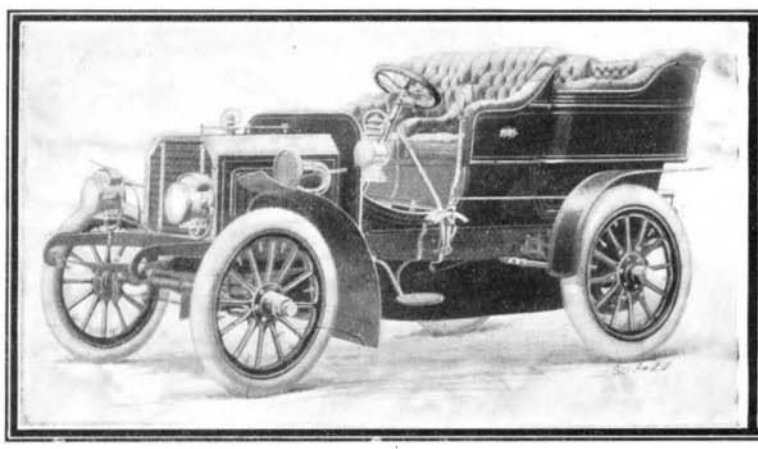
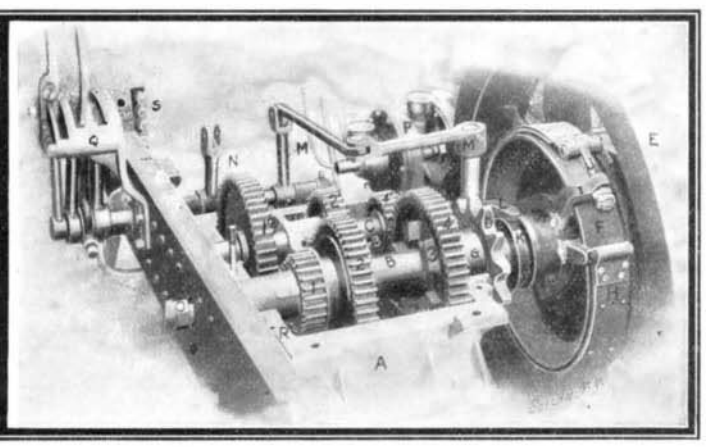
to the lower ends of the cylinder jackets, passing around the cylinders and back to the radiator, which it enters at the top. No separate water tank is carried. A small overflow tube conveys excess water to the ground when filling the circulating system. Compression relief cocks, which are tapped into the cylinders, are connected by a linked rod which extends through the radiator and terminates in a small brass knob, a single movement of which relieves the compression in the four cylinders.

The 1904 Toledo transmission is clearly shown in the accompanying line engraving. It is designed for three forward speeds and a reverse, and the drive is direct on the high gear, the secondary shaft and gears being idle, a result not always attained in "direct drive" transmission mechanisms.



THE STEARNS 24 HORSEPOWER TOURING CAR.



TRANSMISSION OF STEARNS CAR.

Referring to the drawing, the mechanical details and method of operation may be easily understood. Shaft *A* is driven by the motor, and communicates the power to the sliding gear sleeve, *U*, through the medium of the two bevel gears, *C*. Sleeve *U* carries sliding gears, *D* and *D'*, and the male portion, *O*, of a miter gear clutch. These parts are free to move endwise, but are prevented from turning independently of the sleeve by long feathers set in opposite sides of the sleeve. The sleeve, *U*, is free to turn on the transverse transmission shaft, *B*. Directly below this shaft is a countershaft, which carries gears *F*, *F'*, and *P*. The operation of this mechanism is as follows:

It will be noted that driving gear, *E*, is not fixed to the differential case, but may be held in driving relation thereto by the spring, *Q*, which normally presses the spur driving gear, *E*, against hub, *H*, and causes miter teeth on the right-hand face of its hub to mesh with similar teeth on *H*, which is integral with the differential gear case and has miter teeth on its other side also. When teeth on *E* mesh with those on *H*, *E* is locked to the differential case. This relation exists only when the car is being driven on the slow or intermediate speed or the reverse. It will be seen that when driving on the slow speed, sliding gear, *D*, meshes with gear, *F*, on the countershaft, and power is transmitted through the shaft and pinion, *P*, which is in mesh with gear, *E*. The ratio of this gear system is 8 to 1. On the intermediate speed, sliding gear, *D'*, meshes with pinion, *F'*, on the countershaft, and the power is conveyed to the driving shaft through pinion, *P*, and gear, *E*, as before. The ratio of this combination is 5 to 1. In reversing, sliding gear, *D*, is meshed with pinion, *G*, and power is transmitted through the reverse shaft and pinion, *G'*, and gear, *F*.

The most interesting feature of the new Toledo transmission is the method of driving on the high speed, at which time the only gears in mesh between the motor and the driving wheels are the bevel gears, *C*. This is accomplished by sliding the gear set, *DD'*, to the left until its miter teeth, *O*, are in mesh with those on hub, *H*. This movement also pushes gear, *E*, to the left sufficiently to disengage miter gears on its hub from those on *H*, thus releasing the countershaft and establishing a positive connection between sleeve, *U*, and the differential. On returning to the lower speeds, spring, *Q*, again establishes a positive driving relation between gears *E* and hub *H*.

Further reference to the drawing of the transmission will show that ball bearings are used extensively, the bearings being unusually long, while every opportunity for close adjustment is afforded by the construction.

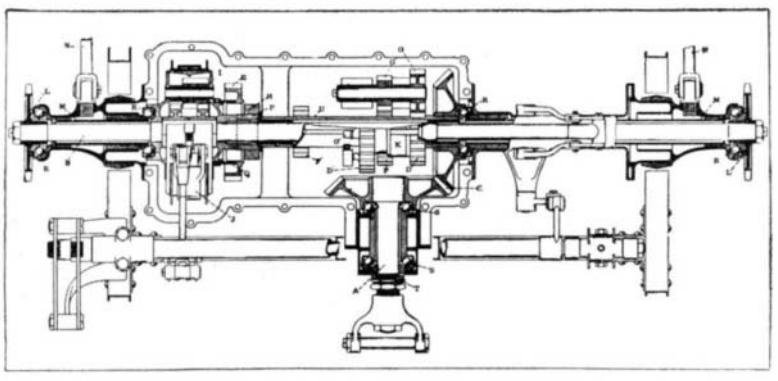


DIAGRAM OF TRANSMISSION OF THE POPE-TOLEDO CAR.

An internal cone clutch with multiple springs takes the place of the ordinary push clutch found in previously designed Toledo cars. The mechanism is entirely inclosed, while at the same time the interior is readily accessible by removing the friction ring, which is bolted to the rim of the flywheel. The end thrust of the clutch spring is relieved from the motor shaft by means of a large ball bearing thrust collar, and the springs are easily adjustable from outside the clutch by means of screw plugs with lock nuts. When the clutch is engaged there is virtually no end thrust.

The three forward speeds and the reverse are controlled by a single lever. The brake lever applies two hub brakes and releases the clutch. The hub brakes are of the expanding-ring type, while a pedal-actuated band brake operates on a drum carried by the differential.

The wheel base of the car is 93 inches, and the tread is standard. The front wheels are 32 inches in diameter, and the rear wheels are 34 inches. The tires are 4 inches in diameter.

The frame of the car is of pressed steel, and the side bars are extended to form "pump-handle" spring hangers. Sheet steel is used extensively in the construction of the car, notably in the curved seat panels and the hollow dash. These parts are pressed into shape in special dies and, being perfectly smooth, present a suitable surface for the finishing enamel, which is baked on, and is a durable and attractive substitute for paint.

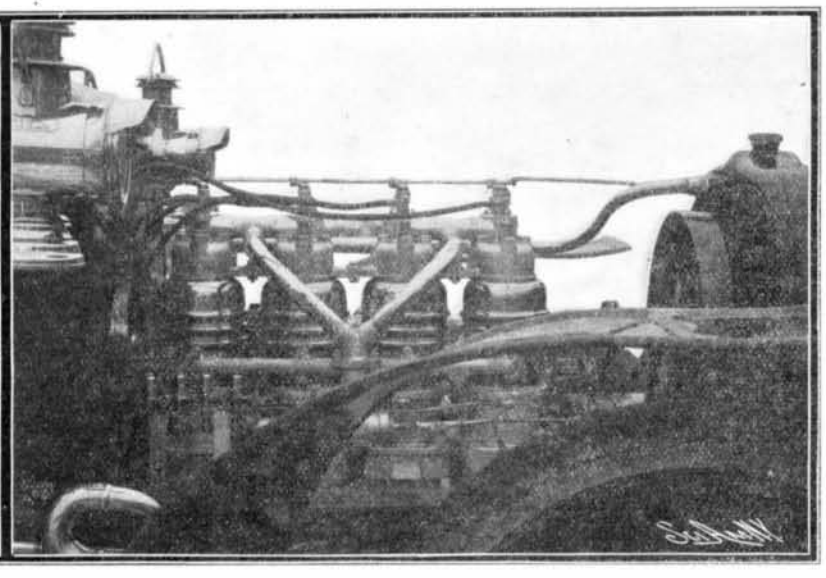
The Pope-Toledo car is built by the Pope Motor Car Company, of Toledo, Ohio.

THE STEARNS GASOLINE TOURING CAR.

The Stearns car and its transmission are shown in the accompanying cuts. This machine is a powerful touring car with a motor of the double, opposed-cylinder type, running at a normal speed of 900 revolutions per minute, and capable of driving the car as fast as 50 miles an hour. The motor is fitted with a brass water jacket square in cross-section. It is fed with gas from two float-feed, atomizing carbureters in which the suction is against the spraying nozzle instead of in the direction in which it points. This novel construction is said to offer advantages in the way of supplying a good mixture at widely varying speeds. The cooling water is circulated by a centrifugal pump, *P*, friction-driven from the flywheel, through a flanged radiator consisting of about a dozen small copper pipes laid side by side horizontally in front of the bonnet and coiled back and forth in an S-shaped formation. The warm water of the cooling system enters the bottom of the oil tank and heats the oil, at the same time putting a pressure on it and causing it to flow to the six sight feeds that supply oil to the motor through small copper pipes. The pipes that oil the cranks are curved so that the drops of oil forming in the ends of them are caught in small cups on the crank-pin boxes, as the cranks pass under the oil-pipe ends.

The transmission gears run in an oil-tight case, *A*. The flywheel is shown at *E*, and the band brake clutch, *J H*, by clamping the drum, *F*, of the flywheel when the shipper, *K*, spreads levers, *I I*, drives the shaft, *B*, through levers, *I I*, which are mounted on studs on a flange at end of *B*. The gears are slid in mesh by a lever working in the H-shaped slot, *Q*. They are of the usual pattern, giving a direct drive on the high speed by the meshing of miter gears, 3, 3. The first and second speeds are obtained through 1, 1', 4', 4, and 2, 2', 4' 4 respectively, gear 4, sleeve *G*, and sprocket *D* being one solid piece of steel. In the position shown, the reverse is accomplished by raising a wide intermediate pinion beneath 1 and 1' so that it meshes with each gear. The motor is started by a crank applied at *O*. The frame of the Stearns machine is of armored wood. The car has a long wheel base and large 34 and 36-inch artillery wheels shod with 4 and 4½-inch tires. The throttle control of the motor is very flexible, thus making it possible to obtain speeds of from 5 to 50 miles an hour on the high gear. The throttles on both carbureters are operated by a pedal, or they can be set by a handle on the steering wheel. One of these machines made an extremely good showing in the New York-Pittsburg run last October, and, despite some mishaps due to hard driving, reached Pittsburg among the first at the end of the contest.

THE POPE-TOLEDO 24-HORSEPOWER TOURING CAR.



SEPARATE CYLINDERS OF MOTOR, SHOWING CORRUGATED COPPER JACKETS.