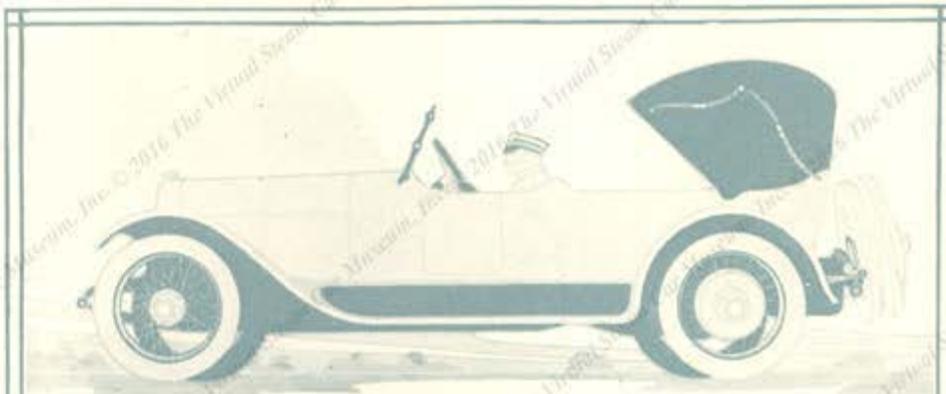




 **DOBLE**
STEAM CAR

Copyrighted, 1916
General Engineering Company
Detroit, Mich.

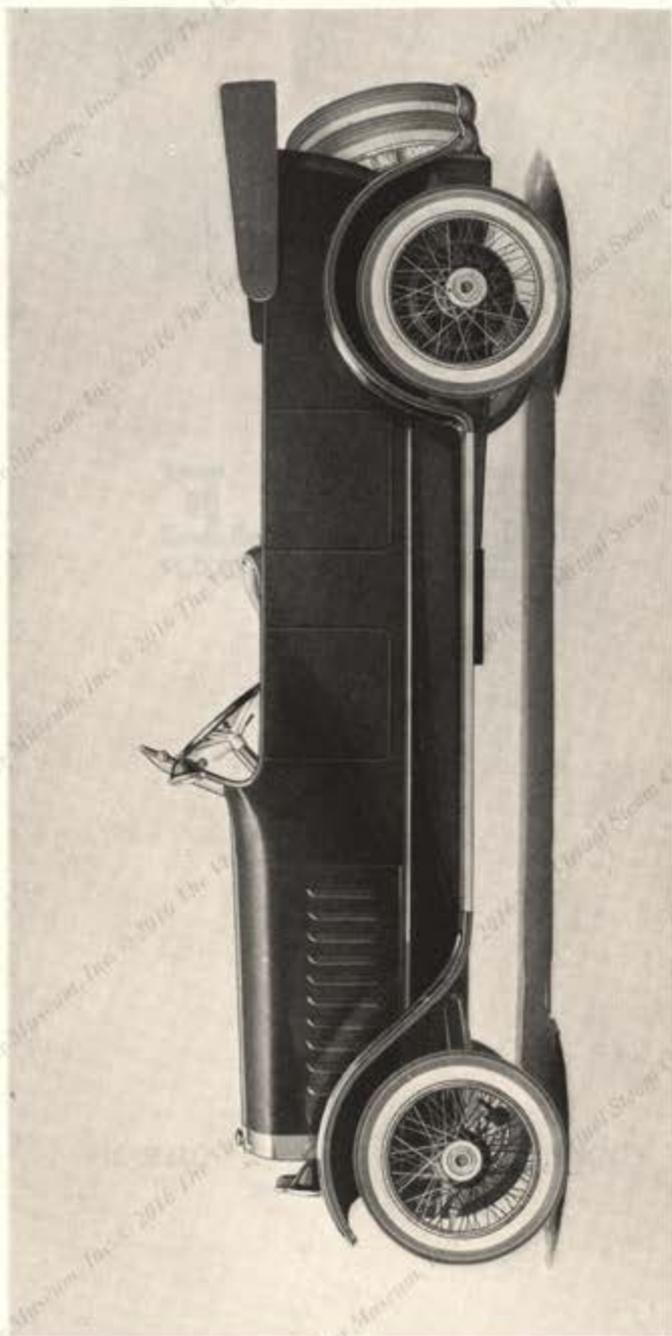


DOBLE
STEAM CAR

NO GEARS TO SHIFT;
NO CLUTCH; NO UNIVERSAL
JOINTS; NO DRIVE SHAFT.
ONLY TWENTY-TWO
MOVING PARTS

GENERAL ENGINEERING COMPANY
DETROIT, MICHIGAN





Doble Seven Passenger Touring Car

DOBLE STEAM CAR



UTOMOBILE engineers have for years recognized steam as the ultimate source of power. Abner Doble has developed a steam power plant by nine years of persistent work which makes the Doble Steam Car pre-eminent among motor cars. Actual performance is the standard by which motor cars are judged. This is what the Doble Steam Car will do.

It will creep along at less than one mile an hour and accelerate to sixty in fifteen seconds. That is flexibility.

It climbs any hill, on which the wheels can secure traction, although the engine is geared one to one with the back axle. That is power.

There are only twenty-two moving parts in the Doble Steam Car, of which eleven are in the engine. There is no gear-set, clutch, or drive shaft. That is simplicity.

The Doble Steam Car uses only kerosene for fuel, and runs fifteen miles on a gallon. One gallon of lubricating oil suffices for eight thousand miles. That is economy.

All exhaust steam is condensed and used over and over again, thus insuring absolute silence and conserving heat energy. The car will run 1000 to 1200 miles on twenty-five gallons of water.

The burner is lighted by an electric spark. The car will start in one minute although perfectly cold. After standing ten hours it will start in twenty seconds. Cold weather can never cause ten or fifteen minutes of bad running as in a gas car.

The two cylinder Doble engine gives the same number of impulses per revolution as an eight cylinder gasoline motor with the added elasticity and power derived from steam.

To sum up—the Doble Steam Car possesses perfect flexibility and silence, more power and speed than is actually needed, extreme simplicity and economy.

It is the highest type of motor car yet developed.



The Doble Steam Power Plant

THE steam power plant, designed by Abner Doble and used in the Doble Steam Car, consists primarily of the steam and water system, the fuel and combustion system, and the engine or power transmission system.

The first of these is probably of the greatest interest to those who are acquainted with steam cars, as it includes the steam generator or boiler, which has always heretofore been considered the least satisfactory element of the steam plants used to propel motor cars.

The Doble generator in point of construction is based on the water-tube type, and carries a water level in the evaporating zone.

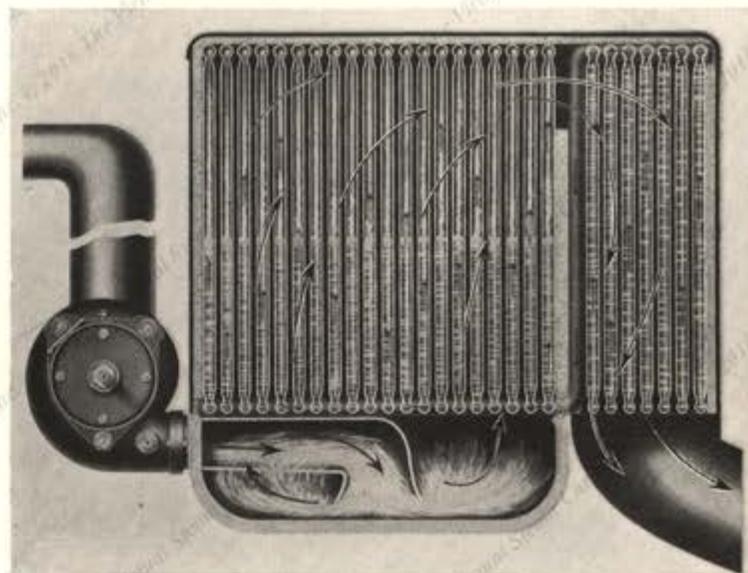
It consists of 28 identical sections placed in an insulated casing. Each section consists of two horizontal headers connected by sixteen vertical tubes. They are made entirely of cold drawn seamless steel tubing of about one-half inch diameter. The vertical tubes are swaged at either end to about three-eighths of an inch, and are welded to the headers by the autogenous acetylene process, thereby making the section in effect one piece of steel, and actually stronger at the welded joints than the tubing itself.

Eight of the sections are used as the economizer, and the remaining twenty for the actual generation of steam. The generator sections are completely encased, except at the bottom, by a three-quarter inch wall of Kieselguhr heat insulating material, and a planished iron jacket. Kieselguhr brick is a remarkably effective non-conductor of heat, and considerably increases the efficiency of the generator.

The combustion chamber is directly beneath the steam generating sections, while the exhaust for burned gases is below the economizer sections.

The intake water manifold delivers water simultaneously to the economizer sections through their lower headers, the water being forced in by a crank-driven plunger pump. When the economizer sections are completely filled, the water overflows from the upper headers into a manifold, which delivers it simultaneously to the lower headers of the evaporating sections.

Here the water level is maintained about half way up the generator by means of a by-pass valve, so arranged that when the regulator tube is filled with steam and consequently hot, the by-pass valve is closed by the expansion of this tube, forcing the water from the pumps to lift the check valve and enter the generator.



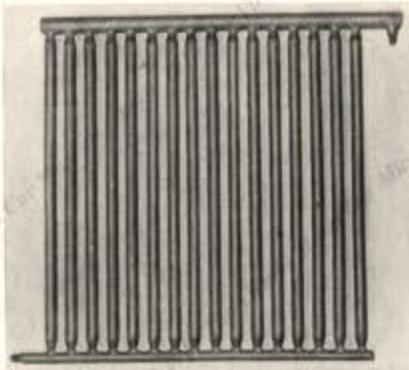
Doble Steam Generator—Sectional view. Large arrows indicate flow of gases of combustion—small arrows indicate flow of water. Water enters the lower headers of the Economizer Sections, shown at the right. Steam leaves the upper headers of the Evaporating Sections, all those above the combustion chamber

As the water level rises the regulator tube is filled with water from an exposed pipe. This water, not being in circulation in the generator, is quite cool, so that the relatively large change in temperature causes the regulator tube to contract, thereby opening the by-pass valve and allowing the water to return to the supply tank.

The economizer sections are partially shut off from the remainder of the generator by a bridge-wall of Kieselguhr brick, which is virtually an extension of the rear wall of the combustion chamber, and extends about three-fourths of the height of the generator.

The hot gases rise from the combustion chamber, giving up their heat to the closely grouped vertical tubes, pass over the bridge wall, and a large number of their remaining heat units are absorbed by the relatively cool water flowing slowly up through the economizer sections.

From the foregoing description it should be noted that the Doble generator possesses the most distinctive advantages of



A section of the generator showing vertical tubes swaged at ends and welded to upper and lower headers

both the fire-tube and flash boilers.

The excellent heat transfer conditions, and the large reserve of water heated to the steam temperature, are true of the former. The progressive flow of the water counter to that of the gases, with no circulatory flow, and the all steel construction with its consequent immunity from leaks due to low water, duplicate the most desirable features of the flash type.

The normal steam pressure in the generator, while power is being used, is 600 pounds, which means a terrific acceleration with the opening of the throttle. Pressure is maintained at this point by an automatic device which cuts off or renews the fuel supply according to the variation of the pressure from normal.

Every section of the generator is tested to withstand an hydraulic pressure of 5000 pounds, and the actual bursting point is over 8000 pounds.

To prevent any possibility of an accident to the generator tubing a safety valve is also attached, which operates if the steam pressure reaches 1000 pounds.

The live steam is led from the upper headers of the generator into a manifold, passes through the throttle valve, and down to the steam chest of the engine.

The throttle valve is a combination of a poppet and piston valve, so arranged that the poppet valve portion serves to keep the throttle tight (i. e., in a non-leaking condition) while the piston valve portion regulates the amount of steam which passes to the engine. The seats are made of a non-rusting alloy of great toughness and durability, which, due to the additional fact that the velocity of the steam passing the poppet valve seat is never high, will run continuously without attention.

The exhaust steam from the cylinders is carried to the top of the radiator, and is forced down through it by the pressure of following steam. A honeycomb type radiator is used, thereby

obtaining approximately six times the radiating surface of the type which was formerly used on steam cars.

The water of condensation enters the water tank very near the bottom, so that any steam that might find its way to the tank, is at once condensed in bubbling up through the water. This will occur only when accelerating rapidly from a slow speed or pulling slowly on a heavy road.

If the unfavorable condition of slow, heavy pulling continues for some time, a small part of the steam will remain uncondensed. To guard against any accumulation of such steam a vent is provided in the top of the water tank.

This system of condensation is so effective that a Doble car will run approximately 1100 miles on one filling of water.

The lubrication of the throttle and cylinder valves, the cylinder walls, the interior of the generator, and the water pumps, is accomplished by the addition of a small quantity of standard cylinder oil to the water.

The oil rapidly goes into emulsion with the water, due to the violent agitation and intimate contact. Agitation in the tank is insured by the entrance of the return from the radiator at the bottom of the tank and by the unevenness of the road.

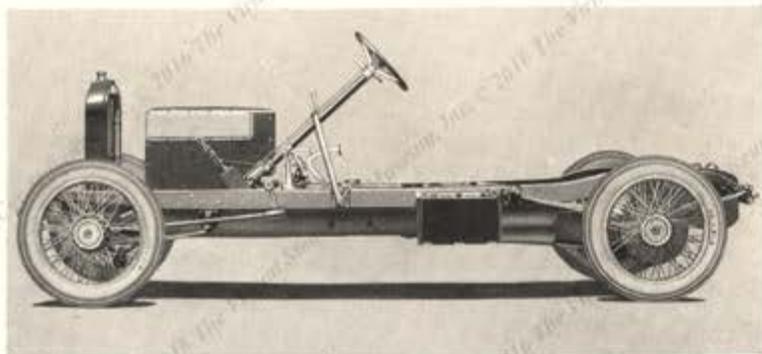
The oil is, therefore, regularly pumped into the generator along with water, and there performs several valuable functions. First it thoroughly coats every portion of the interior of the generator with a very thin coating of oil. While this coating is exceedingly thin at ordinary temperatures, it is very much thinner at 485 degrees F., which is the approximate temperature of the generator at 600 pounds pressure.

No scale will stick to a surface coated with oil, therefore the interior of the generator is absolutely protected from accumulations of scale, as well as from rusting.

A second function of the oil is to prevent particles of scale from adhering to one another and finally clogging some passage.



The honeycomb radiator of the Doble Car



Doble Chassis—75 h. p.—weight 2400 lbs. The steam generator is located directly behind the radiator; the water tank is below the front foot boards; the rear end of the crank case is integral with the rear axle housing; the kerosene tank is between the rear springs

This is effectually accomplished by the oil thoroughly coating each particle of scale as it is thrown out of solution and thus rendering it incapable of sticking to any other particle.

All scale therefore remains in suspension, and, due to the violent ebullition and constant flow of the medium toward the steam outlet, it is carried along and out with the steam, finally ending up in the water tank. This action appears to be extremely thorough, and in several years' use no accumulation of scale can be detected in any portion of the generator.

As the bubbles of steam break through the water surface, they take a certain amount of oil along with them, thus lubricating the throttle valve, and then the valves and pistons of the engine.

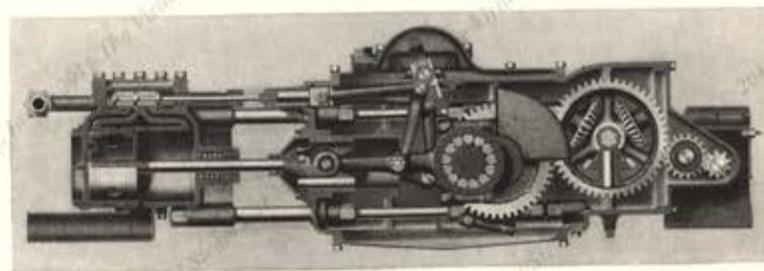
The condensing system, previously described, saves the oil along with water, and as the oil is never exposed to a destructively high temperature, none is lost due to heat.

Lastly there is no contamination of the oil, by gasoline, carbon or road-dust, as in an internal combustion motor.

The result of the foregoing conditions is that a Doble Steam Car will use only one gallon of oil in running 8000 miles.

For the same reason the oil can be added to the water and kept in circulation, alcohol may be added in winter to prevent freezing, just as in the cooling system of a gas car.

Even if a freeze-up should occur through carelessness, no damage can be done by it to the generator, as the steel tubing will expand without bursting.



Doble Steam Engine—Sectional View

The Doble Engine

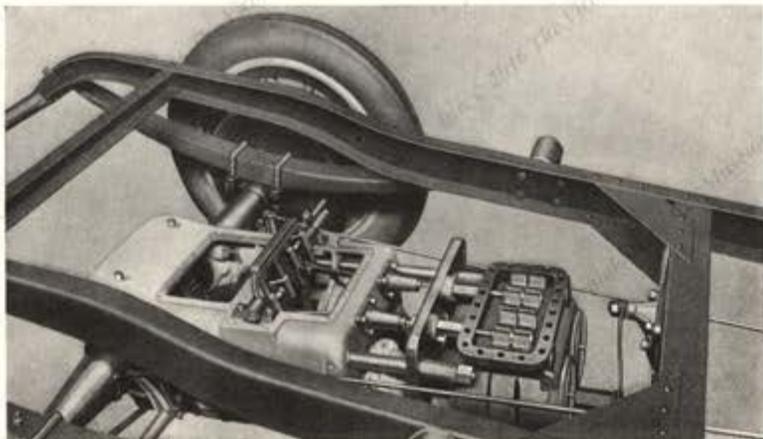
THE engine used in the Doble power plant is exceedingly simple and contains but eleven moving parts. The dimensions of all the working parts are ample to insure uninterrupted service under maximum conditions of load.

It is a two-cylinder, single expansion, double action engine. The uni-flow principle is employed in order to provide the high expansion desirable, with a noiseless valve gear and only one valve per cylinder. The valve takes care of the steam inlet, while the exhaust passes out through ports uncovered by the piston at the end of the stroke. It is thus possible to secure cut-off at 5 per cent of the stroke, if desired.

Since the thermal conditions in the uni-flow cylinder are practically ideal, it is unnecessary to use superheated steam. This means that very little internal lubrication is required, and none of the troubles caused by superheated steam need be anticipated.

The slide valves are on top of the cylinders, and are each made in two pieces so that they can lift in slow running, whenever the compression exceeds the steam-chest pressure. This makes a smooth running engine at all speeds, and also allows a high compression at higher speeds and steam-chest pressures.

The valves are actuated by a specially designed Doble Valve Gear, which dispenses with the need for eccentrics, thus making a one piece crank shaft possible. This gear gives an excellent steam distribution, and also reverses the engine without additional devices.



Rear Half of Chassis—Cover plates are removed from crank case and steam chest

The Doble Valve Gear is a simplified form of the Joy Valve Gear, and eliminates the correcting and anchor links employed in the latter. The rocker guide in the Doble is straight instead of curved.

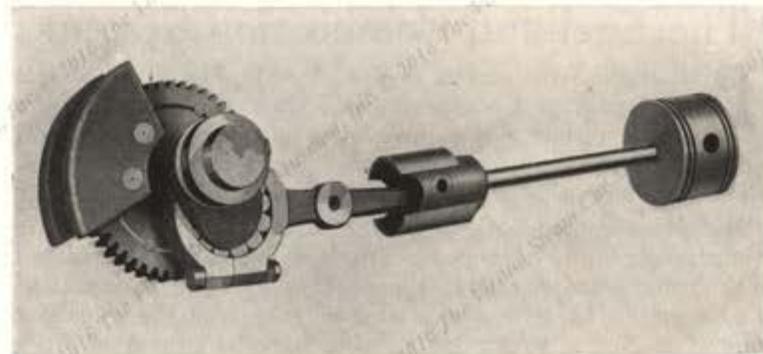
The bore of the cylinders is 5 inches, the stroke, 4 inches. A cut-off at one inch is used for all ordinary running, and the Doble gear operates this cut-off with perfect accuracy on either stroke of the piston. For starting or heavy pulling a cut-off is used at $\frac{5}{8}$ of the stroke; for high speed and economy $\frac{1}{8}$ is used.

The piston rod passes through a specially designed cast iron gland, which is made such a perfect fit on the piston rod that no steam can blow by. Due to the long bearing surface there is practically no wear, and never any need for repacking.

The crank-case is an aluminum casting, and contains the moving parts of the engine, except the piston and valves. The differential is also contained in the crank-case, and the taper-tubes of the axle bolt directly to it, thus making the engine and rear axle one unit.

The forward end of the engine is suspended from a cross-member of the frame by a flexible steel strap.

The crank shaft, differential, and big end connecting rod bearings are annular roller, and are of such proportions that no wear can occur during the natural life of the car. All of the other bearings, such as the wrist pins and valve gear bearings, are hardened steel, running in hardened steel bushings.

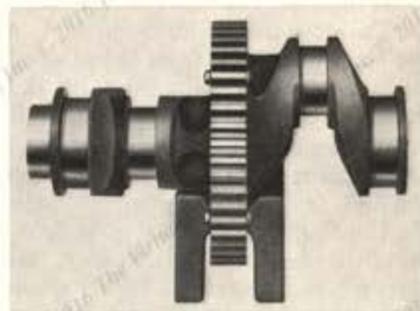


Assembly of piston, crosshead, connecting rod with roller bearing at big end, and crank shaft showing counter-weights

Due to the low speed of the engine (geared one to one with the axle) and to the steel bearings, no forced feed oiling system is necessary or even desirable. The casing is oil tight; the oil is always comparatively cool; and as no carbon, water, or gasoline can contaminate the oil, the supply in the crank case lasts for several seasons. All parts of the axle are oiled from the same bath.

The power is transmitted to the rear axle by means of two large spur gears, a 47-tooth gear on the engine crank shaft and a 49-tooth gear on the differential. The engine has more power than is needed to spin the wheels on dry pavement, while the car is held stationary.

The electric generator, which charges the storage battery used for lighting and ignition purposes, is driven through an idler gear, of the spur type, meshing with the main gear of the differential. It is worth noting that the few gears used in the Doble power plant are constantly in mesh and are therefore not subject to anything like the wear that is undergone by gears that are frequently shifted in and out of mesh.



Doble counter-balanced crank shaft

The Fuel and Combustion System

THE combustion system evolved by Mr. Doble in the last three years of his experimental work is a long step in advance of any system ever used on any previous steam motor car, and effectively eliminates the objectionable features, which were formerly the despair of steam car drivers.

Kerosene is used both for starting and running; the burner is electrically ignited; every trace of flame is completely enclosed in the combustion chamber; there is no pilot light; combustion is so complete that no soot is ever deposited on the generator tubing; sufficient steam for running may be generated from perfectly cold water in less than a minute.

Kerosene is made to flow to a float chamber by an air pressure of three pounds. The float chamber is of the standard carburetor type, and feeds the kerosene to a spray nozzle. This nozzle projects into a venturi tube leading to the combustion chamber.

Air, drawn through the radiator by a small electrically driven multivane blower, passes the spray nozzle with a sufficient velocity to draw out the kerosene and atomize it. This velocity immediately decreases due to the widening of the venturi tube, and the fuel mixture is ignited by an electric spark. As soon as the burner is lighted the spark ceases automatically. The combustion takes place in a chamber made of a special refractory material, which attains a very high temperature, and positively insures complete combustion by heating the gases before they burn, and by its very effective catalytic action.

The hot gases rise, giving up their maximum heat to the evaporating sections of the generator, pass over the bridge wall and down past the tubes of the economizer, where the remaining heat units are abstracted.

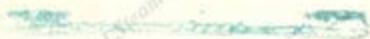
To stop the combustion it is only necessary to switch off the electric current from the motor-blower. As noted before, this is done automatically by a regulator set to operate at a predetermined steam pressure, or by the operation of a hand switch.

The quickness with which steam may be generated in the Doble plant requires a word of explanation. It is due in part to the high temperature attained in the combustion chamber and to the unusually large heating surface of the generator tubing (one hundred and fifty square feet); but most of the time saved in starting, as compared to other steam cars, is due the elimination of the time formerly required for heating the vaporizer preparatory to lighting the main burner.

Specifications

<i>Engine</i>	Two cylinder, uni-flow, double action, single expansion. Stroke 4"—Bore 5".
<i>Valves</i>	Inlet — 2 piece slide valve. Exhaust-ports uncovered by piston.
<i>Valve Gear</i>	Doble type.
<i>Crank Shaft</i>	One piece, drop forging, with crank-pins 2½" in diameter. Balanced.
<i>Combustion System</i>	Doble type. Kerosene only fuel used. Electric ignition.
<i>Steam Generator</i>	Doble type — 75 h. p.— 150 sq. ft. heating surface.
<i>Ignition and Lighting System</i>	Delco.
<i>Axles</i>	Front and Rear — Doble-American Ball Bearing Co.
<i>Water Pump</i>	Crank driven plunger pump.
<i>Water Tank</i>	20 gallons.
<i>Radiator</i>	Honeycomb, 4" core.
<i>Kerosene Tank</i>	25 gallon tank, mounted at rear of chassis. Air pressure, 3 pounds.
<i>Bearings</i>	Crank shaft, big end connecting rod and main bearings are annular roller. Front Axle — Annular ball, Hess-Bright. Rear axle — Annular roller, Bower type.
<i>Wheelbase</i>	128".
<i>Tread</i>	Standard.
<i>Driving Gears</i>	Spur type, engine to axle, 47 to 49 ratio.
<i>Wheels</i>	Rudge-Whitworth wire wheels.
<i>Tires</i>	Goodrich Silvertown Cord 33" x 5".
<i>Steering Gear</i>	Gemmer model "K," heavy duty type.
<i>Drive</i>	Steering wheel and hand brake lever on left side.
<i>Brakes</i>	Two expanding brakes — 16" drums, completely enclosed. Service brake — hydraulic-type — operated by foot pedal. Emergency brake — hand lever.
<i>Springs</i>	Semi-elliptic. Front 44" x 2"— Rear 56" x 2½". Rebound shock absorbers.
<i>Frame</i>	6" deep. Heat treated alloy steel.
<i>Weight</i>	3100 pounds.
<i>Bodies</i>	Seven passenger touring body. Three passenger roadster. Special bodies as listed below can also be furnished. Four passenger sporting type. Four passenger collapsible coupe. Town coupe.

RECEIVED
FEB - 3 1917



 **DOBLE**
STEAM CAR