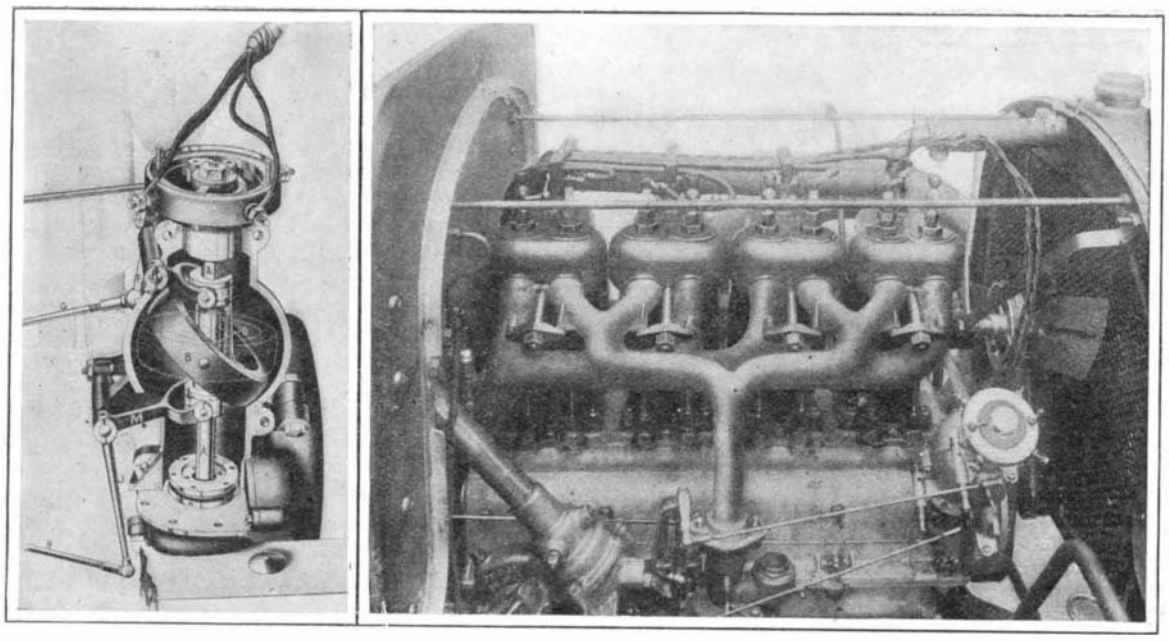
ENGINES

THE CADILLAC 20-HORSE-POWER FOUR-CYLINDER ENGINE AND GOVERNOR.

BY WALTER GALLAND.

The motor of the new Cadillac light touring car, which we illustrate herewith, follows rather closely in design the larger motor which has been used for the last two years upon the Cadillac heavy touring car. The cylinders are cast separately, and are fitted with copper water jackets. This arrangement, as is well known, gives a cylinder of uniform thickness throughout, and consequently one that can be cooled to advantage. The separate cylinders also have the advantage of being readily replaced in case of breakage. The valves are all mechanically operated from a single camshaft, and are placed side by side in valve chambers on one side of the motor cylinders. The exhaust and inlet pipes are clamped to the valve chambers by four bridge pieces held by single nuts as shown. The spark plugs are placed immediately over the inlet valves, and the priming cocks over the exhaust valves. The carbureter is of the automatic float-feed type. All valves are interchangeable, and each valve rod is provided with a hardened steel roller and pin. The connecting rods are H-section steel drop forgings. The crankshaft is also a steel drop forging, which is put through a special strengthening process to give it strength and toughness, and which also has its bearing surfaces carefully ground. The connecting-rod bearings are readily accessible by removing large covers in the aluminium crankcase. There are dividing walls and separate bearings between all the cranks. The bearings are attached to the upper part of the crankcase. The motor has a three-point suspension. Lubrication of the motor is by the automatic splash system, the supply of oil in the crankcase being maintained by a belt-driven force-feed lubricator mounted beside it. One of the main features of the Cadillac 4-cylinder cars is the governor, the use of which makes it possible to set the car at any given speed, and have it maintain that speed when running up or down hill as well as on the level. The governor, which is of the automatic ring type and which is described in detail on another page, can be seen in the illustration of the motor at the forward end. It is inclosed in a globe-shaped casting that is surmounted by the commutator, and the connections from the governor to the carbureter and from the commutator to its shifting lever are plainly to be seen. Both spark and throttle levers are located on sectors in the steering wheel, and are connected by means of solid and hollow rods passing through the steering column to suitable levers seen at its base. The car is also provided with an accelerator pedal for suddenly increasing its speed by throwing the governor out of action. The governor, a perspective view of which is shown herewith, is built up

(*Continued on page 51.*)

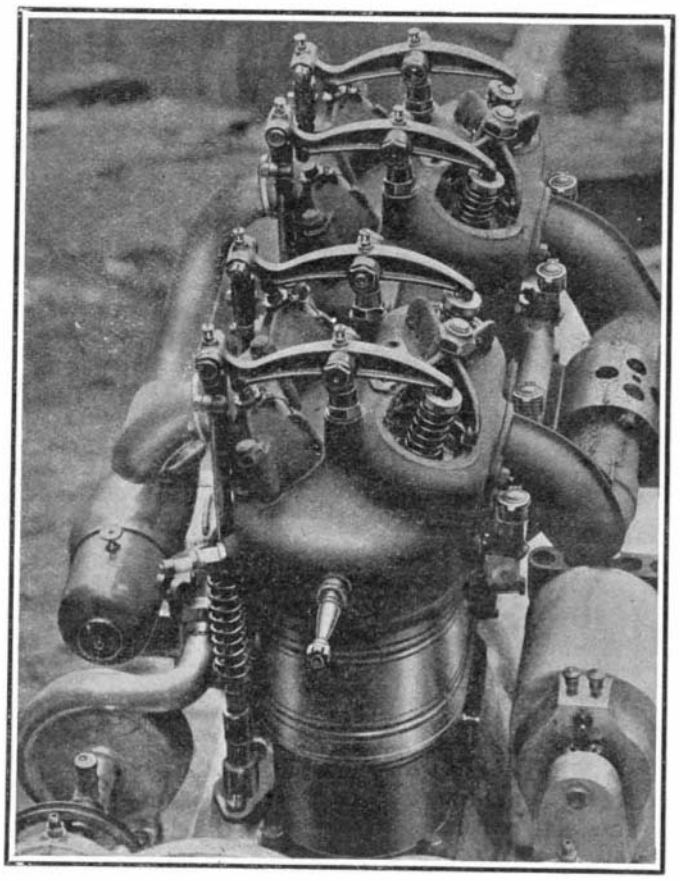


CADILLAC GOVERNOR AND TIMER.

A. Vertical shaft driven by bevel gears from half-speed camshaft. *B*. Governor ring. *C*, *D*. Spring and link connecting *B* with collar *E*. *F*, *G*. Lever and rod making connection with throttle. *H*, *J*, *M*, *L*. Rod, lever, shifting fork, and collar connected with accelerator pedal.

THE 20-HORSE-POWER ENGINE OF THE NEW CADILLAC LIGHT TOURING CAR, SHOWING STEERING GEAR, CARBURETER, AND GOVERNOR.

The cylinders of this engine are provided with copper water jackets which are clamped in place by the heads. The governor is seen in the globular casing on the right with connections extending to the carbureter and with the timer superposed. The belt-driven fan can be seen behind the radiator, and the steering column and carbureter beside the engine.



THE 50-HORSE-POWER ENGINE OF THE CAR DE LUXE.

The bore and stroke are 125 x 135 mm. (6.692 x 7.086 inches). Each pair of valves is worked from a single camshaft by means of the walking-beam arrangement shown. The water pump and magneto are gear-driven on opposite sides of the crankcase.

ENGINE OF THE CAR DE LUXE.

One of the highest grade machines at present being manufactured is the Car de Luxe, which is built in Toledo, Ohio, and Detroit, Mich. The photograph shows a top view of the engine, and displays prominently its several novel features. Some of these are the following: Corrugated copper water jackets, extending entirely around each pair of cylinders; valves arranged in the heads of the cylinders, and operated by walking beams; and Hess-Bright ball bearings in the crankshaft. This latter, as well as many other parts, is of chrome nickel steel. An inspection of the photograph will show the method of retaining the valves in the heads of the cylinders. The valve cages have ground joints, and rest upon copper gaskets. The inlet valve caps are secured by two bolts and nuts each, while the exhaust valve cages for each pair of cylinders are held in place by a single X-shaped piece secured by a single nut.

The enlarged, rounded part of the cylinder around the exhaust valves is where a special water jacket is cast for the purpose of keeping these valves cool. The walking-beam method of valve operation shown simplifies the construction considerably, and reduces the number of push rods and tappets to but four. Double cams, that is, cams having both a raised and a depressed surface, are used on the camshaft, so that immediately after the raised cam has caused the exhaust valve to open and close, the drop of the push-rod roller into the depressed cam causes the curved valve tappet to rock downward upon the inlet valve and open this at the proper time. This walking-beam method of valve operation was brought out on the Fiat cars a couple of years ago, and at the present time there are but one or two other firms which are using it. The valves, located as they are in the cylinder heads, are very accessible and can be readily removed. Another distinctive feature is the use of a special form of split piston ring. This ring is triangular in cross section, and there are six segments of a corresponding ring that fit within, and that tend to press it outward in all directions by means of flat steel springs that form chords of the six segments. The magneto is gear-driven by spiral gears from the half-speed camshaft, and is seen at the right of the motor, while the water pump is similarly located on the left-hand side. The magneto has a high-tension distributor at one end. A carbureter of the automatic type is located on the left-hand side and connected to the inlet valves. Spark plugs are screwed into sockets in the cylinder heads, as shown. A spindle projecting out from the front end of the head is for the fan, which is belt-driven and runs on ball bearings. The exhaust pipe is shown on the right-hand side of the engine. The camshaft is readily removed by means of an ingenious arrangement. It revolves in special bronze bushings. Besides

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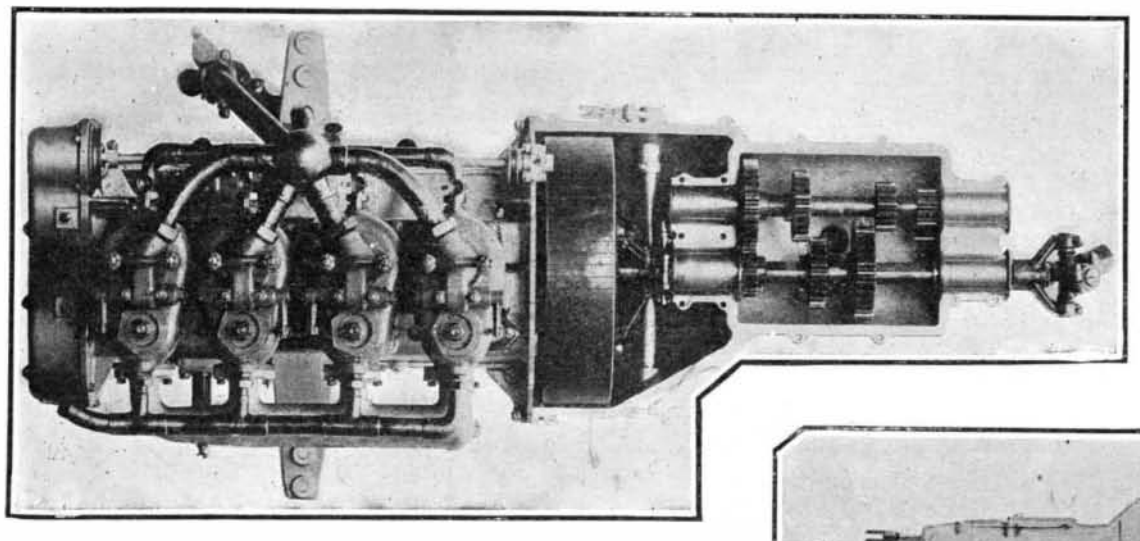
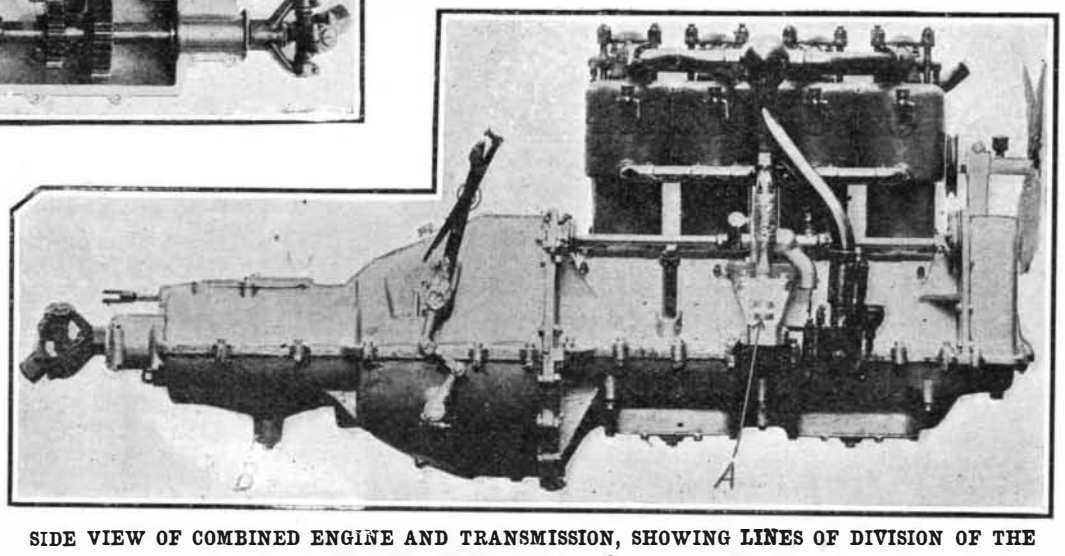


PLAN VIEW OF AUTOCAR COMBINED ENGINE AND TRANSMISSION WITH COVER OF TRANSMISSION REMOVED.

The inlet valves are in the center of the cylinder heads and are mechanically operated by inclosed tappets.



SIDE VIEW OF COMBINED ENGINE AND TRANSMISSION, SHOWING LINES OF DIVISION OF THE CRANK AND GEAR CASES.—[See page 51.]

Two of the points of the 3-point suspension are shown at *A* and *B*. The rear point, *B*, is supported on a coiled spring on a cross member of the frame.

as the Haynes Company's leading model for the present year.

The machine on our front page which most resembles the automobile of to-day is that constructed more than ten years ago by Mr. Ransom E. Olds, of Lansing, Mich. The picture is reproduced from the SCIENTIFIC AMERICAN of November 21, 1896. Like almost all of the first machines, as above stated, Mr. Olds's early car had the engine and transmission mounted upon the running gear, while the body was supported on three full elliptic springs. The engine used was a single-cylinder one of 5 horse-power placed horizontally on the running gear, and arranged to drive a countershaft through three separate speed changes giving 4, 8, and 12 miles an hour normally, while by speeding up the engine, the car could be driven as high as 18 miles an hour. A single chain from the countershaft drove the rear axle, there being a considerable reduction, as can be seen. The rear axle was provided with a differential. Wood wheels provided with 1½-inch solid cushion tires were used on this car, the wheels being provided with ball bearings. A tiller steering device turned both front wheels on a simple design of steering knuckle. In our former description a great point is made of the fact that the fuel supply is located below the engine, and has no connection with the body. This was done in order to obviate any chance of explosion.

While the machine in question was one of Mr. Olds's first gasoline cars, it was by no means his first machine, as several years before he produced a three-wheeled steam automobile which had a huge boiler behind fired by liquid fuel. After turning his attention to the gasoline engine, however, as can be seen from the illustration, Mr. Olds produced a very creditable machine for that day, and he has since held his own in an industry that has become vast and in which improvements have been made more rapidly, perhaps, than in any other field.

THE CADILLAC 20-HORSE-POWER FOUR-CYLINDER ENGINE AND GOVERNOR.

(*Continued from page 24.*)

around a central vertical or inclined shaft, *A*, driven by gears from the camshaft and running upon ball bearings. Pivoted on a pin passing through this shaft, and held in the tilted position shown by the spiral spring, *C*, is the ring, *B*. As the revolutions of the shaft, *A*, and ring, *B*, increase, centrifugal force tends to make the ring assume the horizontal position shown by the dotted lines, and as it does so, it pushes upward on the link, *D*, and raises the collar, *E*. A shifting fork on this collar, as it is raised and lowered, rotates a shaft, *K*, and consequently moves back and forth the lever, *F*, which is connected by rod, *G*, to the throttle. In this manner the throttle valve is closed. By varying the tension on the spring, *C*, which the driver can do through the connections, *H J*, and their shifting fork, *M*, and collar, *L*, the governor can be set so that it will not close the throttle beyond a desired point. The placing of the commutator above the governor makes it very accessible. This type of governor is an exclusive feature of the Cadillac 4-cylinder cars.

ENGINE OF THE CAR DE LUXE.

(*Continued from page 24.*)

the ordinary force-feed oiler for lubricating the engine, there is a special plunger pump on the footboard, by which oil can be pumped into the crankcase. Should the oil overflow above the proper level, it runs into a special reservoir attached to the bottom of the crankcase. Should the latter overflow, the oil will run upon the ground. The crankpins are all hollow, and they are thoroughly lubricated by means of eccentric oil rings placed upon the crankshaft. The water pump is of the centrifugal type, and is made up of a bronze wheel that revolves in an aluminium casing. The radiator is of horizontal flat tubes indented, so as to allow for expansion in case of freezing. The water circulates back and forth from one side to the other, and from top to bottom through 20, 17, 15, 14, and finally 12 tubes, the idea being that as the water cools in descending from the top to the bottom of the radiator, it does not require so much room. Everything about this motor is of the finest, and it is undoubtedly one of the highest grade automobile engines constructed. The bore and stroke are 125 and 135 millimeters respectively, and the horse-power is 50 to 60. Besides the engine this car contains several other novel features, such as the rear axle, which is described on page 34.

THE AUTOCAR COMBINED ENGINE AND TRANSMISSION.

The engine and transmission shown on p. 24 is that of the type XIV Autocar tonneau, and it is noteworthy as being one of the few examples of the recent practice of combining engine and transmission in a single unit and giving this unit a three-point support. As can be readily seen, the transmission gear case and the crank case of the motor are bolted together, and the two cases are so shaped as to completely inclose the flywheel and clutch. The latter is of the three-ring metallic type, consisting of a bronze ring with cork or felt inserts that is clamped between two steel rings attached to the flywheel. As the bronze ring is rather light, it has but little momentum, and consequently both it and the gears come quickly to rest when the clutch is thrown out. This makes stripping of the gears improbable.

The motor shown is the four-cylinder, vertical, water-cooled one used on the tonneau. (The company also builds for its runabout a 12-horse-power double-opposed cylinder motor having the same arrangement.) The bore is 4¼ inches, stroke 4½, and the motor is said to develop 30 horse-power. The cylinders are cast separately with integral heads, water jackets, and exhaust valve chambers, and large mechanically-operated valves. The inlet valves are placed in the center of the cylinder heads, directly over the pistons, thus insuring complete filling of the cylinders at all speeds. All the valves are large and are mechanically operated from one camshaft, the lifts being provided with large rollers, which insure long life and little friction. The adjustment of the exhaust valve is by cap screws, which screw in the plunger and are held in the desired place by lock nuts. The inlet valve adjustment is by cap and lock nuts on top of the valve lift rod. The crankshaft is a weldless steel forging, oil tempered, with a large flange for bolting on the flywheel. This wheel can be easily removed and replaced with little trouble and no danger of becoming loose or running out of true. The crankshaft has three long split bearings which can be readily taken up should any wear occur. The crank case is made of aluminium alloy, of high tensile strength, and all the bearings are bolted to the upper half. The lower half can be removed without disturbing any other parts, and the crankshaft and pistons can be removed without removing the cylinders. The upper half of the crank case is provided with two large openings, through which all adjustments can be made without removing the bottom half. The camshaft and pump shaft gears are at the forward end of the crank case, where they are fully inclosed and run in oil. The centrifugal water pump is mounted on the crank case, and is directly driven from the camshaft by fiber gears. It circulates the water through a finned tubular radiator.

The timer also is mounted on the crank case and is driven by means of miter gears from the cam shaft. The ignition is of the high-tension type from current supplied by accumulators. Lubrication is effected by a force feed oiler, with an individual pump for each lead pipe. One pipe goes to each motor bearing and a separate pipe to the crank case to keep