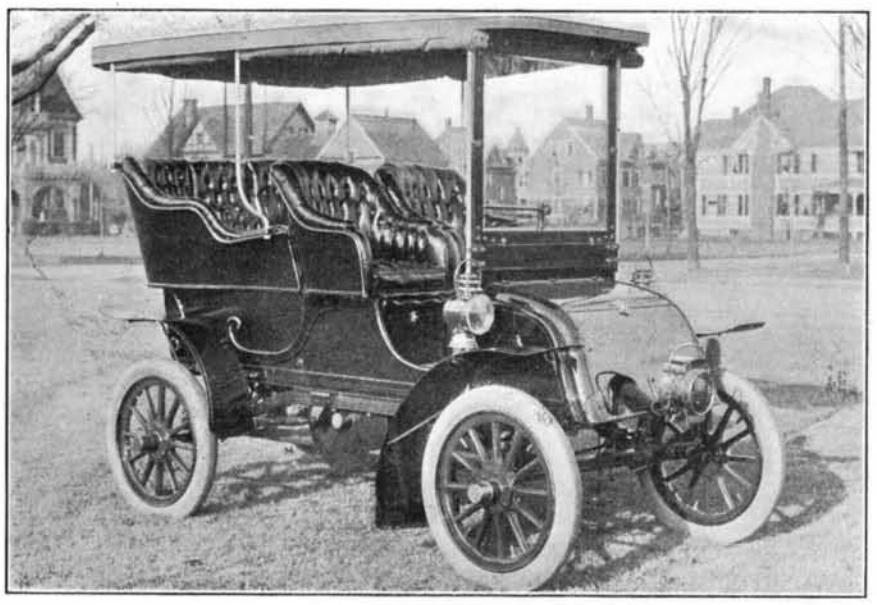
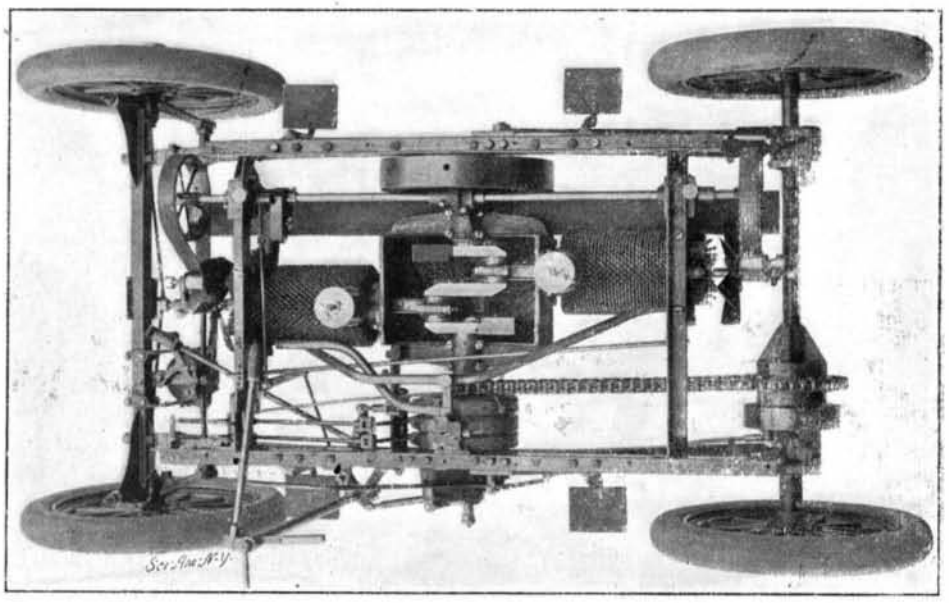
sible to advance the spark by moving the sleeve with respect to the shaft while they are rotating together. The bore and stroke of the engine cylinders are 4¼ and 4½ inches respectively, and 7 horse power is claimed for it at 700 revolutions per minute. This powerful motor weighs but 160 pounds, 78 pounds of which is in the flywheel. That this rating is conservative is shown by the car's performances. The cylinder heads of the motor consist of large caps that are screwed in with a special wrench. This makes it possible to remove the head quickly if for any reason the cylinder needs inspection. The disk at the bottom of the plan view picture is on the crank shaft and is bolted to a similar one on the transmission.



THE KNOX 16-HORSEPOWER TOURING CAR.

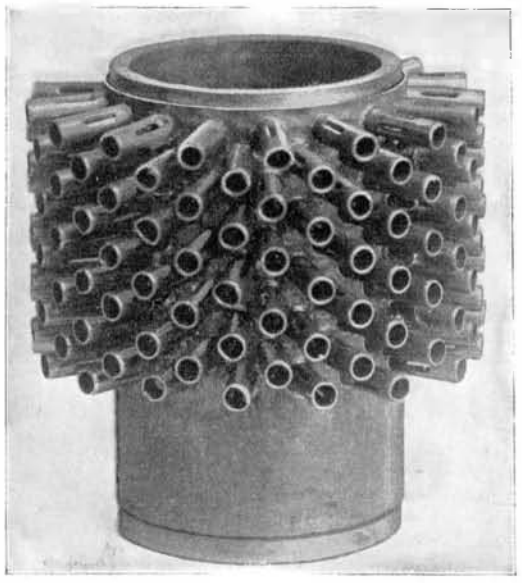


KNOX CHASSIS, SHOWING OPPOSED-CYLINDER MOTOR AND FANS.

The picture of the chassis shows the body, which is hinged at the edge of the front seat, tipped forward. The gears and their individual clutches are visible, as well as the specially shaped cams above them. These are operated by a rack and pinion, when the speed-change lever is moved, in such a manner as to throw in one clutch after another in their proper sequence, and yet, when the lever is moved from the third speed back to the "off" position, the second and first speeds are passed through without engaging the clutches. With the individual clutch system, which is used on very few cars, the gears are always in mesh and turning idly when the motor is running. The motor is set going from the seat by turning the small handle beside the steering lever. This is a very convenient feature of the machine. On the bottom of the steering post is a horizontal sprocket which is connected by a chain with a similar one on the front axle, the latter of course being connected so as to move the tie rod of the front wheel steering knuckles. The steering is sensitive and is geared down so that a slight movement of the handle will accomplish the desired result. The multiple oiler on top of the motor feeds all bearings and is turned on by a small handle in front.

## THE KNOX DOUBLE-CYLINDER CARS WITH FAN-COOLED MOTORS.

After exhaustive tests throughout the past year, the Knox Automobile Company has now brought out a new line of tonneaus, surreys, and delivery wagons fitted with a 16-horsepower, 5 x 7, double, opposed-cylinder motor of their well-known, fan-cooled type, with which 1,760 threaded steel pins, 2 inches in length, are screwed into the surface of each cylinder to radiate the heat. This arrangement makes it possible to obtain 32 square inches of heat-radiating surface per square inch of outside cylinder surface, which is about four and one-half times that obtainable with the ordinary type of air-cooled cylinder with cast flanges; and it is for this reason that the Knox Company has been able to use a single cylinder of as large dimensions as 5 x 8 (the size used on the runabout) where most other manufacturers have heretofore not been able to go above 3¼ x 3½. The chassis of the double-cylinder cars is quite similar to that of the single-cylinder ones. It consists of an angle iron frame bolted down to the middle horizontal part of two reach springs that connect the front and rear axles. The front axle is a single trussed casting of a special aluminium bronze having a tensile strength of 60,000 pounds per square inch and also the property of bending rather than breaking. The rear axle is one solid steel shaft. It is keyed to the hub of the wheel on the end farthest away from the differential, and is supported in a Timkin roller bearing, while from the differential to the other end it passes through a sleeve which is keyed to one of the bevel gears in the differential, as well as to the hub of the nearby wheel, and which also runs in a roller bearing in the bearing box next to the differential. The reach springs are slidably and revolubly mounted in the bearing boxes; and each of the radius rods screws into a nut placed between two projecting lugs of one of the boxes. By unscrewing this nut with a wrench, it is backed off on the radius rod and carries the axle with it, since it pushes against the lug of the bearing box. This tightens the chain. The emergency brake is of the expanding ring type, the ring forming part of the bearing box and being cast of the aluminium-bronze alloy before mentioned.

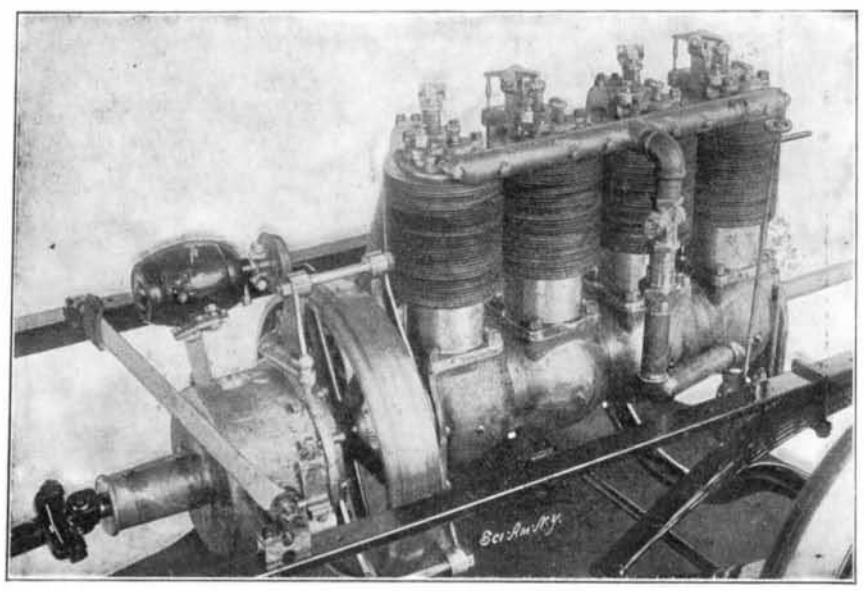


ARRANGEMENT OF SLOTTED TUBES ON REGAS CYLINDER.

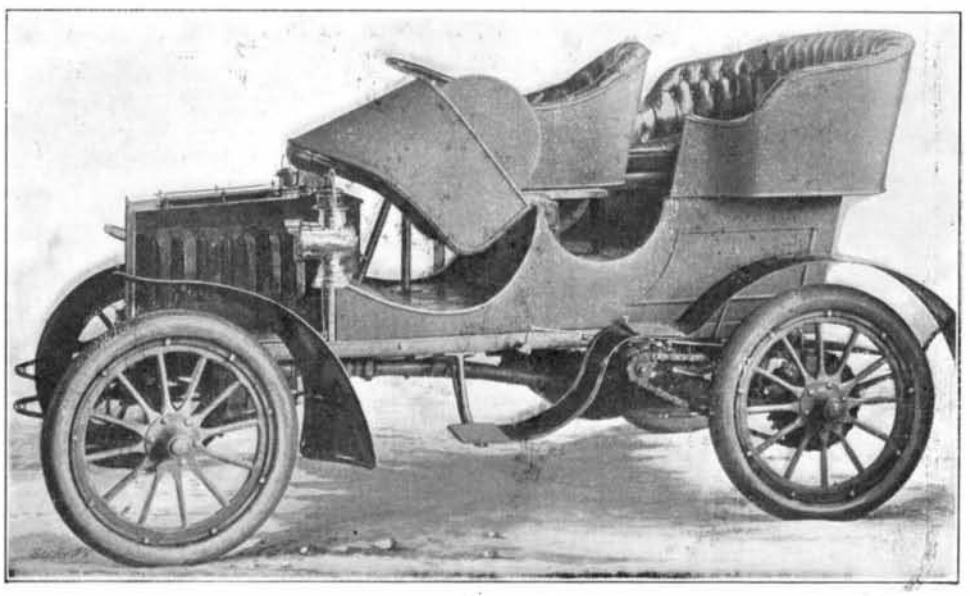
The other features of the Knox chassis can be seen almost at a glance, so simple in arrangement is the whole structure. The two cylinders are bolted to the cast-iron crank case, and are supported by four large cap screws that pass through holes in the cross members of the frame, and screw into lugs projecting from the cylinders. The heavy, 2-inch crank shaft, mounted in long bearings in the crank case, carries a flywheel on one end and the planetary transmission gear on the other. The three band brakes of the latter are, from the frame toward the motor, (1) the reverse drum brake, (2) the brake drum one, and (3) the low speed brake. The first two are operated by pedals, and the third by the handle projecting backward near the top of the steering post. The smaller handle, that projects outward, advances or retards the spark and at the same time opens or closes the throttle. The high-speed clutch consists of a ring of round hardwood blocks placed between two metal surfaces within the transmission, and clamped thereto when the clutch is thrown in. This clutch of small wooden blocks has been adopted in place of the expanding ring clutch formerly used. It is readily adjusted, and the wear upon it is slight. It can be slipped a good deal without burning the blocks, and it is unaffected by centrifugal force. Being within the transmission, it is completely protected from dirt.

The half-speed cam shaft is driven by a worm and spiral gear. It passes through bearings fitted with grease cups, near each end; and on each end there is a pulley for the fan belt, which is kept taut by adjustable jockey pulleys. These and the fan pulleys also are fitted with small grease cups. The contact box, seen on the cam shaft near the left-hand cross-member of the frame, contains a cam-and-spring make-and-break device of large size. Platinum-iridium contact points are used, which wear but little with long use. Besides the quart oil cups on each cylinder, which lubricate the pistons and hollow wrist pins, the motor has large grease cups on the flywheel end of the crank shaft (for the crank shaft and crank pin bearing on that end) and on the inner crank side member (for the other crank shaft and crank pin bearings and the transmission). The transmission is also oiled by squirting oil through small holes in the drum.

The regular Knox float-feed atomizer is used. It draws its air through small holes in the perforated



24-HORSEPOWER FRANKLIN AIR-COOLED MOTOR, SHOWING IGNITION DYNAMO AND TRANSMISSION GEAR.



REGAS 12-HORSEPOWER CAR WITH SIDE ENTRANCE TONNEAU AND 4½ x 5 TWO-CYLINDER AIR-COOLED MOTOR.

pipe, that is placed beside the front cylinder, and feeds through the other branched pipe to the inlet valves of the motor. The exhaust of the motor is carried into the long muffler pipe *M*, which has perforations in each end.

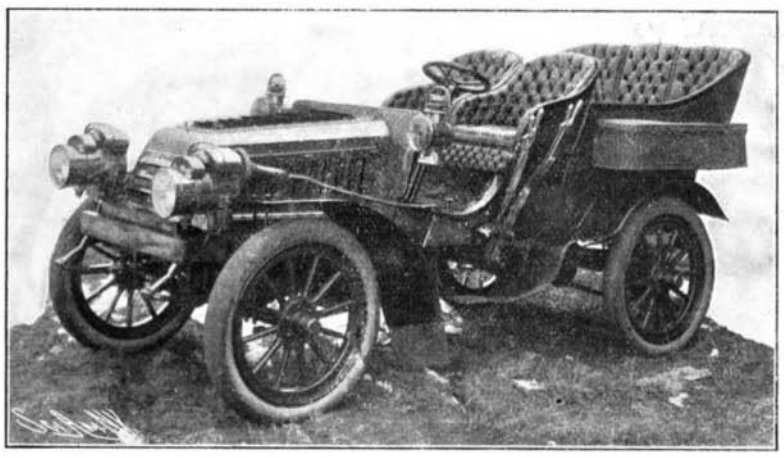
The tonneau model we illustrate is fitted with a substantial top having a glass front and side curtains. The glass front is similar to those used on the best European cars, and the driver, without leaving his seat, can unfasten it at the bottom by turning two thumb screws, raise it, and secure it against the canopy top. The car is well finished throughout, and that it does not belie its appearance is shown by the fact that two machines of this type, besides one of the single-cylinder cars, completed the most trying endurance run to Pittsburg last October.

### THE REGAS AIR-COOLED AUTOMOBILE.

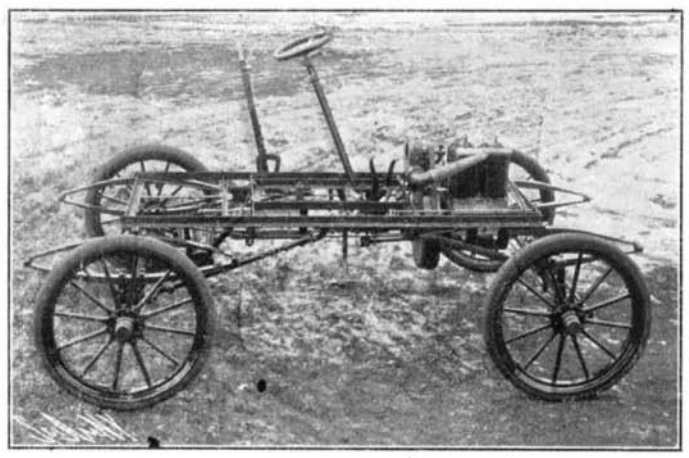
The air-cooled motor on the Regas cars is of distinctly novel design, as will be seen from the illustration. It is a two-cylinder motor with the cylinders set at an angle of about 45 degrees, an arrangement which is said to greatly reduce vibration and, in this instance, to allow of a better air circulation around the cylinders. The method of cooling the cylinder is new. It consists of clamping against it, by means of an outer sheet steel jacket, 172 slotted copper tubes, ½ inch x 1½ inches long. These tubes, it is claimed, not only have a large radiating surface, but they also act on the principle of the Bunsen burner, *i. e.*, the hot air passing out the end of the tubes draws in cold air through the slots. Thus radiation and air circulation are set up without mechanical means.

The light tonneau car with side entrance has a 4½ x 5, two-cylinder, V-motor, for which 12 horse power is claimed at a speed of 1,200 revolutions per minute. Each cylinder is oiled by a sight-feed oiler on dash, to which oil is supplied by the exhaust pressure. Splash lubrication is employed inside the crank case. The inlet valves are automatic and easily removable, and the exhaust valves, also, can be easily taken out. A four-cylinder 5 x 5 motor is also made for a large touring car.

The side-entrance tonneau is a novelty here, though it is much in vogue abroad. It offers all the advantages of the usual tonneau without the disadvantage of having to dismount in the muddy road instead of on the sidewalk.



THE MITCHELL AIR-COOLED FOUR-CYLINDER TONNEAU.



CHASSIS OF RUNABOUT, SHOWING BLOWER FOR COOLING MOTOR.

### THE NEW FRANKLIN TONNEAU.

When the H. H. Franklin Manufacturing Company, of Syracuse, N. Y., brought out a runabout with a four-cylinder air-cooled motor about a year and a half ago, the automobile world was skeptical as to whether four 3¼ x 3¼ flanged cylinders arranged close together could be made to operate successfully. The endurance runs of the last two years—the New York-Pittsburg run especially—have nevertheless brought out the fact that an air-cooled motor of this sort can compete with motors of the water-cooled type, even under the most adverse conditions. That the Franklin Company's product is speedy as well as reliable has been shown on many of the race tracks of the country throughout the past season.

As the original Franklin car was anything but a failure, it is to be presumed the new 24-horsepower touring car, in which a four-cylinder, 4 x 5 motor with copper radiating flanges is used, has been thoroughly tested and proved successful by the company before putting it on the market. We understand a road test of 11,000 miles has been made, and this is of course good evidence that the motor works. On the new car the cylinders are arranged longitudinally on the frame, instead of transversely, as heretofore, and a fan is employed to aid in cooling them. The achievement of developing the air-cooled motor of the flanged type, which had been pronounced a failure by the French, and of bringing it to such a degree of perfection as to enable the use of as large a cylinder as is at present employed, should be credited to the Franklin Company. That others, realizing the advantages of air-cooled motors, are rapidly following this company's lead, is shown by the fact that over a half-dozen new firms are already in the field with air-cooled cars, some of which have distinctly novel methods of cooling.

The new touring car is a roomy "King of the Belgians" tonneau on precisely the same lines as the lighter runabout and tonneau which we have illustrated heretofore, with the exception noted above as to the arrangement of the motor. The planetary gear transmission is arranged in an oil-tight case attached to the crank case of the motor. It gives a speed reduction between the motor and the 32-inch wheels of 3½ to 1 on the high speed, 10 to 1 on the low speed, and 20 to 1 on the reverse. A universally-jointed shaft and bevel gear drive transmits power to the rear axle. The engine is fitted with hand control on the steering column by means of spark and throttle, and the car can be run from 4 to 40 miles on the high gear. Its weight complete is 2,000 pounds. It is fitted with roller bearings, and 4-inch detachable tires. Its tread is standard, and the wheel base is 96 inches. Fuel sufficient for a 150-mile run is contained in a 14-gallon tank.

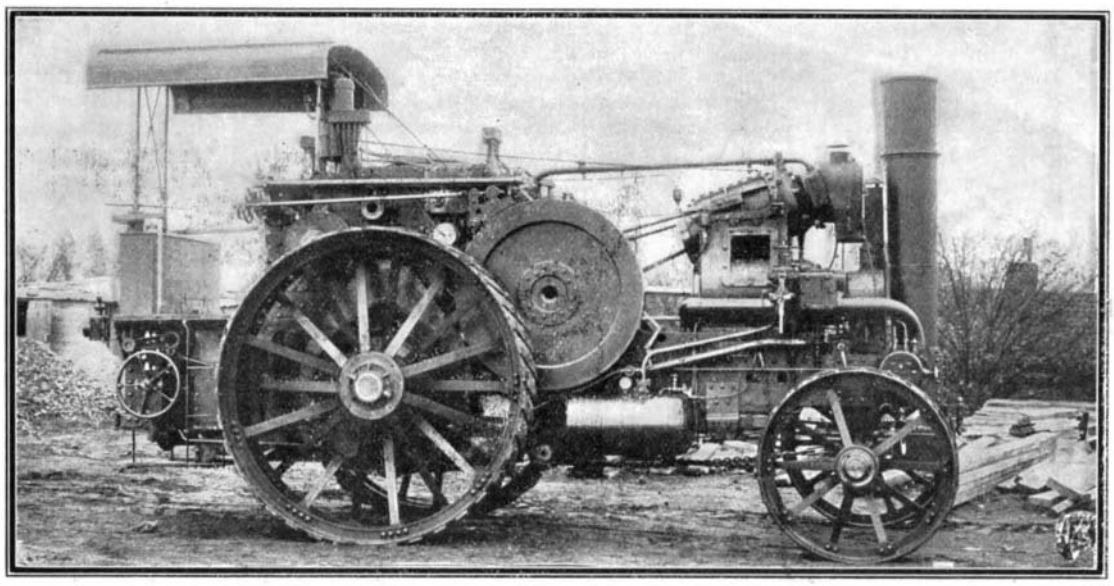
### THE MITCHELL AIR-COOLED CARS.

Another firm to bring out a touring car with an air-cooled motor is the Mitchell Motor Car Company. Our illustrations show the chassis of this company's two-cylinder runabout, and the new four-cylinder tonneau car. The runabout model has been tested thoroughly the past season, and is said to have given satisfaction. The system of air-cooling employed consists in directing the draft from a rotary blower upon the cylinder heads of the motor. The blower is driven by a belt from the flywheel, which is large and heavy considering the size of the motor. The bore and stroke are 3½ x 4 inches, and the motor is rated as giving 7 brake horse power at 1,200 revolutions per minute. The cylinders are fitted with plain copper radiating flanges and are mounted on an aluminium crank case. The motor and transmission are oiled from a row of sight-feed oilers on the dash, to which the oil is forced from the oil tank by the pressure of the exhaust gases when the motor is running. As soon as it stops, the oil ceases to flow. Jump spark ignition by means of dry batteries is employed. An improved contact maker is used, and it is so placed that it is impossible for the points to become fouled with oil or dirt. The muffler has a cut-out, so that the explosions can be heard when desired.

The transmission gear is of the sliding type, giving three speeds ahead and reverse. There is the usual cone clutch in the flywheel, and the shaft connecting it with the transmission has a universal joint, according to the latest practice. The runabout has chain drive to the rear axle, and the tonneau to each rear wheel. The bodies are easily removable from the channel steel frames. The tonneau weighs 2,400 pounds and is a particularly roomy car.

### THE PRIZE-WINNING MILITARY TRACTOR OF THE BRITISH WAR OFFICE.

The premier prize of £1,000 which was offered by the War Office some months ago for a traction engine suitable for military purposes, has been awarded to Messrs. Hornsby & Sons, Limited, of Grantham. The conditions were that the engine should be capable of hauling a gross load of twenty-five tons over a distance of 40 miles at an average speed of 3 miles an hour over ordinary roads and hills, without taking fuel or water on board. The weight of the engine, fuel, and water was not to exceed thirteen tons, and the engine must also be able to travel in case of necessity at a maximum speed of 8 miles an hour. The conditions of weight and space were so difficult that ordinary steam engines were practically debarred from competing, being unable to travel further than 10 or 12 miles without taking a fresh supply of fuel and water. Hornsby & Sons, in fact, was the only firm that was able to build an engine calculated to fulfill the conditions. It was propelled with an oil engine of the Hornsby-Akroyd type, constructed on the lines of an ordinary traction engine, spring mounted at both ends, and fitted with the usual speed-change gears. In the course of the trials at Aldershot the engine fulfilled every requirement, and not only carried off the first prize of £1,000, but also gained bonuses amounting to £180 in consequence of being able to travel a distance of fifty-eight miles without a stop for fuel and water, £10 per mile being offered for every mile thus covered beyond the forty miles stipulated.



THE PRIZE-WINNING MILITARY TRACTOR OF THE BRITISH WAR OFFICE.

### Formetal—A New Metal Possessing Great Resistance to Rupture.

The automobile industry, always up-to-date with novelties, is beginning to employ, for the construction of parts which must be able to resist great pulling or twisting strains, a bronze unalterable by the air or even weak acids, and which has been given the name "Formetal."

Its inventor is M. Henri Nouri, engineer E. C. P., late vice-president of the Committee of Copper Founders. The alloy contains, besides the normal elements of bronzes and brasses, other metals of high mechanical resistance, which constitute with the first a veritable chemical combination. It can be cast perfectly, rolled, and drawn in bars of any outline desired.

The tests of resistance which were made on bars of this metal at the Conservatory of Arts and Trades and under the supervision of the French Navy Department, have given the following results, which are remarkable for pieces of cast bronze: Resistance to breakage: 43 kilogrammes per square millimeter; or, 6.12 pounds per square inch. Elastic limit: 27 to 28 kilogrammes per square millimeter; or 3.84 to 3.98 pounds per square inch. Lenthening: 40 per cent.

The metal, drawn in bars or rolled and forged, resisted rupture under pressures up to 60 kilogrammes per square millimeter (8.53 pounds per square inch) with a lengthening of from 24 to 25 per cent.

This metal can be worked with ease in a lathe. It is suitable for the manufacture of unoxidizable nuts and screws, part of the electrical equipment, very strong supporting brackets for carbureters, and parts of the change speed gear.