NEW VEHICLES AND PARTS.

The Pope-Toledo Four Cylinder Touring Car.

A very tastefully designed and luxuriously finished touring car is the Pope-Toledo four cylinder car, fitted with a 24 horse power vertical water cooled engine. While of the general foreign type, this car has novel features in practically every part of its mechanism. Some of these features are: Copper cylinder jackets, Cardan shaft connection between engine and change speed gear, sliding gears moving transversely to the axis of the car, internal expanding hub brakes, etc.

The frame is constructed of pressed steel, having an inverted U shaped section, with cross braces of the same material and shape. The front ends of the side rails are extended to form the hangers for the front springs. Longitudinal channels forming an underframe are provided to carry the engine. The springs are semi-elliptic, the front springs being pivotally connected in front and shackled at the rear, and the rear springs shackled at both ends. The proportions are such as to insure easy riding.

Both front and rear axles are heavy walled steel tubes having the steering axle ends and stubs riveted and brazed on. The front axle is dropped in the centre to clear the engine under all conditions of spring action. The axle ends and steering knuckles are of forged steel. The artillery type wood wheels are 32 inches in diameter in front and 34 inches diameter in rear, and fitted with 4 inch detachable tires and ball bearings. Brake drums are fixed to the hubs of the rear wheels for the emergency brakes, which are constructed on the internal expanding block type and are claimed to be equally effective in either direction.

THE ENGINE.

The engine cylinders are of 4¼ inch bore and 5¼ inch stroke, and the engine is rated at 24 horse power at 900 revolutions per minute. The cylinders are cast separately without water jacket and are accurately bored on a boring mill, several cuts being taken to insure a parallel bore from top to bottom. They are also machined on the outside, leaving a cylinder wall of even thickness which is claimed to result in uniform expansion under heat, and thereby holding the compression much better than where walls are of uneven thickness. The cylinders are then fitted with corrugated copper water jackets which are much lighter than jackets cast on.

As shown in Fig. 2, circumferential grooves are cut in the outer wall of the cylinder at the bottom of the water jacket to receive the copper jacket, which is slightly flanged. When the jacket is placed in position babbitt metal or hard solder is poured into the dovetail shaped groove around the flange of the copper jacket, making a water tight joint. The top of the jacket is flanged inward and forms the gasket for the head

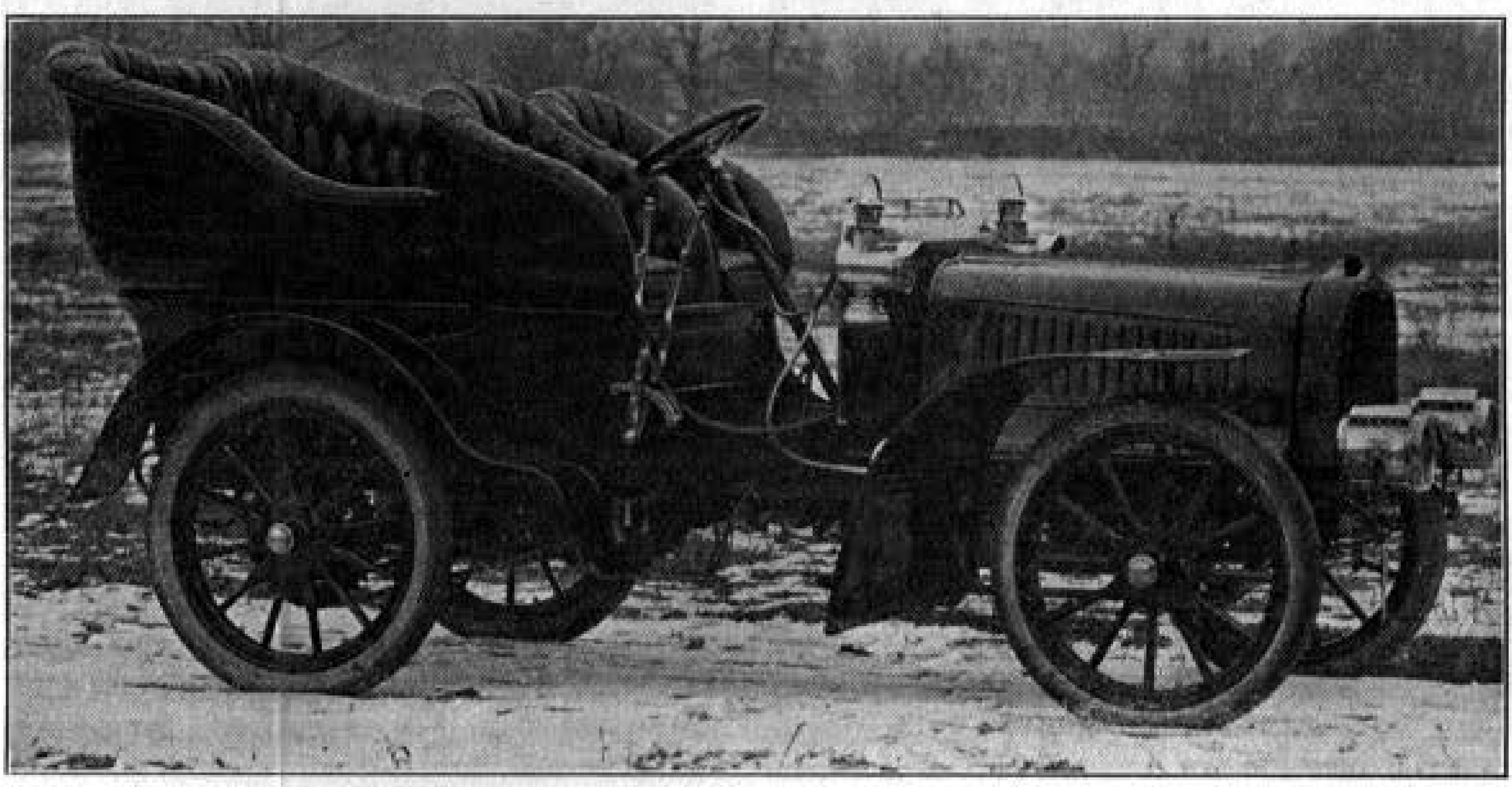

FIG. 1—POPE-TOLEDO FOUR CYLINDER TOURING CAR.

or valve chamber, thus doing away with the usual asbestos gasket. This joint is subjected to a 100 pound cold water pressure to test its tightness. The cylinder head and valve chamber are of cast iron and cast integral, and provided with a water jacket, as shown.

An automatic self contained inlet valve is employed, located immediately over the exhaust valve, so that by loosening the set screw A, Fig. 2, the inlet valve can be removed, exposing the exhaust valve for inspection or removal. The inlet valves are made of nickel steel; they are very light and have a flat seat. The exhaust valves also are of pure nickel. They have 45 degree seats and are operated in the usual manner by cams on a half speed cam shaft enclosed in the crank case, through the intermediary of push rods D. It is worthy of notice that these push rods move in a very long guide B, the wearing surface of which is protected from dust and grit by a cap C fastened to the push rod. Each cylinder is provided with a compression relief cock E, as shown, and all four cocks are connected to a single rod and can be opened and closed simultaneously by a single motion.

The pistons are of somewhat unusual design; they are very long and very light walled, and have five packing rings each, four at the upper end and one at the lower. As characteristic of the efforts made by the designer to eliminate all unnecessary or dead weight, attention is called to the fact that the piston wall is reduced in thickness back of the packing rings, and the piston head is arched or bulged outwardly to give a maximum strength for the thickness of wall employed, though this latter arrangement may have been dictated by considerations of compression space. The engine works with high compression.

The connecting rods are of the marine type, forged of steel, and fitted with phosphor bronze bearings bored true and scraped. The crank shaft is of forged steel, and is provided with three intermediate bearings, besides the two end bearings. The crank case is cast of aluminum alloy, cylindrical in form and cast in halves. The upper half supports the bearings, and is cast with ribbed feet by which the engine is supported on the underframe. The lower half of the crank case acts as a dust cover and oil well. The cam shaft gear is constructed of fibre, and located in front of the crank case.

IGNITION.

Ignition is by the common jump spark

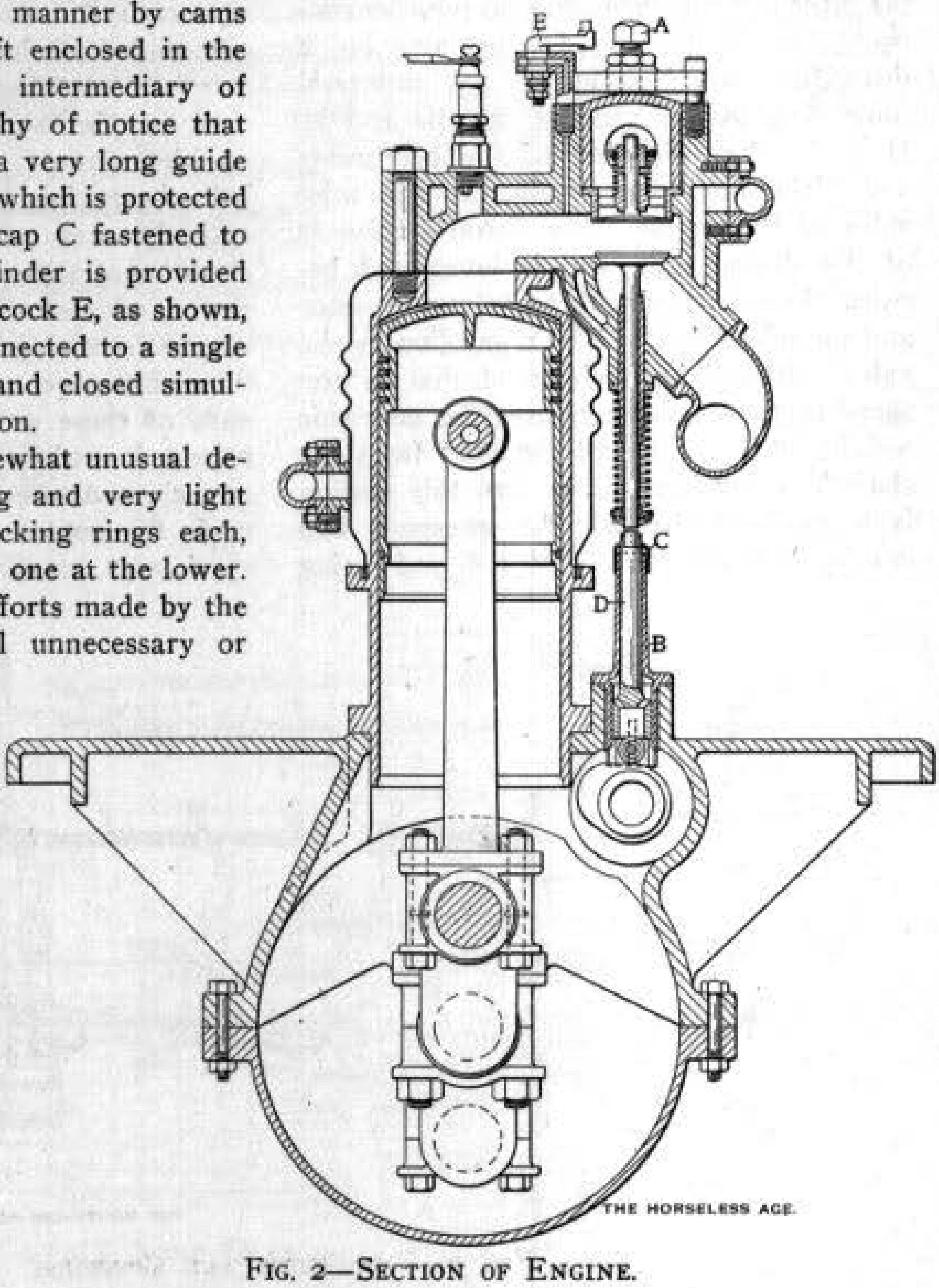

FIG. 2—SECTION OF ENGINE.

system, the ignition equipment comprising a storage battery carried in a box at the side of the chassis, four vibrator coils in a box fastened to the dashboard, and a commutator secured to the forward end of the exhaust cam shaft and operated for varying the period of the spark by means of a small lever on the steering wheel, as will be more fully described further on. Extra heavily insulated stranded copper cables are used for the secondary connections.

The water cooling system comprises what is termed a planetic radiator (closely resembling a cellular radiator in appearance) of the manufacturer's own design, which is located in front under the hood. The total water capacity of the system is 3½ gallons, and the water is circulated by a pump gear driven off the forward end of the cam shaft (by the fibre cam shaft gear). As evidence of the positive character of the pump action, it is stated that the pump will furnish a water pressure of 105 pounds to the square inch. The radiation is assisted by a fan back of the radiator driven by belt from the crank shaft.

CARBURETOR AND GOVERNOR.

The engine speed is controlled by a centrifugal governor, which acts on the throttle valve, built together with the carburetor. Governor and carburetor are shown in Fig. 3 herewith. In this figure A is the fibre cam shaft gear, to the web of which are pivoted the governor weights B B. The bell cranks of these governor weights act on a sleeve or collar C on the cam shaft, and the latter acts on the throttle rod D through the lever E. This lever has no positive connection with the rod D, but acts on it through a coiled spring F. A universal joint G is inserted in the throttle rod D. H is the float chamber of the carburetor and I the inlet tube leading to the inlet valve of the engine. The throttle valve is of the sliding type, and is interposed between the mixing chamber of the carburetor and the inlet tube I. N is a gasoline needle valve. It will be understood that as the speed of the engine increases the governor weights B B are forced outward from the shaft by centrifugal force, and this motion is transmitted through the governor bell cranks, sliding collar C, lever E and spring F to the throttle D, moving this rod to the left, and thereby closing the throttle and limiting the possible speed of the engine. When the engine runs free its speed is limited to about 250 revolutions per minute. By means of a small lever on the steering wheel the action of the governor on the throttle can be overcome, and thus any desired engine speed be obtained, up to the maximum. This lever is connected by the rod R to the double armed lever L, a forked end of which acts on the collar M on the rod D, and allows the rod D to be held in position against the pressure of the spring F, due to the action of the governor. This arrangement of the accelerator mechanism is claimed to possess the advantage that it does not act directly on the governor, and therefore obviates a lot of wear on the governor parts.

A copper gasoline tank having a capacity of 14 gallons, sufficient for a run of 200 miles under ordinary conditions, is located under the front seat.

THE FRICTION CLUTCH.

The friction clutch (Fig. 4) is of the internal cone type, in which all end thrust is self contained. The flywheel A is bolted to a flange turned on the end of the engine shaft B, and has bolted to it the cast iron clutch ring C. The clutch cone D is bolted to the clutch sleeve E, which is capable of sliding on the end of the crank shaft B, being provided with a brass bushing to prevent undue friction. The clutch is nominally held in engagement by four helical springs S surrounding the studs F, which are screwed into a plate G at one end, and are guided at the other end by sleeves H screwed into the clutch cone. The reaction of the springs F naturally comes on the plate G and is taken up by a ball thrust bearing between the plate G and the web of the flywheel A. The pressure of the springs can readily be adjusted without dismounting any parts, by simply screwing the guides H farther through the web of the cone D. The outer ends of these guides are for this purpose provided with square heads to take a wrench, and when the adjustment has been made the guides are locked in position by check nuts, as shown. The clutch cone is

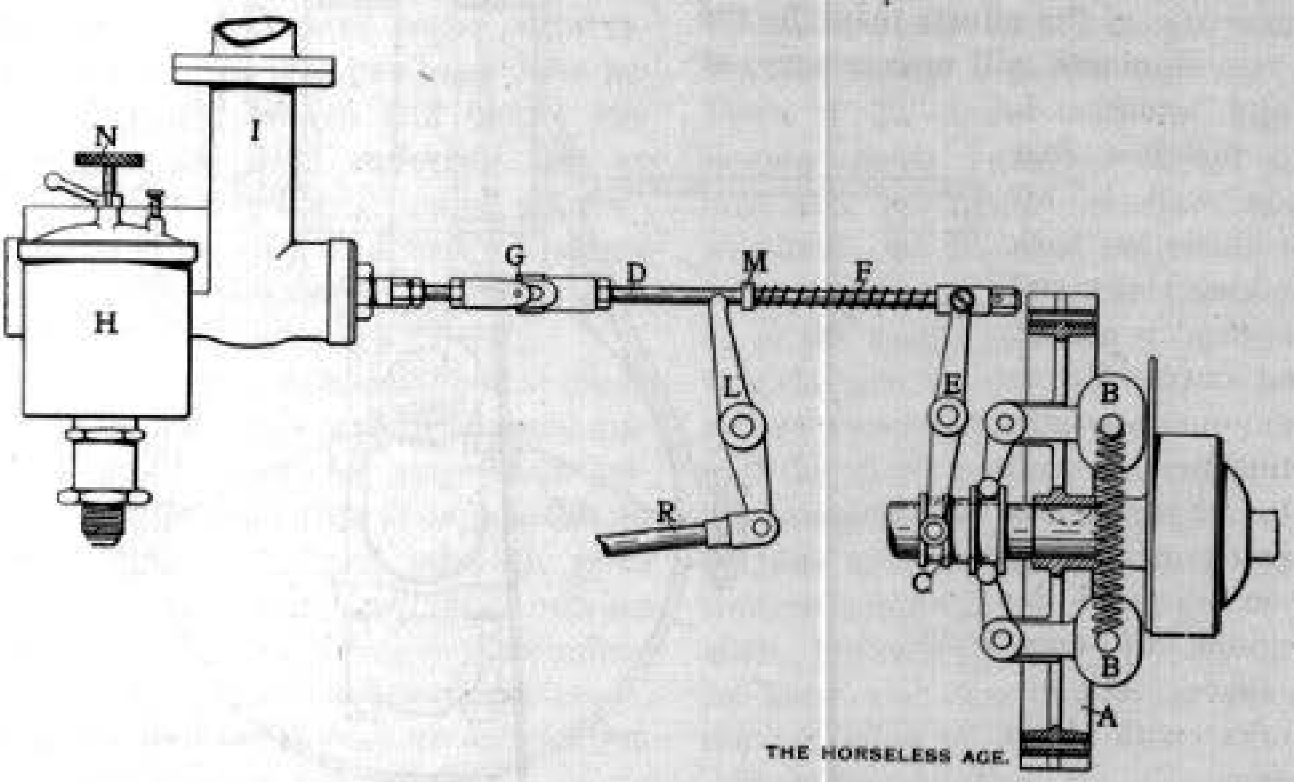

FIG. 3—CARBURETOR AND GOVERNOR.

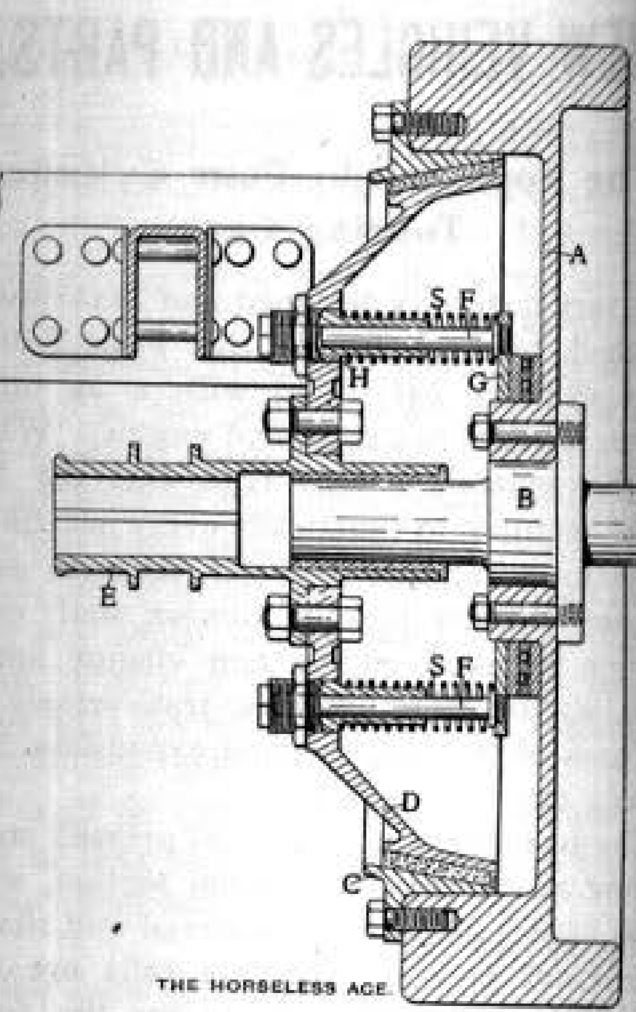

FIG. 4—FRICTION CLUTCH.

faced with mineral leather riveted to the rim. The clutch sleeve E has a square opening broached through it to receive the end of the shaft transmitting the motion to the change speed gear.

THE CHANGE SPEED GEAR.

Undoubtedly the most original part of the entire mechanism of the car is the change speed gear, of which two views are shown herewith, Fig. 5 being a vertical sectional view and Fig. 6 a horizontal sectional view of the gear. Referring to these figures, A is the driving shaft which receives its motion from the engine through a Cardan shaft, the universal joint at the rear end of the latter being shown in Fig. 6. To shaft A is keyed the bevel gear B, meshing with the bevel gear B′ on the hollow shaft C. This shaft C is provided with bronze bushings and turns freely upon a differential shaft D. A pair of sliding pinions E F are arranged to slide freely on the hollow shaft C, on two feather keys at opposite sides of the shaft. Below the jack shaft D is arranged a countershaft G journaled in bearings supported by the gear case, and to this countershaft are rigidly secured the gear pinions E′, F′ and H′. The pinions E′ and F′ are adapted to be meshed with the sliding pinions E and F, respectively, and the pinion H′ meshes with the gear wheel H, this gear wheel being normally in driving connection with the hub of the differential gear I. The driving connection between the gear H and the differential gear I is obtained in the following manner: The hub of the differential gear is provided with radial lugs I′ I′, which are adapted to engage into openings of the hub of gear wheel H, which is slidably arranged on the hub of the differential gear. A coiled spring S normally keeps the gear wheel H in its extreme left hand position, in which position the slots or openings in the hub of gear H are occupied by the lugs I′ I′, thereby virtually keying gear H to the hub of differential gear I. The differential gear is of the common spur pinion type.

To the rear of the jack shaft is located a second countershaft J, supported also in bearings formed in the gear case, and carrying two reversing pinions R R′. The operation of the gear is as follows:

For the slow forward speed, pinion E is brought into mesh with pinion E′, and then the power is transmitted from the engine shaft A through the mitre gears B B′ to hollow shaft C, through spur pinions E E′ to countershaft G, through spur pinions H H′ to the differential gear I, and through the latter to the jack shaft D D′. For the second speed the sliding pinions E F are shifted further to the right until the pinions F and F′ are in mesh. The motion is then transmitted essentially in the same manner as for the first forward speed, except that it is transmitted from hollow shaft C to countershaft G through pinions F F′ instead of through pinions E E′, the former pair of pinions giving a smaller ratio of reduction from engine shaft to jack shaft.

To secure the highest forward speed, which is a direct drive, the sliding pinions E F are shifted still further to the right. It will be noticed that the pinion F is provided with positive clutch jaws, and over these clutch jaws is arranged a ball thrust bearing K. When the sliding pinions E and F are shifted into their extreme right hand position, the ball thrust bearing K bears against the flange of the gear H, and, compressing the coiled spring S, forces the gear H to the right until it is out of engagement with the lugs I′ I′ and turns free upon the hub of the differential gear. At the same time the positive clutch jaws J′ J′ engage with the jaws I′ I′, thereby locking the differential gear I to the hollow shaft C and securing direct drive. The only set of change speed pinions which are now in mesh are H H′, and as H is now loose upon the hub of the differential gear I, none of the change speed gears are in motion.

The sliding pinions are shown in the two drawings in the reversing position. Pinion E now meshes with the intermediate pinion R and intermediate pinion R′ secured to pinion R meshes with pinion E′ on the countershaft G. It will thus be seen that all three forward speeds and the reverse are obtained by a continuous sliding motion of the sliding gears E F. This sliding motion is obtained by means of a shipper lever L fixed upon a shifting rod M supported in bearings in the gear case. This shifting rod receives its motion from the gear shifting lever N at the side of the driver's seat, through the tubular rocking shaft O, the lever arm P, link Q, bell cranks T and links U. The rock shaft O is supported in bearings fixed to the right main frame member and a cross frame member respectively. The shaft V for operating the emergency brakes is placed inside the hollow shaft O and has fixed to its outer end the brake operating lever W. A foot brake operates on the drum of the differential gear, as plainly shown in Fig. 6. It will be noticed that all bearings of the change speed gear and jack shaft are ball bearings. The housings X X of the jack shaft bearings are bolted to the aluminum gear case with flanged joints, thus insuring continued perfect alignment of all bearings. These housings are supported in hangers Y bolted to the main frame beams, and have eye bolts Z screwed into them, to which the

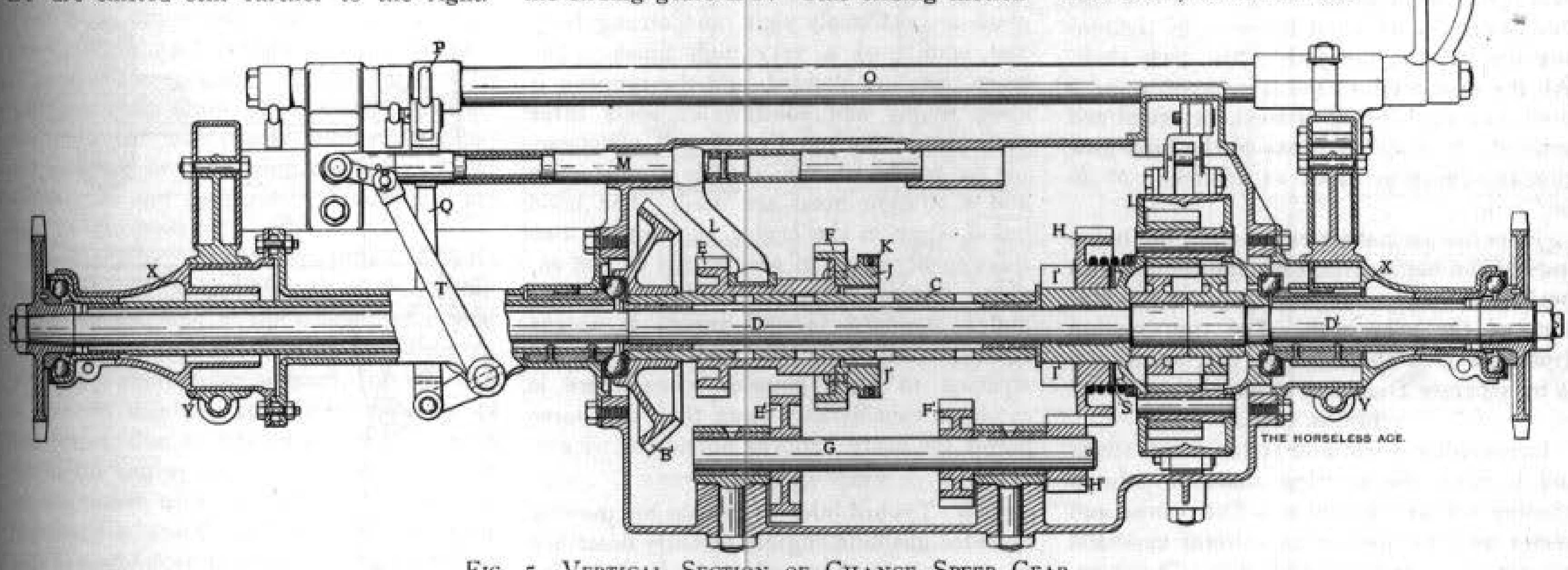

Fig. 5—Vertical Section of Change Speed Gear.

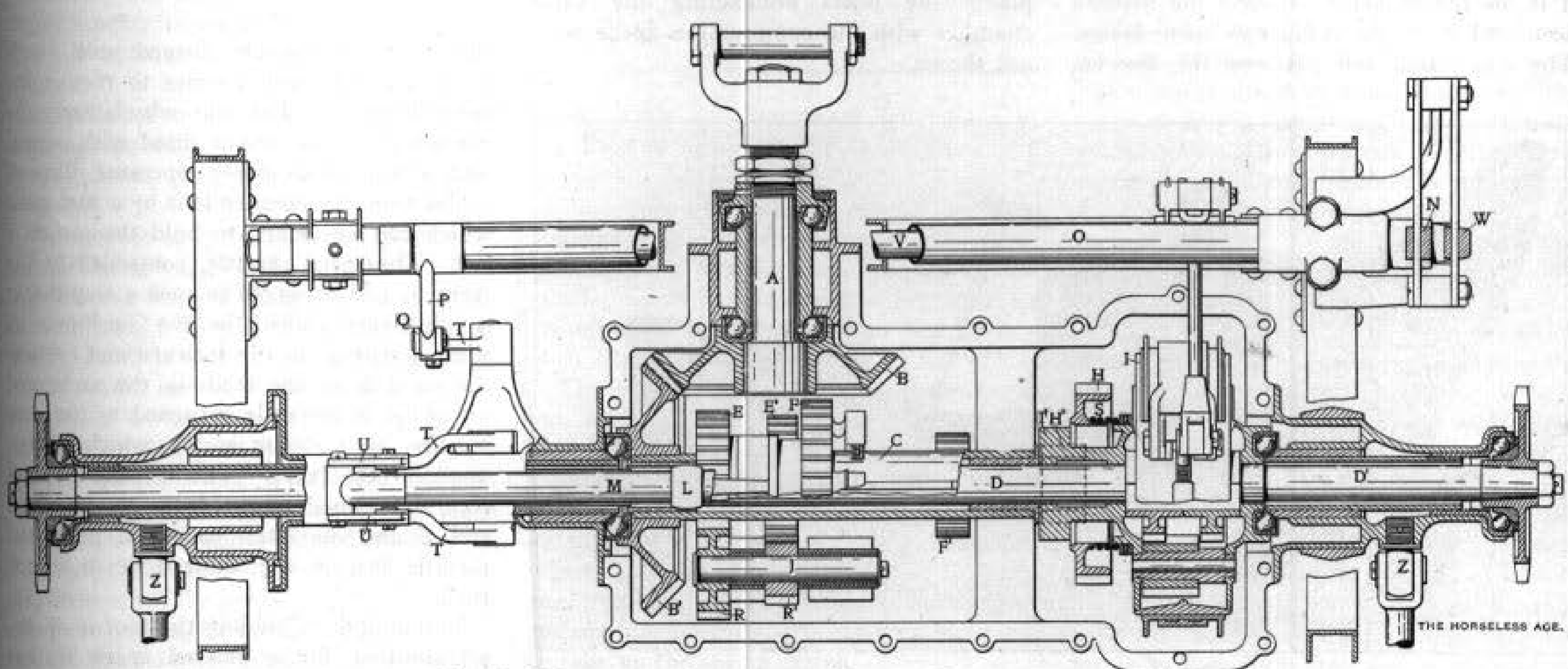

Fig. 6—Horizontal Section of Change Speed Gear.

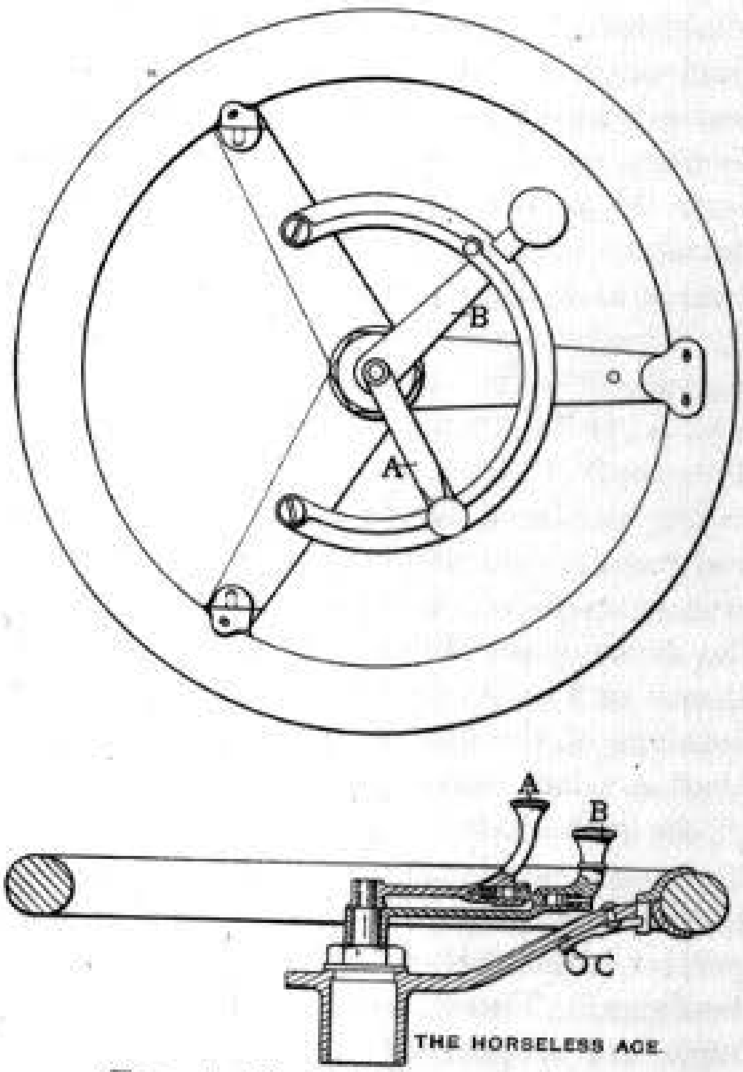

Fig. 7—The Steering Gear.

chain adjusting rods are pivoted. The outer ball bearings are provided with oil retainers and dust washers. All of the ball bearings can be readily adjusted for wear by tightening the nuts at the end of the jack shaft. All the gear teeth of the transmission are 6 pitch, the gears being of steel, hardened and ground. It is claimed that on the high gear this transmission gives an efficiency of 88 per cent.

The entire jack shaft runs in oil, the housings of the ball bearings being provided with pockets to return the surplus oil to the bottom of the gear case. The transmission from the jack shaft to the driving wheels is by separate Diamond roller chains.

STEERING GEAR.

Irreversible worm and sector wheel steering is used, the steering shaft or column turning on ball bearings. The worm and sector are enclosed in an oiltight case and all wearing parts are adjustable. The steering wheel can be tilted out of the way when it is desired to enter or leave the driver's seat, and is of the company's own design. The connecting rod between the steering knuckles is a straight steel tube located in front of the axle, and has spring cushioned, adjustable ball and socket joints. The connecting rod between the worm gear and the steering knuckle occupies normally a substantially horizontal position, reducing to a minimum the effect of the spring action in the steering operations.

In order to secure the most convenient control the spark and throttle levers are arranged right on the steering wheel, instead of on the column below the wheel, as is common practice. In Fig. 7 A is the spark lever and B the throttle lever. The spark is advanced by moving lever A from left to right, and the throttle is opened by moving lever B in the same direction, both these operations giving normally an increase of engine speed. This illustration shows also quite plainly the manner in which the tilting action of the steering wheel is obtained. The wheel rim is swiveled to two of the three arms of the spider, and when in its normal position can be locked by a switch C pivoted on the third arm.

The standard tonneau body is used, the front seats and tonneau being made from open hearth mirror finished steel, which gives an extremely light and strong body and admits of a very high finish. The front seats are divided, and the tonneau is quite roomy and comfortably seats three passengers. Tufted French roll upholstering is employed and a hollow steel dash and a straight hood are used. The hood has a hinge in the centre allowing its two sides to be raised to give access to the engine. The car has a wheel base of 91 inches and a standard 54 inch tread; it weighs 2,300 pounds fully equipped and can be stripped to 1,900 pounds, when there is available considerably more than one horse power for every hundred pounds of weight.

J. W. Tygard informs us that his moving cylinder gasoline engine, recently described in our columns, has adequate facilities for cooling the cylinder. In the cut of the piston the ports connecting the valve chamber with the compression space were not shown.