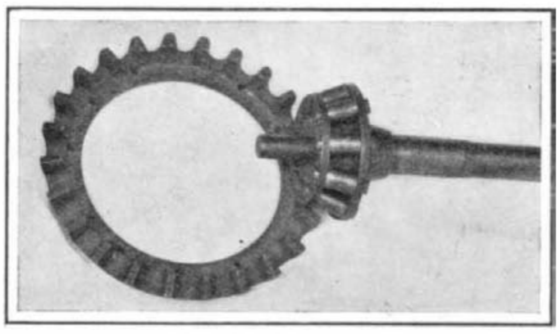
THE HAYNES TRANSMISSION AND ROLLER BEVEL DRIVE.

Two of the distinctive features of the Haynes cars are illustrated herewith. These are the roller bevel drive, which replaces the usual bevel gears at the rear axle; and the use of pawls and ratchet teeth for transmitting the power received by the master gear of the transmission to the hub of this gear, thereby allowing it to revolve idly when not in use, as when the car is running on the high speed, for example, or when it is coasting on the intermediate, and the other gears on the main and lay shafts are in mesh. As a general rule, if the gears are shifted back to intermediate while the car is running at a good speed, there is usually a terrific grating noise and the chauffeur is lucky if he does not strip a gear. The reason of this is that as the two intermediate gears attempt to mesh, they are revolving at a very rapid rate and are being driven one by the rear wheels of the car, and the other by the momentum of the clutch. Under these conditions it is well nigh impossible to mesh the intermediate or low-speed gears at all, or at least to accomplish this without damaging them. The Haynes ratchet device obviates this trouble by freeing the low and intermediate gears on the lay shaft, and allowing them to run ahead of the clutch shaft gear when the change is made from high to intermediate or low. Therefore, when these gears are meshed with those on the main shaft under the conditions stated, since they are at rest and have no inertia, no noise or damage can result. The gears can be shifted back without throwing out the clutch.

The other distinctive Haynes feature is the roller bevel drive. Instead of the usual large bevel gear on the differential, a large sprocket having specially-shaped teeth is used, while the bevel pinion is replaced by one having hardened and ground steel rollers set at an angle to match the teeth on the large ring. So efficient is this form of drive, on account of doing away with side thrust and also because of the diminished friction, due to the use of rollers, that tests of chassis have shown a loss of but 7 to 8 per cent in transmitting the power from the motor to the rear wheels. The cars upon which these improvements are used are of first-class construction throughout. That the material in them is good is evidenced by the fact that the racer which did so well in the last Vanderbilt race was a regular stock chassis equipped with a 50-horse-power engine. After demonstrating what his car could do in so severe a test, Mr. Haynes is engaged in constructing a considerable number of these high-powered machines in addition to his regular 30-horse-power model during this year.

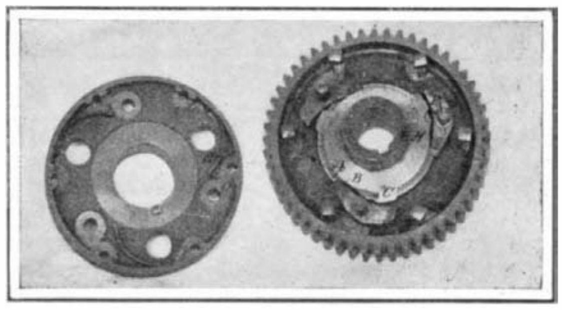
TRANSMISSION GEAR WITH DOUBLE CLUTCHES.

It is a well-known fact that on account of its large size and heavy weight, the usual cone clutch employed on automobiles has sufficient momentum, when it is thrown out, to spin around for some seconds and keep the gears in the transmission revolving at a considerable speed. When passing from a low speed to a high speed there is not so much danger of stripping gears as when the gears are changed in the opposite direction. Nevertheless, the beginner often experiences difficulty in speeding up his car, and before he knows it frequently starts to strip a gear, the result being that shortly after a number of the gears require renewal. An improvement noted on the new Thomas machine is the brake applied on the hub of the clutch when the latter is thrown out. This brings the clutch and gears to a reduced speed, although they still revolve at the speed at which the movement of the car forward drives them. A still greater improvement, which is also of American origin, is shown in the diagram, in which a second clutch is provided between the gear box proper and the differential. This clutch, *B* (see diagram), is in a separate compartment, and has its shifting lever, *D*, connected to the same pedal, *E*, to which the shifting lever, *C*, of the regular flywheel clutch, *A*, is linked. Thus when the pedal is depressed both clutches are thrown out, and brakes (not shown) are applied to the hubs, *V V'*, of the clutches, thereby bringing them and the gears immediately to rest. The gears can then be changed without any noise and without any danger of stripping. A



HAYNES ROLLER BEVEL DRIVE USED AT THE REAR AXLE.

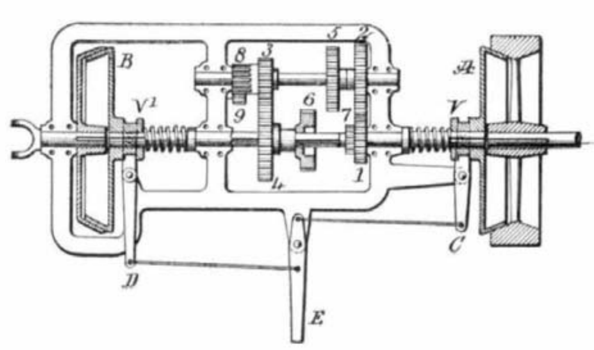
This form of drive does away with side thrust and is very efficient.



HAYNES RATCHET-AND-PAWL CONNECTION IN TRANSMISSION GEARS.

A. Ratchet tooth. *B.* Pawl on gear. *C.* Cam on collar carrying ratchet teeth and attached to hub. *H.* Hub keyed on lay shaft. *P.* Pivot pin of pawl. *O.* Hub in cover that fits over *P.* *S.* Spring for holding pawl against collar.

device of this kind has, we understand, been applied to one of the recent makes of British cars. While somewhat more complicated and cumbersome than the latest American idea of using a multiple-disk clutch in the gear box, it is nevertheless a safe and sure way of protecting the speed-change mechanism from damage where the cone type of clutch is used. The latest forms of multiple-disk clutch are, as a rule, so light and of such small diameter that the driving gears come to rest almost as soon as the clutch is thrown out. The use of a second clutch, however, assures their shifting without damage.



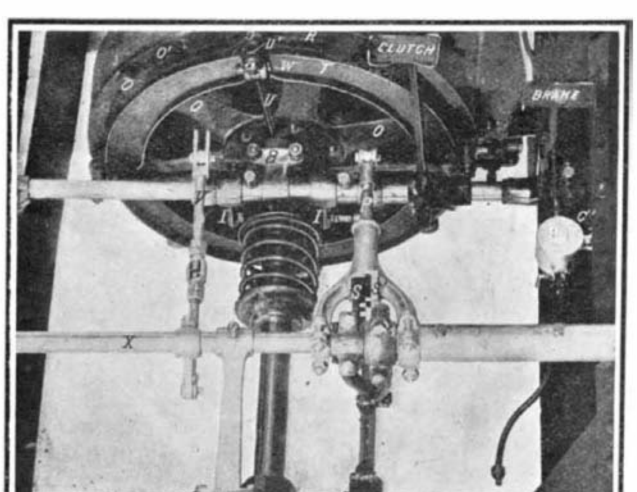
IMPROVED TRANSMISSION WITH DOUBLE CLUTCHES.

A. Regular flywheel clutch. *B.* Extra clutch between gears and propeller shaft. *C, D.* Operating levers. E. Clutch pedal. *V, V'.* Location of brake shoes for clutches. Gears are on low speed through *1, 2, 3, 4.* Intermediate speed is through *1, 2, 5, 6.* High speed is direct drive, 6 locking with 7. Reverse is through *1, 2, 8, 9, 4.*

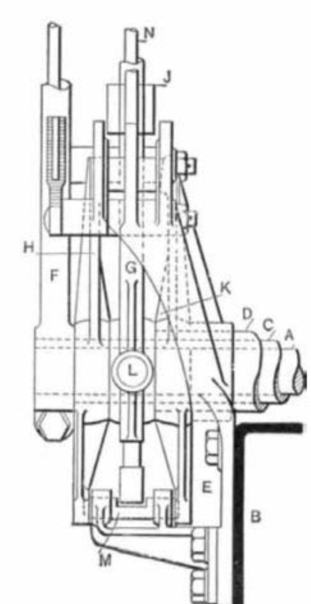
NOVEL CLUTCH AND TRANSMISSION FEATURES OF 1907 CARS.

The Thomas clutch, which is of the three-ring metallic type, is shown in one of the illustrations, as is also the interlocking arrangement, which makes it impossible to shift the gears until after the clutch has been withdrawn. The central clutch ring, *R*, of manganese bronze, is attached to the main shaft extending forward from the transmission. It has sixteen cork inserts that extend out 1/32 of an inch beyond its face and form much of the friction surface. The clamping disks, *O, O'*, are of gray iron and are attached to the flywheel by four studs that terminate in caps hollowed out to receive the ends, *U'*, of the levers, *U*, which are pivoted on pins, *W*, carried in lugs in an outer ring, *T*. The large coiled spring shown presses against the levers, *U*, and causes their tips, *U'*, to bear upon adjustable screws, *a*, in the ends of the hollowed caps, the result being that the fulcrums, *W*, of the levers, *U*, are forced toward the flywheel and the rings, *T O*, clamp the ring, *R*, between themselves and *O'*, which is attached to the flywheel by screws. A novelty is a brake shoe, *B*, that is applied to the clutch collar when the clutch is withdrawn, and which checks the rotation of the latter caused by the momentum of a rather heavy ring.

Another point about this clutch is that the pressure of the compressing spring is exerted through the levers upon the peripheries of the clutch disks, where the friction surface is greatest. This makes it impossible for the disks to become sprung or fail to take hold. The clutch is interlocked with the gears in such a manner that it is impossible to change gears without first throwing it out. This is accomplished by means of a short lever, fastened on the same transverse shaft that carries the clutch pedal and clutch shifter (the two arms of which are seen at *I I*). This lever, as it moves forward with the pedal lever when the clutch is thrown out, withdraws from engagement with the two notched sectors, *S S'*, the plunger, *P*. When this plunger is in engagement with these sectors, the gears are effectually locked. The sectors are on two hollow sleeves, one within the other, that extend to the gear-shift lever on the outside of the frame. Should the gears not be completely in mesh, the plunger, *P*, cannot slip back into place, and, consequently, the clutch cannot be thrown in. This arrangement, therefore, makes it well-nigh impossible to damage the gears. These are of wide face and large diameter, the face and pitch being respectively 1 3-16 inches and 8. Ball bearings are used throughout the transmission with the exception of that at the forward end of the main shaft, which is a Hyatt roller bearing. Annular ball bearings are also used on the differential and the sprockets. The transmission and differential are in a single case, which is suspended from three points on cross members of the frame. The gear-shifting system is altogether new. It is easy of operation and practically fool-proof. By referring to the diagram of the gear-shift lever, the reader can see how this mechanism works. The two sleeves which carry the sectors, *S S'*, are shown in the diagram at *C* and *D*, while the emergency brake shaft, which extends across the car inside of a smaller sleeve, is shown at *A*. This shaft carries a lever, *F*, upon its outer end. The two sleeves, *C* and *D*, have fastened to them vertical levers, *H* and *K*, respectively, and these levers have at their upper ends notches to receive the latch *J*, when the gear shift lever, *N*, is moved to one side or the other through the gate of the H-shaped plate that is usually employed in a four-speed selective transmission. When moved sideways, the lever, *G*, turns upon suitable pivots, *L*, while when moved forward and backward it rotates around sleeve, *C*. The bottom part of this lever consists of a curved sector, which engages in a slot in pin, *M*. This pin sets in two eyes

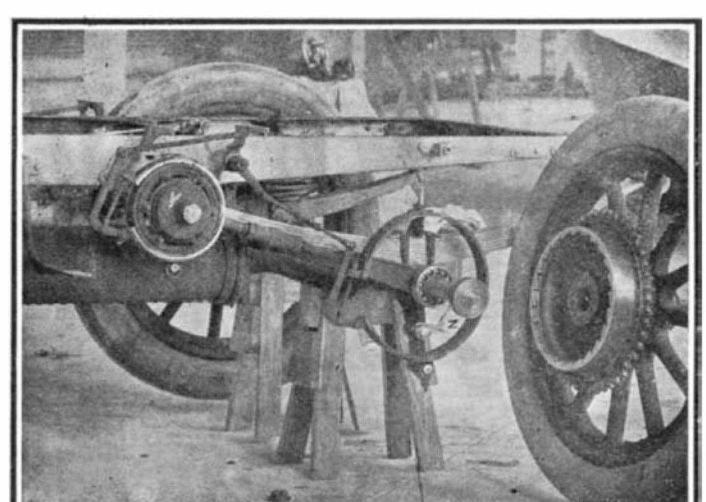


THREE-DISK METALLIC CLUTCH AND INTERLOCKING MECHANISM OF THOMAS CAR.



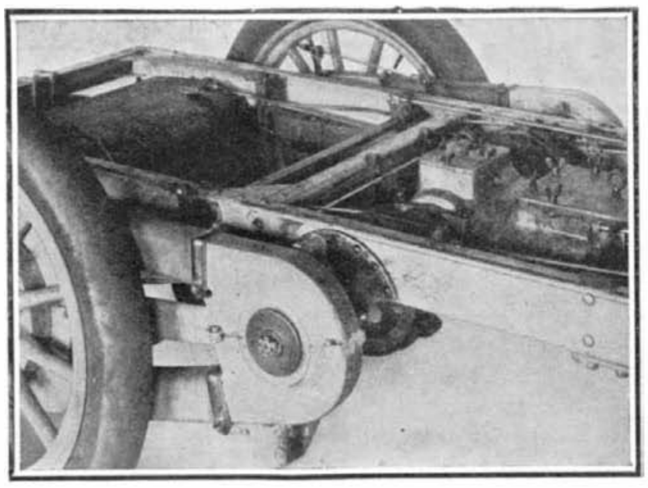
INTERLOCKING GEAR-SHIFT LEVER.

B. Chassis frame. *E.* Bracket.



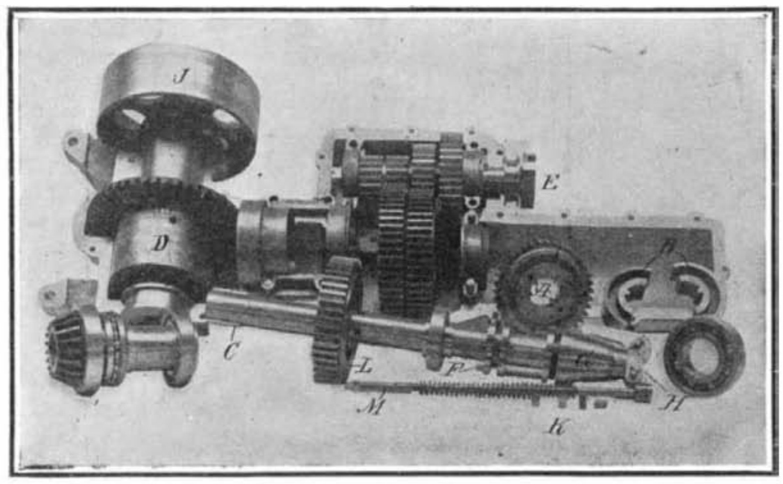
RADIUS ROD, BRAKES, AND REAR WHEEL OF 60-HORSE-POWER THOMAS CAR.

in the bottom ends of the levers, *H* and *K*. In the position shown it effectually locks these levers, and holds the gears in the neutral position. When it is desired to insert a gear in mesh, the operator first moves lever, *G*, to one side or the other of the H-shaped quadrant, and thereby releases at the bottom the lever that its latch, *J*, engages at the top. As soon as the clutch is thrown out the driver can then move *G* forward or backward in its slot until he has in mesh the gear desired. To bring into play the other gear set he must, after releasing the clutch, slip the lever, *G*, through the gate, or opening in the H-shaped quadrant, and thereby cause the latch, *J*, to lock into the other short lever, *H*, which is at the same time automatically released by the pin, *M*, while its twin is locked. Thus, it will be seen that there is a double interlock on this car, a fact which should make it extremely difficult for the novice to get into trouble while shifting the gears. The rear axle and countershaft construction is shown in one of the photographs. As already stated, the countershaft revolves on Hess-Bright ball bearings, and these are placed in the drum, *Y*, directly beneath the driving-sprocket, which is attached on the six studs shown. The brakes are both of the contracting type, the foot brakes being applied upon drums which carry the driving sprockets, as can be plainly seen, while the emergency brakes, worked by the lever, *F*, are applied upon sprocket drums on the rear wheels. These drums are internally notched with ratchet teeth, and the pawl, *Z*, can be dropped into engagement with them to stop the car from running backward down hill. Last year this device was applied in a similar manner, except that the ratchet teeth were external instead of internal. The reverse is interlocked with the pawls, so that these cannot be engaged when the car is being backed. Perfectly straight, drop-forged radius rods, the rear ends of which completely encircle the rear axle, are employed on the new model Thomas cars. The construction is very substantial, and the car is one of the best-arranged machines used with a final chain drive.



PROTECTIVE CHAIN CASING ON THE LOZIER TOURING CAR.

This is one of the much-needed improvements on cars employing the double chain drive. The countershaft of this car is also fitted with a separate water-cooled band brake near each end.



THE BERKSHIRE INDIVIDUAL CLUTCH TRANSMISSION.

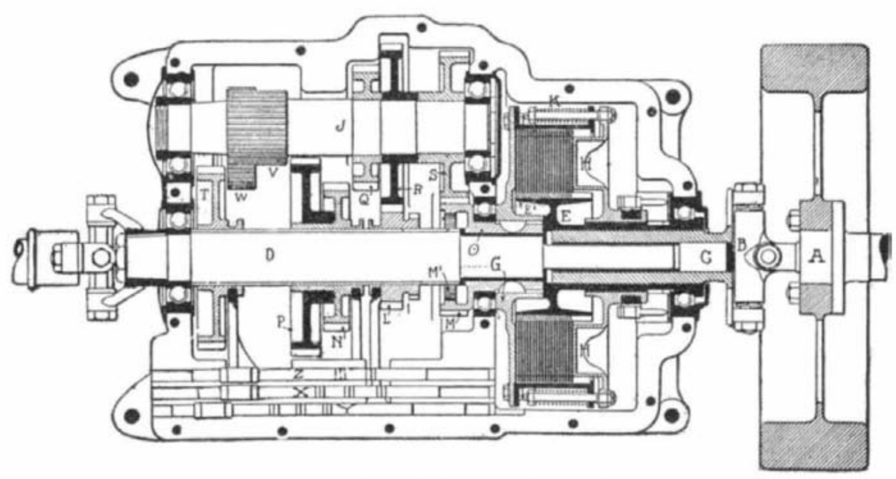
A. One of the gears with clutch inside. *B*. Expanding clutch shoes. *C*. Keys on hollow shaft for bevel driving pinion. *D*. Differential and large bevel gear. *E*. Universal joint for drive shaft from engine. *F*. Shifting collar for sliding hollow shaft, *C*. *G*. Shifter for tapered pin, *M*. *H*. Pivoted end piece for working shifter, *G*. *L*. One of the four gears with clutches that slide on shaft, *C*. *K*. Four tapered blocks that are expanded by *M* through holes seen beside *L* and that thus serve to expand shoes *B*.

THE LOZIER PROTECTED DRIVE CHAIN.

One of the great disadvantages of the double side-chain drive over the drive by propeller shaft and bevel gears, is that in the former case the chains are near the wheels, where mud and dirt can splash upon them, and where, as a rule, no protection is given them. An improvement on the 1907 40-horse-power Lozier touring car is shown herewith. This consists in the protective casing for each chain, which completely incloses it and keeps off both dust and mud. The casing is composed of two aluminium castings, which surround the sprocket on the countershaft and the sprocket on the wheel respectively. These two castings are connected by a straight central supporting member of rectangular cross section, while rubber tubing (also rectangular in cross section) surrounds the chain, and connects the aluminium castings at the top and bottom. These rubber connections are clamped to the castings in such a way as to make a tight joint. Being flexible, they allow for any movement of the countershaft relative to the rear axle. The protection is very complete, and adds greatly to the life of the chain as well as to its quiet running. Another feature of this car is the fitting of separate brakes near each end of the countershaft, just inside of the frame. These brakes are connected to the pedal through an equalizing device, and they are water-cooled, being fitted with water jackets supplied from a special tank.

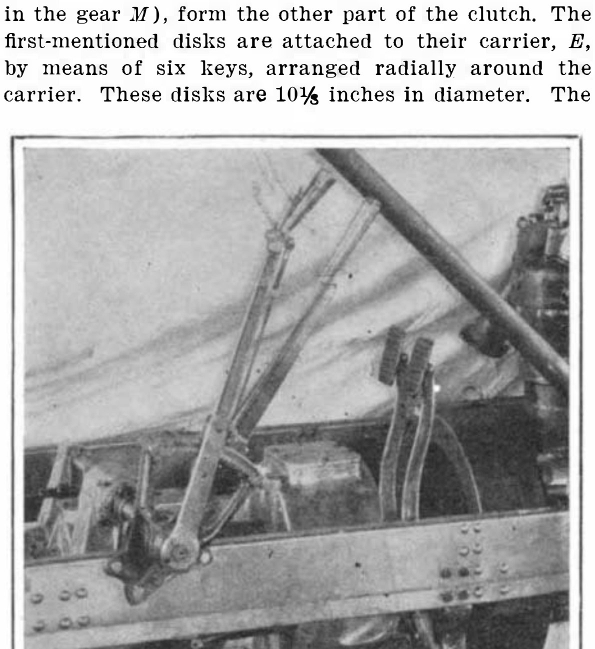
THE POPE-TOLEDO COMBINED CLUTCH AND TRANSMISSION.

The photograph and line drawing reproduced herewith give a good idea of the new combined clutch and transmission, which is used as a separate unit on the Pope-Toledo 40-horse-power touring car. All the gears and shafts are of chrome nickel steel, and every moving part is fitted with Hess-Bright ball bearings. Besides the carrying of the clutch in the forward part of the gear case, another feature of this transmission is that the direct drive is obtained upon the third speed by sliding gears *L I* to the right, so that *I* meshes with the internal gear *M*, while the fourth speed, which is used only under the best conditions, is had through *M S R L* as shown in the diagram. The drive on the first and second speeds is through *M S V P* and *M S O N*, while the reverse is obtained by sliding *T* into mesh with the intermediate pinion *W*, the drive then being through *M S V W T*. The clutch is formed of nineteen soft-steel disks, *E′*, which are carried on the special carrier, *E*. This carrier is keyed to the hollow shaft that connects with the universal joint, *B*. Twenty hard-steel disks supported at their peripheries on another carrier, *G* (which terminates in the gear *M*), form the other part of the clutch. The first-mentioned disks are attached to their carrier, *E*, by means of six keys, arranged radially around the carrier. These disks are $10\frac{1}{8}$ inches in diameter. The other disks, which are $10\frac{3}{4}$ inches in diameter, are attached to their carrier, *G*, by four series of slots placed 90 degrees apart around their peripheries, and through which pass bolts carrying spring washers between the disks, to assist in separating them when the clutch is disengaged. On the extreme outside of the disks are eight springs, *K*, placed radially at equal intervals. These act through the pressure plate, *H*, to press the disks together. By placing them on the outside of the disks, and causing them to work through this pressure plate, all the disks are compressed uniformly throughout their entire surface. Besides a universal joint, *B*, between the crankshaft, *A*, and the hollow stub shaft around *C*, there are two other universal joints between the transmission and the countershaft, which is located some distance farther back on the frame as an entirely separate unit. This makes it possible to use short driving chains, and is a distinctive feature of the new Pope-Toledo car. The entire power transmission of this machine is, therefore, quite different from that ordinarily used. The idea of incasing the clutch with the gears is a good one, as is also the plan of placing the countershaft as near the rear wheels as possible. The Pope-Toledo engine of $4\frac{7}{8}$ bore by $5\frac{1}{4}$-inch stroke is rated at 40 horse-power. It is very similar to the De Luxe engine illustrated on page 24, as it has the same walking-beam valve mechanism, and the cylinders are cast in pairs and provided with copper water jackets. A peculiar arrangement is noted in the oiling of this engine, which is accomplished by pressure feed, from a small oil tank placed beneath the floor, and having a pressure of 5 pounds per square inch, supplied by a hand-operated air pump between the individual front seats. There is also a plunger for forcing oil directly into the crankcase. A convenience with regard to the carbureter is that it can be primed by pressing a button arranged beneath the radiator at the front of the car. The fuel is forced by air pressure from a double 25-gallon tank at the back of the car to a 5-gallon running tank on the dash, in which the gasoline is kept at a certain level automatically. Should it fall below this level, an alarm is sounded.



CROSS-SECTION OF POPE-TOLEDO COMBINED TRANSMISSION AND CLUTCH.

A. End of crankshaft carrying flywheel. *B*. Universal joint. *C*. Bearing of main transmission shaft, *D*, in hollow stub shaft that carries clutch disk drum, *E*. *E′*. Driving disks of clutch. *F*. Rear shaft extending to countershaft. *G*. Driven drum of clutch. *H*. Pressure plate of clutch. *I*. High-speed gear that fits in internal gear, *M′*. *J*. Lay shaft. *K*. Clutch springs. ●. Sleeve carrying master pinion, *M*. *X*, *Y*, *Z*. Notched shifting-gear rods.



TRANSMISSION AND OPERATING LEVERS OF POPE-TOLEDO TOURING CAR.

The multiple-disk clutch is in a compartment at the front end of the gear box. The countershaft for the double chain drive is placed by itself some distance back of the gear box, thus allowing short chains to be used.

A NOVEL INDIVIDUAL CLUTCH TRANSMISSION.

The accompanying photograph shows the transmission of the Berkshire car taken apart to show the interior construction. The top half of the case is simply removed to show the interior. At one end of the top half of the case is a raised housing. Dependent from the inside of this housing are the shifting forks, which in turn are connected by a shaft to the operating lever on the side of the car. The shaft, *E*, is connected direct to the engine. Upon this shaft are keyed the steel gears which mesh into the phosphor bronze ring gears, *B*. Each of these ring gears are supplied with internal expanding frictions, the two halves of which are shown at *B*. These two halves are again shown placed in position at *A*. The sliding shaft, *C*, upon which this ring gear is placed moves longitudinally, when placed in position in the case, through all of these gears. At a point in this movable shaft, four square holes are made, which open into a hole drilled longitudinally through the entire length of the shaft. These holes are shown beside *L*. The steel wedge pins, *K*, are inserted in these square holes, *L*, and when located under any of these ring gears, are forced outward by the internal expanding wedge *M*, which is operated by a side lever on the car, in connection with the depending shifting forks, which are connected with *F* and *G*. The forward motion of the lever operates *F*, which is fast to the shaft and moves the shaft longitudinally under the desired gear. The backward movement of the lever operates forks connected with the tapered cone, *G*, and forces it under the fingers, *H*, which are fulcrumed on

(*Continued on page 53.*)