Cars of this type have frequently been experimented with abroad, but this is one of the few instances in which they have been developed in this country.

The advocates of the two-cycle engine are represented by a new touring car with three cylinders, for which they claim to secure the same horse-power as can be developed with six cylinders of the same diameter and stroke. It goes without saying that structurally the two-cycle is a far simpler engine than the four-cycle, and theoretically it should, on the same cylinder capacity, give double the power. Hitherto, however, the difficulty of getting rid of the exhaust before the introduction of the fresh charge, has rendered it impossible to bring the brake horse-power up to the theoretical horse-power. It is claimed that in the engine above referred to, and in some other new designs of the two-cycle type, this problem has been satisfactorily solved. As against this and other losses, there is a distinct gain in respect of the heat losses through radiation, which must necessarily be less because of the reduction of cylinder surface. There is also an obvious gain in reduction of parts and wearing surfaces, to say nothing of the weight. A commendable two-cycle engine was exhibited at the recent Grand Central Palace Show as applied to motor trucks. In this engine the charge is directed up through the center of the piston, being admitted to the latter through a port in the cylinder walls.

A simplification and decided improvement in valve mechanism is obtained by the use of walking-beams operating pairs of valves set in the cylinder heads, the valves of each pair being on opposite sides of the center line of the engine. This permits of the operation of the valves, say of a four-cylinder engine, with four instead of eight cams and rods, the whole being operated from a single camshaft.

Low tension ignition is not widely used. Indeed, it has not had the vogue which was predicted for it at the time of the exposition one year ago. The prevailing practice is to use the high tension jump-spark with the magneto; although some makers prefer to use two separate systems, with separate plugs for the battery and coils and for the magneto.

SOME EARLY AMERICAN AUTOMOBILES.

STEAM MACHINES.

One afternoon in the late autumn of 1855 three men whose names add luster to the history of the mechanic arts were discussing the feasibility of building an automobile wagon. Each agreed that such a vehicle was practicable, and each asserted that if put to it he would produce a self-propelling carriage that would meet every needed requirement. The discussion resulted in an odd wager, which was that all three should build a self-moving wagon, and to the one whose effort was most successful the award should be made.

The trio which entered into this strange compact was composed of the late Richard Dudgeon, famous as the inventor of the hydraulic jack; William Fletcher, the best-known builder of steamboat engines in his day; and another great inventor to whom the world owes much, "Boss" Hudson, of the Rogers Locomotive Works. Each set to work at the task with enthusiasm, not for the possible profits that success might have yielded, but much after the manner of three boys doing "stunts," each zealous to outdo his companions in friendly rivalry.

Before long the three wagons were completed, and queer enough they must have looked in those days, when even the locomotive was in many parts of the country a curiosity. It would be to no purpose to describe the machines of Fletcher and Hudson, since they were both failures, holding however within themselves, no doubt, great latent possibilities, had the spirit of the times encouraged further efforts. But the Dudgeon machine was perfect in every point. Of course, it was not the finished, graceful, triumphant vehicle that to-day glides by with scarcely a whirr to tell of its passing; but then the automobile of the present is the fruition of years of endeavor, whereas the Dudgeon machine was but the hasty effort of an inventor—with limited tools and devices to fashion the necessary parts—to give concrete expression to his theory of how such a vehicle should be constructed.

This machine, it is claimed, traveled forty miles an hour, and it is said to have been under perfect control when "rushing" over the roads at the rate of thirty-five. When we recall that only a few years back the sight of an automobile caused the average citizen to stand in his tracks and note it with open-eyed wonderment, it is not difficult to imagine the impression made upon the populace of Manhattan Island by this strange device, that swept through Broadway and startled both man and beast.

Unfortunately, this original wagon was destroyed in the memorable fire that caused the destruction of the Crystal Palace, for it was there on exhibition; and to old New Yorkers, at least, it need scarce be said that it was not the least inspected of the many wondrous things gathered under the roof of that historic edifice. But the inventor was not dismayed by its loss; for the embers of the machine had scarce stopped smoldering when he was at work upon a second wagon—the one here illustrated. This machine was completed in 1860, and soon became a familiar sight as it puffed and snorted through the upper section of Manhattan Island, through which the owner and inventor was wont to "exercise" it.

It is an exact duplicate of its prototype, which was given birth under such strange conditions, and is to-day just as it was when turned out of the shop, save that fifteen years ago its rust-caked boiler was replaced by a new one. This wagon, it should be added, was a product of the days when mechanical appliances in the machine shop, the carriage builder's, or the wheel-wright's were few in number, so that it was practically made by hand.

The solid cedar wheels, it will be observed, are in a remarkable state of preservation, the tires not having expanded perceptibly since they were shrunk on forty-five years ago.

It will be interesting to engineers and mechanics to learn that it was while at work on this wagon that its inventor conceived the idea of the roller-tube expander, which, together with his hydraulic jack, have made the name of Richard Dudgeon secure in an honored place in the history of this country's inventors. A brief description of his automobile is appended.

The engine, which develops 8 to 10 horse-power, was built in accordance with the locomotive design common during the period of its construction. The boiler is of the ordinary locomotive type. The cylinders, two in number and located one on each side of the forward end of the boiler, are of 4½-inch bore, with ordinary slide valves. The cut-off of the latter is adjusted by a shifting link. The stroke is 18 inches, and the crossheads slide on two rods extending from each cylinder, which is set at an angle with the horizontal. The cranks are directly on the rear axle, which likewise carries the valve eccentrics, and the connecting rods thus extend from the crossheads to the rear axle.

The machine is guided from the driver's seat, located at the rear end of the machine, by means of a steering wheel like that of the automobile of to-day. The steering is done by turning the front axle through the usual intermediate gearing. The throttle for governing the speed is of the common locomotive type.

Ten passengers can be carried on two longitudinal seats or benches, above and on each side of the boiler, as appears from the accompanying illustration. Under each bench is a long metal water tank to supply the boiler. The fuel (coal) is carried in a sort of cab at the rear of the machine, in which also the driver's seat is placed. The smokestack, like that of the ordinary locomotive, is located at the forward end of the boiler. The firebox is of the ordinary design, and is located at the rear. The whole machine is carried by leaf springs.

Another steam machine that was planned a decade later than the first Dudgeon car, and that was eventually constructed and run over the roads in and around Bridgeport, Conn., in 1866, was that of the House brothers (James A. and Henry A.)—inventors who were at that time actively engaged with the firm of Wheeler & Wilson in perfecting the sewing machine. The House steamer, as can be seen from the drawing, was in several respects like the modern automobile. It had, for example, a double side chain drive from a countershaft to the rear wheels, the engine was placed under the seat, and the steering was accomplished by a wheel at first, though a lever was afterward resorted to on account of its quicker action and greater sensitiveness. The entire front axle was swung on a fifth wheel by means of a chain that ran from one end of the axle back around horizontal sprockets on the reaches and then forward to the other end of the front axle. One of these sprockets was on the lower end of the vertical steering column, which was provided near the bottom with a double sliding universal joint and turned by a vertical wheel on top connected with it through a worm gear. After running through fences several times owing to their wheel steering device not being quick enough, the inventors placed a lever directly on the vertical shaft, and afterward experienced no more trouble. The machine steered very easily, as most of the weight was on the rear wheels and when it was running the front wheels rested lightly on the ground.

The boiler used on the House machine was of the regular fire-engine fire-tube type, but it was noteworthy as being the first steel shell boiler to be constructed in the vicinity of New York. The boiler was built in Bridgeport, Ct. It was tested hydraulically to 300 pounds pressure, and ordinarily carried this pressure when used on the machine. The gage on the footboard indicated only half this amount, however, as people at that time were afraid to ride alongside of a boiler carrying 300 pounds of steam. A pop safety valve was fitted, but this used to scare so many horses that it was taken off and the regular spring-and-lever, locomotive type (which could be held down when a horse came in sight) was substituted. The boiler was fired with a mixture of cannel coal and charcoal from a seat placed transversely behind it for the fireman. On each side of the boiler was an upholstered seat capable of accommodating two persons. Besides the driver and fireman, five passengers could therefore be carried. The fuel was placed in an inclined box built around the boiler, and the water in a tank forward and under the fuel.

The motive power consisted of a twin-cylinder, double-acting, slide-valve steam engine having a 4¼-inch bore by 6-inch stroke. The connecting rods worked on disk cranks and the engine was provided with the usual link valve gear. The throttle and reverse levers were brought up through the middle of the front seat. There were two chains from the engine shaft to the countershaft, either of which could be put in use by means of jaw clutches on the latter. With one of these a speed reduction of 3 to 1 was had from the crankshaft to the countershaft, while with the other, or high speed, a similar increase was obtained. In order to allow for the differential movement of the wheels in turning corners, the brothers drove the sprockets on the countershaft through a double-acting ratchet and pawl, which answered for both forward and backward motion. When in the backing position the engine could be used as a brake. The machine had no brakes, the reverse being used for this purpose and enabling a very quick stop to be made. To reverse the car, all that was necessary to do was to kick the ratchet reverse lever on the footboard to one side, set the links of the engine with the reverse lever beside the seat, and open the throttle.

There were two water gages placed beside the boiler, one back of the front seat for the driver and one behind the boiler for the fireman. A variable-speed pump was driven from the engine by a slotted lever connected to the crosshead. The pump connecting rod was attached to a block in this slotted lever, which could be set at different distances from the fulcrum of the lever and thus made to vary the stroke of the pump. This device was worked by the fireman. The engine complete with water pump, etc., weighed but 110 pounds, and so perfectly was it balanced that Mr. Henry House states he could lift it off the ground while it was running at the rate of 1,500 R. P. M. It developed about 12 horse-power in the machine, but if supplied from a boiler of sufficient capacity it would have developed fully 50 horse-power. The 12-horse-power actually attained was sufficient to send the machine along an ordinary country road at over 30 miles an hour. The best performance the brothers made with it was 5 miles in 10 minutes. The weight of the machine complete, with water and fuel sufficient for a 10-mile run, was 1,800 pounds.

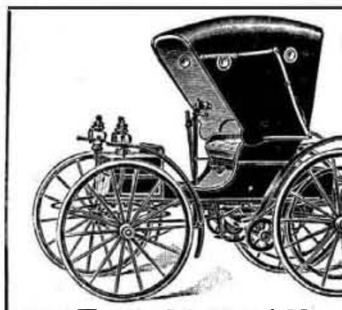
THE FIRST ELECTRIC AUTOMOBILE.

To Mr. Andrew L. Riker belongs the credit of having devised and run the first electric automobile in America. When abroad in 1886, he brought home from England a Coventry tricycle, to which, the following year, he applied a 1/6-horse-power battery motor of his own make in the manner shown on our front-page illustration, and thus produced a motor-driven tricycle capable of a speed of 8 miles an hour on good roads. The 8-volt motor drove the large wheel of the tricycle by means of a grooved pulley that fitted the solid rubber tire. The motor was mounted on a long arm, which, as the motor tended to climb the wheel, drew it tighter against the latter and thus increased the friction. The four cells of storage battery were carried in a box mounted on the frame of the tricycle. Their capacity was sufficient to run the machine for four hours, so that a 25-mile ride could easily be taken on level roads. From this first simple machine, within a decade, Mr. Riker advanced to the manufacture of the first successful electric automobile built in this country. Afterward he turned his attention to gasoline cars, with which he has also been very successful, one of the racing cars of his design having won third place in the Vanderbilt cup race of 1905.

EARLY GASOLINE CARS.

One of the photographs reproduced on our front page shows Mr. Charles E. Duryea's second gasoline automobile, which was constructed in 1893. This was one of the first crude attempts at converting an ordinary horse-drawn phaeton into a motor vehicle. The engine was placed horizontally beneath the center of the vehicle at the rear. It was a single-cylinder engine, with the crankshaft placed vertically and with the flywheel located, as shown, on the under side. The original arrangement used was a friction drive, the face of the flywheel being used as the driving surface. Parallel to the lower face of the flywheel was a drum on a countershaft. Between this drum and the flywheel was fed a loose belt, the speed of which, and consequently of the drum, was determined by the distance out from the center of the flywheel. The flywheel was hollowed out a little at the center, to re-

(Continued on page 50.)



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WINTER USE. It is during that season of the year when the temperature is below freezing and there may be considerable snow on the ground, that the practical utility of an automobile is put to the test. If the machine cannot readily do that work it is not a complete success, and is not equal to the exacting service of a practicing physician. The automobile that is suited for that service necessarily must be entirely satisfactory the balance of the year.

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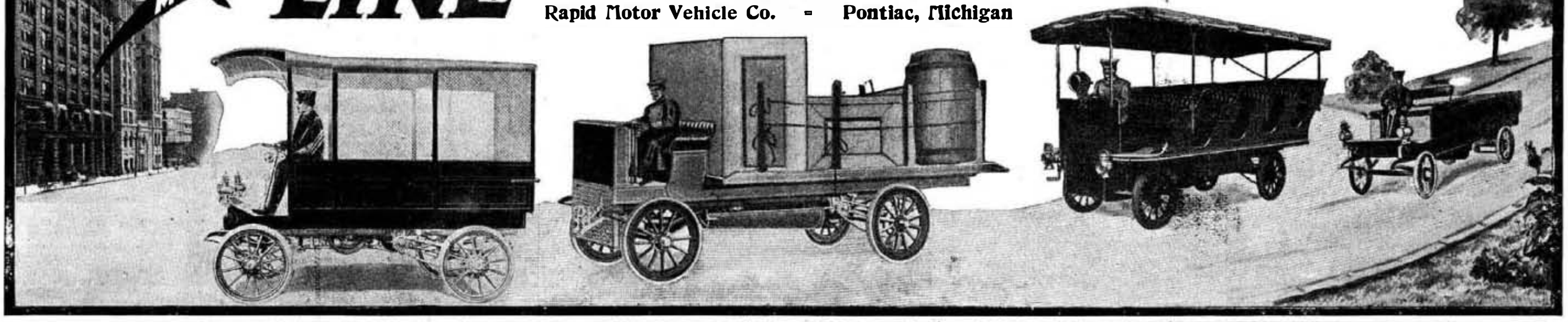


placed over the inlet valves is used with the magneto. The clutch is of the internal expanding type, consisting of a leather-lined steel band expanded by a single spring in the flywheel. The transmission is of the four-speed selective type. By meshing the reverse gears on the clash gear system it has been found possible to shorten the gear case and gear shaft several inches, thereby increasing their strength. The shafts are mounted on annular ball bearings lubricated from without, and thoroughly protected from the oil used in the gear box. Both the motor and transmission are mounted upon a three-point suspension, and are connected by a short shaft fitted with two universal joints.

The car is fitted with 34-inch wheels having 4-inch tires on the front and 4½-inch on the rear. The wheel base is 114 inches. Internal and external brakes are used on the rear wheels. The fenders are of the new type, being brought down on the inside to the side bars of the frame, and thus thoroughly protecting the occupants of the car from being splashed by mud or water. Several types of body, both open and closed, are used on the standard chassis.

SOME EARLY AMERICAN AUTOMOBILES.

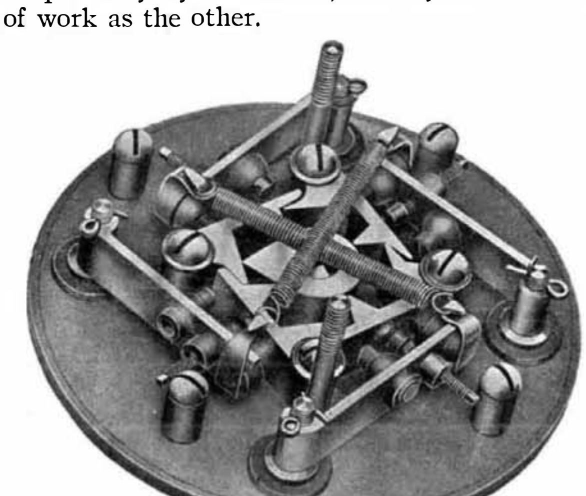
(*Continued from page 23.*)

lieve the belt and avoid twisting. The drum inclosed a differential gear, and there were driving sprockets on each end of the countershaft. The engine was fitted with make-and-break ignition from dry batteries. The gasoline was allowed to run from a high reservoir to one placed at a lower level. The carbureter, or mixer, was placed between the two, and by an overflow arrangement a constant level was maintained, the excess of gasoline falling into the bottom tank, whence it was raised once more to the upper tank by a small hand pump. Although most of the running of the machine shown in the photograph was done with a friction drive, Mr. Duryea was constantly trying to improve on this, the result being that he fitted a three-speed individual-clutch transmission, which is the arrangement shown in the photograph. The countershaft directly under the flywheel was driven by bevel gears, and carried three separate gears with individual clutches. These gears were constantly in mesh with three other gears on the driving countershaft, which terminated in sprockets, as shown. By picking up the three clutches in succession, he was able to pass from the slow to the fast speed. Vertical movement of the tiller steering lever accomplished this. The machine was in use for several years, and made fairly good speeds (ten or twelve miles an hour), although the inventor at that time did not attempt to go much faster than a horse would trot. The very first Duryea, built in 1891, was constructed along the same lines. Like the machine shown, it was quite a light rig, weighing between 600 and 700 pounds, and it was propelled by a friction drive. It was under-powered, and would only run under extremely favorable circumstances.

The original Haynes gasoline car shown on our front page was built along the lines upon which many of the early designers worked, and which comprised the placing of the engine and transmission upon the running gear and mounting the body on the springs independently. Mr. Haynes built his running gear of steel tubing and mounted it upon wire wheels provided with pneumatic tires which were made specially at a nearby rubber factory. The body was placed upon a pair of side-bar springs. The original engine was of the single-cylinder two-cycle type. It was mounted at the rear of the frame, and drove a countershaft through chains and individual clutches giving two forward speeds. A double chain drive was provided from the countershaft to the rear wheels, as can be seen from the photograph. The machine traveled successfully over the country roads in the vicinity of Kokomo, Ind., at a speed of about 10 miles an hour. Subsequently, Mr. Haynes replaced the two-cycle engine with one of the four-cycle type; but it is nevertheless noteworthy that in striving for simplicity he adopted a two-cycle engine in the beginning, while many people believe to-day that this type of engine will eventually be largely used on automobiles. Another point in which Mr. Haynes was in advance of other American experimenters was the use of pneumatic tires. That he has kept in advance in design and workmanship is evidenced by the novel features of his cars (see page 28) and also by the fact that one of these stock chassis, fitted with a 50-horse-power motor, made an exceptionally fine showing in the Vanderbilt cup race last October. This car, which was exhibited at the automobile show, has been duplicated in touring car form

Climax Electrical Timer

Every Automobile manufacturer who is interested in making his cars perfect in their electrical equipment will obviate the usual trouble caused by failure to get a strong spark at the proper time and at the right point, by having the **CLIMAX ELECTRICAL COMMUTATOR** installed in every machine he turns out. Whether there are two, four or six cylinders, this system insures a strong spark at the point desired. Each cylinder gets its spark at the proper moment, and as the sparks are perfectly synchronized, each cylinder does the same amount of work as the other.



This system insures perfect working to every car and consequent satisfaction to the buyer. It makes unnecessary the use of the old type of spark coil with vibrators which stick and constantly need re-adjustment.

The Climax System explodes the charge, no matter how rich or lean it may be. Causes every cylinder to explode at the exact point, saving breaking of crankshaft and uneven running of Engine. Prevents unseating of valves.

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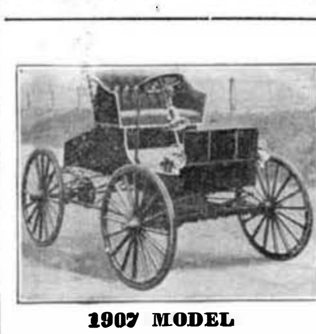

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as the Haynes Company's leading model for the present year.

The machine on our front page which most resembles the automobile of to-day is that constructed more than ten years ago by Mr. Ransom E. Olds, of Lansing, Mich. The picture is reproduced from the SCIENTIFIC AMERICAN of November 21, 1896. Like almost all of the first machines, as above stated, Mr. Olds's early car had the engine and transmission mounted upon the running gear, while the body was supported on three full elliptic springs. The engine used was a single-cylinder one of 5 horse-power placed horizontally on the running gear, and arranged to drive a countershaft through three separate speed changes giving 4, 8, and 12 miles an hour normally, while by speeding up the engine, the car could be driven as high as 18 miles an hour. A single chain from the countershaft drove the rear axle, there being a considerable reduction, as can be seen. The rear axle was provided with a differential. Wood wheels provided with 1½-inch solid cushion tires were used on this car, the wheels being provided with ball bearings. A tiller steering device turned both front wheels on a simple design of steering knuckle. In our former description a great point is made of the fact that the fuel supply is located below the engine, and has no connection with the body. This was done in order to obviate any chance of explosion.

While the machine in question was one of Mr. Olds's first gasoline cars, it was by no means his first machine, as several years before he produced a three-wheeled steam automobile which had a huge boiler behind fired by liquid fuel. After turning his attention to the gasoline engine, however, as can be seen from the illustration, Mr. Olds produced a very creditable machine for that day, and he has since held his own in an industry that has become vast and in which improvements have been made more rapidly, perhaps, than in any other field.

THE CADILLAC 20-HORSE-POWER FOUR-CYLINDER ENGINE AND GOVERNOR.

(*Continued from page 24.*)

around a central vertical or inclined shaft, *A*, driven by gears from the camshaft and running upon ball bearings. Pivoted on a pin passing through this shaft, and held in the tilted position shown by the spiral spring, *C*, is the ring, *B*. As the revolutions of the shaft, *A*, and ring, *B*, increase, centrifugal force tends to make the ring assume the horizontal position shown by the dotted lines, and as it does so, it pushes upward on the link, *D*, and raises the collar, *E*. A shifting fork on this collar, as it is raised and lowered, rotates a shaft, *K*, and consequently moves back and forth the lever, *F*, which is connected by rod, *G*, to the throttle. In this manner the throttle valve is closed. By varying the tension on the spring, *C*, which the driver can do through the connections, *H J*, and their shifting fork, *M*, and collar, *L*, the governor can be set so that it will not close the throttle beyond a desired point. The placing of the commutator above the governor makes it very accessible. This type of governor is an exclusive feature of the Cadillac 4-cylinder cars.

ENGINE OF THE CAR DE LUXE.

(*Continued from page 24.*)

the ordinary force-feed oiler for lubricating the engine, there is a special plunger pump on the footboard, by which oil can be pumped into the crankcase. Should the oil overflow above the proper level, it runs into a special reservoir attached to the bottom of the crankcase. Should the latter overflow, the oil will run upon the ground. The crankpins are all hollow, and they are thoroughly lubricated by means of eccentric oil rings placed upon the crankshaft. The water pump is of the centrifugal type, and is made up of a bronze wheel that revolves in an aluminium casing. The radiator is of horizontal flat tubes indented, so as to allow for expansion in case of freezing. The water circulates back and forth from one side to the other, and from top to bottom through 20, 17, 15, 14, and finally 12 tubes, the idea being that as the water cools in descending from the top to the bottom of the radiator, it does not require so much room. Everything about this motor is of the finest, and it is undoubtedly one of the highest grade automobile engines constructed. The bore and stroke are 125 and 135 millimeters respectively, and the horse-power is 50 to 60. Besides the engine this car contains several other novel features, such as the rear axle, which is described on page 34.

THE AUTOCAR COMBINED ENGINE AND TRANSMISSION.

The engine and transmission shown on p. 24 is that of the type XIV Autocar tonneau, and it is noteworthy as being one of the few examples of the recent practice of combining engine and transmission in a single unit and giving this unit a three-point support. As can be readily seen, the transmission gear case and the crank case of the motor are bolted together, and the two cases are so shaped as to completely inclose the flywheel and clutch. The latter is of the three-ring metallic type, consisting of a bronze ring with cork or felt inserts that is clamped between two steel rings attached to the flywheel. As the bronze ring is rather light, it has but little momentum, and consequently both it and the gears come quickly to rest when the clutch is thrown out. This makes stripping of the gears improbable.

The motor shown is the four-cylinder, vertical, water-cooled one used on the tonneau. (The company also builds for its runabout a 12-horse-power double-opposed cylinder motor having the same arrangement.) The bore is 4¼ inches, stroke 4½, and the motor is said to develop 30 horse-power. The cylinders are cast separately with integral heads, water jackets, and exhaust valve chambers, and large mechanically-operated valves. The inlet valves are placed in the center of the cylinder heads, directly over the pistons, thus insuring complete filling of the cylinders at all speeds. All the valves are large and are mechanically operated from one camshaft, the lifts being provided with large rollers, which insure long life and little friction. The adjustment of the exhaust valve is by cap screws, which screw in the plunger and are held in the desired place by lock nuts. The inlet valve adjustment is by cap and lock nuts on top of the valve lift rod. The crankshaft is a weldless steel forging, oil tempered, with a large flange for bolting on the flywheel. This wheel can be easily removed and replaced with little trouble and no danger of becoming loose or running out of true. The crankshaft has three long split bearings which can be readily taken up should any wear occur. The crank case is made of aluminium alloy, of high tensile strength, and all the bearings are bolted to the upper half. The lower half can be removed without disturbing any other parts, and the crankshaft and pistons can be removed without removing the cylinders. The upper half of the crank case is provided with two large openings, through which all adjustments can be made without removing the bottom half. The camshaft and pump shaft gears are at the forward end of the crank case, where they are fully inclosed and run in oil. The centrifugal water pump is mounted on the crank case, and is directly driven from the camshaft by fiber gears. It circulates the water through a finned tubular radiator.

The timer also is mounted on the crank case and is driven by means of miter gears from the cam shaft. The ignition is of the high-tension type from current supplied by accumulators. Lubrication is effected by a force feed oiler, with an individual pump for each lead pipe. One pipe goes to each motor bearing and a separate pipe to the crank case to keep

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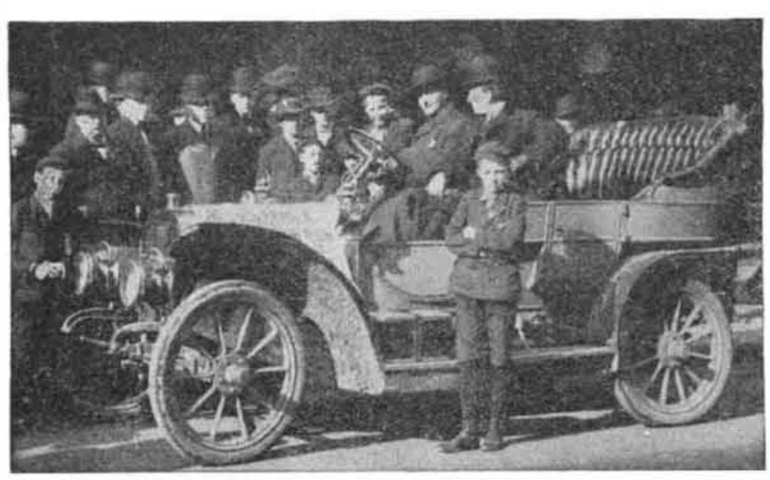

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Motor Endurance, again demonstrated on November 20 at Cleveland, when Model "A" completed a 100-hour non-stop run. A copy of sworn statements giving details of this run will be sent to those interested on request.

Touring Quality, demonstrated on the 350-mile non-stop run made by Model "A" from Detroit, Mich., to Cincinnati, O., in 14 hours and 12 minutes, actual running time. This run was made on the high gear. When Cincinnati was reached the car was driven to the top of Vine Street Hill, still on the high gear. The car which made this remarkable demonstration of touring and hill-climbing ability was taken fresh from the factory and represented the average run of stock cars.

Roadability, demonstrated by the 75-mile run from New York to Poughkeepsie over difficult hills and trying road conditions with the high speed lever sealed in. Also in the Santa Barbara, California, run, and the St. Catharines to Toronto, Canada, high-speed-lever-sealed-in run.

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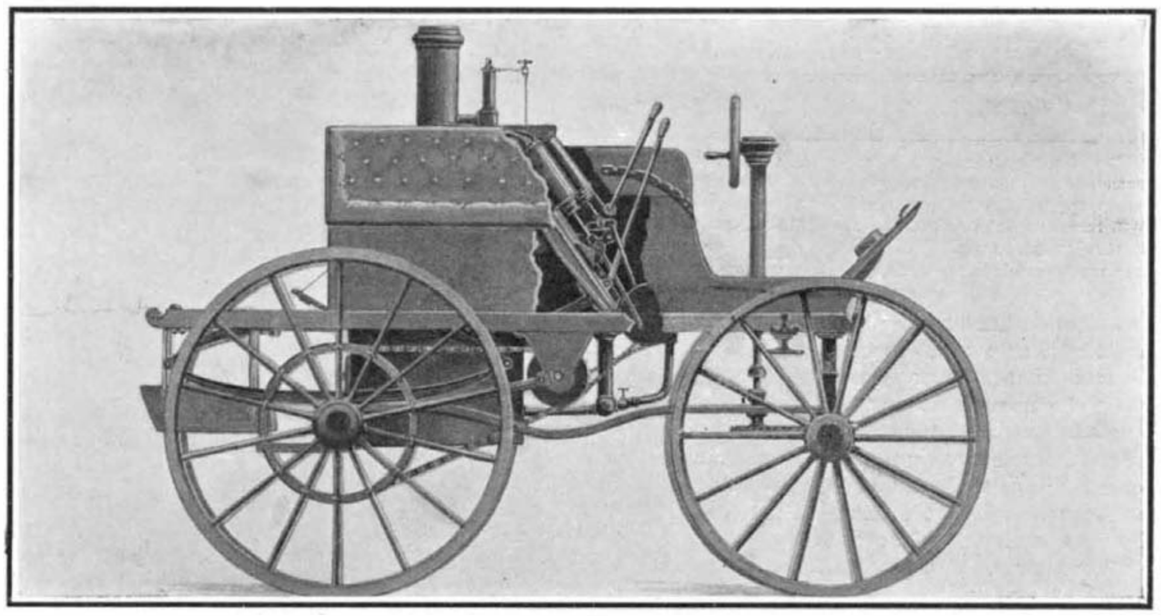
$3.00 A YEAR

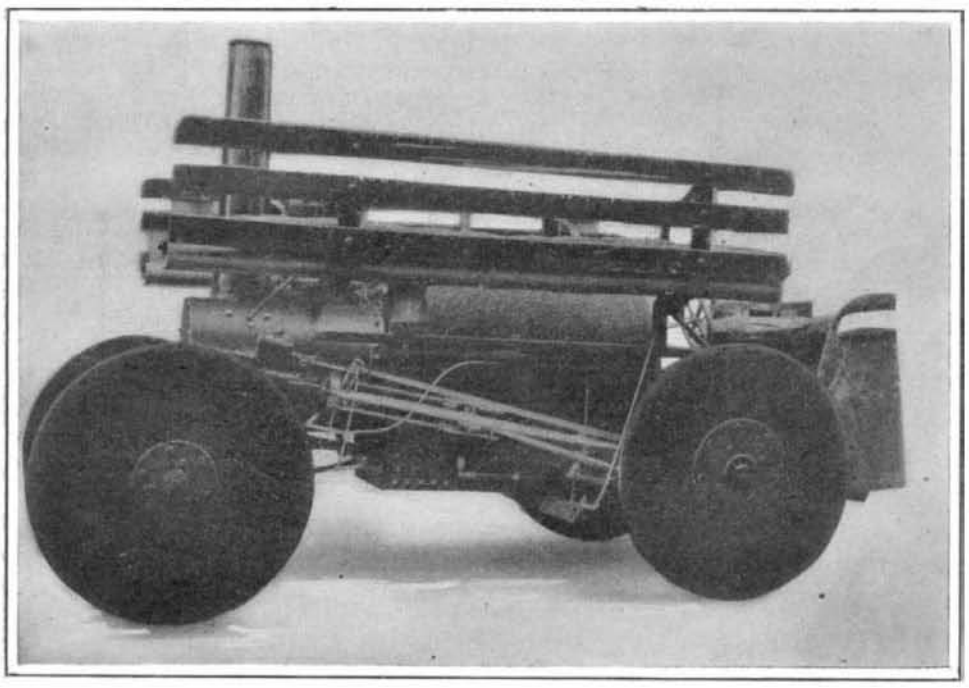
A. L. Riker's Electric Tricycle, Built Twenty Years Ago.

A small battery motor drove the large wheel by friction.



The House Brothers' Steam Wagon of Forty Years Ago.

This is the first machine built along the lines of the present-day automobile.

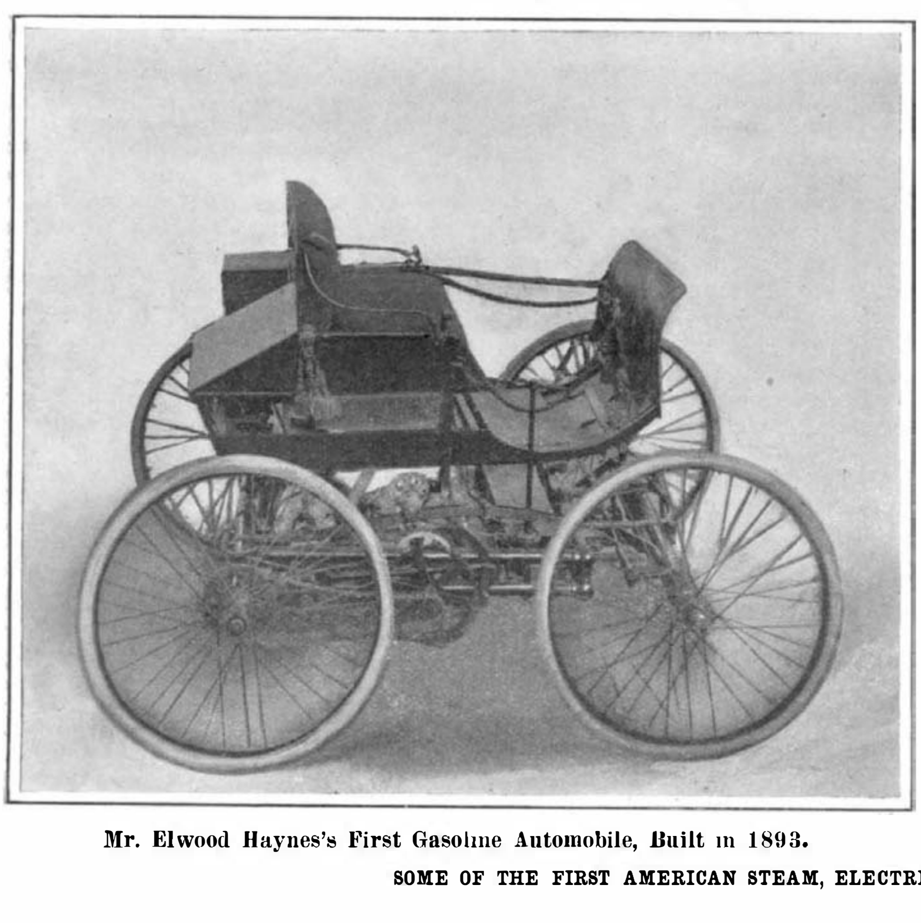


Richard Dudgeon's Steam Road Car, Built in 1860.

The original machine, of which this is a duplicate, was constructed in 1855.

Mr. R. E. Olds' First Gasoline Machine, Built in 1896.

The 5-horse-power motor and 3-speed transmission were arranged on the running gear.



Mr. Elwood Haynes's First Gasoline Automobile, Built in 1893.

One of Mr. Charles E. Duryea's Oldest Gasoline Machines, Built in 1893.

SOME OF THE FIRST AMERICAN STEAM, ELECTRIC, AND GASOLINE AUTOMOBILES.—[See page 23.]