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A MACHINE THAT EATS ITS WAY THROUGH THE HEAVIEST SNOWS—[See page 219]

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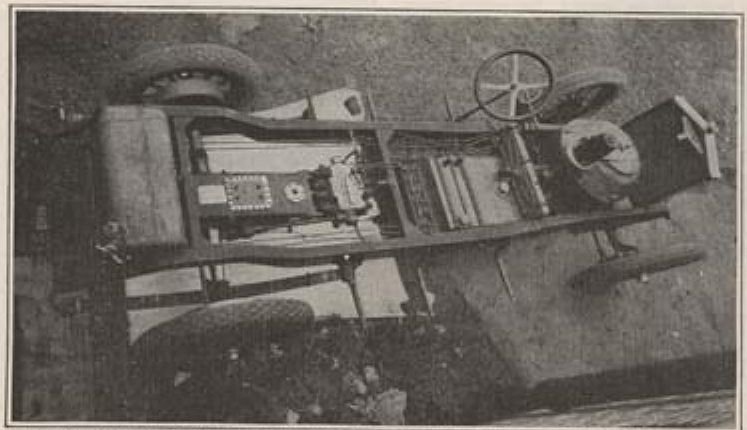


The arrangement of the power plant and auxiliaries, as seen looking down upon the chassis from above

The conical-frustum arrangement of the boiler tubes

Again the Steam Automobile

The Latest Effort to Produce a Steam Car with All the Advantages of Gas and of Steam

THE steam automobile, it seems, will not die. Everybody is using the gas car, but nobody seems quite satisfied with its performance, or quite ready to admit that it is the last word in automotive construction. Accordingly, we find ingenious people continually putting forward new versions of the ultimate car, propelled by steam; and the very wide vogue which this effort has attained forces us to ask on what grounds it is based.

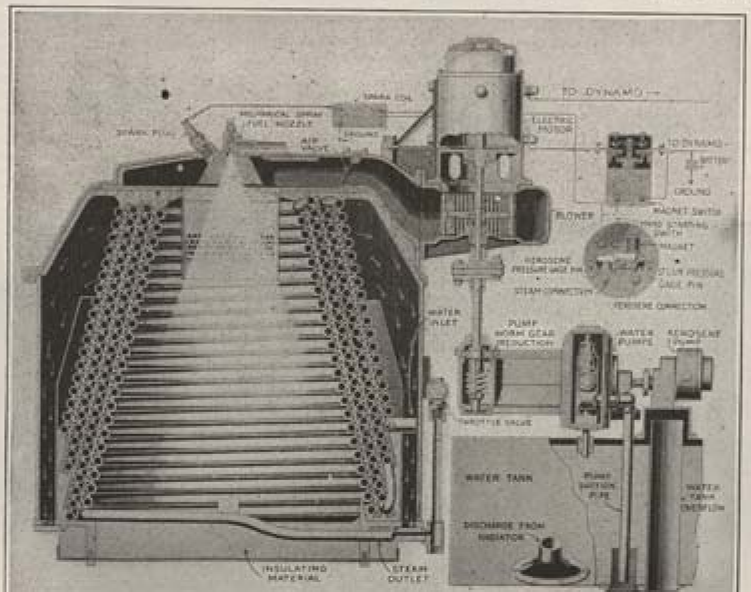
The advantages claimed for steam propulsion are many. Some of the chief ones may be recognized in the ability to burn *completely* a low-grade fuel; the rapid acceleration without gear shift or clutch manipulation; the simple control by throttle valve altogether; the greater quiet and freedom from vibration; the high torque at low speeds; the greater overload capacity; the small number of moving parts, and the slow motion of these which makes them more durable as well as simpler than their prototypes in the gas-driven car; the ability to reverse while going full speed ahead; the impossibility of killing the engine at some critical moment; the elimination of transmission, gearshift and clutch, of fly wheel and drive shaft, of universal joints, and above all else of the ignition system; the freedom from carbon and knocking; the emancipation from valve grinding; the absence of engine racing and smoky exhaust.

Against these, the drawbacks which have been noted in the steam automobile as worked out in the past may be summarized as time required to raise steam in a cold boiler; danger from fire and explosion; the labor and knowledge required in getting up steam, and the handling of dirty parts in this operation; the short life of the boiler and the attention required in blowing it off; the noise from the fire and the water pumps; the continual packing of joints; difficulty of maintaining an even, automatically controlled steam pressure and temperature; the use of two fuels, both under high pressure; the short water-mileage; the freezing problems in cold weather; the sooting of boiler coils, etc.

Messrs. L. L. Scott and E. C. Newcomb, of St. Louis, have been experimenting with steam systems for many years; and recently have undertaken the development of a steam plant for automotive use, with the intention that this plant shall preserve the advantages enumerated above and eliminate the disadvantages. They have had their system in successful operation in an automobile for over a year. They claim that they can raise steam from a stone-cold boiler in from 20 to 50 seconds, and that the only manual operation involved in this process is the turning of a switch. The fuel is not vaporized, but is burned in a cold state, and burned completely. At the present time kerosene is being used but heavier fuels are available if desired.

The inventors insist that they have a boiler which will not prime, is non-explosive, will not crust up or scale, and can be forced to the limit. It has had five years of automobile use. The car will run a mile on the stored steam after the fire is cut off. They say they have learned how to burn fuel without sooting the spark plugs or boiler coils and without concentrating the heat on any single coil or on the refractory lining. All of the complicated automatic control devices have been eliminated, the steam gage controlling wholly the temperature and pressure, and keeping these uniform. The water pumps have no stuffing boxes, and run noiselessly, submerged in oil.

The boiler is of the continuous flow type, consisting of a conical frustum of coils connected in series so as to form a continuous tube through which the water fed in and the steam discharged out must pass. These coils are arranged one within the other about a central combustion chamber. Circulation of water through this boiler is dependent upon the water pump. The velocity of the steam through the coils approximates 450 feet per second. This high velocity, with the use of deflocculated graphite in the kerosene for lubricating the engine, does away with scale and deposit. The boiler has 72 square feet of heating surface and can produce 500 pounds of steam per hour.



Schematic layout of the components of the latest steam-driven automobile

The kerosene fuel is ignited cold by an electric spark. The spark-plug circuit is cut off automatically after two seconds by a switch operated by the kerosene gage. No pressure is carried on the fuel tank. When the fire is on, the fuel is pumped by a small electric motor which also runs the water pump and the air blower. The fuel passes through a very fine atomizing nozzle and is discharged in a fine spray at 35 pounds pressure, directed downward from the top of the boiler into the combustion chamber. This nozzle holds back the fuel until proper spraying pressure is reached. The air from the blower, it will be noted, has nothing to do with fuel atomizing, which depends solely upon pressure and upon the shape of the nozzle.

The combustion chamber is quite long, and is com-

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a combination of these; the regular drift that could be attacked on the steam-shovel plan was rather the rarity.

A better performance was given by the apparatus illustrated on our cover and at the lower left of this page. This machine runs along, tracking on the ground already cleared and so free from danger of stalling. The shovels at the front collect the snow, which is carried up the chute and deposited in the box-like receptacle at the rear. This holds ten cubic yards—a good truck-load. When it is full, a truck draws up and at the throw of a lever receives the snow for hauling to the dump. Or if this is not convenient, the machine will discharge the snow at the side, just like the ordinary plow save for the manner in which the trick is done. It is claimed for this machine that unless its progress is retarded by an extraordinary accumulation of solidly frozen material, it can proceed through a snow-covered street at from two to ten miles per hour and deliver the snow at the rate of 10 cubic yards per 30 seconds, and that it can do this with any fall of snow up to five feet.

This machine was given a very successful trial, but it was not obtainable in sufficient numbers to make any real impression on the snow. In fact, the instrument which did the most to free New York, at least partly, from the bonds of the weather was one in whose favor little could be said except that it was to be had in any quantity necessary to enable it to do the job. This was a stream of water from the ordinary fire hose. Turned on a drift, a shoveler's pile, or the high ridge of snow thrown from the side-walk and left standing between the gutter and the single-track roadway broken through the middle of the street by the traffic, it demolishes the frozen mass in short order and washes it away down the grade. The melting effect obtained through this very broad contact of the snow and ice with water which is itself but little above the freezing point, is far greater than got through the very limited application of intense heat. By the time the swiftly flowing mass reaches the sewer opening at the end of the block, it is in shape to enter and continue on its way to the outlet at the river front, without clogging the sewer as would be the case if large chunks of ice were dumped promiscuously into the manholes. Most of the down-town streets were finally freed this way—and in connection with the process there was one glorious retribution. As the surging tide rushed toward the sewer, the store-keeper who had cleaned his gutter out properly in the first place could watch it with no thought save for the emancipation of traffic in prospect; but the tenants who had slacked in the cutting of the gutters, or who had ignored this business entirely, could be found knee-deep on their sidewalks, armed with brooms and shovels and ice-cutters, in a desperate attempt to provide a channel for the water and save their cellars from flooding.

Again the Steam Automobile

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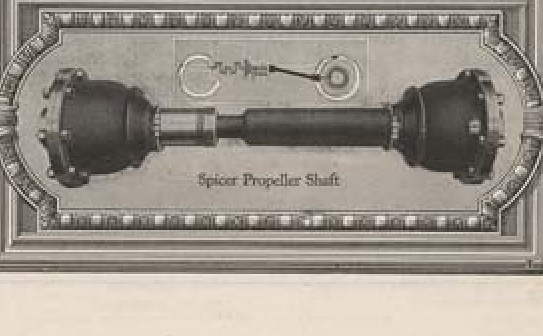
pletely surrounded by pipe coils. In an atomized fire, it is necessary to have a long space for the proper burning of the fuel; but great difficulty has always been experienced in the breaking down of the refractory linings under this sort of a fire. Again, it is necessary to complete combustion before the fire touches the boiler tubes, or sooting will occur. With the combustion chamber as shown in the drawing herewith, the fire cannot play on any coil, and the heat is gradually absorbed over a large area; so no trouble is experienced in burning boiler coils or breaking down the refractory lining.

Much trouble has always been encountered in this sort of a propulsive system with the automatic control of temperature and pressure. Numerous by-pass valves, all of which were delicate, unre-



liable and sluggish in their action, have been employed in this service. The present control system consists of a steam gage which operates an electric switch controlling a motor. As the water and fuel pumps are driven by this motor, they are pumped in a definite quantitative relation to the needs of the engine. The length of time that the motor is on depends upon the demand for steam; under different conditions, the motor will be on anywhere from a third to all of the time.

This has the advantage of locating all parts containing water right at the boiler. Also, it is no longer necessary to use a cushion in the water line to prevent hammer. These cushions were usually spring-loaded pistons, which constantly broke their springs and required repacking. The safety valve is likewise eliminated in favor of a fuse in the motor circuit.

In starting and stopping the motor, the steam gage operates a small switch which is set to open at 600 pounds pressure and then to close again when the pressure has fallen to 500 pounds. This differential action between the opening and closing pressures is an absolute necessity, and is brought about by a small magnet on the back of the steam gage, acting with a pin on the Bourdon tube of the gage.

In similar fashion the kerosene gage controls the action of the spark-plug circuit, which is closed from zero to 25 pounds pressure and open above that figure. When the motor is running, the normal pressure on the delivery side of the fuel pump is 35 pounds, so the upper limit of 25 pounds provides for a sufficiently early cutting off of the spark.

In addition to the pressure cut-off, a steam-temperature gage is used in connection with a second cut-out circuit. The normal temperature of the steam in operation runs from 600 to 750 degrees Fahrenheit. The gage is set to cut off the fuel feed at 800 degrees. This switch seldom comes into action in the normal working of the system, but affords a safety means to shut off the fire in the event that the water tank goes dry. It also acts as an automatic corrector of the fuel-water ratio, if this should by any means become upset.

Like the average gas car, this system uses an electric motor, a storage battery and a dynamo. The dynamo furnishes all of the current to the motor direct when the latter is running. When it shuts off, due to steam pressure above 600 pounds, the series field of the dynamo is automatically cut out, reducing the dynamo output to a current suitable for charging the battery. Where the speed of the engine is nearly constant it is possible to eliminate the dynamo, motor and battery; but it is then necessary to have hand starting devices, and a dry battery for ignition and for control of the small magnets that act on the suction valves of the pumps. The inventors feel that the motor and storage battery is the most direct and simple means of attending to all this.

A source of trouble on previous steam automotive systems has been in the water pumps. These were noisy; their valves were short-lived; they would get air-bound when the water in the tank was too hot; they required constant adjustment of stuffing boxes. The attack upon the first of these problems has been made by designing the valves so that they have small lift, and by the fact that regardless of the car speed, the pump runs always at the same speed. On the second count the inventors have tried to secure by using the best of rust-proof metal for the valves. Air-binding is prevented by the practical absence of clearance space. Finally, no stuffing box is used at all; the entire pump is enclosed in a case and submerged in oil. Then the plunger is so designed that there is no side thrust on it, the allinement being perfect at all stages of the stroke. With the pump cylinder long and the bore absolutely round and straight, the stuffing box can be omitted and there is still a minimum of friction between plunger and cylinder.

The engine is of the semi-uniflow type, two-cylinder, double-acting, poppet-valve. The valves never need to be reground. Special care has been taken to have the metal in the cylinders uniform in section, so that even when hot expansion is even.

To avoid heating of the oil in the cam box, the latter, which carries the cam and tappets for operating the valves, is insulated from the cylinders. Different points of cut-off and reverse are obtained by shifting the cam, which is of a special shape permitting this ad lib. Low steam consumption is secured by short cut-off, tight valves, small clearance space, free exhaust, and the uniform section of the cylinder metal. Perfect allinement is again substituted for stuffing boxes on valve stems and piston rods. For pleasure-car use the inventors propose to mount the engine partly on the rear axle but mostly on the frame. For truck work they would mount the engine on the frame of the car, using a standard road axle. In the pleasure car, of course, drive shaft and universal joints are eliminated by the location of the engine with reference to the driving axle.

Melting Brass Electrically

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would require skillful manipulation could not be expected to withstand the rough service to which it would be put in foundry work. The rocking electric furnace has been reduced to very simple form capable of being applied to commercial practice.

It has been found that the speed of production depends entirely upon the rate at which heat can be generated within the furnace safely; that is, without injury to the refractories or to the metal under treatment. The speed of production also depends somewhat upon the efficiency with which this heat is transferred to the brass. During the researches of Dr. Gillett, it was found that the refractories used in the furnace chamber should not be exposed to a temperature very much above the pouring temperature of the metal. If this were done a minimum maintenance cost would result.

Rapid melting requires a great temperature difference between the source of heat and the metal. Therefore, it is desirable to place the heat source in the furnace as close to the metal as practical. There should be no obstacle in the form of a refractory wall between the metal and the source of heat. If such a wall is interposed between the metal and source of heat it will offer a very high thermal resistance which greatly reduces the general efficiency of the furnace.

A good quality of metal depends largely upon the ease and certainty with which the pouring temperature can be reached. The avoidance of impurities and a perfect mixture of the alloy are also factors which enter into the quality of the metal.

The principal cost in melting copper alloys which contain considerable percentages of zinc and lead is the great loss of metal by volatilization and oxidation. It has been found quite impossible to eliminate this process entirely, but, on the other hand, these effects have been reduced to a minimum by melting the metal in a tightly closed furnace chamber and in the presence of a neutral or reducing atmosphere. The fuel-heated furnace must be fed with a constant draught, which not only oxidizes the metal, but also carries away valuable metallic vapors as quickly as they are produced. This is where the electrically-heated furnace has its great advantage over the conventional forms. The furnace chamber of the electrical device is entirely enclosed and the metallic vapors which are produced create a vapor pressure which tends to prevent further vaporization.

The rocking electric furnace hereto-