle Engine

The engine is of the four-cycle type, that is, there are four movements or strokes of each piston and two revolutions of the flywheel to complete each power-producing stroke. The four strokes of the cycle each have a different function and follow one another in the same order as follows:

Suction Stroke. The suction stroke commences with the piston at its highest point in the cylinder and with the inlet and exhaust valves closed. Immediately the piston starts to descend the inlet valve opens and through this valve a charge of gas from the carburetor is drawn into the space above the piston.

Compression Stroke. As the piston starts upward again after completing the suction stroke, the inlet valve closes. As there is then no escape for the gas in the cylinder, it is compressed, the maximum compression being reached when the piston is at the top of its stroke.

Power Stroke. At the completion of the compression stroke, the spark takes place at the spark plug, igniting the compressed charge of gas. The heat resulting from the rapid combustion causes the pressure of the confined gas to rise almost instantaneously to several times its pressure before the explosion. This pressure exerted on the piston forces down the piston and produces the impulse which is transmitted by the connecting rod to the crankshaft, causing it to rotate.

Exhaust Stroke. Just before the piston reaches the end of the power stroke, the exhaust valve opens. It remains open as the piston travels upward again on the exhaust stroke, driving the burned gas out from the cylinders. By the time the piston has reached its highest point it has forced out the burned gas and the exhaust valve closes. Having completed the four strokes, the piston is now ready to draw in a new charge and to repeat the cycle.

The same cycle of events takes place in all of the cylinders but no two pistons are at the same point in the cycle at the same time. In the Cadillac eight cylinder V-type engine, the impulses in the eight cylinders are so timed that a power stroke is begun every quarter turn of the crankshaft. In other words, the crankshaft receives four overlapping impulses every revolution.

PART III

REMOVAL, INSPECTION AND REPLACEMENT

ENGINE

Removal

Remove the rod connecting the arm on the steering gear to the arm on the cross shaft at the rear of the radiator.

Remove the two hood shelves.

Remove the radiator splash shield.

Remove the splash shield under the engine.

Remove the radiator. (See "Removal" under "Radiator," page 149.)

Disconnect one of the cables from the storage battery and place a block of wood under it to prevent it touching the terminal on the battery.

Remove the top cover plate from the generator.

Remove the large cable at the generator, also the three smaller wires.

Remove the floor boards.

Remove the pipe connecting the radiator and the radiator condensor.

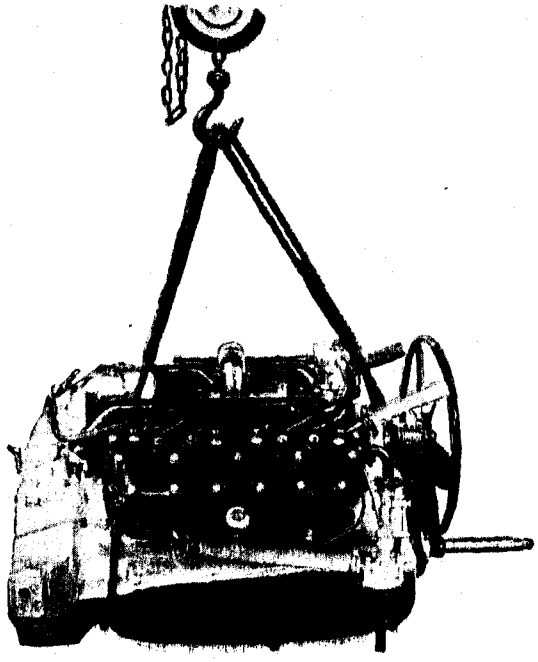


Fig. 49—Position of Rope in Lifting Engine from Frame

Remove the transmission. (If the body is off, do not remove transmission from engine.) (See "Removal" under "Transmission," page 165.)

Remove, from the ignition coil, the high tension wire and the low tension wire and horn wire from side of inspection lamp, which pass to the engine through the conduit.

Remove the conduit bracket from the dash and pull the three wires through the dash.

Remove the enriching rod running from the dash to the carburetor.

Remove the two rods running from the steering gear to the engine.

Remove, from the body of the car, the pipe which leads from the strainer under the front floor, also remove the pipe which leads from the pressure relief valve under the front floor.

Remove the air pipe between the pressure relief valve and the power compressor at the front end of the engine, also the pipe between the settling chamber and the carburetor.

Disconnect the pipe from the oil pressure regulator.

Disconnect the steering gear bracket from the instrument board.

Remove the rear fenders. (See "Removal of Rear Fender" under "Fenders," page 193.)

Loosen the nuts on the two rear body bolts and remove the nuts from the remainder of the body bolts. Tap up the bolts from which the nuts are removed.

Jack up the front end of the body about eight inches and block it up so that it will not drop.

Disconnect the exhaust pipes from the exhaust manifolds.

Remove the cap screws which hold the cap of the front engine support.

Remove the cotter pins and nuts from the two large bolts which hold the rear engine supports to the frame.

Remove the two large bolts. To facilitate removal, jack up the rear of the engine just enough to relieve the bolts of the weight of the engine.

With a suitable chain-fall attached to a stout rope placed around the engine as shown in (Fig. 49) lift out the engine carefully.

Dissassembly

Remove the engine. (See "Removal.")

Wash off the engine and transmission with gasoline or kerosene.

Remove the transmission if not removed before removing engine. (See "Removal" under "Transmission," page 165.)

Remove the intake manifold with carburetor.

Remove the motor generator. (See "Removal of Motor Generator" under "Motor Generator," page 142.)

Remove the starter gear housing. The housing may be lifted off after removing the six cap screws and the two dowel pins and disconnecting the control rods.

Remove the water pumps. (See "Removal of Pump" under "Water Pumps," page 125.)

Remove the drive shaft for the water pumps. (See "Removal" under "Drive Shaft for Water Pumps," page 134.)

Remove the drain plug from the oil pan and drain out the oil.

Remove the oil pan and the baffle plate. (See "Removal" under "Oil Pan and Baffle Plate," page 124.)

Remove the spiral gear and the shaft which drives the oil pump. (See "Removal" under "Spiral Gear for Oil Pump Drive," page 116.)

Remove the fan. (See "Removal" under "Fan," page 116).

Remove the front cover plate. (See "Removal" under "Front Cover Plate," page 122.)

Remove the camshaft driving chain. (See "Removal" under "Engine Chain," page 115.)

Remove the four cylinder head nuts which hold the brackets of the high tension conduits. Remove the distributor head and the low tension wire and remove the conduits with brackets, wires and head.

Remove the distributor rotor. This may be done by lifting it straight up. If the rotor sticks on the shaft force it off with two small screw-drivers. The rotor is recessed on the under side at two points to receive screw-drivers in removing. Lift both sides evenly and carefully.

Loosen the cap screw on the left rear corner of the fanshaft housing and remove the remaining three cap screws. Remove the two threaded dowel pins which position the fanshaft housing on the crankcase. These may be removed by placing over them spring washers large enough to permit the pins to be pulled through them and screwing on and tightening $\frac{5}{16}$ inch x 18 nuts.

Remove the camshaft driver "P" and camshaft sprocket "N" (Fig. 55).

Remove the connecting rods and pistons. (See "Removal" under "Connecting Rods," page 128.)

Remove the cylinder blocks. (See "Removal" under "Cylinder Blocks," page 109.)

Remove the oil pressure regulator.

Remove the top cover plate. (See "Removal" under "Top Cover Plate," page 122.)

Remove the camshaft and the eccentric bearing by pulling them straight forward.

Remove the flywheel. (See "Removal" under "Flywheel," page 137.)

Remove the crankshaft. (See "Removal" under "Crankshaft," page 132.)

Remove the oil manifolds from the crankcase.

Inspection

Inspect all parts in accordance with directions in this book.

Reassembly and Replacement

In reassembling and replacing the engine, reverse operations under "Disassembly" and under "Removal."

After tightening the nuts on the large bolts which hold the rear end of the engine to the frame, loosen them one notch and replace the cotter pins.

ROCKER ARMS AND SHAFTS

Removal

Remove the top cover plate. (See "Removal" under "Top Cover Plate," page 122.) Loosen the set screws holding the rocker arm shafts

in place. Mark each rocker arm to be removed so it can be put back as originally assembled.

Remove the rocker arm shafts by lightly tapping them out.

Inspection

INSPECTION OF ROCKER ARMS AND SHAFTS—After cleaning the arms with gasoline or kerosene remove the pins which hold the rolls. This should be done with a press. Care must be exercised not to spring the arms.

The clearance between a rocker arm bushing and the shaft should not exceed .004 inch.

The clearance between a rocker arm roll and the pin upon which it rotates should not exceed .003 inch.

All bearing surfaces should be smooth.

The outer circumference of the rolls should be true within .0015 inch.

Rocker arm shafts should be a light press fit into the bronze bushings which receive them.

INSPECTION OF OTHER PARTS—Inspect the cams. They should be smooth and show practically no wear.

Replacement

Rocker arm pins should be well lubricated before the rolls are assembled. The rolls should rotate freely after assembly. In replacing reverse the operations under "Removal."

CRANK PIN BEARINGS

Removal

Remove the oil pan and the baffle plate. (See "Removal" under "Oil Pan and Baffle Plate," page 124.)

Open the compression cocks.

Remove the cotter pins and the two nuts from the cap of the straight connecting rod.

Remove the cap, being careful not to mix the liners.

Remove the cotter pins and the four nuts from the caps of the forked connecting rod and remove the caps.

Remove the rod with piston. Care must be exercised not to damage the piston in removing it. Do not allow the skirt of the piston to fall against the connecting rod. Do not allow the halves of the crank pin bearing to drop.

Remove the halves of the bearing.

Inspection

INSPECTION OF BEARING—Clean the bearing with gasoline or kerosene and wipe it off with a cloth. In handling, be careful not to drop it or spring or mar it in any other way.

Inspect the bearing metal. If it is cracked, or cut so that it cannot be cleaned up with a scraper, without increasing the clearance between the bearing and crank pin to more than .006 inch, a new bearing should be substituted. (See under "Fitting Crank Pin Bearings," page 31.)

To insure against excessive oil consumption, smoking at the exhaust, the rapid formation of carbon in the cylinders, and noisy operation, the clearance between a crank pin bearing, when clamped in the rod, and the crank pin should not exceed .006 inch. End play in a crank pin bearing should not exceed .015 inch. There is no adjustment on crank pin bearings. Crank pin bearings .005 inch and .020 inch undersize are furnished by our Parts Department.

Inspect the dowel pin holes in the bearing. The clearance between the pin holes and the pins should not exceed .002 inch.

Examine the oil hole in the bearing, cleaning it out if obstructed.

INSPECTION OF OTHER PARTS—Inspect the crank pin. The crank pin should be round within .003 inch and free from scores; if it is not, it should be dressed down. (See under "Dressing Down Crankshaft Bearing Surfaces," page 35). A new undersize bearing should be fitted if there is more than .006 inch clearance between the pin and bearing after the work is completed. (See under "Fitting Crank Pin Bearings," page 31.)

Examine the oil hole in the crank pin, cleaning it out if obstructed.

Inspect the pistons and piston rings in accordance with directions under "Piston and Piston Rings," page 120. If wear on a piston seems to indicate that the rod is sprung or twisted, test it for alignment. (See "Inspection of Rods" under "Connecting Rods," page 128).

Inspect the cylinder bores. Cylinder bores should be round within .002 inch and free from scores.

Replacement

With a cloth wipe off the halves of the bearing and well lubricate the bearing surfaces with engine oil of a suitable quality before replacing these parts.

In replacing reverse operations under "Removal."

Be sure to replace the connecting rods as originally assembled in engine. Connecting rods are numbered on the channel section, indicating the cylinders in which they go. Number one forked rod and number one straight rod go into cylinders nearest the radiator; number two forked rod and number two straight rod into cylinders just back of these, etc. The numbers on the channel sections of the rods should face downward, and the numbered ends of the crank pin bearings should face to the rear.

Care should be exercised that the dowel pins in the forked rod are in the pin holes in the bearing, before tightening the cap nuts.

All nuts and bolts and both bearing caps of forked rods are numbered. One bolt and nut only and the cap of straight rods are numbered. Bolts, nuts and caps should be replaced in accordance with these numbers.

The following will serve to check the assembly of the connecting rods and crank pin bearings: The forked connecting rods should be

on the left-hand side of the engine. The edges of the crank pin bearing halves where they come together should be in the horizontal plane when the pistons attached to the forked rods are on upper and lower centers. The longer piston pin bosses on the upper ends of the two center connecting rods in each cylinder block, should face toward each other. The longer piston pin bosses on the upper ends of the end connecting rods in each cylinder block should face from each other.

In adjusting the straight connecting rod follow directions under "Adjustment of Connecting Rod Bearings," page 29.

After replacing the oil pan refill it with seven quarts of suitable engine oil. Cadillac Engine oil is recommended.

MAIN BEARINGS

Removal

Remove the oil pan and the baffle plate. (See "Removal" under "Oil Pan and Baffle Plate," page 124.)

Remove the pipe between the main bearing cap and the oil feeder pipe.

Remove the cotter pins and nuts from the main bearing cap.

Remove the bearing cap with the lower half of the bearing. If more than one bearing is to be removed at a time, it is best to first remove the connecting rods to insure against springing them, should one end of the crankshaft drop lower than the other, (see "Removal" under "Connecting Rods," page 128), also to support the crankshaft to prevent it dropping, which might injure it.

Care must be exercised not to mix the liners.

The upper half of the bearing can be removed by rotating it.

Inspection

Inspection of Bearing—Clean the bearing with gasoline or kerosene and wipe if off with a cloth.

In handling the bearing be careful not to drop it or spring or mar it in any other way.

Carefully inspect the babbitt. If it is cracked, or cut so that it cannot be easily cleaned up with a scraper, replacement of the bearing should be made. (See under "Fitting Main Crankshaft Bearings," page 33).

The end thrust of the crankshaft is taken by the rear main bearing.

The shaft should have no more than .020 inch end play.

Inspection of Other Parts—Inspect the main bearing surfaces of the crankshaft. If any of them are out of round more than .003 inch, or scored, the shaft should be dressed down and the bearings refitted. (See under "Dressing Down Crankshaft Bearing Surfaces," page 35.)

Replacement

The bearings, liners and bearing cap should be carefully wiped off and the bearing surfaces lubricated with a good grade of engine oil before replacement is made.

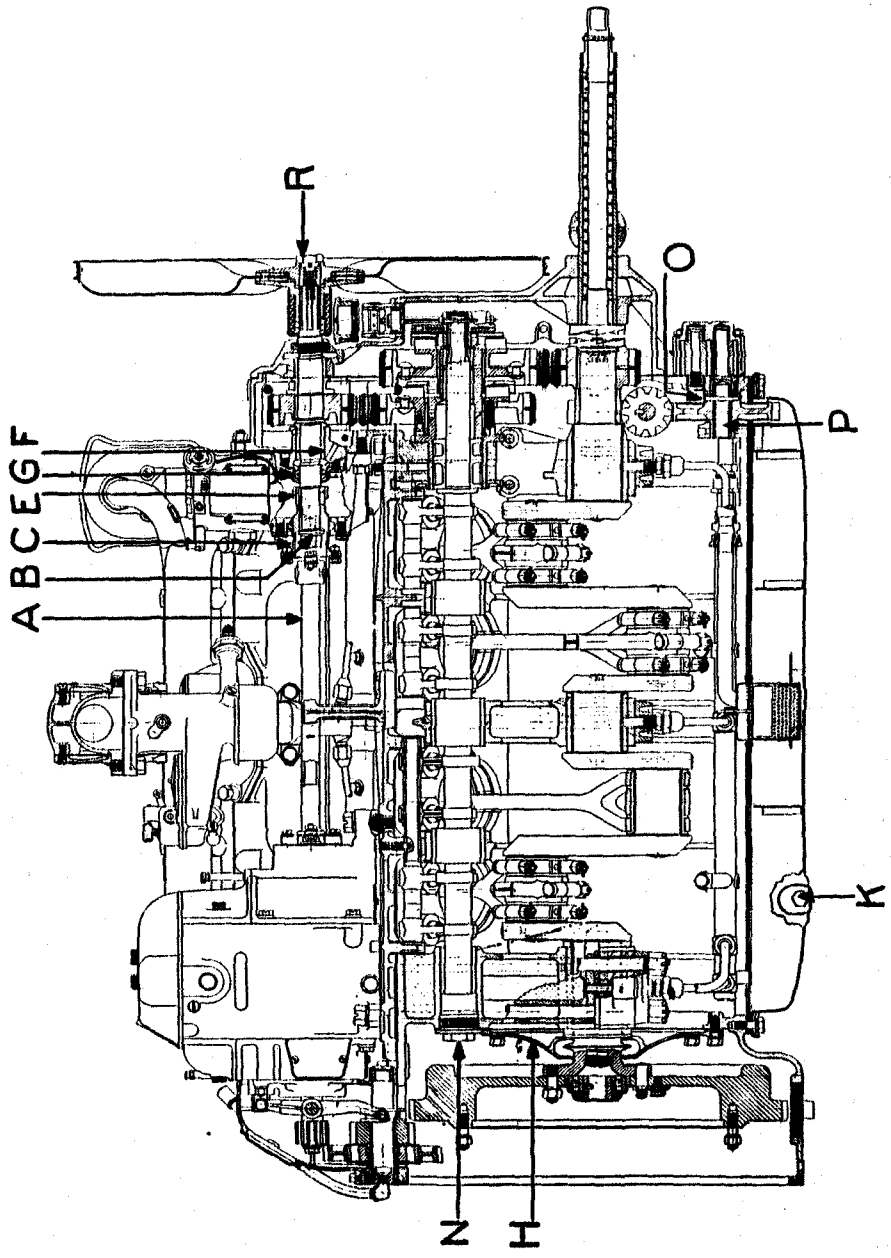


Fig. 50—Cross Section of Engine, Side View

In replacing, reverse operations under "Removal."

The bearings are numbered on one end. The one nearest the radiator is stamped "1," the center bearing "2," and the rear bearing "3." In replacing have the numbered ends toward the radiator.

In readjusting main bearings follow directions under "Adjustment of Main Crankshaft Bearings," page 30.

After replacing the oil pan refill it with seven quarts of suitable engine oil. Cadillac Engine oil is recommended.

If after starting the engine it is found that the pressure gauge does not register pressure, stop the engine at once and prime the oil pump. This may be done by disconnecting at its upper end the oil pipe from the oil pressure regulator and forcing two to three gunfuls of clean engine oil into the pipe. Connect the pipe and tighten the union before starting the engine.

FANSHAFT

Removal

Remove the fan. (See "Removal" under "Fan," page 116.)

Remove the carburetor. (See "Removal" under "Carburetor," page 150.)

Remove the generator drive shaft "A" (Fig. 50.)

Remove the large cap screw "B."

Remove the coupling "C" by use of Cadillac puller, tool numbered 71955.

Remove the distributor and timer. (See "Removal" under "Distributor and Timer," page 145.)

Remove the small spiral gear "E." Use Cadillac puller numbered 83221.

Remove front cover plate. (See "Removal" under Front Cover Plate, page 122.)

Remove fan drive chain by cutting off the riveted head of one of the seat pins and remove the seat and rocker pins, (See Fig. 11, page 41.)

The chain and fan shaft can now be removed.

Inspection

Clean all parts with gasoline or kerosene.

Inspection of Fanshaft and Bearings—Inspect the bronze bearing in fanshaft housing.

Inspect the oil drain hole "F" and felt washer "G" (Fig. 50) and clean out the hole if obstructed.

Replacement

In replacing, reverse operations under "Removal."

All parts should be clean, and bearings well lubricated with a good grade of engine oil before replacement is made.

It is necessary to retime the ignition after replacing the distributor housing (see under "Timing Ignition," page 54), also to put four ounces of number two grease into the distributor housing. This may be done after removing the breather "Z" (Fig. 65, page 147.)

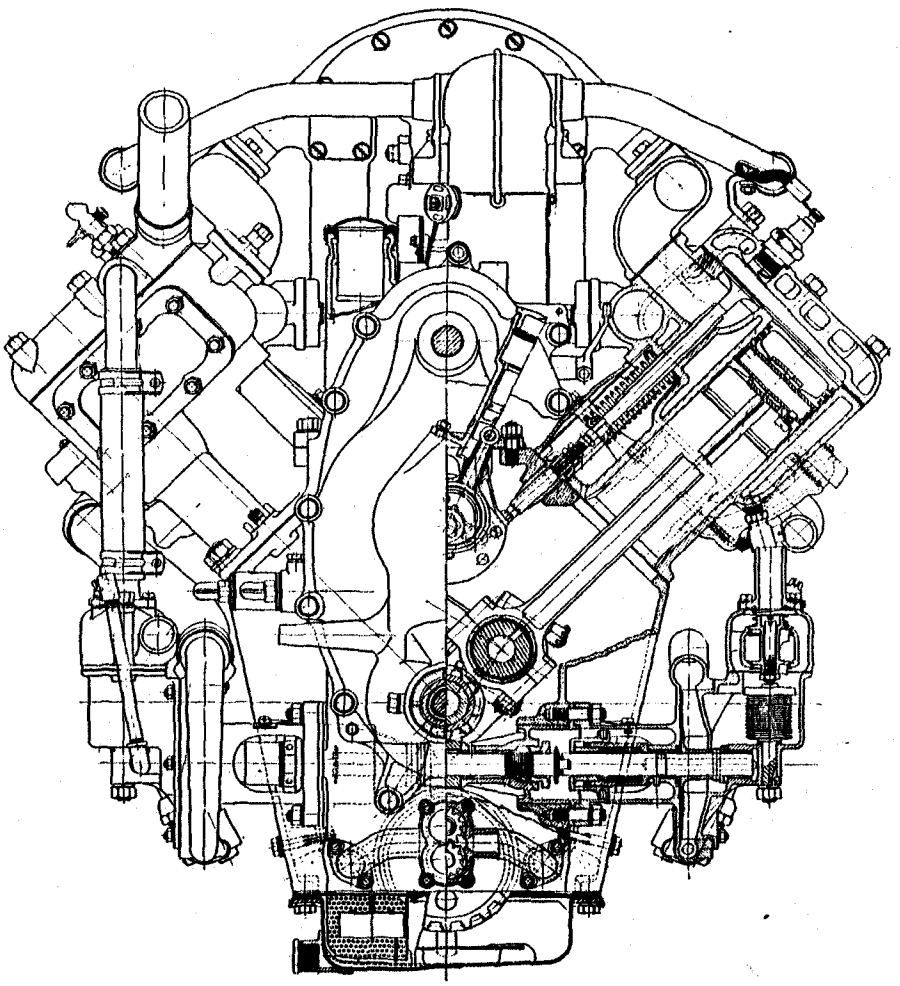


Fig. 51—Cross Section of Engine, Front View.

CYLINDER BLOCKS

Removal

Drain the Cooling System. (See under "Draining the Cooling System," page 67.)

"Remove the connecting rods and pistons. (See "Removal" under "Connecting Rods," page 128.) It is possible to remove the cylinder

block without first removing the connecting rods and pistons; to prevent damage to these parts, however, it is recommended that they be removed.

Remove the hose connections from the cylinder blocks.

Disconnect the high tension wires from the spark plugs, and remove the conduit brackets from the cylinder head. Remove the forward

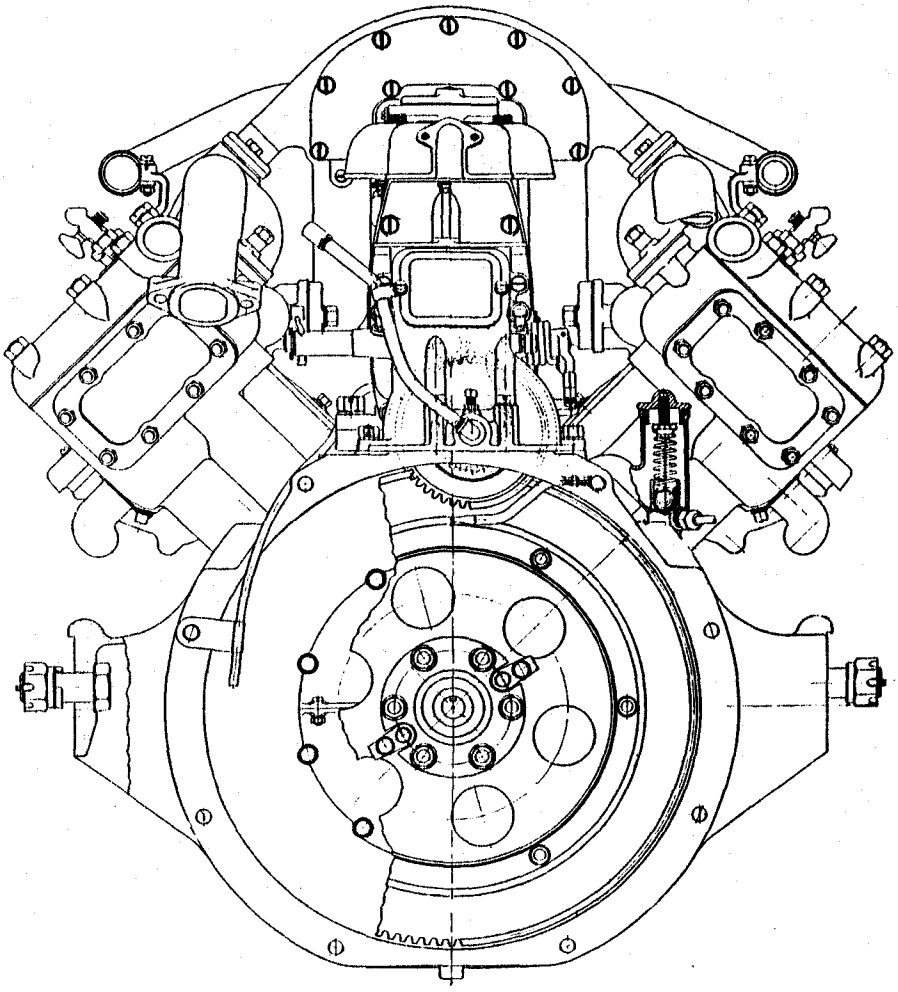


Fig. 52—Cross Section of Engine, Rear View.

end of the conduit from the aluminum cap by removing the two screws holding the bracket on the end of the conduit to the cap. Lay the conduit with wires back out of the way.

Remove the intake manifold. (See "Removal" under "Intake Manifold," page 119.)

Disconnect the exhaust pipe from the exhaust manifold by removing the two bolts or remove the exhaust manifold from the cylinder block, leaving it attached to the exhaust pipe.

Remove the large threaded dowel pin at each end of the cylinder block by placing a spring washer over the pin large enough to permit the pin to be pulled through it, and screwing down and tightening one of the cylinder hold down nuts.

Remove the exhaust valves from the end cylinders. (See "Removal" under "Valves and Valve Springs," page 136.) This will facilitate the removal of the end hold down nuts on the inner row.

Remove the cylinder hold down nuts.

The cylinder block can now be removed.

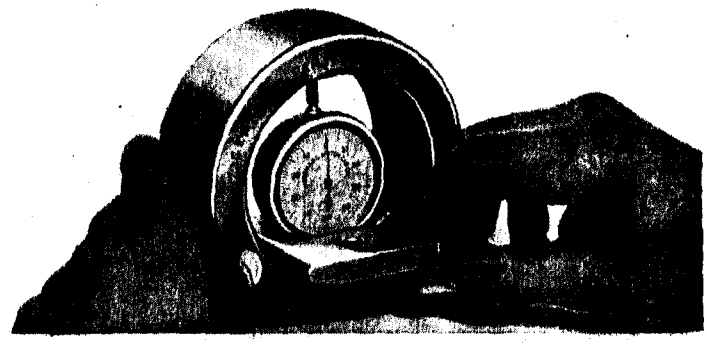


Fig. 53—Setting Cylinder Indicator with Master Ring.

Inspection

INSPECTION OF CYLINDER BLOCK AND VALVES—Remove the large cover plate at each end of the cylinder block and wash out the water jacket. Replace the end covers, making sure that the gaskets are in good condition, and clean the cylinder block with gasoline or kerosene.

Examine all cylinder bores. Cylinder bores should be free from scores and should be round within .002 inch.

To test cylinder bores for size and parallelism use Cadillac indicator and master ring, tool numbered 71967, as shown in (Fig. 53.)

To use this indicator proceed as follows:

With a cloth free from lint soaked in kerosene carefully clean out the cylinder bore and wipe dry. Wipe out the master ring and wipe off the shoe which holds the indicator. Then set the indicator with shoe into the master ring as shown in (Fig. 53) and turn the face of the indicator so that the hand points to zero. This will set the indicator to the mean standard size, which is 3.126 inch. Standard size Cadillac cylinders in manufacture are ground to the following limits: 3.125 inch to 3.127 inch. Set the indicator with shoe into cylinder bore as shown in (Fig. 54) and with a bent rod fitted into the hole drilled in the shoe, move the indicator

back and forth. The size of the cylinder bore and any variation in size between the upper and lower end may thus be determined.

Caution:—Use great care in handling the master ring and indicator. These parts may easily be rendered inaccurate.

Note:—The above tool cannot be used for testing first oversize cylinders 3.141 inch to 3.143 inch or second oversize cylinders 3.156 inch to 3.158 inch.

There should be no more than .007 inch clearance between a cylinder bore and that part of the piston below the lower piston ring.

Inspect the valve seats, as well as the surfaces of the valves which contact with the seats. This may be done by forcing open the valves by hand. At the same time note if the valve stems work freely in their guides; if not, the valves should be removed and the stems and guides cleaned and lubricated.

Determine the clearance between the valve stems and the bushings in the cylinder blocks. This should not exceed .004 inch.

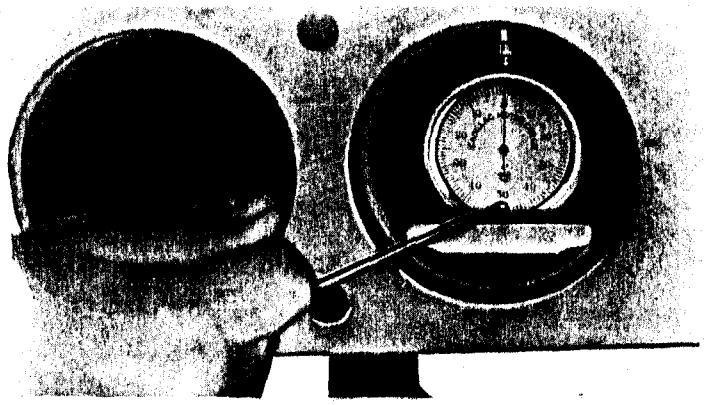


Fig. 54—Indicating Cylinder Bore.

If a valve or seat is pitted or if it appears that the valve has been leaking, the valve should be reground. (See under "Grinding Valves," page 39.) If valve seats require reseating use Cadillac reseater tool numbered 65743.

INSPECTION OF OTHER PARTS—Inspect the pistons and piston rings. (See "Inspection of Piston and Rings" under "Piston and Piston Rings," page 120.) If the wear on a piston seems to indicate that the rod is sprung or twisted, test the rod for alignment. (See "Inspection of Rods" under "Connecting Rods," page 128.)

Inspect the crank pin bearings. (See "Inspection of Bearings" under "Crank Pin Bearings," page 104.)

Inspect the crank pins. Crank pins should be round within .003 inch and free from scores; if not they should be dressed down. (See under "Dressing Down Crankshaft Bearing Surfaces," page 35.) A new undersize bearing should be fitted if there is more than .006 inch between a pin and bearing after the work is completed. (See under "Fitting Crank Pin Bearings," page 31.)

Replacement

Make sure that the cylinders and the pistons are free from carbon. Carbon can be removed with a soft iron scraper.

In replacing, reverse operations under "Removal."

Be careful to replace the connecting rods as originally assembled into the engine. Connecting rods are numbered on the channel section indicating the cylinders into which they go. Number one forked rod and number one straight rod go into cylinders nearest the radiator; number two forked rod and number two straight rod go into cylinders just back of these, etc. The numbers on the channel sections of the rods should face downward and the numbered ends of the rod bearings should face to the rear.

Care should be exercised that the dowel pins in the forked rod caps are in the pin holes in the bearings before tightening the cap nuts.

All nuts and bolts and both bearing caps of forked rods are numbered. One bolt and nut only and the cap of straight rods are numbered. Bolts, nuts and caps should be replaced in accordance with these numbers.

The following will serve to check the assembly of the connecting rods and crank pin bearings: The forked connecting rods should be on the left-hand side of the engine. The edges of the crank pin bearing halves where they come together should be in the horizontal plane when the pistons attached to the forked rods are on upper and lower centers. The longer piston bosses on the upper ends of the two center connecting rods in each cylinder block should face toward each other. The longer piston pin bosses on the upper ends of the end connecting rods in each cylinder block should face from each other.

In adjusting the straight connecting rod follow directions under "Adjustment of Connecting Rod Bearings," page 29.

After replacing the oil pan refill with seven quarts of engine oil of a suitable quality. Cadillac Engine oil is recommended.

If a new cylinder block is installed it will be necessary to ream the dowel pin holes. With the block in place use a number 8 standard taper reamer, being careful to catch all chips from the under side. Ream only enough to clean up the holes.

CRANKCASE

Removal

Remove and disassemble the engine. (See "Removal" and "Disassembly" under "Engine," pages 101 and 102.)

Inspection

With gasoline or kerosene clean all parts.

INSPECTION OF CRANKCASE—Examine the casting carefully and inspect all machined surfaces.

Examine the bearings for the camshaft. There should be no more than .005 inch clearance between the bearings and the shaft. The

bearings should be free from scores. If it is necessary to replace one of the bronze bearings tap it out carefully and carefully tap in the new bearing. Cadillac tool, numbered 72407 can be used for this purpose. If it is necessary to replace the rear bearing it will be necessary to first remove the cap "N" (Fig. 50, page 107.) The bearing may then be tapped out from the rear.

Make certain that all crankcase studs are tight in the aluminum and that they are screwed in as far as they should go.

INSPECTION OF OTHER PARTS—Inspect all parts in accordance with directions in this book.

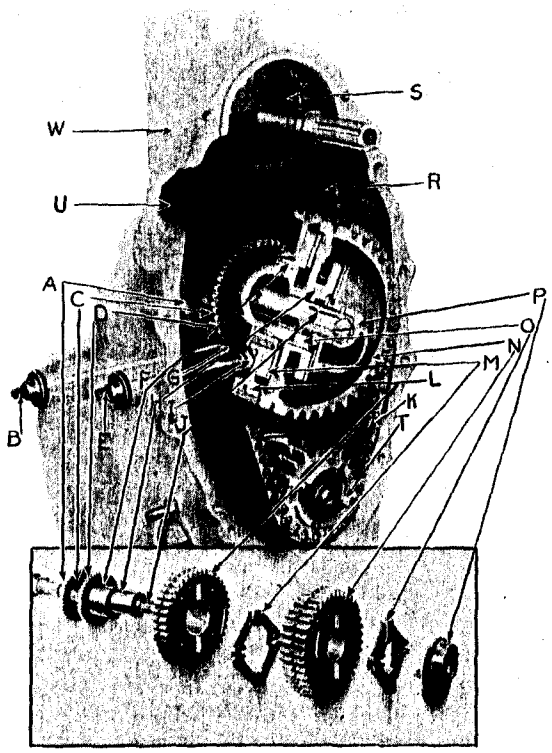


Fig. 55—Adjustment for Engine Chains

Replacement

After inspecting all parts, reassemble and replace the engine. (See "Reassembly and Replacement" under "Engine," page 103.)

ENGINE CHAINS

Description of Adjusting Mechanism

Camshaft sprockets "N" and "L" (Fig. 55) are not integral nor do they bear upon the camshaft as in earlier eight cylinder construction,

The camshaft sprockets have their bearings and rotate upon eccentric surfaces "H" and "F" of the support "C."

The support "C" is clamped into the crankcase by the locking collar "A". The camshaft "J" rotates in bearings carried in the support "C."

Shafts "E" and "B" fitted with worm gears "I" and "G" meshing with teeth cut upon the flange "D" of the support "C" and with teeth cut upon the collar "A" serve as means whereby the collar "A" may be loosened or tightened and the support "C" turned.

Turning the support "C" by the shaft "E," which may be done after the collar "A" is loosened by turning the shaft "B" in a clockwise direction, raises the sprocket "N" and lowers the sprocket "L" as these sprockets have their bearing upon eccentric surfaces of the support "C." In other words, the center distances are increased between the crankshaft sprocket "T" and the camshaft sprocket "N" and between the fan sprocket "S" and the camshaft sprocket "L." The chains are thus tightened.

Camshaft sprocket "N" is driven from the crankshaft sprocket "T" by the chain "K." Camshaft sprocket "L" is driven from camshaft sprocket "N" by a universal cross "M" through lugs on the inner surfaces of these sprockets. Camshaft "J" is driven by camshaft sprocket "N" through the universal cross "O" and the driver "P." The fanshaft sprocket "S" is driven from the camshaft sprocket "L" by the chain "R."

Removal

Remove front cover plate. (See "Removal" under "Front Cover Plate" page 122.)

Cut off the riveted head on one of the seat pins in the camshaft driving chain "K" (Fig. 55) and remove the seat and rocker pins. (See Fig. 11.)

In cutting off the seat pin use a thin chisel with a long point and hold a heavy peice of brass under the end of pin to prevent the chisel from slipping and damaging the chain. The camshaft driving chain can now be removed.

To remove the fanshaft driving chain "R" (Fig. 55) remove the camshaft driving chain "K" as above and then remove the camshaft driver "P" by driving out taper pin. Remove camshaft sprocket "N" and crosses "M" and "O".

On the first type engines remove the four screws holding the sprocket "S" to the fanshaft.

Fan drive chain can now be removed.

On the latter type engines the fanshaft chain can be removed by cutting off the seat pin and removing pin through hole "U" in fan housing "W" (Fig. 55.)

Replacement

In replacing chains care must be exercised that the chains are so placed on the sprockets that the valve timing is correct.

If the fanshaft chain has been removed replace it before replacing the camshaft chain. In reassembling reverse operations under "Removal" page 115. Use Cadillac rivet inserter 56331 and riveting block 83231.

One tooth of the camshaft sprocket "N" (Fig. 55) is marked with an arrow and the tooth diametrically opposite with an "O". One tooth on the crankshaft sprocket "T" is marked with an "O." Turn the camshaft sprocket and crankshaft sprocket into position or with zero marks vertical with center lines of shafts. Without turning either of the sprockets replace the chain, with the arrows which are stamped on the outside links, pointing in the direction in which the chain is to run.

Bring the ends of the chain together, preferably on the upper side of the camshaft sprocket, then insert the pins and rivet. (See under "Riveting Chains," page 41.)

Replace camshaft driver (use Cadillac pusher numbered 83233) and make certain that sprockets are in correct position with zero marks in line and both valves closed on number one cylinder. Replace front cover by reversing operations under "Removal," page 115.

FAN

Removal

Remove the radiator. (See "Removal" under "Radiator," page 149.)

Remove the screw "R," (Fig. 50) (Right hand thread.)

The fan with hub can now be removed by pulling it straight forward.

Inspection

Inspection of Fan—After cleaning the fan inspect the surfaces against which the friction discs press, also the rivets at the rim of the fan and at the center.

After the fan is put back and the engine is started, note if the fan runs true. If it does not it should be trued up.

Replacement

In replacing the fan reverse the operations under "Removal."

SPIRAL GEAR FOR OIL PUMP DRIVE

Removal

Remove the oil pan and the baffle plate. (See "Removal" under "Oil Pan and Baffle Plate," page 124.)

Remove the front cover. (See "Removal" under "Front Cover," page 122.)

Determine the amount of clearance between the teeth of the gear to be removed and those of the gear with which it meshes. (See under "Inspection.")

Remove the taper pin "O," (Fig. 50, page 107.)

Remove the shaft "P." To do so tap it forward carefully.

Inspection

With kerosene or gasoline clean all parts.

There should be no more than .018 inch clearance between the teeth of the gear just removed and those of the gear with which it meshes. The bearing surfaces of the drive shaft, and those of the bushings in which it rotates should be free from scores. There should be no more than .004 inch between the shaft and bushings. If necessary to replace either bushing drive it out carefully. Unless very great care is exercised in removing and replacing, there is a possibility of cracking the aluminum.

Examine the oil holes to each bushing. Clean out if obstructed.

Examine the faces of the thrust washer. They should be free from scores.

The gear should have no more than .008 inch end play.

Replacement

In replacing, reverse operations under "Removal."

After replacing oil pan, refill with seven quarts of engine oil of a suitable quality. Cadillac Engine oil is recommended.

If, after starting the engine, it is found that the pressure gauge does not register pressure, stop the engine at once and prime the oil pump. This may be done by disconnecting, at its upper end, the oil pipe from the oil pressure regulator and forcing two to three gunfuls of clean engine oil into the pipe. Connect the pipe and tighten the union before starting the engine.

CYLINDER HEADS

Removal

Drain the cooling system. (See under "Draining the Cooling System," page 67.)

Remove the hose connections from the cylinder head.

Disconnect the high tension wires from the spark plugs and remove the conduit brackets from the cylinder head. Remove the forward end of the conduit from the aluminum cap by removing the two screws holding the bracket at the end of the conduit to the cap. Lay the conduit with wires back out of the way.

Remove the spark plugs. Remove the twenty nuts by which the cylinder head is held to the block.

Remove the cylinder head and the gasket.

Inspection

INSPECTION OF HEAD AND GASKET—Inspect the machined surfaces of the cylinder head. Inspect the gasket. Do not use the gasket again unless you are sure it is in condition for further use. Ordinarily a gasket may be used several times unless it is injured in removing.

INSPECTION OF OTHER PARTS—Inspect the cylinder bores. Cylinder bores should be free from scores.

Examine the machined face of the cylinder which presses against the gasket.

Replacement

With a soft iron scraper remove all carbon from the cylinder head, cylinder and piston heads.

Before replacing gaskets coat them with heavy cup grease. After replacing the head, screw on the twenty hold-down nuts by hand. Then begin with the center nut in the middle row, work towards the ends, tightening the nuts lightly with a wrench. Then do the same with the nuts on the inner row, and finally with those on the outer row. After all nuts are tightened lightly, go over them again, tightening them firmly.

In refilling the cooling system follow directions under "Filling Cooling System," page 65.)

FANSHAFT HOUSING

Removal

Remove the fan. (See "Removal" under "Fan," page 116.)

Remove the distributor and timer. (See "Removal" under "Distributor and Timer," page 145.)

Remove the fanshaft. (See "Removal" under "Fanshaft," page 108.)

Remove the two dowel pins which locate the fanshaft housing on the crankcase. To remove the dowel pins place spring washers over the pins large enough to permit the pins to be pulled through them, and screw on and tighten $\frac{5}{16}$ inch x 18 nuts.

Remove the four cap screws by which the fanshaft housing is held to the crankcase and the two cap screws by which the housing is held to the front cover plate.

The housing can now be removed.

Inspection

Clean all parts with gasoline or kerosene.

INSPECTION OF FANSHAFT HOUSING—Examine the machined surfaces of the housing. Also examine the casting.

INSPECTION OF OTHER PARTS—Inspect the fanshaft and fanshaft bushings. (See "Inspection of Fanshaft and Bearings," under "Fanshaft," page 108.)

Replacement

In replacing, reverse operations under "Removal."

After replacing the distributor and timer, retime the ignition and place four ounces of Cadillac distributor grease in the housing. The grease may be put in after removing the breather "Z," (Fig. 65, page 147.)

INTAKE MANIFOLD

Removal

Remove the two cap screws holding the carburetor to the manifold.

Remove the two cap screws holding each intake manifold flange to a cylinder block.

The intake manifold can now be removed.

Inspection

CLEANING INTAKE MANIFOLD—Remove the manifold jacket cover plates and clean out the carbon deposit from the inside of the hot air jacket. Use a wire brush or other suitable tool.

INSPECTION OF INTAKE MANIFOLD—After cleaning the manifold inspect the finished surfaces against which the carburetor and cylinder blocks are bolted. The surfaces must be in good condition and perfectly flat to prevent air leaks at these points. Inspect the hot air jacket.

INSPECTION OF OTHER PARTS—Inspect the surface of the carburetor and the surface of the cylinder blocks which bolt against the manifold. These surfaces must be in good condition and perfectly flat.

Replacement

In replacing the intake manifold, reverse the operations under "Removal." Make sure that all gaskets are in good condition, also that the cap screws holding the manifold to the cylinder blocks and the carburetor to the manifold are drawn down together and well tightened to prevent air leaks.

WRIST PINS

Removal

Remove the piston and connecting rod. (See "Removal" under "Connecting Rods," page 128.)

The wrist pin can be removed by pressing it out by hand after the small set screw in the wrist pin support is removed.

Inspection

Thoroughly clean all parts with gasoline or kerosene and wipe them off with a cloth.

There should be no more than .003 inch clearance between the wrist pin and the bushing and no more than .0015 inch clearance between the wrist pin and the piston.

Replacement

To facilitate replacement of the screw which locks the wrist pin, place the piston on the rod so that the wrist pin support, with the screw, is on the side of the rod with the longer wrist pin boss.

PISTON AND PISTON RINGS

Removal

Remove the connecting rods with pistons from the engine and the pistons from the connecting rods. (See "*Removal*" under "Connecting Rods," page 128.)

With hack saw blades as shown in (Fig. 56) remove the piston rings. The teeth should be ground from the saw blades to prevent injury to the piston and rings. Care must be used in removing the rings not to strain them.

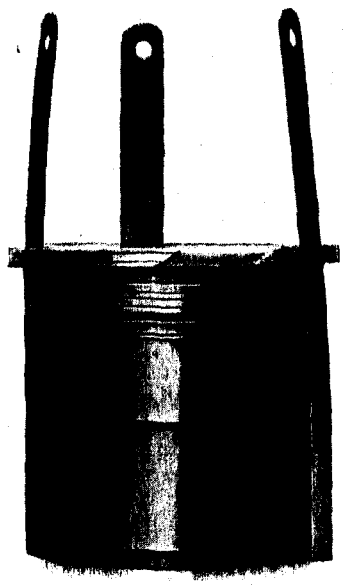


Fig. 56—Removing Piston Rings

Inspection

Clean all parts with gasoline or kerosene.

INSPECTION OF PISTON AND RINGS —Pistons should be free from scores and round within .002 inch. The difference in width between the piston rings and the grooves should not exceed .003 inch.

Piston pins should have no more than .0015 inch clearance in the piston.

There should be no more than .007 inch clearance between the cylinder and the skirt of the piston and no more than .020 inch clearance between the ends of the rings when the piston is in place in the cylinder.

INSPECTION OF OTHER PARTS—If wear on a piston seems to indicate that the connecting rod is sprung or twisted, test the rod for alignment. (See "Inspection of Rods" under "Connecting Rods," page 128.)

Inspect the wrist pin. (See "Inspection" under "Wrist Pins," page 119.)

Inspect the wrist pin bushings. (See "Inspection of Rods" under "Connecting Rods," page 128.)

Inspect the crank pin bearing. (See "Inspection of Bearing" under "Crank Pin Bearings," page 104.)

Inspect the crank pin. The crank pin should be round within .003 inch and free from scores; if it is not, it should be dressed down. (See under "Dressing Down Crankshaft Bearing Surfaces," page 35.)

A new standard or undersize bearing should be fitted if there is more than .006 inch clearance between the pin and the bearing after the work is completed. (See under "Fitting Crank Pin Bearings," page 31.)

Inspect the cylinder bores. Cylinder bores should be round within .002 inch and free from scores.

Replacement

With a scraper clean the carbon from the piston head and rings. A piece of heavy twine or a twisted strip of cloth can be used to clean the ring grooves.

Clean all parts carefully and lubricate all bearing surfaces with engine oil of suitable quality.

Be careful to replace the connecting rod as originally assembled into the engine. Connecting rods are numbered on the channel section, indicating the cylinders into which they go. Number one forked rod and number one straight rod go into cylinders nearest the radiator. Number two forked rod and number two straight rod in cylinders just back of these, etc. The numbers on the channel sections of the rods should face downward, and the numbered ends of the crank pin bearings should face to the rear.

All nuts and bolts and both caps of forked rods are numbered. One bolt and nut only and the cap of the straight connecting rod are numbered. Bolts, nuts and caps should be replaced in accordance with these numbers.

Care should be exercised that the dowel pins in the forked rod caps are in the pin holes in the bearing before tightening the cap nuts.

The following will serve to check the assembly of the connecting rods and crank pin bearings. The forked connecting rods should be on the left-hand side of the engine. The edges of the crank pin bearing halves where they come together should be in the horizontal plane when the pistons attached to the forked rods are on upper and lower centers. The longer wrist pin bosses on the upper ends of the two center connecting rods in each cylinder block should face toward each other. The longer wrist pin bosses on the upper ends of the end connecting rods in each cylinder block should face from each other.

In adjusting the straight connecting rod follow directions under "Adjustment of Connecting Rod Bearings," page 29.

After replacing the oil pan refill it with seven quarts of engine oil of a suitable quality. Cadillac Engine Oil is recommended.

FRONT COVER PLATE

Removal

Remove the radiator. (See "Removal" under "Radiator," page 149.)

Remove the hood shelves, also the splash pan at the front of the radiator.

Remove the splash pan under the engine.

Remove the fan. (See "Removal" under "Fan," page 116.)

Remove the air compressor cylinder and piston from the front cover plate. To remove the cylinder, first disconnect the air pipe, then remove the two small hold-down nuts. To remove the piston, crank the engine over by hand until the piston is at the top of its stroke, then move it forward.

Remove the cap of the front engine support.

Remove the two small nuts which hold each oil pump elbow flange to the crankcase.

Jack up the front end of the engine about four inches.

Remove the two dowel pins which position the cover plate on the crankcase. These pins may be removed by placing over them spring washers large enough to permit the pins to be pulled through, then screwing on and tightening $\frac{3}{8}$ inch x 16 nuts.

Mark the twelve cap screws holding the cover plate in place and remove the screws.

Remove the cover plate.

Inspection

Clean the cover plate with kerosene or gasoline.

Carefully inspect all machined surfaces, also the gasket between the plate and crankcase.

Make sure that the starting shaft works freely in its bearings.

Replacement

In replacing, reverse operations under "Removal."

Be certain that the twelve cap screws which hold the cover plate to the crankcase are replaced as originally assembled.

TOP COVER PLATE

Removal

Remove the intake manifold with carburetor. (See "Removal" under "Intake Manifold," page 119, and under "Carburetor," page 150.) It is unnecessary, however, to remove the carburetor from the manifold, or to drop the drain pocket located under the carburetor.

Remove the motor generator. (See "Removal of Motor Generator" under "Motor Generator," page 142.)

Remove the distributor and timer. (See "Removal" under "Distributor and Timer," page 145.)

Remove the oil level dial. This may be done after the two small cap screws holding it to the cover plate are removed.

Drain the oil pan by removing the drain plug "K," (Fig. 50, page 107.) It is not absolutely necessary to drain the oil pan, but doing so allows the float and float tube to drop, reducing the amount exposed above the cover plate. This is desirable as there is less likelihood of damaging the tube.

Remove the small red ball at the top end of the indicator tube. This may be done by tapping lightly upon the under side of the ball.

Remove the unions connecting the drain pipes to the drain pocket under the carburetor, and push the pipes to one side out of the way.

Remove the drain pocket.

Remove the nuts holding the cover plate to the crankcase, also the threaded dowel pin at each end of the cover plate. To remove a threaded dowel pin, place over it a spring washer large enough to permit the pin to be pulled through it, then screw on and tighten a $\frac{5}{16}$ inch x 18 nut.

Remove the cylinder heads. (See "Removal" under "Cylinder Heads," page 117.)

Raise all sixteen valves and hold them in the raised position. This may be done with two Cadillac valve-lifters, tool numbered 69283. If these tools are not at hand remove all sixteen valves. (See "Removal" under "Valves and Valve Springs," page 136.)

Remove the clamps holding the cam slide bushings in place and raise the cam slides and bushings.

The top cover plate can be removed by lifting it straight up and at the same time cranking the engine over very slowly. Both ends of the cover plate must be lifted evenly.

Inspection

Clean all parts with gasoline or kerosene.

INSPECTION OF TOP COVER PLATE—Inspect the cover plate.

Test with a straight edge the machined surfaces which bolt against the crankcase.

The bronze bushings in which the rocker arm shafts are held should be tight in the aluminum.

INSPECTION OF OTHER PARTS—Inspect the rocker arms and rocker arm shafts. (See "Inspection of Rocker Arms and Shafts" under "Rocker Arms and Shafts," page 104.)

Inspect the cams. They should show practically no wear.

Replacement

Make sure that the gasket between the plate and crankcase is in good condition.

In replacing, reverse the operations under "Removal."

After replacing distributor and timer, retime the ignition (see under "Timing Ignition," page 54) and put four ounces of Cadillac Distributor Grease or number two cup grease into the distributor housing. This may be done after removing the breather "Z," (Fig. 65, page 147.)

Refill the oil pan with seven quarts of suitable engine oil after replacing it. Cadillac Engine Oil is recommended.

OIL PAN AND BAFFLE PLATE

Removal

Remove the splash pan under the engine.

Drain the oil pan. This is done by removing the plug "K" (Fig. 50, page 107.)

Remove the twenty-seven nuts holding the oil pan to the crankcase, and remove the oil pan, being careful not to injure the cork gasket between the oil pan and the baffle plate.

Remove the oil float with the tube to which it is soldered. The small red ball at the upper end of the float tube will prevent the tube dropping down. The ball may be removed, however, by pushing the float up an inch or so and pulling it down, repeating the operation until the ball is forced off.

Remove the baffle plate, being careful not to injure the cork gasket between the baffle plate and crankcase.

Inspection

Inspection of Oil Pan and Baffle Plate—With gasoline or kerosene clean the oil pan and baffle plate. Make a careful inspection of these parts, also of the cork gaskets. The oil pan should be free from dents. The surface which presses against the gasket must be in good condition.

The screen of the baffle plate must be free from injury.

Inspection of Other Parts—Make sure that the unions are tight on all of the oil pipes inside of the crankcase. To determine this try them with a wrench.

Determine if the float contains oil. If it does it may be repaired by soldering it after the oil has been drained out.

If the float tube is bent in removing, straighten it before replacing.

Replacement

In replacing, reverse operations under "Removal."

To replace the red ball on the upper end of the indicator tube, it is necessary to remove the oil indicator, which can be done by removing the two screws. The red ball is a taper fit on the oil tube and should be tapped in place lightly.

After replacing the oil pan, refill it with seven quarts of suitable engine oil. Cadillac Engine Oil is recommended.

If after starting the engine it is found that the oil pressure gauge does not register pressure, stop the engine at once and prime the oil

pump. This may be done by disconnecting the oil pipe from the oil pressure regulator and forcing two to three gunfuls of clean engine oil into the regulator. Connect the pipe and tighten the union before starting the engine.

OIL PUMP

Removal

Remove the splash pan under the engine.

With gasoline or kerosene wash the pump and the front end of the engine around the pump.

Remove the two small nuts on each pump flange and the four small nuts by which the body of the pump is held to the front cover plate.

Remove the pump by pulling it straight forward. The pump will come off easily if both ends are removed evenly.

Inspection

Clean all parts with kerosene or gasoline, and inspect the pump body and elbows.

There should be no more than .004 inch clearance between the teeth of the pump gears and the pump body, no more than .004 inch clearance between the bearings at each end of the pump gears and the bushings in which they operate, and no more than .006 inch end play in the pump gears when the pump is bolted in place on the front cover plate.

Replacement

In replacing, reverse operations under "Removal," first making sure that all gaskets are in good condition, also that the surfaces which press against these gaskets are clean. Line up pump to make sure that spiral gear for pump drive turns freely.

If Cadillac made gaskets are not procurable make gaskets of paper .009 inch to .011 inch in thickness. If the gaskets are too thick, too much end play in the pump gears will be permitted resulting in a less efficient pump. All three gaskets must be made of paper of equal thickness.

If after starting the engine it is found that the pressure gauge does not register pressure, stop the engine at once and prime the oil pump. This may be done by disconnecting the oil pipe from the oil pressure regulator and forcing two to three gunfuls of clean engine oil into the regulator. Connect the pipe and tighten the union before starting the engine.

WATER PUMPS

Removal of Pump

Drain the cooling system. (See under "Draining the Cooling System," page 67.)

Remove the splash pan under the engine.

Disconnect at the water pump all hose connections.

Remove the two nuts which hold the pump to the crankcase.

The pump can now be removed. Remove both sides evenly.

Removal of Pump Impeller

Remove the pump. (See under "Removal of Pump," page 125.)

Disconnect the pipe "M" (Fig. 25, page 65), on the first type pump.

Remove the pump cover.

The impeller with shaft may then be removed. The pump shaft is held to the pump impeller by a taper pin. The shaft may be forced out of the impeller with a press after the pin is removed.

Removal of Thermostat (First Type)

Remove the pump. (See under "Removal of Pump," page 125.)

Disconnect thermostat drain pipe nut "E" (Fig. 25, page 65.)

Remove thermostat valve body "F."

Remove nut "G."

Thermostat can now be removed.

Removal of Thermostat Valve (First Type)

Drain the cooling system. (See under "Draining the Cooling System," page 67.)

Disconnect at the water pump, hose connection "O," (Fig. 25); also copper pipe "M."

Remove the thermostat housing cap "A."

Remove the spring.

The valve may now be removed.

Removal of Thermostat (Second Type)

Remove the thermostat housing cap "F" (Fig. 26, page 66.)

Remove the large brass nut "J" and the shaft "B."

Remove the thermostat valve body "K" with valve and thermostat intact.

With a screw-driver remove the slotted locking nut "E" and unscrew the valve "D" from thermostatic member. The thermostat "C" can now be removed.

Removal of Thermostat Valve (Second Type)

Drain the cooling system (See under "Draining the Cooling System" page 67).

Remove the thermostat housing cap "F" (Fig. 26).

Loosen the locking nut "E" and unscrew the valve "D" from thermostatic member.

Be careful not to injure the thermostat in removing.

Inspection

Test the thermostatic member. To do so proceed as follows:

Place the thermostat in water at a temperature of between 165° and 170° Fahrenheit. A first class thermometer should be used in determining the temperature of the water.

Under these conditions the thermostatic member should elongate from $\frac{3}{16}$" to $\frac{1}{4}$" in 15 to 30 seconds.

Inspect the valves "I" (Fig. 25) and the valve seats. Remove any rust or scale which has accumulated and regrind the valves if necessary.

The pump impeller and the bushings in which it operates, should be free from scores. The clearance between the shaft and either bushing should not exceed .006 inch. If it is necessary to remove the bushing which has the packing gland on its outer end, drive it out with a soft brass drift, after first driving out the $\frac{5}{16}$ inch x $\frac{3}{16}$ inch brass pin "J." The bushing in the pump cover may be removed by pulling it out. This bushing is not pined.

The pump impeller should have no more than .010 inch clearance in the pump body with the pump cover in place.

Examine the packing in the gland "K." If it is necessary to repack the gland follow directions under "Water Pump Packing Glands," page 68.

Replacement

In replacing, reverse operations under "Removal."

If the adjustment between the valves "I" (Fig. 25) and the thermostat "H" has been altered, readjust in accordance with directions under "Adjustment of Water Pump Valve," page 68.

OIL PRESSURE REGULATOR

Removal

Remove the oil pipe from the regulator by unscrewing the union.

Remove the four one-fourth inch nuts and washers holding the regulator to the crank case and remove the regulator.

Unscrew the cap from the regulator and remove the spring and ball.

Inspection

With kerosene or gasoline clean all parts.

Examine the ball. It should be clean and free from pits.

Examine the ball seat. The seat should be free from pits. It can be removed from the housing by driving it out carefully.

Examine the one-sixteenth inch by-pass hole "D" in the housing. (See Fig. 87.) The by-pass has an outlet in the hole through which oil passes to the pressure gauge pipe. The by-pass should be cleaned if obstructed.

The valve spring should have a free length of two and seven-sixteenths inches and should support a load of between six and one-half and seven and one-half pounds when compressed to one and three-fourths inches.

The surfaces of the housing which bolt against the crankcase should be in good condition.

Replacement

In replacing, reverse operations under "Removal."

If the regulator is in proper adjustment after installation the pressure gauge on the instrument board will indicate a pressure of between five and seven pounds when the engine is warm, idling at approximately 300 revolutions per minute, and the oil in the engine is of a suitable quality and fresh. Cadillac Engine Oil is recommended. If a higher or lower oil pressure is indicated, readjustment should be made in accordance with direction under "Adjustment of Oil Pressure Regulator," page 199.

CONNECTING RODS

Removal

Remove the oil pan and the baffle plate. (See "Removal" under "Oil Pan and Baffle Plate," page 124.)

Open the compression cocks.

Remove the cotter pins and the two nuts from the cap of the straight connecting rod. Remove the cap, being careful not to mix the liners.

Remove the rod and piston. Care must be exercised not to damage the piston in removing it. Do not allow the skirt of the piston to fall against the connecting rod.

Remove the cotter pins and the two nuts from each cap of the forked connecting rod and remove the caps.

Remove the rod and piston, being careful not to damage the piston or to allow the halves of the connecting rod bearing to drop.

Remove the bearing halves.

Remove the pistons from the connecting rods. This can be done by first removing the small set screw in the piston pin boss and pushing out the pin by hand.

Inspection

With kerosene or gasoline clean all parts removed.

Inspection of Rods—The wrist pin bushing should be free from scores. There should be no more than .003 inch clearance between the pin and the bushing. If it is necessary to replace the bushing proceed as follows: With a press force out the used bushing and force in the new one, being sure that the oil holes line up. Be careful not to spring the rod. Then ream the new bushing, using a three-fourths inch reamer. The size of the bushing when reamed should be between .7495 inch and .7502 inch. The rod should be tested for alignment after the bushing is in place and reamed.

Cadillac gauge, numbered 71969 as shown in (Fig. 57) can be used for this purpose.

To align the rod clamp the arbor into the lower bearing and with the hand lightly force an arbor of the correct size into the upper bearing. With the indicator in place on the gauge, set the connecting rod with arbor into the gauge as shown in (Fig. 57,) first making certain that the arbor and the bearing surfaces of the gauge are clean. Each end of the

small arbor should rest squarely upon the machined surfaces of the gauge; if they do not, remove the rod from the gauge and spring it lightly until they do. Then move the small end of the connecting rod up and down and watch the indicator. Set the indicator to zero by turning the dial. Remove the connecting rod with arbors and set it back in the gauge upside down. Move the small end of the rod as before and watch the indicator. If the hand does not indicate zero, remove the connecting rod and spring it lightly. Continue in this manner until the arbors are parallel.

The bearing at the lower end of the forked connecting rod must clamp in the rod. To cause this the diameter of that portion of the bearing which is held in the rod must be .001 inch greater than the rod diameter, taken lengthwise of the rod. If the bearing is not clamped, the caps on the rod may be reduced by rubbing them carefully over fine emery cloth stretched tightly over a machined surface plate.

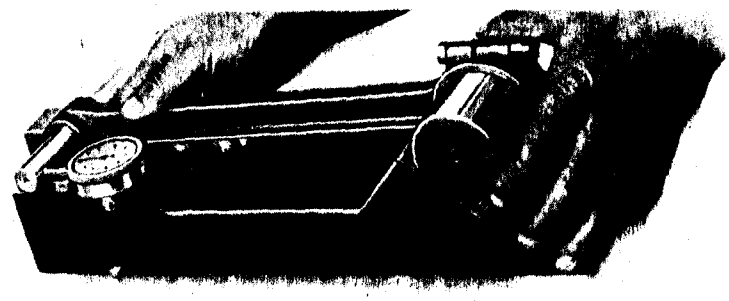


Fig. 57—Testing Connecting Rod for Alignment.

The bearings in the upper and lower ends of the rods should be parallel and in the same plane.

To test the forked rod for alignment proceed as directed in the preceding paragraph, "under Alignment of the Single Connecting Rod," with the lower bearing clamped in place. If the arbor is not a tight fit in the lower bearing use a new bearing.

Inspect the crank pin. The crank pin should be round within .003 inch and free from scores; if it is not it should be dressed down. (See under "Dressing Down Crankshaft Bearing Surfaces," page 35.) A new undersize bearing should be fitted if there is more than .006 inch clearance between the used bearing and pin, after the work is completed. (See under "Fitting Crank Pin Bearings," page 31.)

Inspect the pistons and the piston rings in accordance with directions under "Piston and Piston Rings," page 120.

Inspect the wrist pins. (See "Inspection" under "Wrist Pins," page 119.)

Inspect the cylinder bores. They should be round within .002 inch and free from scores.

Replacement

With a cloth carefully wipe off the pistons, connecting rods, and bearings and lubricate the bearing surfaces with engine oil of a suitable quality.

To facilitate replacement of the screws which lock the wrist pins, pistons should be so placed on the rods that the supports which have the screws are on the sides of the rods which have the longer wrist pin bushing bosses.

In replacing, reverse the operations given under "Removal."

Connecting rods are numbered on the channel section, indicating the cylinders into which they go. Number one forked rod and number one straight rod go into cylinders nearest the radiator; number two forked rod and number two straight rod into cylinders just back of these, etc. The numbers on the channel sections of the rods should face downward, and the numbered ends of the bearings at the lower ends of the rods should face to the rear.

Care should be exercised that the dowel pins in the forked rod caps are in the pin holes in the bearing before the cap nuts are tightened.

All nuts and bolts and both bearing caps on the forked rods are numbered. One bolt and nut and the cap only of the straight rod are numbered. Bolts, nuts and caps should be replaced in accordance with these numbers.

The following will serve to check the assembly of the connecting rods and crank pin bearings: The forked connecting rods should be on the left-hand side of the engine. The edges of the crank pin bearing halves where they come together should be in the horizontal plane when the pistons attached to the forked rods are on upper and lower centers. The longer wrist pin bosses on the upper ends of the two center connecting rods in each cylinder block should face toward each other. The longer wrist pin bosses on the upper ends of the end connecting rods in each cylinder block should face from each other.

In adjusting the straight connecting rod follow directions under "Adjustment of Connecting Rod Bearings," page 29.

After replacing the oil pan, refill it with seven quarts of suitable engine oil. Cadillac Engine Oil is recommended.

CAMSHAFT

Removal

Remove the camshaft driving chain. (See "Removal" under "Engine Chains," page 115.)

Remove the camshaft driver and sprocket. Use Cadillac puller numbered 83234.

Remove the carburetor. (See "Removal" under "Carburetor," page 150.)

Remove the generator drive shaft "A" (Fig. 50, page 107.)

Disconnect the timer control rod.

Remove the two cylinder head nuts which hold the brackets on the left-hand high tension conduit. Loosen the small screws of the brackets

which hold the right-hand conduit. Remove the distributor head and the low tension wire and lift the left-hand conduit with wires and head over to the right side.

Remove the distributor rotor. This may be done by lifting it straight up. If the rotor sticks on the shaft, force it off with two small screw drivers. The rotor is recessed on the under side at two points to receive screw drivers in removing. Lift both sides of the rotor evenly and lift it carefully.

Loosen the cap screw on the left rear corner of the fan shaft housing and remove the remaining three cap screws.

Slide forward the fanshaft housing with the distributor and timer attached.

Remove the top cover plate. (See "Removal" under "Top Cover Plate," page 122.)

Remove the lock nut for eccentric bearing by turning locking worm in a clockwise direction.

Remove the camshaft and eccentric bearing by pulling the shaft straight forward.

Camshaft bearings can be removed by the use of Cadillac tool, numbered 72407.

To remove a camshaft bearing place the large casting against the web of the crankcase as shown in (Fig. 58.) With the smaller washer in

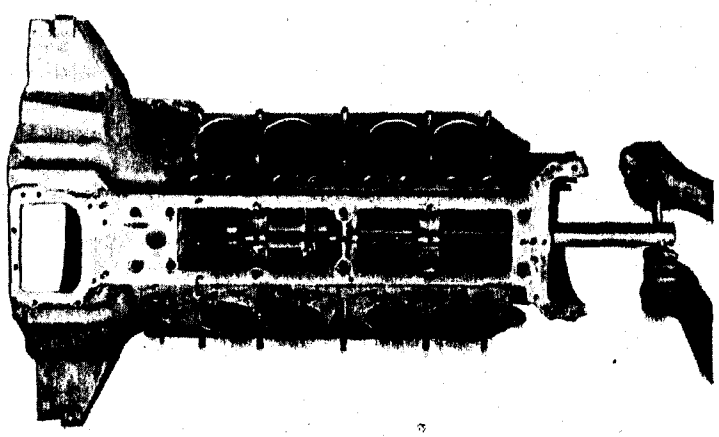


Fig. 58—Removing Camshaft Bearing

place against the edge of the bearing, screw on and tighten the nut, using the long socket wrench.

To replace a bearing reverse the casting and with either the larger or smaller washer in place, screw up on the nut. It is well to lubricate the new bushing before putting it in.

Inspection

INSPECTION OF CAMSHAFT—Clean the shaft with gasoline or kerosene and wipe it off with a cloth.

Inspect the oil hole in the shaft, cleaning it out if necessary.

Inspect the cams carefullly. They should show practically no wear.

All bearing surfaces of the camshaft should be round within .003 inch and free from scores. The clearance between the camshaft and the bearings should not exceed .005 inch.

INSPECTION OF OTHER PARTS—Inspect the camshaft bearings in the crankcase. The bearing surfaces should be free from scores. If it is necessary to replace one of the three center bearings tap it out and carefully tap in the new bearing; Cadillac tool, numbered 72407 can be used for this purpose. If it is necessary to replace the rear bearing, first remove the flywheel (see "Removal" under "Flywheel," page 137), then remove the cap "N" (Fig. 50.) The bearing may then be driven out from the rear.

Inspect the rocker arms and rocker arm shaft. (See "Inspection of Rocker Arms and Shafts" under "Rocker Arms and Shafts," page 104.)

Replacement

In replacing, reverse operations under "Removal."

When replacing cam shaft driver use Cadillac pusher numbered 83233.

Be sure to replace the camshaft driving chain correctly. (See "Replacement" under "Engine Chains," page 116.)

CRANKSHAFT

Removal

Remove the top cover plate. (See "Removal" under "Top Cover Plate," page 122.)

Remove the camshaft driving chain. (See "Removal" under "Engine Chains," page 115.)

Remove the flywheel. (See "Removal" under "Flywheel," page 137.)

Remove the cover "H" (Fig. 50), at the rear end of the crankcase.

Remove the connecting rods and pistons. (See "Removal" under "Connecting Rods," page 128.)

Determine the amount of clearance between the teeth of the spiral gear on the crankshaft and those of the gear with which it meshes. (See under "Inspection.")

Remove the main bearings, being careful that the shaft does not drop. (See "Removal" under "Main Bearings," page 106.)

Carefully tap up the main bearing bolts until their lower ends are flush with the machined surfaces against which the liners are held.

The crankshaft can now be removed.

Inspection

INSPECTION OF CRANKSHAFT—Remove the twelve plug screws by unscrewing them with a large screw driver and clean out the oil ways

thoroughly. Replace the plugs and tighten, locking them by making a fairly light punch mark between the shaft and each screw.

Wash the shaft with gasoline or kerosene and inspect all bearing surfaces. If any of the bearing surfaces are cut, or out of round more than .003 inch they should be dressed down. (See under "Dressing Down Crankshaft Bearing Surfaces," page 35.) If after dressing down a crank pin there is more than .006 inch clearance between the pin and the crank pin bearing, a new standard or undersize bearing should be fitted. (See under "Fitting Crank Pin Bearings," page 31.)

End play in a crank pin bearing should not exceed .015 inch. The clearance between a crank pin bearing and the crank pin should not exceed .006 inch. There is no adjustment on crank pin bearings. Crank pin bearings .005 and .020 inch undersize are furnished by our Parts Department.

The end thrust of the crankshaft is taken by the rear main bearing. The crankshaft should have no more than .020 inch end play in this bearing.

Place the shaft on lathe centers. It should run out of true no more than .004 inch at the center bearing.

INSPECTION OF OTHER PARTS—Examine the oil hole in the spiral gear on the crankshaft. Clean out if obstructed.

Inspect the main and crank pin bearings. (See "Inspection of Bearing" under "Main Bearings" and under "Crank Pin Bearings," pages 106 and 104.)

Inspect the pistons and piston rings. (See "Inspection of Piston and Rings" under "Piston and Piston Rings," page 120.) If the wear on a piston seems to indicate that the rod is sprung or twisted, test the rod for alignment. (See "Inspection of Rods" under "Connecting Rods," page 128.)

Inspect the cylinder bores. They should be round within .002 inch and free from scores. See under "Inspection of Cylinder Block," page 111.)

When the crankshaft is in place there should be no more than .018 inch clearance between the teeth of spiral gear on the shaft and those of the gear with which it meshes.

Inspect the camshaft and fanshaft driving chains and sprockets.

Inspect the flywheel. (See "Inspection" under "Flywheel," page 138.)

Inspect the annular ball bearing at the rear end of the crankshaft. The races should rotate smoothly and quietly and have no more than .015 inch end play.

Replacement

Before replacing the shaft, wipe it off with a cloth and lubricate the bearing surfaces with engine oil of a suitable quality.

In replacing; reverse the operations under "Removal."

The main bearings are numbered on one end. The bearing nearest to the radiator is stamped "1," the center bearing "2" and the rear

bearing "3." In replacing, have the numbered ends toward the radiator. In adjusting the main bearings follow directions under "Adjustment of Main Crankshaft Bearings," page 30.

Be careful to replace the connecting rods as originally assembled into the engine. Connecting rods are numbered on the channel section, indicating the cylinders into which they go. Number one forked rod and number one straight rod go into cylinders nearest radiator; number two forked rod and number two straight rod go into cylinders just back of these, etc. When placed in the engine the numbers on the channel sections of the rods should face downward, and the numbered ends of the bearings at the lower ends of the rods should face to the rear.

All nuts and bolts and both bearing caps of forked rods are numbered. One bolt and nut only, and the cap of straight rods are numbered. Bolts, nuts and caps should be replaced in accordance with these numbers. Care should be exercised that the dowel pins in the forked rod caps are in the pin holes in the bearings before the cap nuts are tightened.

The following will serve to check the assembly of the connecting rods and crank pin bearings. The forked connecting rods should be on the left-hand side of the engine. The edges of the crank pin bearing halves where they come together should be in the horizontal plane when the pistons attached to the forked rods are on upper and lower centers. The longer wrist pin bosses on the upper ends of the two center connecting rods in each cylinder block should face toward each other. The longer wrist pin bosses on the upper ends of the end connecting rods in each cylinder block should face from each other.

In adjusting the straight connecting rods follow directions under "Adjustment of Connecting Rod Bearings," page 29.

After replacing the oil pan refill it with seven quarts of suitable engine oil. Cadillac Engine Oil is recommended.

If after starting the engine it is found that the pressure gauge does not register pressure, stop the engine at once and prime the oil pump. This may be done by disconnecting the oil pipe from the oil pressure regulator and forcing two to three gunfuls of clean engine oil into the regulator. Connect the pipe and tighten the union before starting the engine.

DRIVE SHAFT FOR WATER PUMPS

Removal

Remove the splash pan under the engine.

Drain the cooling system. (See under "Draining the Cooling System," page 67.)

Remove the oil pan and the baffle plate. (See "Removal" under "Oil Pan and Baffle Plate," page 124.)

Determine the amount of clearance between the teeth of the gear on the drive shaft for the water pumps and those of the gears with which it meshes. (See under "Inspection.")

Remove one of the water pumps. (See "Removal of Pump" under "Water Pumps," page 125.)

Remove the packing nut. Place the Cadillac puller, tool numbered 66869, in position as shown in (Fig. 59,) screwing the threaded portion well into the bearing to be removed and screw up and tighten the large nut. The right hand bushing has a left hand thread while the left hand bushing has a right hand thread. There is a right hand thread on one end of the tool and a left hand thread on the other for the removal of either bushing.

Remove the drive shaft with gear and thrust bearing.

The remaining drive shaft bushing can be removed by use of Cadillac tool, numbered 66869, if desired, after removing the remaining water pump.

Inspection

Clean all parts with kerosene or gasoline.

INSPECTION OF DRIVE SHAFT, GEAR, BUSHINGS AND THRUST BEARING—The drive shaft and the bushings in which it rotates should be free from scores. There should be no more than .006 inch clearance between the shaft and bushings.

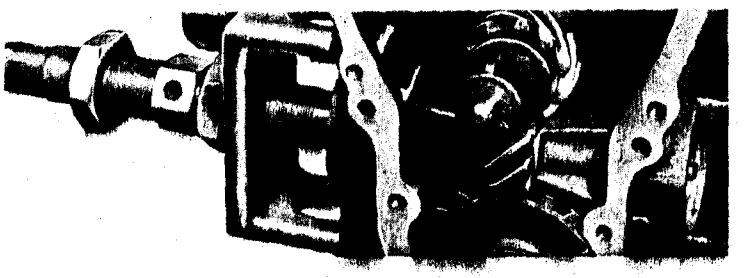


Fig. 59—Removing Water Pump Bearing

Inspect the balls of the thrust bearing, also the thrust washer and the side of the gear upon which the balls rotate. The balls should be free from pits and in good condition. The surfaces of the washer and gear should be free from pits and worn no more than .006 inch where the balls contact with them. If these parts are worn or pitted they may be reversed and used again.

There should be no more than .018 inch clearance between the teeth of the gear and those of the gears with which it meshes. If it is necessary to remove the gear from the shaft do so with a press. Be sure in pressing on the gear that it stands exactly in the center of the shaft.

INSPECTION OF OTHER PARTS—Examine the packing in the glands of the water pumps before replacing the pumps. (See under "Water Pump Packing Glands," page 68.)

Replacement

In replacing, reverse operations under "Removal."

The grooved end of the shaft should be on the left side.

With the bushings in place the drive shaft should have no less than .002 inch end play and no more than .005 inch.

CAM SLIDES AND GUIDES

Removal

Remove the valve, over the cam slide and guide to be removed. (See "Removal" under "Valves and Valve Springs," page 136.) The cam slide may then be lifted out.

Remove the clamp which holds the guide for the cam slide and remove the guide.

The guide may be removed by the use of Cadillac puller, tool numbered 72394, as shown in (Fig. 60.)

Insert the part "A" (Fig. 60) in the cam slide guide, force it to one side of the guide and insert the locking wire "B." With a bar under the hook "C" the guide can be removed.

Inspection

INSPECTION OF CAM SLIDE AND GUIDE—There should be no more than .004 inch clearance between a cam slide and the guide in which it operates.

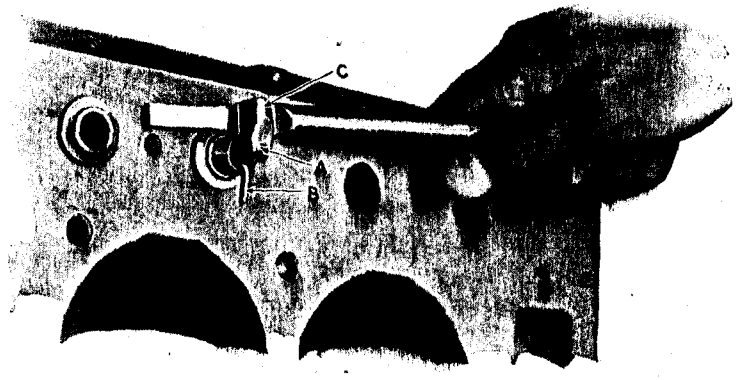


Fig. 60—Removing Cam Slide Guide

The upper face of the head of the cam slide adjusting screw should show very little wear.

INSPECTION OF OTHER PARTS—Inspect the valves in accordance with directions in this book. (See "Inspection" under "Valves and Valve Springs," page 137.)

Replacement

In replacing, reverse operations under "Removal."

Time the valves in accordance with directions in this book under "Adjustment of Cam Slide," page 39.

VALVES AND VALVE SPRINGS

Removal

Remove the cylinder head. (See "Removal" under "Cylinder Heads," page 117.)

Remove the carburetor. (See "Removal" under "Carburetor," page 150.)

Remove the valve cover plate.

Force up washer "E," (Fig. 10,) page 39), by use of Cadillac valve lifter, tool numbered 65201, then remove the split collar "F." Let the washer "E" down carefully and both sides evenly.

(If all valves in a block are to be removed at one time, and tool numbered 69283, furnished by our Parts Department, is at hand, all eight washers "E" (Fig. 10) may be lifted at one time and the washers and springs held in position while the collars and valves are removed and replaced.)

Inspection

Clean all parts with gasoline or kerosene.

INSPECTION OF VALVES—Clean the valve seat in the cylinder block, and the bushing in which the valve stem operates. Any carbon on the valve stem, or in the bushing should be removed.

There should be no more than .004 inch clearance between a valve stem and the valve stem bushing.

Inspect the valve seat in the cylinder block and the surface of the valve which bears on the seat. If the valve or valve seat is pitted or if it appears that the valve has been leaking it should be reground. (See under "Grinding Valves," page 39.)

Inspect the valve spring. Valve springs should have a minimum free length of four and three-fourths inches and a minimum pressure of 90 to 95 pounds when compressed to three inches.

Replacement

In replacing, reverse the operations under "Removal."

The timing of the valves should be checked up after replacement is made. (See under "Adjustment of Cam Slide," page 39.)

FLYWHEEL

Removal

Remove the transmission. (See "Removal" under "Transmission," page 154.)

Remove the flywheel pointer.

Remove the two five-sixteenths inch cap screws and clips holding the dowel pins in place.

Remove the dowel pins. This may be done by placing spring washers over them large enough to permit the pins to be pulled through them and screwing on and tightening two of the nuts which hold the flywheel.

Remove the six seven-sixteenths inch nuts which hold the flywheel to the crankshaft, and remove the felt washer retainer, steel washer, felt washer and two paper gaskets.

The flywheel can now be removed.

Inspection

INSPECTION OF FLYWHEEL—Make an inspection of the teeth on the flywheel. If the teeth are burred somewhat on the ends, smooth them up with a mill file.

INSPECTION OF OTHER PARTS—With kerosene or gasoline wash out the annular ball bearing at the rear end of the crankshaft. Inspect this bearing by rotating the inner race and by noting the amount of end play in the race. The race should rotate smoothly and quietly and should have no more than .015 inch end play. The bearing is a close fit in the crankshaft and may be removed either with a suitable puller, or by suitably bent pries.

Replacement

Before replacing the felt washer soak it in lubricating oil of a good quality, and fill the space between the races of the bearing with number two cup grease or Cadillac distributer grease.

Have the piston in No. 1 cylinder on firing center before replacing the flywheel. Then replace the flywheel, having the 1-5 center mark on the wheel pointing up.

Replace the flywheel pointer and adjust it as follows: With the left hand cylinder head removed, turn the crankshaft and flywheel in the direction in which the engine runs, until the piston in No. 1 cylinder has passed top center and has travelled $\frac{1}{4}$ inch on its downward stroke. Then adjust the nuts on the pointer so that the tip of the pointer is exactly opposite the 1-5 center mark on the flywheel.

ELECTRICAL SYSTEM

CIRCUIT BREAKERS

Inspection

The left-hand circuit breaker (looking at the dash from the driver's seat) protecting the circuits to the horn, inspection lamp, tonneau-lamp and cigar lighter, should remain closed, under a load of 25 amperes, but should open and remain open under a load of 30 amperes, or more. The right-hand breaker protecting circuits to the ignition apparatus, and the remainder of the lamps should remain closed under a twenty-five ampere load, but should vibrate under a load of thirty amperes or more.

The right-hand circuit breaker may be tested by removing the wire leading to the side of the inspection lamp body, connecting one wire from a rheostat to the wire and the other wire from the rheostat to the frame of the car. The left-hand circuit breaker may be tested by removing one of the head light wires, connecting one wire from a rheostat to the wire and the other wire from the rheostat to the frame of the car. By turning on current to the headlamps and watching the ammeter on the dash the amount of resistance may be determined. The dash ammeter registers 30 amperes only, which is sufficient for testing either circuit breaker. Increasing the load to more than 30 amperes may injure the ammeter.

If either circuit breaker operates under a load of less than 25 amperes,

or refuses to operate under a load of 30 amperes, it is recommended that the breakers be replaced and returned to the factory for adjustment.

Removal

Disconnect at the storage battery one of the large cables and block it up to prevent it touching the terminal of the storage battery.

Mark the four wires on the circuit breakers so that they may be replaced as originally assembled. Loosen the nuts on the four terminals and remove the wires.

Remove the two small bolts which hold the circuit breakers to the dash.

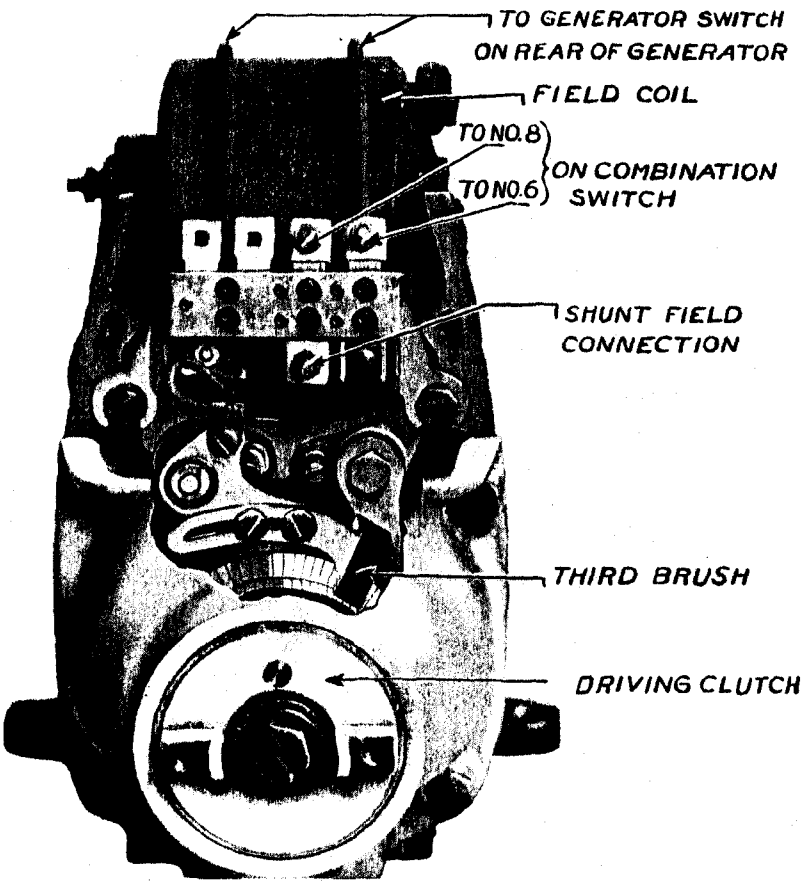


Fig. 61—Motor Generator, Front View

Replacement

In replacing the circuit breakers make sure that the four wires are replaced as originally assembled, that the terminals on the wires and on the circuit breakers are clean and that all connections are well tightened.

MOTOR GENERATOR

Testing the Motor Generator. (On Car.)

Test the generator field windings and the generator armature windings for short circuit, open circuit or ground by turning on ignition and observing the operation of the armature. If there is no short circuit, open circuit or ground in the generator field windings, the armature will rotate at between 175 and 300 revolutions per minute. The speed at which the armature should rotate depends upon the state of charge of the storage battery. If there is a short circuit, open circuit, or ground in the generator armature windings, the armature will fail to rotate or, if it rotates, will do so with a jerky motion.

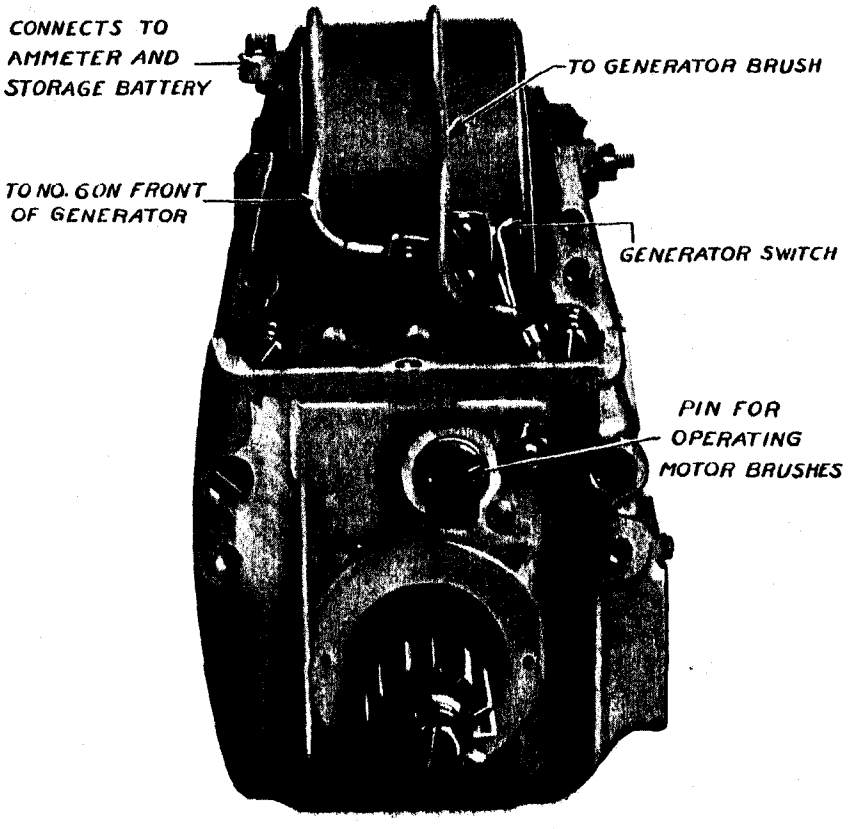


Fig. 62—Motor Generator, Rear View.

Test the motor field circuit and the motor armature circuit by turning on ignition, pushing down on the starter pedal and immediately switching off the ignition. Before making this test be sure that the battery is in a charged condition, the motor commutator is clean, the brushes bear properly on the commutator, and that all electrical connections are tight.

If the engine turns freely, the motor generator should crank it over at approximately 90 revolutions per minute.

To determine if either generator bearing is noisy, remove the generator drive shaft, and turn on ignition.

Testing the Motor Generator. (Off Car.)

If the motor generator is not on the car the foregoing tests may be made by connecting one wire from a charged six volt storage battery to number four terminal on the motor generator (Fig. 20) connecting together terminals three and four and connecting the other wire from the battery to the frame of the generator. Test the generator windings with the motor brushes lifted. Test the motor windings with the motor brushes against the commutator and the generator switch open. Operated as a motor, the armature should rotate at high speed.

Removal and Disassembly of Driving Clutch

The driving clutch may be removed without removing the generator from the engine.

Remove the carburetor. (See "Removal" under "Carburetor," page 150.)

Remove the generator drive shaft.

Remove the large cap screw in the end of the armature shaft and with Cadillac puller, numbered 65493 or 83227, remove the complete clutch.

The clutch may be disassembled by removing the locking wire in the space "B" (Fig. 63.) The ends of the wire come together at a recess "A." The wire can be removed by picking out one end of it with a sharp pointed instrument and then removing the entire wire. In replacing the wire make sure that the ends come together at the recess "A."

Removal of Generator Brushes

The brushes which bear on the generator commutator may be removed without removing the generator from the car. To remove these brushes proceed as follows:

Remove the large cable from the storage battery and block it up with a piece of dry wood to prevent it touching the terminal of the battery.

Disconnect the copper strip running from the field coil to the rear of the shunt field connection terminal. (See Fig. 61.)

Disconnect, at the terminal on the field coil, the wire from the third brush arm.

Remove the two cap screws holding the terminal bracket and the brush arm bracket in place, and remove the terminal bracket and brush arm bracket with brushes.

Removal of Motor Brushes

To remove the brushes which bear on the motor commutator, remove the generator in accordance with directions under "Removal of Generator" and remove the rear end housing as directed under "Removal of Roller or Annular Ball Bearing." The remaining motor brush can then be removed.

Removal of Motor Generator

Disconnect from the storage battery one of the large cables and block it up with a dry piece of wood to prevent it touching the terminal of the battery.

Remove the top cover plate from the motor generator and disconnect the large cable and the four small wires.

Remove the carburetor. (See "Removal" under "Carburetor," page 150.)

Remove the generator drive shaft.

Remove the two filister-head screws holding the motor generator to the starter gear housing.

Remove the three large cap screws which hold the motor generator to the top cover plate and remove the motor generator. Exercise care in removing not to drop the brush control pin. (See Fig. 59.)

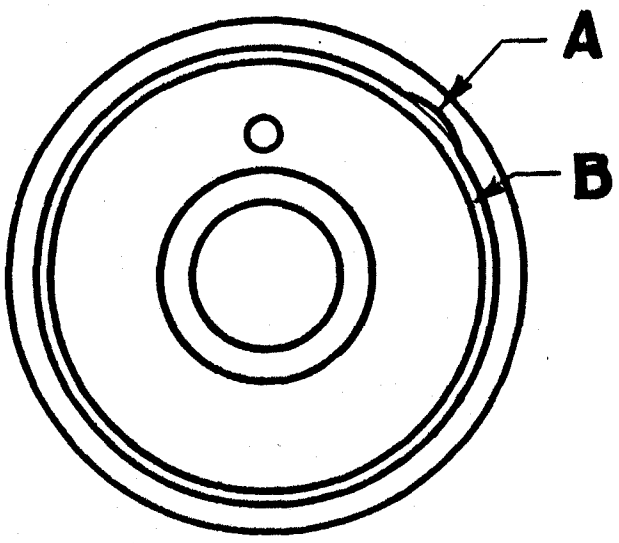


Fig. 63—Motor Generator Driving Clutch, Rear View.

Removal of Annular Ball Bearing

Remove the motor generator. (See "Removal of Motor Generator," on this page.)

Remove the driving clutch. (See "Removal and Disassembly of Driving Clutch," page 141.)

Remove the four cap screws holding the aluminum front housing in place and remove the housing.

To remove the ball bearing from the housing, first remove the four machine screws which hold the bearing retainer in place, then tap out the bearing.

Removal of Roller or Annular Ball Bearing

Remove the motor generator as directed under "Removal of Motor Generator," page 142.

Remove the left-hand motor brush arm. This is the one which is not attached to the rear end housing.

Remove the four cap screws holding the rear end housing in place, and remove the housing complete with armature and bearing.

Remove the four small machine screws which hold the bearing retainer to the housing and remove the housing.

The mounting for the roller bearing can be removed by tapping it out through the two small holes provided.

Removal of Field Coils

Remove the motor generator in accordance with directions under "Removal of Motor Generator," page 142.

Remove the rear end housing with armature as directed under "Removal of Roller or Annular Ball Bearing," page 143.

Remove the front housing with bearing.

Remove the terminal bracket and the brush arm brackets.

The coils can now be removed after taking out the small filister head screw in the right side of the generator frame and the long bolt which passes through the coils and holds the two sides of the frame together.

Inspection

Examine the commutators. Burnt or blackened segments of the generator commutator indicate high mica, a short circuit, ground, open circuit or insufficient spring tension on the brushes. If the commutators require it, place the armature between lathe centers and turn them down. Turn off no more than is necessary to clean up the commutators. If the mica between the segments of the generator commutator is above the surface against which the brushes press, or $\frac{1}{64}$ inch or less below, cut the mica down so that it is $\frac{1}{32}$ inch below the surface. Use a hacksaw blade ground off on the sides of the teeth so that it will cut a slot between the segments, very slightly wider than the mica. Remove the sharp edges on the segments with a fine three-cornered file but do no more than take off the sharp edges.

Examine the insulators on the terminal board, particularly the one which holds terminals numbers four and six (Figs. 20 and 61.)

Inspect the ball and roller bearings. The races of the ball bearing should rotate smoothly and quietly and should have no more than .005 inch radial play and no more than .015 inch end-play. The roller bearings should have no more than .005 inch radial play. The rolls should be free from pits and not chipped on the ends.

The generator and motor brushes should have a good bearing on the commutators; if not they should be refitted. (See "Fitting Motor Generator Brushes," page 46.)

The tension of the coil springs on the brush arms should be sufficient to cause a brush pressure of between twenty-five and thirty ounces on the generator commutator, and between thirty and thirty-six ounces

on the motor commutator. The pressure between the third brush and the generator commutator should be sixteen to twenty ounces.

Replacement

Make certain that all connections are clean and well tightened.

Before replacing either bearing, fill it well with light cup grease.

The third brush should be so adjusted that the maximum output of the generator is seventeen amperes, this means fifteen amperes when current for ignition is deducted. (See "Current Regulation," page 58.)

DISTRIBUTOR HEAD

Removal

Remove the aluminum cap covering the distributor head. The cap may be removed by lifting it straight up after the two small screws are removed which hold each conduit bracket to the cap and the bail over the top of the cap is pushed to one side.

Press back the spring clamps on the side of the distributor head.

Remove the distributor head by lifting it straight up and then to one side. Be careful not to catch the rotor button, and thus injure the rotor button spring.

If it is desired to remove the distributor head from the high tension wires, unscrew the nine terminals.

Inspection

Inspection of Distributor Head—Clean the head with gasoline and wipe it off with a clean cloth.

The track against which the rotor button presses should be smooth and clean. Clean with a piece of cloth moistened with vaseline, then polish with a dry cloth. Do not use sand-paper, emery cloth, or anything of that nature.

Make sure that the contact in the center of the head works freely in its guide.

Inspection of Other Parts—Inspect the rotor button and rotor button spring. (See "Inspection of Rotor" under "Distributor Rotor," page 145.)

Replacement

In replacing, reverse the operations under "Removal."

DISTRIBUTOR ROTOR

Removal

Remove the distributor head. (See "Removal" under Distributor Head," on this page.)

Remove the rotor by lifting it straight up. If the rotor sticks on the shaft it may be forced off by the use of two small screw-drivers. The rotor is recessed on the under side at two points to receive screw-drivers in removing. Lift both sides evenly and carefully.

Inspection

INSPECTION OF ROTOR—The upper face of the rotor button should be smooth and clean. If it is necessary to clean it use an oil stone.

Inspect the rotor spring for tension. In replacing the spring make sure that it bottoms in the hole which receives it, otherwise the resulting increased pressure will cause cutting in the distributor head. Under a pressure of between five and ten ounces the rotor button flange should just rest on the rotor.

INSPECTION OF OTHER PARTS—Inspect the distributor head. (See "Inspection" under "Distributor Head," page 144.)

Inspect the timer contact points. If they are burned or pitted or out of adjustment, see under "Adjustment of Timer Contact Points", page 52.

Replacement

To replace the rotor, reverse the operation under "Removal," first making sure that the shaft over which the rotor sets, as well as the hole in the rotor which receives the shaft, is clean. If the rotor fits tightly tap it lightly at the center with the wooden end of a screw-driver.

DISTRIBUTOR AND TIMER

Removal

Remove the carburetor. (See "Removal" under "Carburetor," page 150.)

Remove the generator shaft "A," Fig. 50.

Remove the coupling "C" from the rear end of the fanshaft. To do so first remove the large cap screw "B," then remove the coupling with Cadillac puller, numbered 71955, as shown in (Fig. 64.)

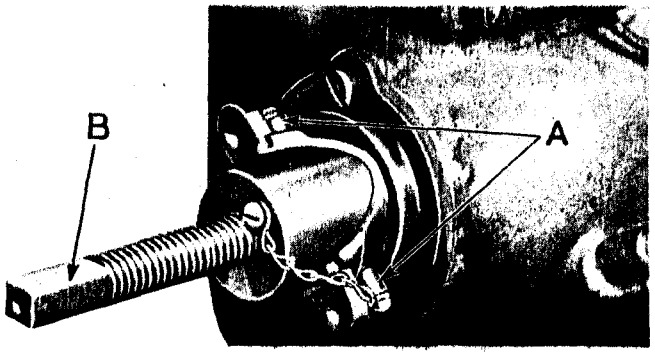


Fig. 64—Removing Fan Shaft Coupling

Remove the two cylinder head nuts which hold the brackets of the left-hand high tension conduit. Loosen the small screws in the brackets which hold the right-hand conduit. Remove the distributor head and the low tension wire and lift the left-hand conduit with wires and head over to the right side.

Remove the distributor rotor. This may be done by lifting it straight up. If the rotor sticks on the shaft, force it off with two small screw drivers. The rotor is recessed on the under side at two points to receive drivers in removing. Lift both sides of the rotor evenly and lift it carefully.

Remove the dowel pin "X" (Fig. 65) by tapping it out from the front.

Remove the spark control rod.

Remove the two bolts, nut and two cap screws which hold the distributor and timer to the fanshaft housing.

The distributor and timer may now be removed by tapping it lightly. As the dowel pin "Y" is still in position, care must be exercised to remove both sides evenly.

Removal of Plain Bearing

Remove the rotor.

Remove the nut "A" (Fig. 21), the resistance unit, and the condenser "D."

Remove the oiler "W."

Remove the screws "K" "L" and "M." With a screw driver or a knife blade start the contact-arm spring out of the recess in the housing. Lift out the segment plate "N."

Remove the headless screw in the yoke "F" (Fig. 65) and remove the yoke and shaft to which it is attached.

Remove the plate "B."

Remove the locking washer "H."

Remove the distributor shaft complete with ball bearings by lifting it out through the top of the housing.

The bushing "C" can now be removed by tapping it out carefully.

Removal of Annular Ball Bearing

Remove the distributor shaft as directed under "Removal of Plain Bearing," page 146.

Loosen the lock screw "I" and remove the cam "J" (Fig. 65.)

Remove the locking washer and lift out the two steel washers and the felt washer.

Remove the ball bearing by tapping it off carefully.

Removal of Gear

Remove the distributor shaft complete in accordance with directions under "Removal of Plain Bearing," page 146.

Remove the screw "P" and drive out the straight pin "R" (Fig. 65.)

Remove the locking washer and the collar "T."

Remove the locking washer held to the spiral gear "O" by the screws "V." The gear with sleeve can now be removed from the shaft. The gear is held to the sleeve by a taper pin.

Removal of Spring

Remove the distributor shaft as directed under "Removal of Plain Bearing," page 146.

Remove the gear as directed under "Removal of Gear," page 146.

Remove the pin "N" (Fig. 65).

Remove the two large headed screws holding the automatic advance weight.

Remove the sleeve below the spring.

Remove the spring.

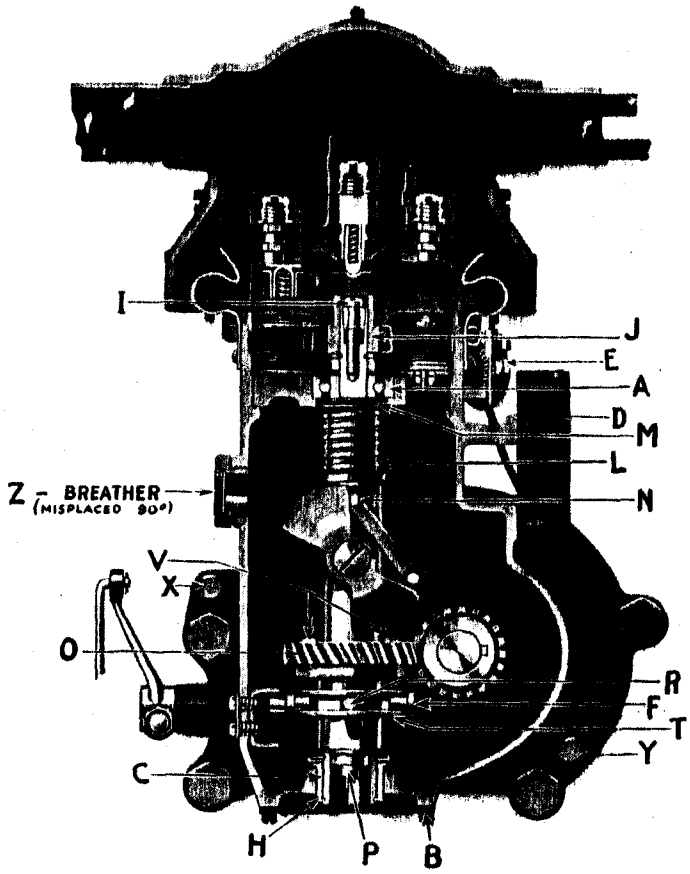


Fig. 65—Distributor and Timer, Sectional View.

Inspection

Check up the amount of side play in the annular ball bearing "A," also in the plain bearing "C." The side play in the ball bearing should not exceed .003 inch. The side play in the plain bearing should not exceed .004 inch.

The ball bearing should rotate smoothly and quietly.

Examine the spring. All springs in distributors stamped with a date previous to July 8, 1922, or distributors installed on engines numbered 61-W-1 to 61-W-88 inclusive should compress to .956 inch under a load of between eleven and twelve ounces and to .500 inch under a load of between three pounds seven ounces and four pounds three ounces.

All distributors stamped with the date July 8, 1922 or with a later date have a somewhat stiffer spring which gives a lesser amount of automatic spark advance. This is made necessary by comparatively recent changes in fuel by oil companies in certain sections of the country.

Examine the teeth of the gear "O" and those of the gear with which it meshes.

Examine the timer contact points. They should be clean, fit squarely against each other, and in proper adjustment. (See under "Adjustment of Timer Contact Points," page 52.)

The tension of the springs on the contact arms should be great enough to cause a pressure of eighteen to twenty ounces between the contact points.

INSPECTION OF OTHER PARTS—Inspect the distributor rotor. (See "Inspection of Rotor" under "Distributor Rotor," page 145.)

Inspect the distributor head. (See "Inspection of Distributor Head" under "Distributor Head," page 144.)

Replacement

To replace, reverse operations under "Removal," being careful to replace in their proper positions all the small insulating bushings and washers. After replacing the segment plate "N" (Fig. 21, page 53) and before tightening the screws "M," "L" and "K" and the nut "A" adjust the segment plate as accurately as possible by the eye, so that the contact arms are directly on top of lobes of the cam "J" at the same time. Then test for simultaneous opening of the contact points (see under "Adjustment of Contacts for Simultaneous Opening," page 53) and adjust the segment plate in accordance with the directions under "Adjustment of Segment Plate," page 54.

After replacing the distributor and timer remove the breather "Z" and place four ounces of Cadillac distributor grease in the housing.

Retime the ignition in accordance with directions under "Timing Ignition," page 54.

Exercise care, in replacing the distributor head, not to catch the rotor button on the side of it, also to make sure that the head fits down evenly and that it is locked in place.

Removal of Inspection Lamp

Remove the four screws holding the lamp body to the dash and remove the "Inspection Lamp."

Inspection

Inspect the lamp cord and switch.

If the lamp cord fails to return properly remove the three nuts and screws holding the cover to the lamp body and remove the cover.

Place the cord around spool one or two turns or enough to allow lamp to return to the socket properly and without any tension remaining on

the cord when the lamp is in place. The lower lever is for releasing the spool to return lamp to the socket. The upper lever is for operating the switch. These two levers should work freely.

The switch may be removed from the side of the lamp body by removing the two small screws and drawing the switch forward until it clears the three small clips.

The switch and lever may be removed by removing the small straight pin which passes through the lever at the inside of the switch body.

Replacement

To replace, reverse operations, being careful to replace in the proper places all nuts and screws.

Removal of Cigar Lighter

Remove the wire leading to one of the terminals.

Remove the round nut and washer from the handle tube and remove cigar lighter.

To remove the heating unit remove the ash guard. Unit can then be removed by turning it in the socket as is done with a lamp bulb.

Replacement

To replace, reverse operations.

COOLING SYSTEM

RADIATOR

Removal

Remove the wires from the head lamps. To do so lift up the connectors to which the wires are attached, turn them slightly in the counter-clockwise direction and pull them down.

Disconnect at the head lamps the small rods running from the lamps through the radiator casing.

Remove the cap screw and bolt holding the tie rod to the fender support and remove the lamps with brackets and tie rod.

Drain cooling system. (See under "Draining the Cooling System," page 67.)

Remove the hood.

Remove the cross shaft attached to the rear face of the radiator.

Disconnect the tie rod at the radiator by removing the cap screw.

Remove the cotter pins, nuts and springs from the two studs which hold the radiator to the cross member.

Disconnect the five radiator hose connections.

Remove the radiator by pulling its upper end forward slightly, then lifting it up.

Inspection

Inspect the radiator for leaks. To do so proceed as follows: Plug the four large hose connections on the radiator and screw on and tighten the radiator filler cap. Attach an air hose to the lower end of the radiator over-flow pipe, immerse the radiator in water and turn on air under a

pressure of approximately fifteen pounds. Leaks are indicated by air bubbles.

Radiator repair should be attempted only by men who have had experience in this line of work. The following suggestions will assist in repairing a Cadillac radiator:

If a tube leaks where it is soldered to the upper or lower header, resolder it on the inside of the header. This may be done after removing the radiator casing which is held in place by ten small bolts, and removing the tank by unsoldering. If it is necessary to replace a tube, remove both tanks by unsoldering, lay the radiator down flat, and with a blow torch melt the solder the entire length of the tube to be removed. The tube can then be pulled out. Before putting in a new tube, tin it its entire length. After the tube is in place and the fins are lined up, solder the tube to the fins, using a blow torch. With a soldering iron, solder the ends to the headers.

Whenever radiator tanks are removed for any purpose, it is a good plan to test all of the tubes. Test each tube separately by plugging one end and forcing air under approximately fifteen pounds pressure into the open end, while the radiator is immersed in water.

Inspect the radiator fins. They should be parallel to each other and equally distant from each other. To insure maximum radiator efficiency, each fin must be soldered to each tube.

Inspect the radiator cap gaskets.

Replacement

Before replacing radiator flush it out with water. In replacing reverse operations under "Removal."

Unless the radiator is properly lined up the hood will not fit properly.

Lining up Radiator

Remove cotter pin from nut on stud holding radiator to cross member.

Remove nut, spring and spacer from stud.

The nut on upper end of stud which rests in the seat on cross member can now be turned. It may also be necessary to alter the length of the radiator tie rod to line up hood.

GASOLINE SYSTEM

CARBURETOR

Removal

Relieve the pressure in the gasoline system by removing the gasoline tank filler cap.

Disconnect the gasoline feed pipe at the carburetor.

Loosen the clamp screw holding the drain pocket under the carburetor and force the pocket down.

Remove the carburetor control rods at the carburetor.

Remove the two cap screws which hold the carburetor to the intake manifold and remove the carburetor.

Disassembly

Remove the carburetor bowl. To do so remove the nut "A" (Fig. 66.)

Remove gasket "B."

The cork float "H" can be removed after the hinge pin "D" is pulled out.

Inspection

Inspect the face of the carburetor body which bolts against the intake manifold. This face must be in good condition and perfectly flat to insure against air leaks when the carburetor is bolted in place. The throttle, "I" must move freely from the open to the closed position.

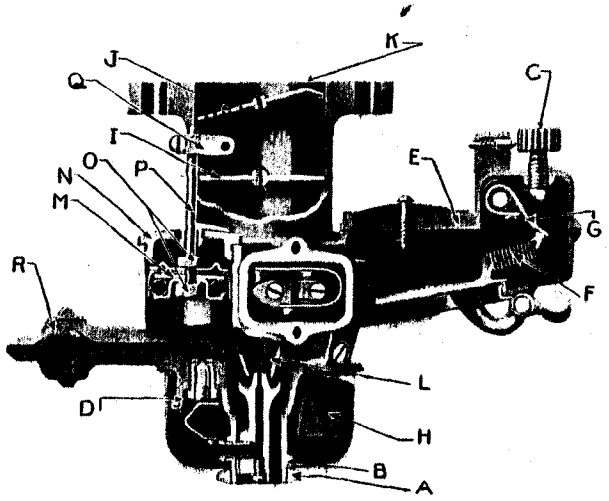


Fig. 66—Carburetor, Sectional View, Single Thermostat Type

When the disc is squarely across the mixing chamber the sum of clearances on opposite sides of the disc should be no more than .002 inch.

Greater clearance will make it impossible to throttle the engine down to the recommended speed of 300 R. P. M. Make sure that the disc is not bent and that the small screw holding it in place is well tightened.

End play in the throttle shaft should not exceed .004 inch. Clearance between the throttle shaft and the bronze bushings in which it operates should not exceed .010 inch.

The shaft of the automatic throttle "J" must work freely in its bearings. Test this by rotating the shaft approximately 180 degrees from the normal position and allowing it to return slowly. If there is any tendency of the shaft to stick, remove it in the following manner and clean the bearings. Remove the two small screws holding the small clamp plate "K" at side of carburetor body. Remove the small screw

holding the throttle disc. Remove the shaft, being careful not to damage the spring.

After making sure that the shaft of the automatic throttle "J" works freely in its bearings check up the tension of the spring on the shaft. See under "Adjustment of Automatic Throttle," page 76.

Examine the strangle tube "L" to see that it is firmly in place. Examine the throttle pump plunger "M" by removing the throttle pump cap "N." The leather should have a good seat and the nuts "O" tight on throttle pump rod "P." The rod "P" should be screwed into the clamp "Q" to the full extent of the thread on the rod or so that the plunger leather does not touch the bottom of well when the throttle is in the wide open position. The throttle pump plunger "M" should work freely the entire length of the pump well with leather resting firmly against the side wall.

Remove strainer "R" at the carburetor inlet. Clean and inspect it.

On the later type carburetor (Fig. 31, page 74) the strainer "A" may be cleaned and inspected by removing the cap "B" and long screw "C" holding strainer to carburetor body.

The clip "D," must be adjusted to insure slight pinch of valve head and enough tension to hold clip on float lever without interference with float movement.

POWER AIR COMPRESSOR IN THE GASOLINE SYSTEM

Removal

Disconnect the air pipe from the compressor by unscrewing the union.

Remove the two one-fourth inch nuts and washers and remove the compressor body.

Crank the engine over until the compressor piston is at the top of its stroke.

Remove the piston with connecting rod by sliding the connecting rod forward, then upward.

Inspection

Clean all parts with kerosene or gasoline and with a cloth wipe out the cylinder and wipe off the piston.

The cylinder and piston should be free from scores. There should be no more than .003 inch clearance between these parts.

There should be no more than .002 inch clearance between the piston pin and the piston and no more than .003 inch between the bearing at the lower end of the connecting rod and the eccentric upon which it operates.

Disassemble the check valve on the pump and thoroughly clean the valve and valve seat.

Replacement

Wipe out the cylinder, wipe off the piston and lubricate these parts with engine oil of a suitable quality before replacing.

See that the check valve stands in the upright position.

In replacing, reverse operations under "Removal."

GASOLINE TANK

Removal of Gasoline Quantity Gauge

To remove the gasoline gauge, first remove the large nickel plated nut and the glass. The gauge can then be lifted out with a pointed tool inserted in the hole in the dial. Care must be exercised not to injure the cork gaskets.

Removal of Tank

Relieve the tank of all air pressure by removing the filler cap.

Remove the drain plug and drain the tank.

Disconnect the air and gasoline pipes from the tank by unscrewing the unions.

Disconnect the long filler by removing the four screws holding the filler to tank and remove filler.

The tank can now be removed after removing the nut at the rear and the cotter pins and the two nuts at the front and pushing the tank forward. In removing the two forward nuts observe the manner in which the washers are placed. These washers must be replaced as originally assembled.

Removal of Gasoline Strainer on early Type 61 cars

Remove the gasoline tank. (See under "Removal of Tank," page 153.)

Remove the four small cap screws and remove the connection plate with strainer and stand pipe.

Inspection

With the gasoline tank removed test it by screwing on and tightening the filler cap, replacing the drain plug, temporarily plugging the nipple from which the gasoline pipe was disconnected, attaching an air hose to the nipple from which the air pipe was disconnected, and with the tank immersed in water turning on an air pressure of approximately six pounds. Do not use a pressure greater than six pounds.

Test the gasoline quantity gauge by draining the gasoline tank, then refilling it with five measured gallons of gasoline. The gauge should indicate five. If it does not, remove it as directed under "Removal of Gasoline Quantity Gauge," page 153, and slightly bend the float arm.

Examine the valve and the valve seat. These should be in good condition.

Replacement

In replacing the stand pipe in the gasoline tank be sure that its lower end enters the hole in the support.

In replacing the washers on the forward tank supports make sure that they are replaced as originally assembled. When assembled correctly, a spherical joint is provided at the bottom of each forward support.

Before replacing the connection plate or filler make sure that the gaskets are in good condition.

CLUTCH AND TRANSMISSION

TRANSMISSION CASE

Removal

Remove and disassemble the transmission. (See "Removal and Disassembly" under "Transmission," pages 165 and 166.)

Inspection

With kerosene or gasoline clean all parts removed.

INSPECTION OF TRANSMISSION CASE—Carefully examine the transmission case and inspect all machined surfaces.

INSPECTION OF OTHER PARTS—Before replacing, inspect all parts removed in accordance with directions in this book.

Replacement

After inspecting all parts, reassemble and replace the transmission. (See "Reassembly and Replacement" under "Transmission," page 167.)

Refill the transmission with two quarts of suitable transmission lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended.

CLUTCH

The amount of wear on the clutch discs may be determined roughly, by noting the distance which the ends of the six studs "V" (Fig. 69, page 161) project beyond the retainer plate "W." This inspection may be made after removing the floor boards and the hand hole plate "X." If the ends of the studs project more than one-half inch beyond the retainer plate, the clutch discs should be removed and recovered.

Removal of Clutch

Remove the transmission. (See "Removal" under "Transmission," page 165.)

Remove the nut "T" and pull off the clutch.

Removal of Ball Thrust Bearing

Remove the clutch. (See on this page under "Removal of Clutch.")

Remove the retainer which holds the thrust bearing to the clutch spider and remove the bearing. Ordinarily the bearing can be removed by pulling it off by hand.

Removal of Clutch Spring

Remove the clutch. (See under "Removal of Clutch," page 154.)

Place the clutch under an arbor press with the ball thrust bearing up. Place a block of wood over the upper end of the clutch spider and with the arbor press slightly compress the clutch spring.

Remove the nuts from the six long studs "V," (Fig. 69.)

Remove the clutch from the arbor press and remove the clutch spider and clutch spring.

Removal of Clutch Discs

Remove the transmission. (See "Removal" under "Transmission", page 165.)

Compress the clutch spring by pushing down on the clutch pedal and place a piece of metal nine-sixteenths inch long between the screw collar which locks the rear annular ball bearing to the clutch connection shaft and the rear face of the clutch spider.

Remove the nuts from the six long studs "V" (Fig. 69) and remove the clutch discs.

Inspection

Examine the ball thrust bearing. If the bearing is noisy or feels rough in spinning the races, replace it by a new one.

Be sure that the bearing is well filled with suitable lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended.

The clutch spring should have a minimum free length of seven and one-half inches and should support a load of from 290 to 310 pounds when compressed to three and one-quarter inches.

Examine the clutch discs. There should be no more than .008 inch clearance between the driven discs and the keys of the clutch hub, and no more than .010 inch clearance between the teeth of the driving discs and the teeth in the clutch ring.

Examine the linings on the discs. If the total thickness of a disc with the two linings is less than five-sixteenths inch, the disc should be recovered. (See under "Relining Clutch Discs," page 79.)

Warped clutch discs should be straightened or replaced.

Examine the faces of the driven discs.

The six long studs should be tight in the plate to which they are fastened.

The clutch hub should be a sliding fit on the splines of the clutch connection.

Replacement

In replacing, reverse operations under "Removal."

In replacing the discs, make sure that the small reinforcements on the driven discs are on the driving sides of the keys of the clutch hub. Also that the teeth of driving discs line up.

In replacing the nuts on the six long studs, screw them down until their upper faces are just flush with the ends of the studs.

TIRE AIR COMPRESSOR (KELLOGG)

Removal

Remove the floor boards.

Remove the drain plug "Q" (Fig. 69) and drain the transmission.

Remove the copper pipe which connects the compressor and the frame of the car.

Remove the four nuts which hold the body of the compressor to the transmission case and remove the compressor.

Disassembly

Remove the plate at front end of the crankcase of the compressor. (Fig. 67.)

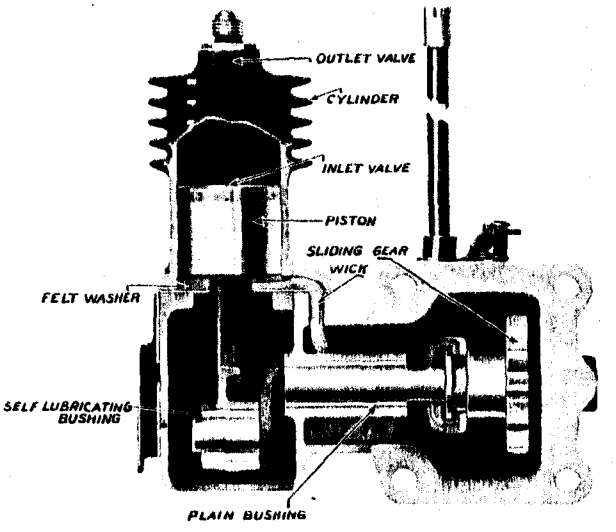


Fig. 67—Kellogg Tire Air Compressor, Sectional View

Remove the nut at the top of the compressor cylinder, also the valve and spring.

Remove the four screws holding the cylinder in place and remove the cylinder.

Remove the two pieces of felt and the felt retainers.

Remove the connecting rod with piston. With the piston at the highest point in its stroke the connecting rod can be removed by sliding it forward.

Remove the locking ring at the rear of the forward crankshaft bearing and pull out the crankshaft.

To remove the shifter yoke from the shaft, drive out the taper pin between these parts. The taper pin can be driven out after removing the small machine screw in the side of the case.

The bushings in which the crankshaft rotates can be removed by tapping them out.

The piston pin can be removed by first pulling out the cotter pin, then lightly tapping it out.

Inspection

Clean all parts with kerosene or gasoline.

Inspect the cylinder bore. It should be free from scores.

Clearance between the piston and cylinder should not exceed .006 inch.

The clearance between the crankshaft and its bearings should not exceed .004 inch.

The clearance between the crankshaft and the driving gear should not exceed .005 inch.

Inspect the teeth of the driving gear.

The clearance between the piston pin and the piston should not exceed .003 inch.

The clearance between the crank pin bearing and the crank pin should not exceed .004 inch.

Placed on lathe centers, the crankshaft should run true within .002 inch.

Inspect the felts. They should be in good condition and well soaked with engine oil.

Inspect the inlet and outlet valves, regrinding them if necessary.

Inspect the inlet and outlet valve springs. The inlet and outlet valves springs should have a free length of one-half inch. When the valve is opened one-sixteenth inch, the outlet valve spring should show a pressure of seven and one-half ounces, the inlet valve spring four and one-half ounces.

Replacement

In replacing, reverse operations under "Removal."

After replacing the drain plug "Q" (Fig. 69) refill the transmission with suitable transmission lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. Two quarts of lubricant are required.

TIRE AIR COMPRESSOR (CASSCO)

Removal

Remove the floor boards.

Remove the drain plug "Q" (Fig. 69) and drain the transmission.

Remove the copper pipe which connects the compressor and the frame of the car.

Remove the four nuts which hold the body of the compressor to the transmission case and remove the compressor.

Disassembly

Remove the ¼ inch plug in end of base.

Remove the end cover.

Insert a punch in pipe plug hole and drive out crankshaft.

Remove the nut at the top of the cylinder, also the valve and spring.

Remove the four nuts and four screws holding the cylinder and oil protector to the base.

Remove the connecting rod with piston and oil protector from cylinder.

Remove the wrist pin.

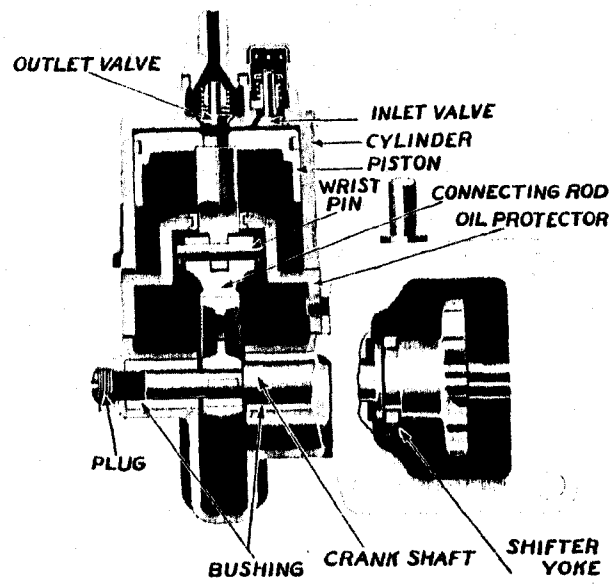


Fig. 68—Cassco Tire Air Compressor, Sectional View

To remove the shifter yoke from shaft, remove the ⅛ inch pipe plug and drive out the taper pin between these parts.

The bushings which the crankshaft rotates can be removed by tapping them out.

Inspection

Clean all parts with kerosene or gasoline.

Inspect the cylinder bore. It should be free from all scores.

Clearance between the piston and cylinder should not exceed .005 inch.

The clearance between crankshaft and its bearings should not exceed .004 inch.

The clearance between the eccentric and connecting rod should not exceed .005 inch.

The clearance between the crankshaft and driving gear should not exceed .005 inch.

The clearance between the piston pin and connecting rod should not exceed .003 inch.

Placed on centers, the crankshaft should run true within .002 inch.

Inspect the inlet and outlet valves, regrinding them if necessary.

The inlet valve spring should have a free length of five-eighths inch. The outlet valve spring should have a free length of three-quarter inch. When the valve is opened one-sixteenth inch, the outlet valve spring should show a pressure of eighteen ounces, the inlet spring ten ounces. The shifter ball spring should have a free length of three-eighths inch.

Replacement

In replacing reverse operations under "Removal."

After replacing the drain plug "Q" (Fig. 69) refill the transmission with suitable transmission lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. Two quarts are required.

CLUTCH CONNECTION AND CLUTCH CONNECTION REAR BEARING

Removal

Remove the clutch. (See "Removal of Clutch" under "Clutch," page 154.)

Remove the six cap screws which hold the clutch connection bearing cap in place, and remove the clutch connection "B" (Fig. 69) with bearing.

Remove the locking ring which holds the check nut in place and remove the nut (left-hand thread). Use Cadillac wrench numbered 83224.

Remove the oil throw-off ring.

The bearing can be removed from the shaft by tapping it off.

Inspection

With gasoline or kerosene clean all parts removed.

Inspection of the Clutch Connection and Rear Bearing—Examine the clutch connection "B." Placed between lathe centers it should run true within .0025 inch. The bore in which the roller bearing "P" operates should be smooth and free from pits. The faces of the gear teeth should show very little wear and should be free from pits. The clutch hub "Z" should be a light press fit on the splines of the clutch connection.

Inspect rear bearing on the clutch connection. The bearings should rotate smoothly. There should be no more than .015 inch end play in the races.

Inspection of Other Parts—Examine the roller bearing "P." The rolls should be free from pits and not chipped on the ends.

Examine the ball bearing "D" which supports the forward end of the clutch connection. It should rotate smoothly and quietly and have no more than .015 inch end play. With the clutch connection, main transmission shaft, and roller bearing in place, there should be no more than .004 inch shake between the shaft and the clutch connection.

Replacement

In replacing, reverse operations under "Removal." (See note under "Reassembly and Replacement", page 167.)

SHIPPER GEARS

Removal of High and Intermediate Shipper Gear

Remove the jackshaft. (See "Removal" under "Jackshaft and Jackshaft Gears," page 162.)

Remove the transmission shaft "L" (Fig. 69) (See "Removal" under "Main Transmission Shaft and Main Transmission Shaft Rear Bearing," page 164.) In pulling out the shaft do not allow the shipper gears "M" and "N" to drop.

The high and intermediate shipper gear "N" (Fig. 69) can now be removed from the bottom.

Removal of Low and Reverse Shipper Gear

Remove the jackshaft. (See "Removal" under "Jackshaft and Jackshaft Gears," page 162.)

Remove the main transmission shaft. (See "Removal" under "Main Transmission Shaft and Main Transmission Shaft Rear Bearing," page 164.) In pulling out the shaft do not allow the shipper gears "M" and "N" to drop.

The low and reverse shipper gear "M" (Fig. 69) can now be removed from the bottom.

Inspection

With kerosene or gasoline clean all parts removed.

Inspection of Gears—The clearance between the sides of the splines of the shaft "L" (Fig. 69) and the sides of the spline ways of the shipper gears should not exceed .004 inch.

The teeth of the gears should show very little wear and be free from pits.

There should be no more than .015 inch between the shifter fork and groove in the gear in which it operates.

Inspection of Other Parts—Inspect the main transmission shaft "L" and its bearings. (See "Inspection" under "Main Transmission Shaft and Main Transmission Shaft Rear Bearing," page 165.)

Inspect the jackshaft gears and bearings. (See "Inspection of Jackshaft and Jackshaft Gears" under "Jackshaft and Jackshaft Gears," page 162.)

Inspect the teeth of the clutch connection gear "A" (Fig. 69) and of the reverse gear. The faces of the teeth should show very little wear and be free from pits.

Replacement

In replacing, reverse operations under "Removal of High and Intermediate Shipper Gear" and under "Removal of Low and Reverse Shipper Gear," page 160. (See note under "Reassembly and Replacement," page 167.)

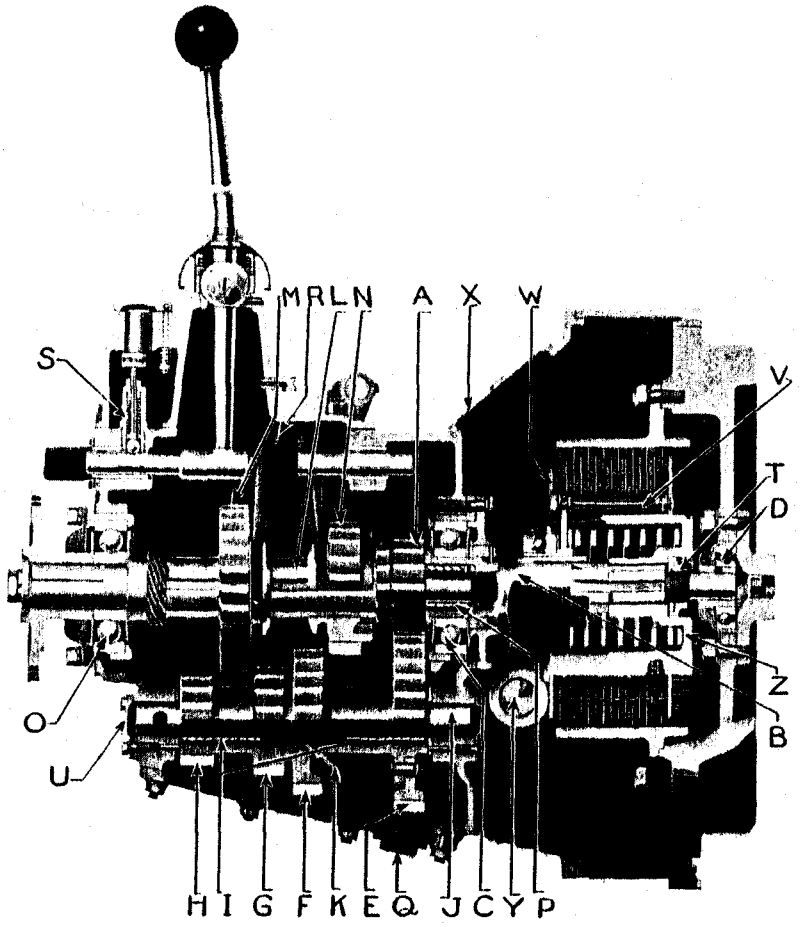


Fig. 69—Clutch and Transmission, Sectional View.

Refill the transmission up to the proper level with suitable transmission lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. Two quarts are required.

JACKSHAFT AND JACKSHAFT GEARS

Removal

Remove the plug "Q" (Fig. 69) and drain the transmission.

Remove the bottom cover plate. The plate is held in place by nine five-sixteenth inch nuts.

Determine the amount of end play in the jackshaft. (See under "Inspection of Jackshaft and Jackshaft Gears," page 162.)

Remove the cap "U."

Remove the screw which holds the shaft "J" in place.

Remove the shaft "J." To do so, screw a ½ inch x 12 cap screw into the rear end of the shaft and with the cap screw pull out the shaft. Be careful in removing the shaft that neither the jackshaft, nor the spacer washers drop.

Inspection

With kerosene or gasoline, clean all parts removed.

INSPECTION OF JACKSHAFT AND JACKSHAFT GEARS—Inspect the teeth of the gears. Gear teeth faces should show but little wear and be free from pits.

Examine the bore of the jackshaft which carries the gears.

With the roller bearings "I" and the shaft "J" (Fig. 69) in place there should be no more than .004 inch play between the shaft "J" and the jackshaft.

The jackshaft when in place in the transmission should have no more than .015 inch end play.

INSPECTION OF OTHER PARTS—Inspect the roller bearings "I." The rolls should be free from pits and not chipped at the ends.

Inspect the bearing surfaces of the shaft "J."

Inspect the teeth of the gears which mesh with teeth of the jackshaft gears. The faces of the teeth should show but little wear and be free from pits.

Replacement

In replacing, reverse operations under "Removal." (See note under "Reassembly and Replacement," page 167.)

After replacing the bottom cover plate and the drain plug, refill the transmission with enough transmission lubricant of suitable quality to bring the level up to the filling hole. This will require approximately two quarts. Cadillac Rear Axle and Transmission Lubricant is recommended.

CONTROL LEVER

Removal

Remove the ball at the top of the control lever by unscrewing it.

Remove the nut which holds the nickel plated dust cover in place and remove the dust cover.

Remove the large adjusting collar by unscrewing it and remove the felt washer and spring.

The control lever can now be removed by lifting it out. Care must be exercised not to drop the centralizing pin into the transmission.

Inspection

INSPECTION OF CONTROL LEVER—Inspect the ball on the control lever which supports it. If the ball has been injured clean it up with a fine mill file.

INSPECTION OF OTHER PARTS—Inspect the centralizing pin.

Inspect the felt washer and spring.

Inspect the seat in which the ball of the control lever rests.

Replacement

In replacing, make sure that the centralizing pin is properly in place before replacing the felt washer and screwing down the collar.

REVERSE PINION

Removal

Remove the drain plug "Q" (Fig. 69) and drain the transmission.

Remove the tire air compressor. (See "Removal" under "Tire Air Compressor," page 157.)

Determine the amount of end play in the reverse pinion. (See under "Inspection," page 163.)

Remove the set screw which holds the reverse pinion shaft in place. This screw is in the left-hand side of the transmission case.

Remove the reverse pinion, being careful not to drop the spacing washer at the rear end of the pinion.

Inspection

With kerosene or gasoline carefully clean all parts.

There should be no more than .004 inch clearance between the bearing in the pinion and the shaft. If it is necessary to replace the bearing press it out and press in the new one. Ream the new bearing to .937 inch to .938 inch after it is in place.

When the gear is in place in the transmission case there should be no more than .015 inch end play.

Inspect the pinion teeth. The faces of the teeth should be free from pits and show very little wear.

Replacement

In replacing, reverse operations under "Removal."

In replacing the pinion have the beveled ends of the teeth forward.

After bolting the tire air compressor in place and replacing the drain plug "Q," refill the transmission case up to the level of the filling plug

with transmission lubricant of the proper quality. Cadillac Rear Axle and Transmission Lubricant is recommended. Two quarts of lubricant are required.

SHIFTER FORKS AND SHAFTS

Removal

Remove the transmission top cover plate. The plate is held in place by six cap screws.

Remove the rod and spring from accelerator pedal.

Remove the two plungers "S" (Fig. 69.)

Remove the taper pin "R" in shipper fork.

The shaft may now be removed by tapping it out through the rear end of the transmission case, at the same time driving out the rear bearing. There is a nine-sixteenth inch ball between the bearings which support the front ends of the shifter fork shafts. The purpose of the ball is to make it impossible to bring both shipper gears into mesh at the same time. Do not allow this ball to drop into the transmission case, and be sure to remove it in case it does.

Inspection

With kerosene or gasoline clean all parts removed.

Inspection of Shifter Fork and Shaft—There should be no more than .004 inch clearance between the shaft and the bushings in which it operates.

There should be no more than .015 inch between the shifter fork and the groove in the gear in which it operates.

The shaft placed on lathe centers should run true within .003 inch.

Inspection of Other Parts—The plunger spring should have a free length of one and one-half inches, and when compressed to one and one-eighth inches should support a load of 13 to 16 pounds.

Examine the ball between the shifter shafts.

Replacement

In replacing, reverse operations under "Removal."

MAIN TRANSMISSION SHAFT AND MAIN TRANSMISSION SHAFT REAR BEARING

Removal

Remove the floor boards.

Remove the plug "Q" (Fig. 69) and drain the transmission.

Remove the top cover plate. The plate is held in place by six cap screws.

Remove the shield over the forward universal joint. The shield is held in place by two small machine screws.

Remove the eight bolts holding the front universal joint to the flange on the transmission shaft and remove the joint. Be careful in removing the bolts that the joint does not drop and injure the rear joint casing.

Remove the six cap screws directly back of the flange and remove the transmission drive shaft and bearing.

Remove the large cap screw which holds the flange to the shaft and remove the flange with Cadillac puller numbered 83225.

Remove the felt washer, felt washer retainer, steel plate and gasket.

Remove the oil throw-off ring.

The bearing "O" (Fig. 69) can now be removed from the shaft by tapping it off.

Inspection

With gasoline or kerosene clean all parts removed.

INSPECTION OF SHAFT AND BALL BEARINGS—The main transmission shaft placed on lathe centers should run out of true no more than .0025 inch.

There should be no more than .004 inch clearance between the sides of the splines on the shaft and the sides of the spline ways in the shipper gears.

The large annular ball bearing should rotate smoothly and quietly and should have no more than .015 inch end play.

There should be no more than .004 inch shake between the front end of the main transmission shaft and the clutch connection when these parts are in place with the roller bearing.

INSPECTION OF OTHER PARTS—Inspect the roller bearing. It should be free from pits and chips.

Examine the teeth of the gears. These should show very little wear and be free from pits.

Examine the felt washer. If it is worn replace it. It should be well soaked in engine oil.

Inspect the forward universal joint. (See "Inspection" under "Universal Joints," page 168.)

Replacement

In replacing, reverse operations under "Removal."

TRANSMISSION

Removal

Remove the floor boards.

Disconnect the brake rods at the hand brake lever and at the brake pedal.

Remove the rod and spring from the accelerator pedal.

Remove the shield over the forward universal joint. The shield is held in place by two small screws.

Disconnect the universal joint from the flange on the transmission shaft. The joint is held to the flange by eight bolts.

Be careful in removing the bolts that the joint does not drop and injure the rear joint casing.

Remove the copper tube between the tire air compressor and the frame of the car.

Disconnect the clutch control rod from the lever at the bottom end of the rod, and remove the clutch pedal pull-back spring.

Remove the four nuts holding the pedal shaft bracket and remove assembly from transmission.

Remove the starter pedal.

Remove the speedometer cable.

Lift front end of car about twelve inches.

Remove the eight bolts holding the transmission to the crankcase. Remove the transmission by moving it straight back. Care must be exercised in removing the transmission not to drop it.

Disassembly

Remove the clutch. (See "Removal of Clutch" under "Clutch," page 154.)

Remove the hand hole cover "X" (Fig. 69.)

Remove the drain plug "Q" and drain the transmission.

Remove the tire air compressor. (See "Removal" under "Tire Air Compressor," page 157.)

Remove the clutch release shaft "Y." To remove the shaft proceed as follows: Remove the lever from the left-hand end of the shaft, also remove the Woodruff key.

Remove the two taper pins which hold the clutch release yoke to the shaft. The shaft may now be removed, tapping it out from the left side.

Remove the transmission top cover plate by removing the six cap screws.

Remove the transmission bottom cover plate.

Remove the shifter forks and shafts. (See "Removal" under "Shifter Forks and Shafts," page 164.)

Remove the reverse pinion. (See "Removal" under "Reverse Pinion," page 163.)

Remove the main transmission shaft. (See "Removal" under "Main Transmission Shaft and Main Transmission Shaft Rear Bearing," page 164.)

Remove the jackshaft with gears. (See "Removal" under "Jackshaft and Jackshaft Gears," page 162.)

Remove the clutch connection and the large annular ball bearing. (See "Removal" under "Clutch Connection and Clutch Connection Rear Bearing," page 159.)

Remove the mounting for the annular ball bearing. This may be removed by tapping it out.

Remove the hand brake lever ratchet.

Inspection

Inspect all parts removed in accordance with directions in this book.

Reassembly and Replacement

In reassembling and replacing the transmission, reverse operations under "Disassembly" and under "Removal."

Before replacing the transmission make sure that the annular ball bearing "D" (Fig. 69) is in good condition and well lubricated.

The forward end of the clutch connection shaft is milled off to receive the key in collar which fits into the annular ball bearing "D." In replacing the transmission, first make certain that the key in the collar and the key-way in the shaft, line up. This is very important. Care must be exercised in replacing the transmission not to damage the ball bearing or the clutch connection shaft.

Note:—The high and intermediate shipper gear on Type 61 cars beginning with transmission numbered 11075 have a longer hub on the main transmission shaft. This necessitates a slightly shorter clutch connection and a somewhat narrower constant mesh gear on the jackshaft. As a result of these changes these parts from an early type transmission cannot be used in a late type transmission; neither can these late type transmission parts be used in the early type transmission.

UNIVERSAL JOINTS AND REAR AXLE

UNIVERSAL JOINTS

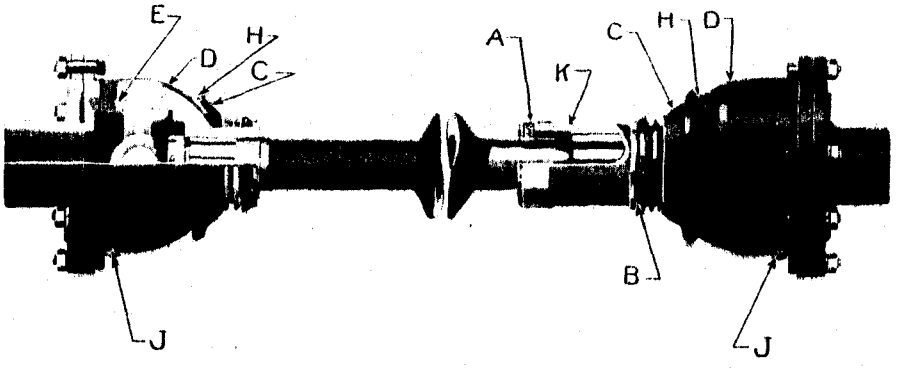


Fig. 70—Universal Joints and Drive Shaft.

Removal of Forward Universal Joint

Remove the shield over the joint. The shield is held in place by two small machine screws.

Remove the eight bolts which hold the joint to the flange on the rear end of the transmission shaft. Care must be exercised not to allow the joint or shaft to drop and injure the rear joint casing.

Remove the collar "A" (Fig. 70) by unscrewing it. The joint can now be removed.

Removal of Rear Universal Joint

Remove the eight bolts holding the universal joint to the flange on the shaft of the axle. Care must be exercised not to allow the joint to drop.

Remove the collar "A" by unscrewing it.

The joint with drive shaft can now be removed by lowering it and pulling it back. Do not allow the forward end of the shaft to drop.

Disassembly of Universal Joints

Remove the joints as directed under headings "Removal of Forward Universal Joint," and "Removal of Rear Universal Joint," page 167 and 168.

Remove the locking ring "B" and the shields "C" and "D."

Remove the locking rings "E" and tap out the bushings. The crosses can then be removed.

Inspection

Thoroughly clean all parts with kerosene or gasoline.

The drive shaft, placed between lathe centers, should run true within .020 inch.

There should be no more than .003 inch clearance between the sides of the splines of the drive shaft and the sides of the spline ways in the hub of the forward joint.

The clearance between the eight bolts which attach each joint and the holes in the flanges should not exceed .002 inch.

There should be no more than .005 inch clearance between the arms of the crosses of the joints and the bushings in which they operate, and no more than .010 inch clearance between the sides of the yokes and the shoulders of the crosses.

Inspect the welded joints of the drive shaft.

Inspect the housings "C" and "D," also the packing washers "H."

Inspect the threads of the filler plugs "J" and the threads in the housings "D" into which they screw.

Replacement

In reassembling, have the mark on the drive shaft and the mark on the hub of the forward joint point directly toward each other. This will bring the yokes on the drive shaft ends in the same plane.

Make sure that the filling holes in the casings "D" do not come opposite the ends of the universal crosses, but directly between the ends. This will make it easier to fill the joints.

After replacing the joints refill each with five ounces of suitable lubricant. Cadillac Universal Joint Lubricant is recommended.

REAR AXLE

Removal

Block the front wheels and jack up the rear end of the frame at least six inches. Block up the frame securely.

Disconnect the four brake rods at the brake arms on the axle.

Disconnect the rear universal joint by removing the eight bolts. Do not allow the joint to drop.

Disconnect the front end of the torque arm from the torque arm bolt, by removing the cotter pin and the nut at the bottom of the bolt. Do not allow the torque arm to drop.

Remove the nuts from the two spring clips at each side, and disconnect the rebound straps.

The axle complete with wheels can now be rolled from under the car.

Disassembly

Remove the wheels. (See "Removal of Rear Wheel and Bearings" under "Wheels," page 185.)

Remove the brake bands. (See under "Brakes," pages 169 and 170.)

Remove the differential complete with gear. (See "Removal" under "Differential and Large Driven Gear," page 170.)

Remove the driving pinion. (See "Removal" under "Driving Pinion and Pinion Shaft," page 174.)

The cage "R" (Fig. 38, page 82) may be removed after removing the six cap screws "L." Remove the long brake shafts for internal brakes. These may be pulled out after removing the cotter pins "S" at spacing spring washers and then loosening the clamp bolts "T" on brake-arms. Remove the torsion arm by taking out the torsion arm shaft. This shaft is held in place by two hollow clamp bolts with two long differential carrier bolts carried in them. Remove the caps at either end of the shaft by removing the long bolt holding them in place. Remove the felt washers in the axle housing sleeves. To do so, remove the cotter pins and remove the retainers.

Inspection

Inspect all parts in accordance with directions in this book.

Reassembly and Replacement

In reassembling and replacing the axle, reverse operations under "Disassembly" and under "Removal."

BRAKES

Removal of External Brake Band

Remove the wheel. (See "Removal of Rear Wheel and Bearings" under "Wheels," page 185.)

Remove the brake pull rod and the pull back spring from the upper end of the lever "D" (Fig. 42, page 87.)

Remove the cotter pin, the adjusting screw "A" and the spring.

Remove the nut from the rear end of the bracket which acts as a stop for the two nuts "B."

Remove the nut "C" and the brake band.

Removal of Internal Brake Band

Remove the wheel. (See "Removal of Rear Wheel and Bearings" under "Wheels," page 185.)

Remove the cotter pins from the support just to the rear of the adjusting screws "R" (Fig. 42.)

Remove the cotter pin, the adjusting screw "J" and the spring.

Remove the pin "M" and remove the brake band.

Inspection

Inspect the brake band lining. The lining should be at least three thirty-seconds inch thick and not glazed. If it is glazed clean it up with gasoline and a stiff wire brush. Lining rivets should be tight and the heads should be beneath the surface of the lining. If it is necessary to reline a brake band follow directions under "Relining Brake Bands," page 88.

All brake pins should fit the shackles and levers within .005 inch.

Brake bands when in place, in correct adjustment and released, should be equally distant at all points from the brake drum. If not, the bands should be reshaped.

Replacement

After replacing the brake bands adjust them in accordance with directions in this book under "Brakes," page 86.

DIFFERENTIAL AND LARGE DRIVEN GEAR

Removal

It is unnecessary to remove the axle in order to take out the differential.

Remove the axle shafts by removing the hub caps and locking rings and pulling them out. (See Fig. 80, page 185.)

Remove the twelve cap screws which hold the rear cover plate "P" in place (Fig. 38, page 82) and remove the plate.

Remove the wires which lock the four large cap screws and loosen the screws. Unscrew the adjusting collars "O" and "N" one-half turn or more, then remove the four large cap screws and the bearing caps "K." Be careful not to drop the differential.

Remove the differential complete with driven gear.

Note:—On some of the type 61 cars the ring gear is riveted to the gear mount. On others it is bolted on. To remove a ring gear mount, with a bolted on ring gear, from the axle of some of the type 61 cars, it is first necessary to remove two adjacent bolts to prevent interference with the carrier. (See "Disassembly," page 171.)

Disassembly

Great care must be taken in disassembling not to spring the ring gear or ring gear mount.

To remove a ring gear which is riveted to the gear mount center punch the center of the oval head of each rivet, drill the head off and carefully tap out the rivet.

To remove a ring gear of the bolted on type counter-sink the center of each bolt and drill off the riveted over portion. The nut may then be removed and the bolt tapped out.

To disassemble the differential remove the twelve cap screws and separate the halves of the housing.

To remove the differential carrier bearings use Cadillac puller numbered 83230.

Inspection

With gasoline or kerosene thoroughly clean all parts.

Inspection of Differential and Driven Gear—The flange of the differential housing should run true laterally and radially within .002 inch.

Examine the faces of the teeth of the driven gear, and of those of the six differential gears. They should show but little wear and should not be pitted. The teeth should not be chipped on the ends.

The hubs of the two large differential gears should have no more than .005 inch clearance in the hub of the cross. The end play in these two gears when the differential halves are bolted together should not exceed .008 inch.

The four small differential gears should have no more than .006 inch clearance on the arms of the cross and no more than .010 inch end play, when in place in the differential housing.

The ends of the cross should fit tightly into the differential housing.

Inspection of Other Parts—Examine the mountings, cones and rolls of the roller bearings. They should be smooth, free from pits and not chipped on the ends. The cages for the rolls should be in good condition.

With the bearing caps bolted in place the mounting for the roller bearings and the adjusting collars should be clamped.

Examine the faces of the pinion teeth. They should show but little wear and should be free from pits. The ends of the teeth should not be chipped.

Replacement

In replacing reverse operations under "Removal."

To replace a ring gear of the riveted on type first carefully face off the surface of the gear mount to which the ring gear is riveted, install the ring gear in place, making sure the surfaces coming in contact are clean, tap in the rivets and rivet them over carefully. Very great care must be used not to spring the gear mount in doing this work.

To replace a ring gear of the bolted on type, proceed as follows:

Clean thoroughly the ring gear and gear mount surfaces coming in contact and place ring gear on gear mount, making certain that the holes are concentric. It is advisable to face off the gear mount in a lathe before installing the ring gear.

Using two temporary bolts, bolt the ring gear to the gear mount. Place the bolts diametrically opposite and draw them up tightly.

Enlarge two diametrically opposite gear mount holes. Select two 90° from the temporary bolts. Using Cadillac reamer numbered 82799, size .430 inch. Finish ream with Cadillac reamer numbered 82800, size .4375 inch. Then ream the countersink in the gear with Cadillac reamer numbered 82802, using the smaller pilot furnished. Tap permanent bolts into these two holes, screw on nuts, and draw them up tightly.

Remove the temporary bolts. Then enlarge, finish ream and countersink ream all of the remaining holes in the manner explained in the preceeding paragraph.

Tap the permanent bolts in all of the finished holes with the exception of two adjacent ones. (These must be left out to permit the differential assembly being put in place without interferance.) Screw on the nuts and them up moderately tight.

Install the assembly in place, then insert the two remaining bolts with nuts and then draw up all of the nuts evenly and tightly.

After the gears have been adjusted and found satisfactory lock the nuts in place by riveting over the cup shaped ends of the bolts with the peen of a hammer. Hold a bar against the bolt heads when riveting. Care must be exercised not to spring the gear mount.

When installing a ring gear where bolts have been used previously, the same procedure is followed except that it is necessary to use oversize bolts and the holes must be reamed with Cadillac reamer numbered 82801, size .4575 inch. The countersinks in the gear must be reamed with reamer numbered 82802 using the larger pilot furnished.

After replacing differential adjust the bearings in accordance with directions in this book under "Adjustment of Pinion Bearings", page 81, and "Adjustment of Ring Gear Bearings", page 83.

After replacing the rear cover plate and tightening the twelve nuts refill the housing with suitable lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. Five quarts are required.

REAR AXLE HOUSING

Removal

Remove and disassemble axle. (See "Removal," and "Disassembly" under "Rear Axle," page 169.)

Inspection

With kerosene or gasoline clean all parts.

Inspection of Housing—Draw a line through the axle, having it pass through the centers of the axle ends at "A" and "B," (Figs. 71 and 72). Dimensions "C" and "D" (Fig. 71) taken from the line to the front and rear machined faces of the housing should vary by no more

than one thirty-second inch. Dimensions "E" and "F" (Fig. 72) taken from the line to the centers of bolt holes "H" and "I" in the front face of the housing should vary by no more than one-thirty second inch.

The spring seats should have no more than .010 inch lateral play and no more than .006 inch radial play. The radial play can be taken up by reducing the edges of the caps with a mill file.

All rivets should be tight.

The threads on the ends of the housing should be in good condition.

INSPECTION OF OTHER PARTS—Inspect all parts removed in accordance with directions in this book.

It is possible to straighten rear axle housing sleeves without removing the axle from the car by using Cadillac tool, numbered 71971, furnished by our Parts Department.

Reassembly and Replacement

After inspecting all parts reassemble and replace the axle. (See "Reassembly and Replacement" under "Rear Axle," page 169.)



Fig. 71—Rear Axle Housing, Top View

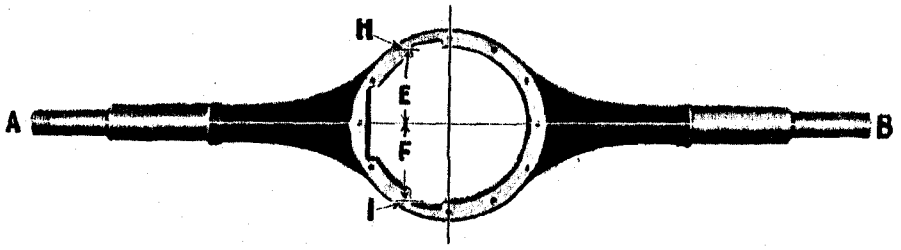


Fig. 72—Rear Axle Housing, Side View.

AXLE SHAFTS

Removal

Remove the oiler "I" (Fig. 80, page 185.) (An oiler is not used on late Type 61 cars.)

Remove the hub cap "B" by unscrewing.

Remove the locking ring "K."

Determine the amount of clearance between the drivers on the axle flange and the recesses which receive the drivers in the hub of the wheel. (See under "Inspection.")

Withdraw the axle shaft. If the axle shaft sticks it may be removed by tapping a cold chisel between the inner faces of the drivers on the axle flange and the bottoms of the recesses in the hub flange. If one of the axle shafts fits particularly tight, remove the looser one in accordance with these directions and drive out the other, by passing a bar of suitable size and length through the opposite end of the axle housing.

Inspection

There should be no more than .010 inch clearance between the drivers on the flange of the axle shaft and the recesses in the hub which receive the drivers.

The clearance between the splines of the axle shaft and the spline ways in the hub of differential gears should not exceed .006 inch.

Placed on lathe centers the axle shaft should run out of true no more than .004 inch.

Replacement

The axle shafts are of the same length and are marked right or left.

Replace on the proper side.

Replace the hub cap.

DRIVING PINION AND PINION SHAFT

Removal

It is unnecessary to remove the axle to remove the pinion and shaft.

Remove the differential complete with driven gear. (See "Removal" under "Differential and Large Driven Gear," page 170.)

Disconnect the rear universal joint by removing the eight bolts. Do not allow the joint to drop and injure the rear joint casing.

Remove the nut which holds the flange to the pinion shaft and remove the flange with Cadillac puller numbered 83225, furnished by our Parts Department.

Remove the shell directly at the rear of the flange and remove the cork disc, packing, spacing ring and spring.

Pull out through the rear of the cage the pinion with the shaft and the bearings.

The front pinion bearing may be removed with Cadillac puller numbered 83228.

The rear or small pinion bearing may be removed with Cadillac puller numbered 83229.

Inspection

Clean all parts with kerosene or gasoline.

Inspection of Pinion and Shaft—Inspect the faces of the teeth of the pinion. They should show very little wear, and be free from pits. The teeth should not be chipped on the ends.

The shaft placed on lathe centers should run true within .002 inch.

Examine the threads on the end of the pinion shaft, also those in the nut.

Inspection of Other Parts—Examine the bearing mountings, rolls and cones. These parts should be smooth and free from pits and not chipped. The bearing cages should be in *good* condition.

The cone of the rear bearing should have no more than .002 inch clearance on the hub of the pinion. The cone of the forward bearing should have no more than .002 inch clearance on the shaft.

Examine the faces of the teeth of the driven gear. They should show but little wear and should be free from pits. The ends of the teeth should not be chipped.

Replacement

In replacing the pinion and driving shaft, reverse operations under "Removal." In replacing the bearings, the driven gear and the driving pinion, make adjustments in accordance with directions in this book under "Rear Axle," page 169.

Refill the axle with suitable lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. Five quarts are required.

FRONT AXLE AND STEERING GEAR

STEERING ARMS

Removal

Remove the nut "P" (Fig. 78, page 180) from the parallel rod bolt.

In removing the left steering arm, next disconnect the steering connecting rod from the arm. (See "Disconnecting Front End" under "Steering Connecting Rod," page 184.)

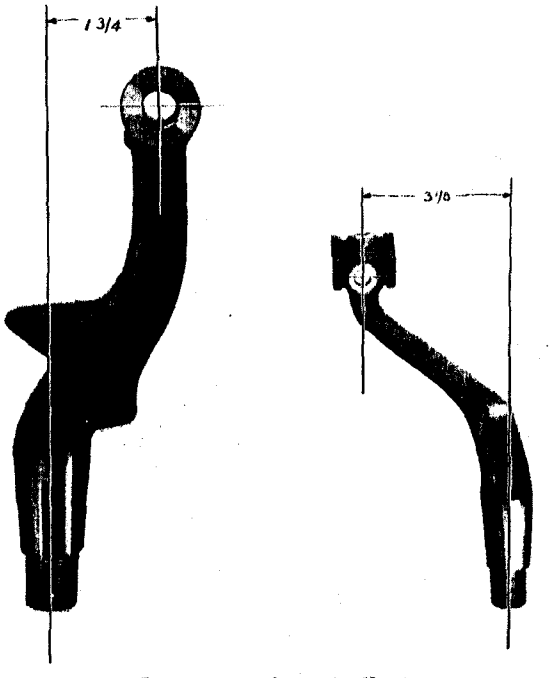


Fig. 73—Right Spindle Arm

Remove the cotter pin and the large nut from the rear end of the arm and drive out the arm.

Inspection

INSPECTION OF ARM—Examine the threads on the steering arm, also the threads in the large nut.

Determine if the arm is bent or sprung. (See Figs. 73 and 74.) (See under "Straightening Bent Parts," page 95.)

Examine the forging carefully.

Inspection of Other Parts—There should be no more than .005 inch clearance between the bushings in the parallel rod yoke and the bolt. If it is necessary to remove one of these bushings, do so with a press or drive it out, and press or drive in the new one.

If the left-hand steering spindle is removed examine the pivot on the arm. It should be round within .010 inch.

Examine the threads in the end of the steering connecting rod, also the threads on the adjusting screw and the surfaces of the bronze bearings.

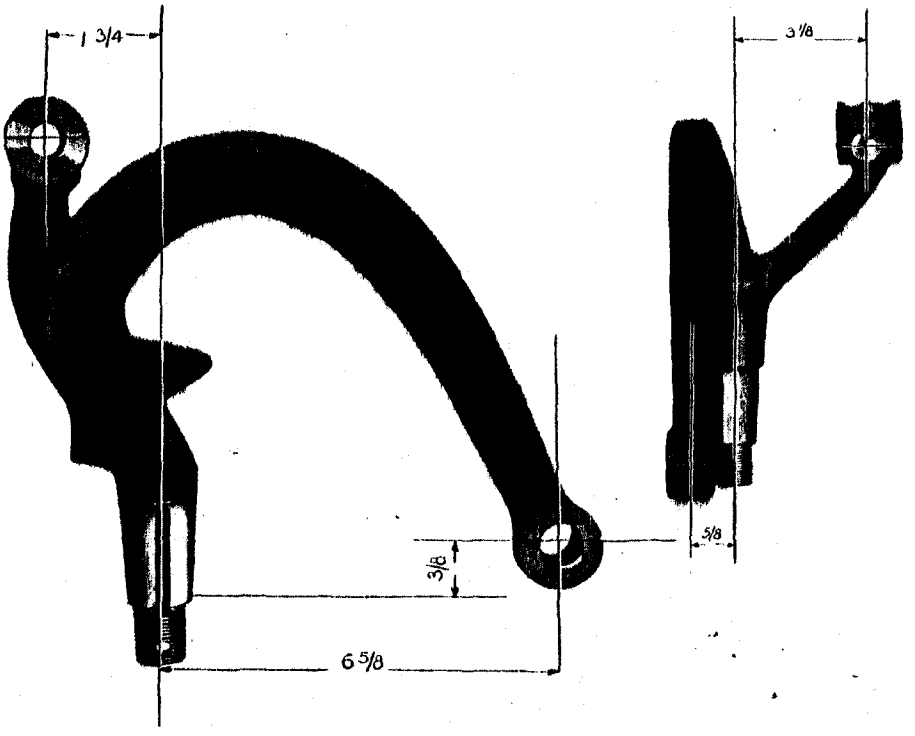


Fig. 74—Left Spindle Arm.

Replacement

In adjusting the screw at the front end of the steering connecting rod do not take it up too tightly. Tighten it only sufficiently to take up all shake.

Do not tighten the nut "P" (Fig. 78, page 180) sufficiently to bind the yoke on the steering arm.

FRONT AXLE

Removal

Jack up the front end of the car until the front wheels are free from the ground.

Remove the front wheels. (See "Removal of Front Wheels and Bearings" under "Wheels," page 185.)

Disconnect the front end of the steering connecting rod. (See "Disconnecting Front End" under "Steering Connecting Rod," page 184.)

Remove the nuts on the spring clips which hold the axle to the spring and remove the spring clips and axle complete with spindles.

Disassembly

Remove the grease connections from the spindles and steering arms.

Remove the parallel rod. (See "Removal" under "Parallel Rod," page 179.)

Remove the spindles with steering arms. (See "Removal" under "Front Axle Spindles," page 179.)

Remove the roller bearing mountings in the upper ends of the axle yokes and the plain bearings at the lower ends of the axle yokes by tapping them out.

The roller bearing mounting can be removed by placing tool numbered 72407 in position as shown in (Fig. 75,) using the large washer. Screw on and tighten the nut. This will force out the mounting.

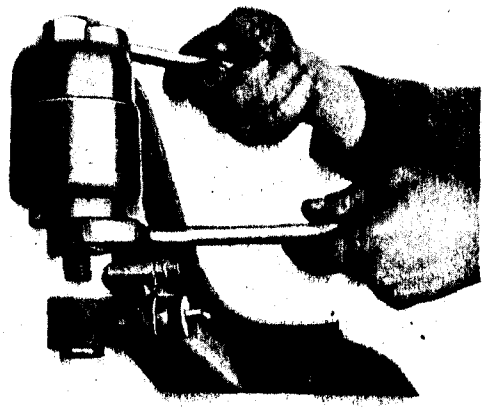


Fig. 75—Removing Roller Bearing Mounting, Front Axle

To replace mounting reverse the large casting, having it bear against the upper edge of the axle yoke, and with the washer in place against the lower edge of the mounting and the mounting lubricated, screw on and tighten the nut. This will force the mounting into place.

Inspection

Lines "C" and "D" (Fig. 76) drawn through the centers of the bores in the axle yokes from which the bearing mountings and bearing

bushings were removed, should be in the same plane and parallel. (See under "Straightening Bent Parts," page 95.)

The center line of the bores in the yokes should be perpendicular or at right angle with the spring seat. This may be tested by placing the axle upside down upon parallel bars as shown in (Fig. 76 and 77) and with a square as shown in (Fig. 77), taking dimensions "A" and "B." These dimensions should be the same.

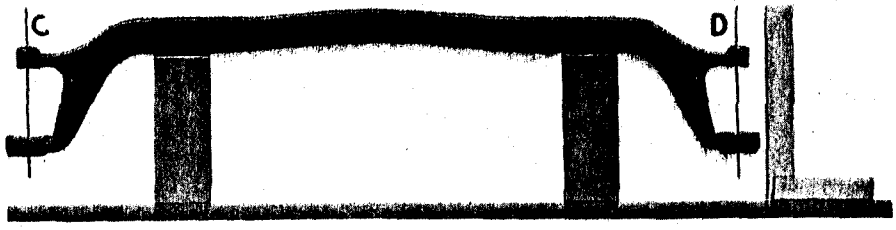


Fig. 76—Inverted Front Axle, Side View.

The mountings at the upper ends of the yokes, and the bushings in the lower ends of the yokes should be a press fit into the axle.

The mountings, cones and rolls of the roller bearings should be smooth, free from pits and not chipped. The cages should be in good condition.

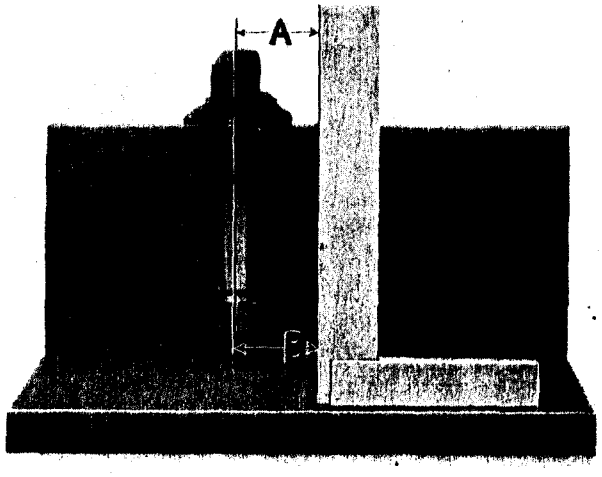


Fig. 77—Inverted Front Axle, End View

There should be no more than .005 inch clearance between the spindle bolt and the bushing at the lower end of the axle yoke.

Inspect the spindles. (See "Inspection of Spindle" under "Front Axle Spindles," page 180.)

Replacement

In replacing the spindle bolts adjust the nuts at the lower ends in accordance with directions under "Adjustment of Spindle Bearing," page 91.

Adjust the front wheel bearings in accordance with directions under "Replacing a Front Wheel and Adjusting Bearings," page 94.

In adjusting the nut at the front end of the steering connecting rod do not adjust it too tightly. Tighten it only sufficiently to take up all shake.

Adjust the spindle arm stop screws "H" (Fig. 78) in accordance with directions under "Spindle Arm Stop Screws," page 90.

PARALLEL ROD

Removal

Remove the nut "P" (Fig. 78) at each end of the parallel rod.

Remove the taper pins which prevent the parallel rod bolts from turning and tap out the bolts, being careful not to damage the threads.

Inspection

INSPECTION OF PARALLEL ROD—Examine the rod. It should be straight and free from dents. The threads on the ends of the rod and in the rod yokes should be in good condition.

There should be no more than .005 inch clearance between the bushings in the yokes and the bolts. If it is necessary to replace one of the bushings remove it with a press, or by driving it out, and press, or carefully drive in, the new bushing.

INSPECTION OF OTHER PARTS—Examine the bearing surfaces of the spindle bolts, also the threads on the ends of the bolts and the threads in the nuts.

Replacement

In replacing the yokes on the rod have the threaded ends at each end extend an equal amount into the yokes.

After replacing the rod, align the front wheels in accordance with directions in this book under "Alignment of Front Wheels," page 94. Do not re-align the front wheels by adjusting one yoke only. Adjust both yokes so that the parallel rod will extend into each yoke an equal amount after the work is completed. Be sure that the parallel rod extends into each yoke at least one inch.

Do not tighten the nuts "P" sufficiently to bind the yokes on the steering arm.

FRONT AXLE SPINDLES

Removal

Jack up the axle and remove the wheel. (See "Removal of Front Wheel and Bearings" under "Wheels," page 185.)

Remove the nut "P" (Fig. 78) from the parallel rod bolt "J."

Remove the taper pin which prevents the parallel rod bolt from turning and tap out the bolt "J," being careful not to damage the threads.

If removing a left spindle, next disconnect the steering connecting rod from the steering arm. (See "Disconnecting Front End" under "Steering Connecting Rod," page 184.)

Remove the nut "B."

Remove the taper pin "A."

Drive out the spindle bolt "C," being careful not to injure the threads. Use Cadillac spindle bolt starter numbered 83223.

Remove the spindle.

To remove the steering arm, first remove the large nut, then either press or drive it out, being careful not to injure the threads.

Inspection

With kerosene or gasoline clean all parts removed.

INSPECTION OF SPINDLE—Placed on lathe centers, that part of the spindle which receives the wheel bearings should run true within .002 inch. (See under "Straightening Bent Parts," page 95.)

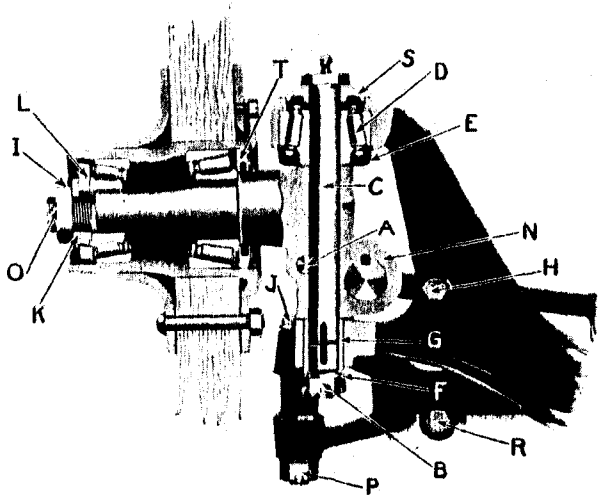


Fig. 78—Front Spindle.

There should be no more than .002 inch clearance between the cones of the roller bearings and the spindle.

The threads on the spindle should be in good condition.

INSPECTION OF OTHER PARTS—Inspect the roller bearings. The cones, rolls and mountings should be smooth and free from pits and chips. The roller cage should be in good condition.

There should be no more than .005 inch clearance between the lower end of the spindle bolt and the bushing in the axle yoke.

The threads on the lower end of the spindle bolt in the nut and in the front wheel adjusting nut and lock nut must be in good condition.

Inspect the spindle arm. (See "Inspection of Arm" under "Steering Arms," page 175.)

Replacement

In replacing, reverse operations under "Removal."

In adjusting the nut at the front end of the steering connecting rod, do not adjust it too tightly. Tighten it only sufficiently to take up all shake.

In adjusting front wheel bearings follow directions in this book under "Replacing a Front Wheel and Adjusting Bearings," page 94.

In replacing the nut "B" make the adjustment in accordance with directions in this book under "Adjustment of Spindle Bearing," page 91.

Adjust the spindle arm stop screws "H" (Fig. 78) in accordance with directions under "Spindle Arm Stop Screws," page 90.

STEERING GEAR

Removal—(Body on Car)

Remove the splash pan under the engine.

Remove the steering arm "H" (Fig. 45, page 92) from the sector shaft. The end of the sector shaft and the hole in the steering arm are tapered and serrated, the parts being held together by a large nut locked with a spring washer. After removing the nut and lock washer, remove the arm with Cadillac puller, numbered 7235-I.

Remove the cap screw "F" and the wrench "G" and pull out the long eccentric adjusting bushing.

Remove the two three-sixteenths inch control rods between the steering gear and engine.

Remove the cover plate "K" (Fig. 44, page 91) on the rear face of the steering gear housing. This plate is held in place by five five-sixteenth inch cap screws.

Push in the sector shaft until its outer end is just beyond the inner face of the frame.

Disconnect at the horn the wire running from the steering gear to the horn and remove the connector from the end of the wire by unsoldering it.

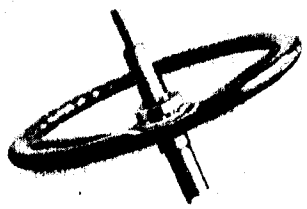


Fig. 79—Removing Steering Wheel

*Remove the small bronze segment gears from the lower ends of the spark and throttle control tubes. These gears are clamped to the tubes by one-quarter inch cap screws.

Remove the horn button and control disc cover which is held in place by a small set screw "M." (See Fig. 44, page 91).

Remove the upper housing which is held in place with two special screws and springs.

Remove the two hand levers "O" and friction plate. Lay back the top and pull out the staff. The staff is clamped in place at the lower

end by a five-sixteenths inch cap screw in the housing support bracket which is bolted to the lower end of the steering gear housing.

If the staff does not pull out easily, open the clamp by carefully tapping in a small chisel. Open the jaws of the clamp only sufficiently to make possible the removal of the staff.

*Remove the nut which holds the steering wheel in place and with Cadillac puller, numbered 77838 (See Fig. 79), or Cadillac puller numbered 83220, remove the wheel.

*Remove the cap from the steering gear bracket attached to the instrument board.

Remove the four three-eighths inch bolts which hold the steering gear housing to the frame.

Raise the front end of the car about six inches and remove the steering gear by passing it down between the crankcase of the engine and the frame of the car.

Removal—(Body off Car)

*To remove the steering gear with the body off the car, omit operations preceded by asterisks under "Removal (Body on Car)."

Disassembly

It is necessary to partly disassemble the steering gear before removing it, provided the engine or body are in place. With the steering gear removed in accordance with directions under "Removal (Body on Car)," proceed as follows in completing the disassembly.

Remove the support bracket at the lower end of the steering gear housing. The bracket is held to the steering gear housing by four three-eights inch cap screws. In removing the bracket do not allow the thrust bearing to drop.

Through the lower end of the housing remove the steering tube with worm, upper thrust bearing for the worm and the spring, washer and cone of the bearing at the upper end of the housing tube.

Remove the two screws "B" (Fig. 45, page 92) and the collar "D" (Fig. 44, page 91) by unscrewing.

Inspection

Inspect the teeth of the worm and sector. They should show very little wear and be free from scores.

There should be no more than .004 inch clearance between the sector shaft and the eccentric bushing in which it has its bearing. The eccentric bushing should be a snug sliding fit in the housing and free from scores.

There should be no more than .004 inch clearance between the hubs of the steering worm and the bearings which receive them.

Inspect the balls and races of the thrust bearings. They should be free from pits and in good condition.

Examine the serrations on the end of the sector shaft and in the steering arm, also the threads on the end of the sector shaft.

The adjusting spring at the upper end of the steering tube should have a minimum free length of three inches. The bushing should be in good condition. The bushing should move freely on the steering tube.

The serrations at the bottom ends of the spark and throttle tubes and in the segment gears should be in good condition.

Inspect the housing, also all machined surfaces of the housing.

Reassembly and Replacement

In reassembling and replacing steering gear, reverse operations under "Removal and Disassembly."

Adjust the thrust bearings for the worm in accordance with directions under "Adjustment of Worm Thrust Bearings," page 91.

In replacing the long eccentric adjusting bushing have the thick side of the bushing face in the direction of the worm of the steering gear, and make certain that the tongues on the inner end of the bushing enter the tongue ways in the thrust ring. Before putting the wrench "G" (Fig. 45) onto the outer end of the bushing, rotate the bushing in a counter-clockwise direction until the correct adjustment between the worm and sector is made. (See under "Adjustment of Worm and Sector," page 92.)

In replacing the small segment gears on the lower ends of the spark and throttle tubes, so mesh the teeth with the teeth of the larger segment gears, that the end teeth of the smaller gears do not pass the ends of the larger gears in moving the spark or throttle levers from the extreme retard to the extreme advance position, or vice versa.

The adjustment of the control rods should be checked. The throttle in the carburetor should be permitted to "close" but should start to open immediately the throttle lever on the steering post is moved from the fully closed position.

The lever on the distributor and timer should be permitted to reach the fully retarded position but should move immediately the spark lever is moved from the retarded position.

After completing this work it is a good plan to recheck the ignition timing. (See under "Timing Ignition," page 54.)

Refill the steering gear housing with suitable lubricant. Cadillac Steering Gear Lubricant is recommended.

If the adjustment of screw "L" (Fig. 44) has been changed, it should be readjusted in accordance with directions in this book under "Adjustment of Worm and Sector," page 92. Make sure that the cap screws in cover plate are tight before making this adjustment.

In replacing the nut which holds the steering arm to the sector shaft, be sure that it is well tightened.

HOUSING FOR STEERING GEAR WORM AND SECTOR

Removal

Remove and disassemble the steering gear. (See "Disassembly" under "Steering Gear," page 182.)

Inspection

With kerosene or gasoline clean all parts removed.

INSPECTION OF HOUSING—Inspect the housing carefully.

The long eccentric bushing should be a sliding fit in the housing.

INSPECTION OF OTHER PART—Inspect all parts in accordance with directions in this book.

Reassembly and Replacement of Steering Gear

After inspecting all parts in accordance with directions in this book, reassemble the steering gear and replace it. (See "Reassembly and Replacement" under "Steering Gear," page 183.)

STEERING CONNECTING ROD

Disconnecting Rear End

Remove the grease connection.

Remove the leather boot.

Remove the cotter pin, adjusting screw and spring.

The rear end of the rod can now be removed from the pivot on the steering arm.

To remove the rear pivot bearing, screw into it a one-fourth inch rod threaded on the end with number 20 thread.

Disconnecting Front End

Remove the grease connection.

Remove the leather boot.

Remove the cotter pin and adjusting screw.

The front end of the rod can now be removed from the pivot on the steering arm.

Inspection

With gasoline or kerosene clean all parts removed.

INSPECTION OF STEERING CONNECTING ROD—Examine the rod. It should be true and free from dents.

Examine the welds at each end of the rod.

The thread in each end should be in good condition.

Inspect the adjusting screws. The threads should be in good condition.

Examine the bronze bearings. All machined surfaces should be in good condition.

The springs should have a free length of approximately eleven-sixteenths inch.

INSPECTION OF OTHER PARTS—Examine the pivots on the steering arms. These should be in good condition and out of round no more than .010 inch.

Replacement

In replacing pack the bearings with cup grease. Cadillac Cup Grease is recommended.

Take up the adjustment just enough to take up all play in the bearings, but not sufficiently to bind the bearings on the pivots. If the adjusting screws are too tightly drawn up, excessive wear on the pivots and bearings, and stiff steering will result.

Do not replace the used cotter pins. Use new ones.

WHEELS

Before starting to remove a wheel, jack up the axle, turn the wheel slowly and determine if it is out of true. A wheel should run out of true no more than five thirty-seconds inch. Do not make this test either on the tire, or on the demountable rim, but on the felloe band of the wheel.

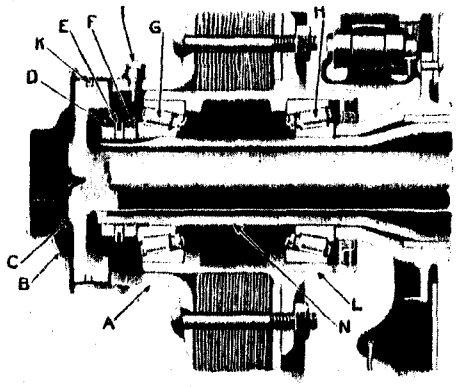


Fig. 80—Rear Wheel Bearings and Adjusting Nuts.

Removal of Front Wheel and Bearings

Jack up the axle until the wheel is free from the ground.

Remove the hub cap by unscrewing it.

Remove the cotter pin "O" (Fig. 78, page 180.)

Remove the locking nut "I."

Remove the washer "K."

Remove the adjusting nut "L."

Remove the wheel, being careful not to drop the outer roller bearing.

The inner roller bearing can be removed, after removing the retainer. The inner and outer mountings can be removed by driving them out.

Removal of Rear Wheel and Bearings

Remove the oiler "P" (Fig. 80) (An oiler is not used on the late Type 61 cars.)

Remove the hub cap by unscrewing it.

Remove the locking ring "K" and withdraw the axle shaft. If the axle shaft sticks it may be removed by tapping a cold chisel between the rear faces of the drivers on the axle flange and the bottoms of the recesses in the hub flange. If one of the axle shafts fits particularly tight, remove the looser one in accordance with these directions and drive out the other, by passing a bar of suitable size and length through the opposite end of the axle housing.

Jack up the axle until the wheel is free from the ground and remove the lock nut "D," the washer "E," and the adjusting nut "F."

Remove the wheel, being careful not to drop the outer bearing. The removal of the wheel is facilitated if it is removed squarely.

The inner bearing may be removed after removing the retainer. The inner and outer mountings can be removed by driving them out.

Inspection

INSPECTION OF WHEEL—The wood parts should be free from cracks and fitted together tightly.

The nuts on all hub and brake drum bolts should be tight. The ends of the bolts should be headed over slightly to prevent the nuts loosening.

Bearing mountings should be a driving fit into the wheel hubs.

Wheels at the felloe band should run true within five thirty-seconds inch laterally.

The brake drums on the rear wheels should run true within one-sixteenth inch radially.

INSPECTION OF OTHER PARTS—Examine the bearing surfaces of the mountings, cones and rolls. The surfaces should be smooth and free from pits and chips. The roller cages should be in good condition.

The bearing cone should have no more than .002 inch clearance on the spindles of the axle.

The bolts for the rim wedges should be straight. The threads on the bolts and in the wedges should be in good condition.

Inspect the demountable rims. Demountable rims should be free from dents or other injuries, and when off the wheel should be round within one-eighth inch. The locking ring, the lock, and the rivet which holds the lock to the rim, should be in good condition. When off the rim, the ends of the locking ring should point directly toward each other and come together.

Replacement

Before replacing the bearings, fill between the rolls with suitable lubricant. Approximately three ounces are required for each wheel. Cadillac Wheel Bearing Grease is recommended.

Adjust the bearings in accordance with directions in this book under "Replace a Front Wheel and Adjust Bearings," page 94.

FRAME AND SPRINGS

FRAME

Removal

Remove the tire carrier with tail lamp.

Remove the body complete with top and windshield. (See "Removal" under "Body," page 191.)

Remove the front fenders. (See "Removal of Front Fender" under "Fenders," page 192.)

Remove the running boards and dust shields. (See under "Running Boards and Dust Shields," page 191.)

Remove the radiator. (See "Removal" under "Radiator," page 149.)

Remove the dust shield over the forward universal joint, and disconnect the joint from the drive shaft on the transmission. Do not allow the joint to drop and injure the rear joint casing.

Disconnect the brake rods from the brake pedal and the hand brake levers.

Remove the pull-back spring between the clutch pedal and the frame and remove the copper pipe between the tire air compressor and the frame.

Remove the engine in accordance with directions under "Engine," page 101, but do not disconnect the transmission from the engine.

Remove the front axle by first removing the spring clips, then disconnecting the steering connecting rod at the front end.

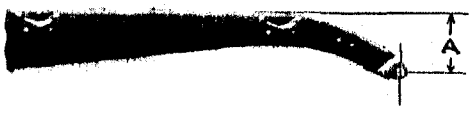


Fig. 81—Side Bar, Front End

Remove the rear axle. (See "Removal" under "Rear Axle," page 169.)

Remove the torque arm support from frame. Use Cadillac wrenches numbered 83236 and 83237.

Remove the three rear springs by removing the spring bolts at the front ends of the side springs and the two spring clips at the center of the cross spring.

Remove the front springs by removing the bolts at the front ends of the springs with Cadillac pusher 83226 and those at the upper ends of the shackles at the rear ends with Cadillac puller numbered 83222.

Remove the gasoline tank by disconnecting the unions on the two pipes to the tank and removing the three nuts. In removing the washers under the two forward nuts observe the manner in which they are assembled. These washers must be put back as originally assembled.

Remove the piping from the frame.

Remove the brake cross shafts.

Remove the steering gear by first removing the steering arm and then removing the four three-eighths inch bolts.

Inspection

Determine if the frame has become bent or sprung. To do so take the following dimensions:

From the machined face of bracket, "C" (Fig. 82) to the machined face of bracket "D" should be from 24 5/16 to 24 3/8 inches.

Dimensions "A" and "B" taken from the center of the socket "E" to the centers of the large bolt holes in the brackets "C" and "D" should vary by no more than .020 inch.

Pass a center line through the center of the socket "E" and through a point equally distant from the machined faces of the bracket "C" and "D." Dimensions "F" and "J," taken from the line to the centers of brackets "H" and "I," should vary by no more than .060 inch. Dimensions "O" and "P" taken from the centers of the taper holes in brackets "M" and "N" should vary by no more than .100 inch. Dimensions "R" and "S" taken from the centers of brackets "K" and "L" should vary by no more than .025 inch.

The distance "A" (Fig. 81) from the center of the spring bolt hole in the brackets at the front ends of the side bars (fenders and hood shelves removed) should be five and eleven-sixteenths inches.

To determine if the frame side bars are parallel, lay parallel bars across the frame directly over the front engine support and over brackets "H" and "I." By sighting across these bars it may be determined if the frame is twisted.

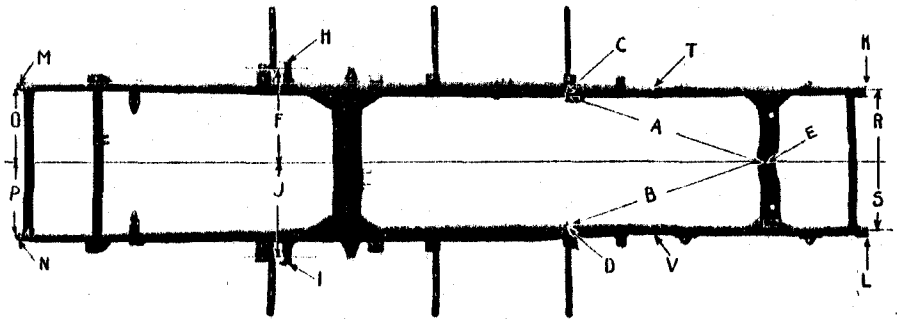


Fig. 82—Frame.

Examine all rivets. They should be tight in the frame.

Examine the machined surfaces of socket "E," also the threads for the socket cap screws.

Inspect the steel bushings "T" and "V." There should be no more than .004 inch clearance between these bushings and the bolts. The bushings should be a tight driving fit into the frame brackets.

These bushings may be removed by using Cadillac puller, numbered 71953 as shown in Fig. 83.

To force out a bushing place the tool in position as shown in Fig. 83 and draw up on the large nut. To replace a bushing reverse the tool. Lubricate the bushing before pulling it in.

The clearance between the sides of the brackets "K," "L," "T" and "H" and the spring ends with the washers in place should not exceed .004 inch. Washers of different thicknesses are provided to take up play at these points.

Examine the bushings in which the brake shafts operate. There should be no more than .004 inch clearance between a brake shaft and brake shaft bearing.

Examine the tubular cross members. They should be straight and tight in the brackets at each end.

Replacement

In replacing, reverse operations under "Removal."

All spring bolts, brake shafts, etc., should be well lubricated before they are replaced.

Do not tighten spring bolts sufficiently to bind the spring ends. After tightening the large bolts which hold the rear engine supports to the frame, loosen the nuts one notch before putting in the cotter pins.

SPRINGS

Removal of Front Spring

Jack up the front end of the car approximately four inches.

Remove the nuts from the double clip.

Remove the bolts at each end of the spring and remove the spring. Use Cadillac puller numbered 83222.

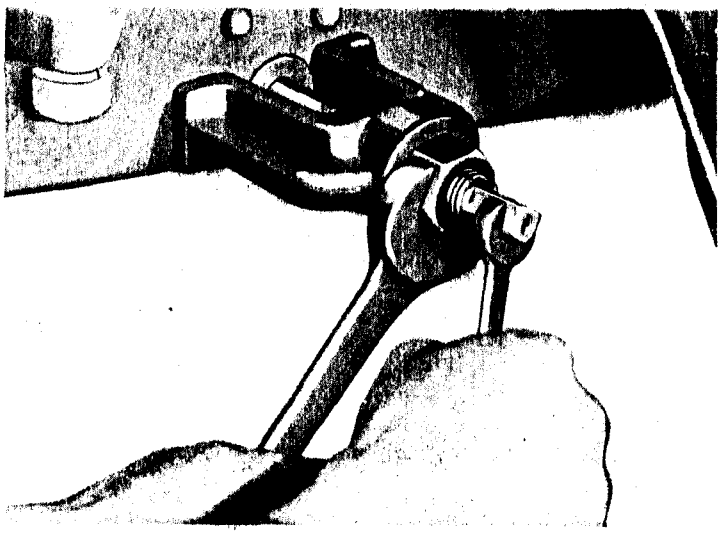


Fig. 83—Removing Shackle Bolt Bushings from Frame

Removal of Rear Side Spring

Jack up the rear end of the car approximately four inches.

Remove the nuts from the double clip.

Remove the bolt at each end of the spring and remove the spring.

A small door is provided in each dust shield to facilitate the removal of the forward bolts.

Removal of Cross Spring

Jack up the rear end of the car approximately five inches.

Remove the nuts from the two spring clips.

Remove the bolts at each end of the spring and remove the spring.

Disassembly

Remove the bolt in the center of the spring and the bolts in the clips which enclose a portion of the leaves. These bolts are headed over on the ends. File the ends off flush with the nuts and remove the nuts. Use new bolts in reassembling springs.

Inspection

Examine the spring leaves; they should be unbroken, free from cracks and smooth where they contact with other leaves. If they are not smooth, clean them up.

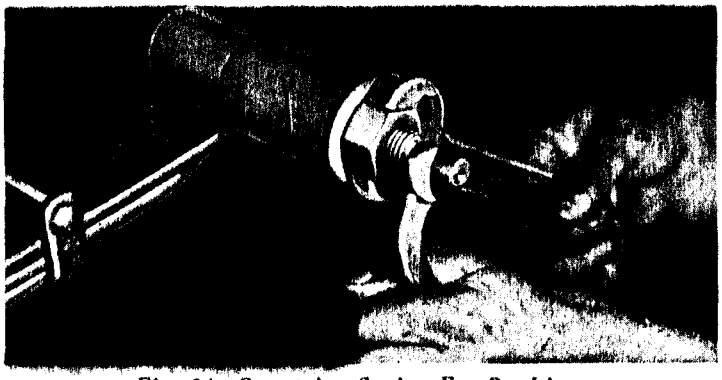


Fig. 84—Removing Spring Eye Bushing

Examine the bronze bushings in the eyes of the longest leaf. The bushings should be a tight driving fit into the spring eyes and have no more than .004 inch clearance on the spring bolts.

These bushings may be removed by using Cadillac puller, numbered 72355, as shown in Fig. 84.

Place the tool in position as shown in Fig. 84. The bushing may then be removed by screwing up on the nut.

To pull a bushing into place, place the tool in the reverse position, lubricate the bushing and tighten up on the nut.

Replacement

All rust should be cleaned from the surfaces of the leaves, which contact with other leaves, and the surfaces should be well lubricated with suitable lubricant before the spring is reassembled. Graphite grease is recommended.

Care must be exercised in drawing up the spring shackle bolts not to bind the spring ends in the shackles.

If there is more than .004 inch clearance between the front ends of the rear and front side springs and the brackets, replace the washers by thicker ones.

All spring clips should be well tightened.

BODY, RUNNING BOARDS AND SHEET METAL PARTS

BODY

Removal

Remove the tire carrier.

Remove the rear fenders. (See "Removal of Rear Fender" under "Fenders," page 193.)

Remove the floor boards.

Remove the cap from the steering gear bracket attached to the instrument board.

Remove the tie rod between the body and the radiator.

Disconnect the two pipes at the left side bar.

Disconnect the pipe at the pressure regulator.

Remove the speedometer cable from the speedometer head.

Disconnect from the storage battery the large cable, and block it up with a dry piece of wood to prevent it touching the terminal of the battery. Remove the generator top cover plate and remove from the generator the three small wires.

Disconnect from the front face of the dash the flexible tube which runs to the right-hand high tension conduit. Disconnect the low tension and high tension wires from the coil and remove these wires through the hole in the dash.

Disconnect the two headlight wires from the body. Connectors are provided at the front end of the body on each side.

Disconnect the rod between the cowl and the carburetor.

Remove the head-lamp reflector control rod button at instrument board and pull out rod.

Place a suitable covering over steering wheel to prevent its being scratched or dented.

Remove the ten nuts which hold the body to the frame and remove the body.

Replacement

Before replacing body make sure that the "anti-squeak" material is in good condition. All body bolts should be drawn down firmly.

Before replacing the wires to the generator, or to the coil or the cable to the storage battery, make sure that the terminals are clean. All terminals should be well tightened.

In setting on the body, care must be exercised not to allow it to strike the steering wheel. A suitable covering should be used for this purpose.

RUNNING BOARDS AND DUST SHIELDS

Removal of Right Running Board and Dust Shield

Remove the two cap screws which hold the rear fender to the running board and the three bolts which hold the fender to the dust shield.

Remove the front fender. (See "Removal of Front Fender" under "Fenders," page 192.)

Remove the nine nuts which hold the running board to the running board brackets and the three nuts which hold the dust shield to the running board.

Remove the running board.

Loosen the forward body bolts and remove the dust shield.

Removal of Left Running Board and Dust Shield

Remove the two cap screws which hold the rear fender to the running board and the three bolts which hold the fender to the dust shield.

Remove the front fender. (See below "Removal of Front Fender," under "Fenders").

Remove the storage battery. This may be done after the two cables are removed, also the nuts on the two long hold-down bolts. Care must be exercised in removing the battery not to drop it or to spill the contents.

Remove the four bolts which hold the dust shield to the frame. The four nuts are directly back of the storage battery.

Disconnect at the dust shield, the terminal on the end of the tube from the tire air compressor.

Remove the nine nuts which hold the running board to the running board brackets and the six nuts which hold the dust shield to the running board.

Remove the running board.

Loosen the forward body bolts and remove the dust shield.

Inspection

Examine the dust shields for cracks and dents.

The running board should be free from cracks and should not be warped.

Examine the threads on the running board hold-down bolts and nuts.

Replacement

In replacing the dust shield make sure that the "anti-squeak" material between the fenders and shield is in good condition.

All bolts and nuts should be well tightened.

FENDERS

Removal of Front Fender

Remove the hood.

Remove the head-lamps with the tie rod.

Remove the two hood pulls. Each hood pull is held in place by two small machine screws.

Remove the hood shelf. The hood shelf is held in place by five bolts.

Disconnect, at the body, the wires to the head-lamp. The connector is at the forward end of the body.

Remove the two cap screws which hold the fender to the running board.

Remove the six small machine screws which hold the fender to the dust shield.

Remove the two large nuts which hold the fender support arms to the fender brackets on the frame, and remove the fender.

Removal of Rear Fender

Remove the two cap screws which hold the fender to the running board.

Remove the three small bolts which hold the fender to the dust shield.

Remove the cap screws which hold the fender to the body and remove the fender.

Inspection

Examine the fenders for cracks and dents.

Replacement

Make sure that the "anti-squeak" material between the front fender and the frame, between the rear fender and the body and between the front and rear fenders and dust shield is put back as originally assembled, or replaced by new if not in good condition.

MUFFLERS

Removal

Disconnect from the side bar the bracket supporting the front end of the tail pipe. Loosen the clamping screws at the ends of the muffler and slide the muffler toward the rear until it is clear of the exhaust pipe. Remove the muffler by pulling it off from the tail pipe.

Disassembly

Remove the forty machine screws holding the ends of the muffler to the center section.

Remove the baffle plates, noting their relative positions so they can be re-assembled in the same order.

Inspection

Clean the carbon from the inside of the muffler shell and from the baffle plates. Inspect the shell and plates, making sure all holes are free.

Reassembly and Replacement

Reassemble the baffle plates in their original order and replace the muffler, reversing the operation under "Removal." Make sure that the end of the muffler with the conical shaped plates is toward the front.

PART IV
LUBRICATION

LUBRICANTS

There are many grades of oils. There are none too good. Naturally, we have experimented a great deal with numerous lubricants to determine which are best adapted for the various parts of the Cadillac car. It is not always an easy matter to obtain suitable lubricants. The constant demand made upon us has induced us to provide suitable lubricants.

Cadillac Engine Oil

Cadillac Engine Oil is recommended and may be used for summer and winter. In the absence of Cadillac Engine Oil we recommend lubricant of the following specifications:

Light Oil Specifications

Flash test (Cleveland open cup)—not below 335° Fahr.

Viscosity (Saybolt Universal)

180-220 seconds at 100° Fahr. and not less than 43 seconds at 210° Fahr.

Carbon residue (Conradson)—not over 0.1%.

Fire point (Cleveland open cup)—not below 380° Fahr.

Pour test—not above 10° Fahr.

Color—not darker than number 4 National Petroleum Association.

Corrosion—Should not corrode any metal used for machine construction.

Acidity—Should not contain acid to exceed an equivalent of 0.05 milligrams of potassium hydroxide per gram of oil.

Medium Oil Specifications

Flash test (Cleveland open cup)—not below 350° Fahr.

Viscosity (Saybolt Universal)

350-410 seconds at 100° Fahr. and not less than 49 seconds at 210° Fahr.

Carbon residue (Conradson)—not over 0.4%.

Fire point (Cleveland open cup)—not below 400° Fahr.

Pour test—not above 45° Fahr.

Color—not darker than number 6 National Petroleum Association.

Corrosion—Should not corrode any metal used for machine construction.

Acidity—Should not contain acid to exceed an equivalent of 0.05 milligrams of potasium hydroxide per gram of oil.

Heavy Oil Specifications

Flash test (Cleveland open cup)—not below 360° Fahr.

Viscosity (Saybolt Universal)—510-575 seconds at 100° Fahr. and not less than 56 seconds at 210° Fahr.

Carbon residue (Conradson)—not over 0.60%.

Fire point (Cleveland open cup)—not below 410°.

Pour test—not above 50° Fahr.

Color—not darker than number 6 National Petroleum Association.

Corrosion—Should not corrode any metal used for machine construction.

Acidity—Should not contain acid to exceed an equivalent of 0.05 milligrams of potassium hydroxide per gram of oil.

Oil purchased under these specifications must be properly refined petroleum oil. It should not contain water, sediment, acid, soap, resin, or any substance not derived from petroleum.

Tests should be made according to standard and tentative methods of the American Society for Testing Materials.

Engine oil should be strained through cheese cloth or fine mesh wire cloth before using.

A list of approved light, medium and heavy oils will be mailed on request.

Rear Axle and Transmission Lubricant

Cadillac Rear Axle and Transmission Lubricant is recommended for the rear axle and transmission or in its absence a mixture of steam cylinder oil and a small amount of cup grease mixed to such a consistency that the mixture flows easily at temperatures from 60° to 70° Fahrenheit.

Transmission and Rear Axle Lubricant Specification

Viscosity—150-200 seconds at 210° Fahr.

Cold Test—Should not channel at 0° Fahr.

Acid Test (As Oleic)—Not over 0.3%.

Transmission and rear axle lubricant should be a straight mineral lubricant and contain no water, grit or foreign matter.

If necessary to secure easier gear shifting in cold winter weather the lubricant can be thinned with the winter grade of engine oil.

Gun Grease

Cadillac Gun Grease is recommended for use in the grease gun or, in its absence, number three cup grease.

Distributor Grease

Cadillac Distributor Grease is recommended for the Distributor.

Universal Joint Grease

Cadillac Universal Joint Grease is recommended for the universal joints on the drive shaft or, in its absence, number three fibre grease.

Steering Gear Lubricant

A mixture consisting of seventy-five per cent of Cadillac Rear Axle and Transmission Lubricant and twenty-five per cent Cadillac Gun Grease or number one cup grease is recommended for the steering gear.

Wheel Bearing Grease

Cadillac Wheel Bearing Grease is recommended for the wheel bearings. In its absence, number one cup grease is recommended.

ENGINE LUBRICATION

Lubricating System

The lubrication of the engine is by oil under pressure. A supply of oil is carried in the oil pan "A" (Fig. 85.) Oil is drawn from the oil pan by the oil pump "C" through the pipe "B" and forced to the main bearings "E," "F" and "G," through the supply pipe "D."

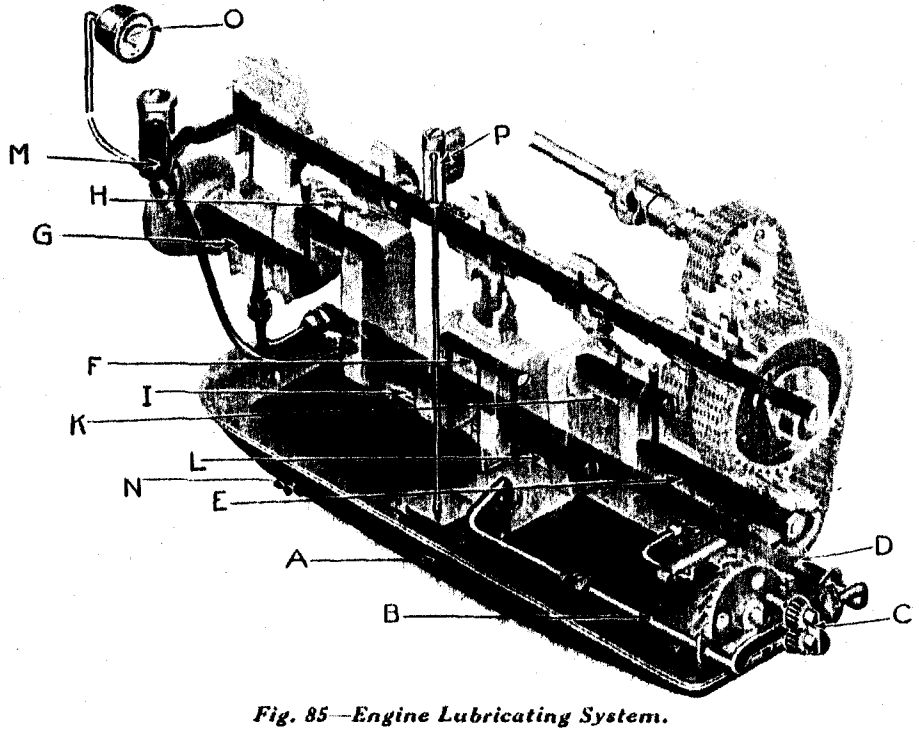


Fig. 85—Engine Lubricating System.

The pressure of the oil is regulated by an overflow valve or pressure regulator "M," containing a valve under spring tension. When the pressure is reached for which the valve is set, the valve is forced open and the oil overflows past the valve. A small hole "D" (Fig. 87) drilled

in the regulator housing allows oil to by-pass the valve when the valve is seated. Oil flowing through the by-pass and oil forced past the valve is carried to the camshaft bearings and power air compressor in the gasoline system through the camshaft. The oil flows to the sprockets and to the chains through the camshaft and holes drilled in the eccentric bearing.

The crank pin bearings "H," "I," "K" and "L," (Fig. 85) on the crankshaft, are lubricated by oil from the main bearings forced through holes drilled in the crankshaft. The hole drilled in the forward end of the crankshaft communicates with a hole drilled in the crankshaft sprocket through which oil is supplied to the camshaft chain. The cylinders are lubricated by oil thrown from the lower ends of the connecting rods.

There is one gauge and one indicator in the lubricating system. The pressure gauge "O" is located on the instrument board. The indicator "P" is attached to the upper cover of the crankcase near the carburetor and indicates the level of the oil in the oil pan "A."

Filling Lubricating System

A filling hole is provided on the fanshaft housing just forward of the distributor and timer. It is of the utmost importance that engine oil be free from dirt and lint and of suitable quality. (See under "Lubricants.")

Add oil if the oil level indicator "P" (Fig. 85) is down to the line marked "Fill."

If the oil level gauge does not operate from any cause or fails to regulate correctly remove the drain plug "N" to determine the oil level before adding oil.

NOTE—If, on removing the plug "N" oil flows from the hole for a few seconds, do not assume that the oil in the pan is up to the proper level.

Replace Engine Oil

At the end of each 500 miles of travel remove the drain plug from the engine oil pan (Fig. 86.) After the oil has drained out replace the plug and through the oil filler on the housing just back of the fan, add seven quarts of fresh engine oil (see under "Replace Engine Oil Frequently During Cold Weather," page 198.) A socket wrench with a long handle is supplied with the tool equipment to facilitate the removal and replacement of the drain plug.

At the end of the first 1,000 miles of travel, at the end of the next 4,000 miles of travel and at the end of every 5,000 miles of travel thereafter, drain the oil pan as directed in the preceding paragraph, replace the plug and through the filler add a mixture consisting of three quarts of kerosene oil and one quart of engine oil. The mixture must be free from dirt and lint. Run the engine at a speed of between 600 and 1,000 revolutions per minute for the period of one minute. Then drain the oil pan, remove it and the screen from the engine and thoroughly clean the oil pan and screen. Do not fail to add seven quarts of fresh engine oil after replacing the oil pan.

After cleaning the lubricating system with a mixture of kerosene and engine oil it is a good plan to clean the valve and seat of the pressure regulator. The regulator is located just back of the right hand block of cylinders. The valve can be removed after removing the regulator cover by unscrewing it. It is important also to make certain that the small by-pass hole by which oil is permitted to escape when the regulator valve is closed, is clean and free from any obstruction.

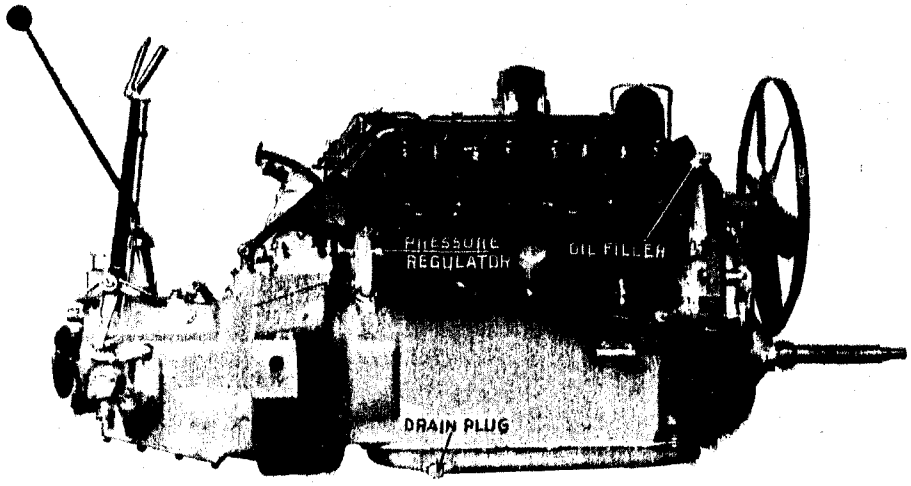


Fig. 86

Oil Filler, Pressure Regulator and Drain Plug.

Do not use waste in cleaning the regulator or its seat. Use cloth free from lint.

Caution:—Do not fail to replace the engine oil as frequently as suggested.

Replace Engine Oil Frequently During Cold Weather

The mileages given under "Replace Engine Oil" at which engine oil should be replaced and the oil pan and screen cleaned are those at which this work should be done during warm weather.

During cold weather water and gasoline may accumulate in the crankcase of the engine. It is necessary, therefore, to drain the oil pan and clean the oil pan and screen much more frequently than during warm weather.

The frequency with which it is necessary to do this depends very largely upon the manner in which the car is driven. In cases where the car is driven short distances only and frequent stops are made so that the

engine base and the oil remain cold it will be necessary to drain the oil pan and to clean the oil pan and screen much more frequently than in cases where the car is driven for longer distances with fewer stops, so that the engine base becomes thoroughly warmed.

If the car is constantly making short trips in cold weather the oil should be drained every 350 miles of travel or once a week and the oil pan and screen cleaned once a month.

Unless the oil is drained out and the oil pan and screen are cleaned frequently in cold weather, serious damage to the engine may result, particularly on cars in short trip service.

Oil Pressure

The pressure indicated by the oil gauge on the instrument board varies with the speed and temperature of the engine and the viscosity of the oil. When the engine is warm and supplied with fresh Cadillac Engine Oil or oil of approximately the same viscosity, the pressure as indicated by the gauge should be from five to seven pounds when the engine is idling. (When idling the engine should run at approximately 300 revolutions per minute, if the throttle stop-screw at the carburetor is properly adjusted.) At higher speeds a higher pressure should be indicated and at lower speed a lower pressure. Before the engine has become warm, higher pressures will be indicated at given speeds. In other words, maximum pressures will be indicated at given speeds when the engine is cold and the oil is fresh; minimum pressures, when the engine is hot and the oil becomes thin from use.

Practically all engine lubricating oils become less viscous from use even under normal conditions. Running the engine too long with the auxiliary air control lever pulled back will cause the oil to be thinned more rapidly due to the condensation of gasoline from the rich mixture.

Adjustment of Oil Pressure Regulator

If, when the engine is supplied with fresh Cadillac Engine Oil, or oil of approximately the same viscosity, and the engine is warm and running at approximately 300 revolutions per minute, the pressure of the oil is more than seven pounds, a readjustment of the pressure regulator should be made. If the pressure is less than five pounds, dirt between the valve and its seat, or an incorrect adjustment of the regulator is indicated. To readjust proceed as follows:

Remove the cap "A" (Fig. 87) by unscrewing it and loosen the lock nut "C."

If a pressure of more than seven pounds is indicated, screw up on the spring seat "B." If a pressure of less than five pounds is indicated and the valve and its seat are clean, unscrew the seat "B."

Lock the adjustment with the nut "C."

If it is found upon replacing the cap and starting the engine that the pressure is still incorrect, remove the cap again and make further adjustment.

Caution:—If when starting the engine after replacing the oil it is found that the gauge does not register pressure, stop the engine im-

mediately and prime the oil pump. This may be done by disconnecting the oil pipe from the pressure regulator and forcing two to three gunfuls of clean engine oil into the regulator. Connect the pipe and tighten the union before starting the engine.

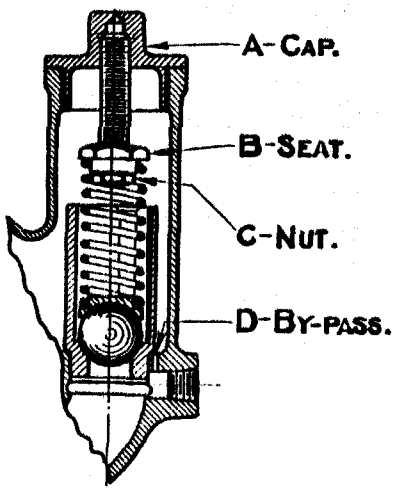


Fig. 87—Oil Pressure Regulator, Sectional View.

GENERAL LUBRICATION

It is manifestly impossible to give exact directions in every instance as to just how frequently each individual point should be oiled or exactly how much lubricant should be applied. In the following directions this is given approximately, based on average use.

With the tool equipment of each car is packed a lubrication chart (see Fig. 88) with a schedule for the lubrication of the car. This is intended to be hung in a garage to serve as a reminder.

EVERY 125 MILES

Engine: 26

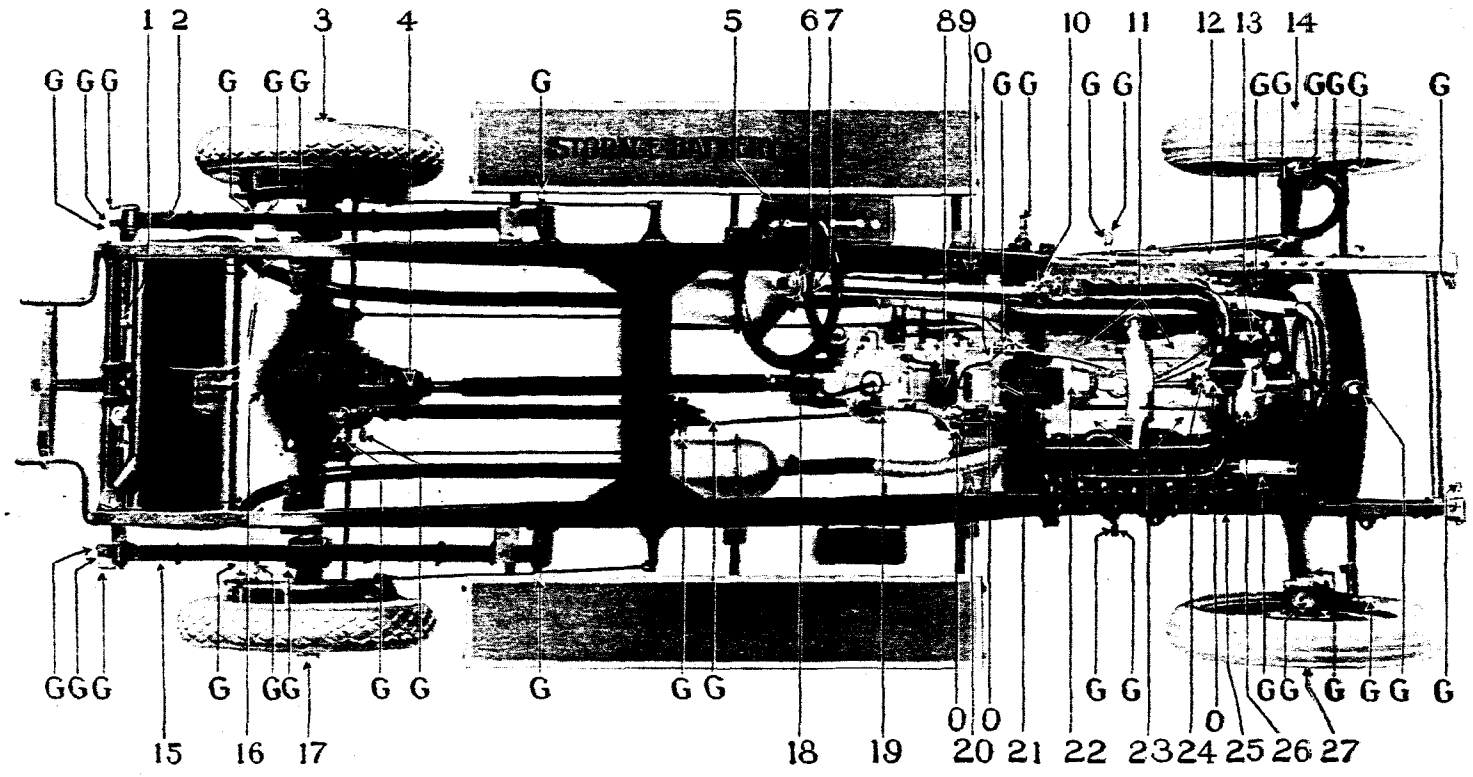
At every 125 miles, or oftener, determine the quantity of oil in the engine and add oil if required (see under "Filling Lubricating System," page 00, and under "Replace Engine Oil," page 197.)

EVERY 500 MILES

Grease Gun Connections: G

Points "G" should be lubricated with the grease gun at every 500 miles of travel.

Grease gun connections at all shackle bolts are fitted to grease cups. This makes it possible to lubricate shackle bolts while the car is on the road by simply screwing down the cups.


1 2 3 4 5 6 7 8 9 0 10 11 12 13 14
G G G

Grease cups should be screwed all the way back before refilling them with the grease gun. A reservoir of grease is thus provided.

Springs: 1, 2, 12, 15, 25

It is recommended that the springs be lubricated every 500 miles by painting the edges and ends of the leaves with engine oil. A small, stiff brush should be used. Do not open up leaves and insert lubricant. After applying the oil, the car should not be washed until it has been driven far enough to allow the lubricant to work in between the leaves.

Replace Engine Oil

Replace the engine oil at the end of every 500 miles of travel. (See under "Replace Engine Oil," page 197 and "Replace Engine Oil Frequently During Cold Weather," page 198.)

Water in Storage Battery: 5

Every five hundred miles or at least every two weeks inspect the level of the acid in the storage battery and add distilled water if the level is low. (See under "Adding Water to Storage Battery," page 58.)

EVERY 1000 MILES

Oil Cups: O

A few drops of engine oil should be applied at points "O" every 1,000 miles.

Universal Joints: 4, 18

Fill the forward and rear universal joints on the drive shaft between the transmission and rear axle with Cadillac Universal Joint Grease every 1,000 miles. A connection is furnished with the grease gun which fits the filling holes.

The forward joint is covered by a cylindrical shield to prevent grease from being thrown onto the under side of the floor. To fill the joint it is necessary first to detach the shield from the transmission case and to slide it back over the drive shaft. This may be done after loosening the two screws which hold the shield and turning the shield through a small arc in a counter-clockwise direction.

Generator Oil Cups: 21, 22

These oil cups conduct lubricant to the forward and rear bearings on the armature shaft of the motor generator. A few drops of engine oil should be applied every 1,000 miles.

Oil Holes at Steering Wheel: 6, 7

A few drops of engine oil should be applied every 1,000 miles.

Engine Rear Supports: 9, 20

There are felt wicks in the frame bracket to which the engine supports are bolted. Engine oil should be applied at these points every 1,000 miles of travel or oftener if necessary.

Clean Engine Lubricating System

At the end of the first 1,000 miles of travel, at the end of the next 4,000 miles of travel, and at the end of every 5,000 miles of travel thereafter, clean the lubricating system and the oil pan and screen. (See under "Replace Engine Oil," page 197 and "Replace Engine Oil Frequently During Cold Weather," page 198.)

EVERY 2500 MILES

Horn

Clean and lubricate the horn every 2500 miles. (See under "Cleaning and Lubricating Horn", page 47.)

Transmission: 19

The transmission should contain sufficient lubricant to bring it up to the level of the filling hole at the right hand side. The level should be inspected every 2,500 miles and lubricant added if necessary. Cadillac Rear Axle and Transmission Lubricant is recommended.

Rear Axle: 16

The rear axle should contain lubricant to bring it up to the level of the filling hole in the rear cover plate. The level should be inspected every 2,500 miles and lubricant added if necessary. Cadillac Rear Axle and Transmission Lubricant is recommended.

Timer and Distributor: 24

Every 2,500 miles remove the small breather at the rear of the distributor housing by unscrewing it and pack distributor grease around the gears by which the timer and distributor are driven.

Valve Stems: 11, 23

Apply engine oil to the valve stems and cam slides every 2,500 miles. This may be done by lifting the valve compartment covers and inserting the spout of the oil gun.

Wheels: 3, 14, 17, 27

Every 2,500 miles, or every six months if the car is driven but little, all the wheels should be removed (see under "Wheels" page 185) and the bearings thoroughly cleaned in either gasoline or kerosene and examined. The bearings should be lubricated with a thin grease. Cadillac Gun Grease is recommended. Do not use heavy grease, as it will roll away from the path of the rolls and will not return.

There is an oil cup in the hub of each rear wheel on early Type 61 cars. Inject engine oil here whenever you are oiling the car. Wipe the dirt from the cups first so that it will not get into the bearings.

Steering Gear: 10

The steering gear should be lubricated every 2,500 miles. Steering Gear Lubricant is recommended. (See page 196.)

Speedometer Flexible Drive Shaft

The flexible shaft by which the speedometer is driven is carried in a flexible casing. The shaft should be removed from the casing and lubricated at the end of every 2,500 miles of travel. Cadillac Cup Grease is recommended.

Do not under any circumstances attempt to lubricate the speedometer head. Any parts in the head which require lubrication are amply supplied when the head is assembled.

EVERY 5000 MILES

Clutch Thrust Bearing: 8

Every 5,000 miles remove the cover plate shown at 8. With the engine not running reach in and turn the clutch thrust bearing so that the small filler screw is at the top. Remove the screw with a screwdriver. Care must be exercised not to drop the screw into the clutch case. With the oil gun furnished in the tool kit inject suitable lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. A connection furnished with the gun fits the threaded hole from which the plug was removed.

Clean Engine Lubricating System

At the end of every 5,000 miles of travel clean the engine lubricating system and the oil pan and screen. (See under "Replace Engine Oil" page 197 and Replace Engine Oil Frequently During Cold Weather," page 198.)

Replace Transmission Lubricant: 19

At the end of every 5,000 miles of travel remove the drain plug from the under side of the transmission case and drain out all of the lubricant. Refill with two quarts of suitable lubricant. Cadillac Rear Axle and Transmission lubricant is recommended. The filler is shown at "19."

Replace Rear Axle Lubricant: 16

At the end of every 5,000 miles of travel remove the drain plug from the axle and drain out all of the lubricant. Refill with 5 quarts of suitable lubricant. Cadillac Rear Axle and Transmission Lubricant is recommended. The filler is shown at "16."

ADDITIONAL

In addition to the places specially mentioned, note carefully and oil all of the small connections and joints throughout the car, such as the various brake rod connections and joints in the brake mechanism.

Remember that wherever one part moves in contact with another, wear will be reduced to the minimum by lubrication.

GENERAL LUBRICATION

Part of Car	Lubricant to Use	Total Amount	Location of Filler	
Engine	Engine oil	Seven quarts	On fan shaft housing	26
Engine rear supports	Engine oil	Several drops	Felts in oil holes	9, 20
Valve stems	Engine oil	Spray from oil gun	Remove valve cover plates	11, 23
Bearings on armature shaft	Engine oil	Several drops	At front and rear of generator	21, 22
Bearing at upper end of steering shaft	Engine oil	Several drops	Oil holes at steering wheel	6, 7
Springs	Engine oil or Cadillac Rear Axle and Transmission Lubricant		Apply to sides and ends of leaves	1, 2, 12, 15, 25
Wheel bearings	Number one cup grease	Three ounces in each wheel	Remove wheels	3, 14, 17, 27
Mechanism in distributor housing	Number two cup grease	Ten ounces	Breather at rear of distributor housing	24
Transmission	Cadillac Rear Axle and Transmission Lubricant	Two quarts	On right side of transmission case	19
Rear axle	Cadillac Rear Axle and Transmission Lubricant	Five quarts	On rear cover plate	16
Clutch thrust ball race	Cadillac Rear Axle and Transmission Lubricant	One-half ounce	On collar of ball race	8
Universal joints	Cadillac Universal Joint Grease or Number three fibre grease	Five ounces each	On casings around joints	4, 18
Steering gear	Cadillac Steering Gear Grease or a mixture consisting of ¾ 600 W Lubricant and ¼ number one cup grease	Three pounds	Grease gun connection	10

NOTE—The figures in the last column refer to the "General Lubrication Diagram," Fig. 88

SPECIAL TOOLS

Axles

Wrench—Spanner wrench for pinion adjustable shell.....79249
Wrench—Spanner wrench for pinion cage locking ring.....79248
Puller—Removal of small pinion bearing.....83229
Puller—Removal of large pinion bearing 83228
Puller—Removal of differential carrier bearings.....83230
Device—To straighten rear axle housing sleeve.....71971
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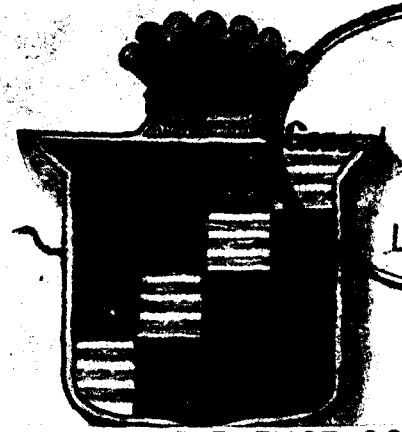
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CADILLAC MOTOR CAR COMPANY
1922 Miscellaneous



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The Coat of Arms of
Le Sieur Antoine
de la
Mothe Cadillac

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The Coat of Arms of Le Sieur Antoine de la Mothe Cadillac

THE family records of le Sieur Antoine de la Mothe Cadillac are burned, but it is fairly certain that he was born on March 5, 1658, in a little town in Gascony. Concerning his boyhood in France we only know that he was a youth of family, for only such were granted commissions in the Royal French Army. His life in America was one of exploration and conquest, adventurous, romantic. As the discoverer of new lands for France, founder of the City of Detroit (1701) and Governor of the great French territory of the Mississippi, he came to the notice of the French court and his King, Louis XIV. His creation as a chevalier of the Military Order of St. Louis, by its royal founder, accorded him the honors of the French court. Further honoring his service in America he was appointed Colonial Councillor to the Crown and was made Governor of Castell Sarrazin for the rest of his life.

There is much of the heroic in the story of Cadillac's life. The armorial bearings of the Cadillac family, symbol of an aristocracy older by four centuries than the coming of Columbus, suggest to the imagination another heroic picture,—of Counts and Earls



The Couronne

and Dukes,—of noble knights and warriors, Crusaders in the service of Holy Mother Church,—of the great lords of France, rulers over many wide acres.

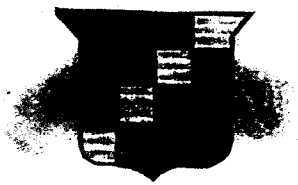
The Cadillac crest is described in the language of the French heralds as follows:

Armes; Ecartelé, aux 1 et 4 d'or à la fasce de sable accompagnée de trois merlettes de même, posées deux en chef et une en pointe; aux 2 et 3, de gueules, écartelé d'argent à trois d'azur.

Translation:

Arms: Quarterly (*the shield divided into four sections*); first and fourth (*quarters*) gold, a fess (*lateral band*), sable (*black*) between three merlettes (*small heraldic birds*) of the same (*black*), posed two in chief (*upper third of section*) and one in base. Second and third (*quarters*) gules (*red*) quartering argent (*silver*) three bars (*small fesses*) azure (*blue*).

This bearing represents the heraldic devices of two ancient French families, the first and fourth quarterings showing the arms de la Mothe; the second and third the arms of another family of the landed gentry, allied thereto by marriage, possibly at



The Shield

a remote period, and probably adding a "Seigneurie" or tract of land to their possessions.

The Couronne or Coronet

The Couronne or Coronet ensigning the arms of Cadillac is that borne by the six ancient counts of France, and is emblematic of descent from the old counts of Toulouse, who were affiliated with the royal French stock. The seven pearls in the couronne indicate the nobleman's descent from these royal counts.

The Shield

The shield is significant of the heroic origin of the Cadillac arms. This is the form in which the coat of arms of the Cadillac family was first displayed by some ancient Holy Crusader.

The First and Fourth Quarterings

These quarterings are strictly the arms of the Mothe family,—"Gold, a fess, sable between three merlettes of the same, posed two in chief and one in base."

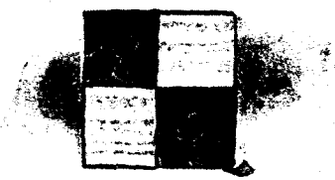
The birds, "merlettes," legless and without beaks, are a heraldic adaptation of the martin. Appearing in threes they have a holy significance, being considered sacred to the Trinity. They were granted to Knights by the ancient School of Heralds, together with the "fess" for valiant conduct in the Crusades. The birds shown in black against a gold background in this section of the Cadillac arms denote wisdom,



First and Fourth Quarterings

riches, and cleverness of mind, ideal qualities for the adventurous and zealous Christian Knight.

Of the merlette, Guillaume, an ancient historian, says: "This bird is given for a difference, to younger brothers to put them in mind that in order to raise themselves they are to look to the wings of virtue and merit, and not to the legs, having but little land to set their feet on." Of the fess, he says: "This is a military girdle of honor," and signifies that the bearer "must always be in readiness to undergo the business of the public weal."



Second and Third Quarterings

The Second and Third Quarterings

These were probably adopted in the Mothe coat of arms when, by some fortunate intermarriage in time long ago, another "Seigneurie" was added to their possessions. In these quarters the colors used denote that the marriage added to the fame of the family de la Mothe something besides broad acres, —"marked prowess and boldness in action" for the red; "purity, charity, virtue and plenty" for the silver. The repetition of the cross bar or "fess" indicates more knightly prowess in the far fields of the Crusades.

Apart from the purely heraldic aspect of a coat of arms is its historic aspect. Every crest is linked with a history in which is enfolded the origin, genealogy, deeds, services, honors and alliances of the family bearing it. In all France there are few families more ancient than the Cadillacs. In both dignity of design and significance of detail the Cadillac coat of arms speaks volumes in courage and honor for the forebears of the Father of Detroit.

CADILLAC MOTOR CAR COMPANY
DETROIT