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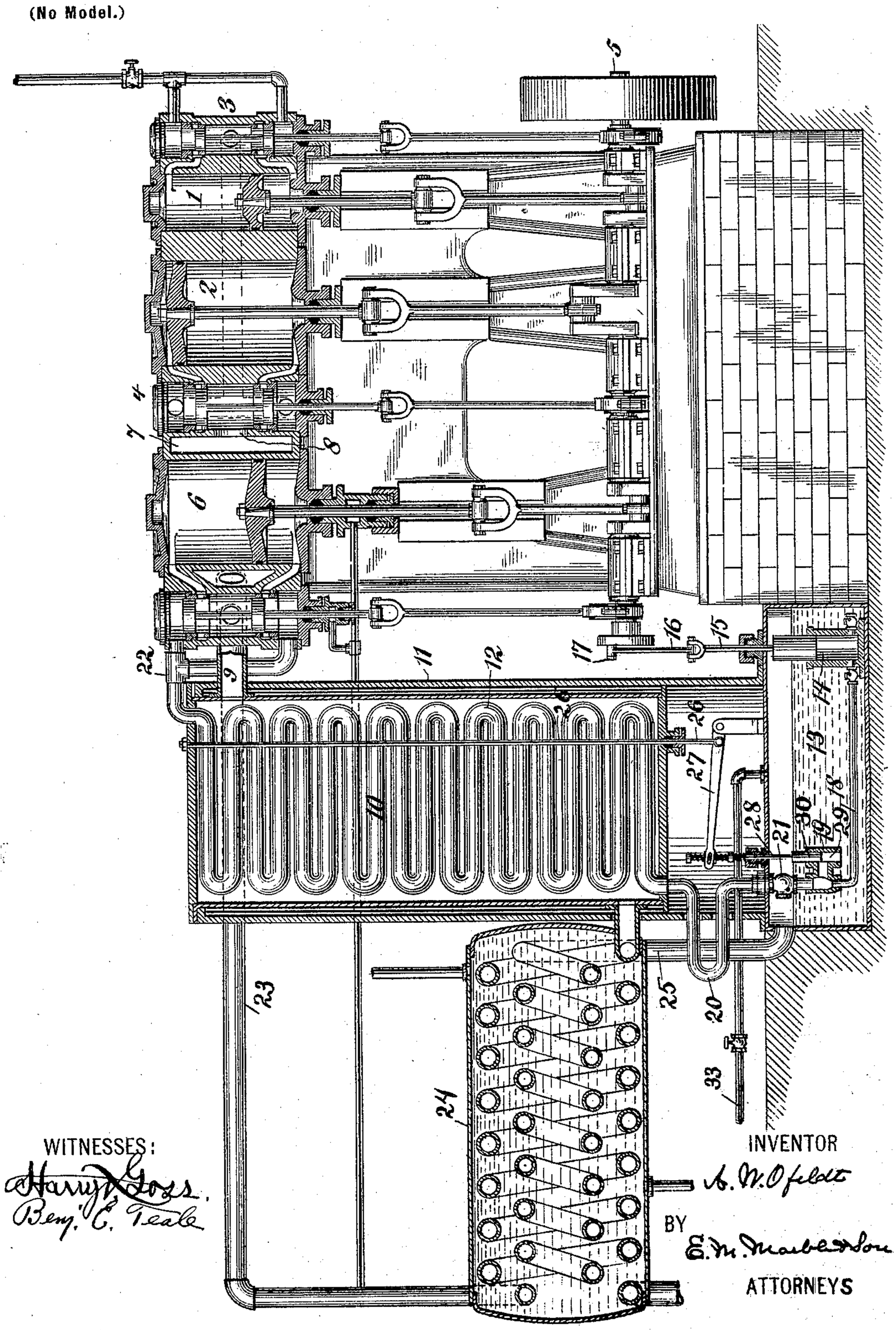
A. W. OFELDT.

FLUID PRESSURE ENGINE.

(Application filed Mar. 18, 1899.)

(No Model.)



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FLUID-PRESSURE ENGINE.

SPECIFICATION forming part of Letters Patent No. 639,088, dated December 12, 1899.

Application filed March 18, 1899. Serial No. 709,576. (No model.)

To all whom it may concern:

Be it known that I, AUGUST W. OFELDT, a citizen of the United States, residing at Nyack, in the county of Rockland and State of New York, have invented certain new and useful Improvements in Fluid-Pressure Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to steam and other fluid pressure motors, and particularly to motors of that class in which steam or other expansible fluid after performing work in a motor, which may be termed a "primary" motor, is caused to pass through a heater or vaporizer, in which it imparts heat to a fluid or vapor of such nature that the pressure produced by it when so heated is greater than the pressure at the same temperature of the working fluid employed in the primary motor, the fluid or vapor thus heated and placed under pressure being then passed through a secondary motor and caused to perform work therein.

My invention consists in providing the secondary motor with a heating-jacket, through which the exhaust from the primary motor is passed before passing into the said vaporizer or heater, in the provision of means for regulating the passage of the secondary working fluid through the heater or vaporizer, and in the novel construction of this regulating device.

The objects of my invention are to utilize the heat contained in the exhaust of steam and other fluid pressure engines in the production of work, to make the apparatus employed as simple and efficient as possible, to render it entirely automatic in its operation, and to prevent loss of the secondary working fluid employed by leakage. These objects are attained in the invention herein described, and illustrated in the drawing which accompanies and forms a part of this specification, which drawing shows a central vertical section of a combined steam and naphtha engine constructed in accordance with my invention, together with the naphtha-vaporizer, the naphtha-supply tank, and the condenser.

In the drawing, 1 and 2 are the high-pressure and low-pressure cylinders, respectively, of a compound steam-engine. 3 and 4 are the valve-chests of said cylinders, and 5 is the crank-shaft.

It is not necessary to describe the details of construction of this engine, as any form of steam-engine, whether simple, double-compound, or triple-expansion, may be employed.

6 is an engine-cylinder, the working fluid used in which when heated by the exhaust from the cylinder 2 is able to perform efficient work in the cylinder 6. Preferably the working fluid employed in cylinder 6 is a substance which at ordinary temperatures or at temperatures reached during the cycle of the engine is liquid and the vaporizing temperature of which is lower than the vaporizing temperature of the substance constituting the working fluid of cylinders 1 and 2. If, as will ordinarily be the case, steam is the working fluid employed in cylinders 1 and 2, then the working fluid of cylinder 6 may be naphtha. The use of naphtha rather than other volatile fluids—such, for instance, as ether—is preferable, because naphtha is cheap, is readily volatilized in a suitable heater by exhaust-steam from a steam-engine, and is readily condensed to a liquid again. Even the exhaust-steam from a condensing-engine working under a vacuum is sufficiently hot to vaporize naphtha.

Cylinders 1 and 2, with their pistons, piston-rods, connecting-rods, and valve-gear, constitute a primary motor, and cylinder 6, with its piston, piston-rod, connecting-rod, and valve-gear, constitutes a secondary motor; but, as shown in the drawing, the primary and secondary motors may be built into a single structure, all of the cylinders being placed over a single crank-shaft, with their connecting-rods connected thereto and their cranks arranged so as to balance each other and produce a uniform turning action. In the drawing the three cranks are set at angles of one hundred and twenty degrees.

Cylinder 6 is provided with a steam-jacket 7, completely surrounding said cylinder and communicating with the exhaust-space of the low-pressure steam-chest 4 through an opening 8. All of the exhaust of the primary motor therefore passes through the steam-jacket surrounding the cylinder of the secondary

motor directly after leaving the primary motor and when it is at its highest temperature. From the side of the jacket 7 opposite the entrance-opening 8 a pipe 9 leads to a vaporizer or heater 10. This vaporizer or heater consists of a closed tank supported from the top by an outer frame or casing 11 and has inside it a series of tubular return-bend coils 12. The exhaust-pipe 9 of the primary motor is arranged to discharge the exhaust after passing through the jacket 7 into the interior of the tank 10 and around these coils 12.

Beneath the vaporizer 10 is a tank 13, containing the liquid which when vaporized becomes the working fluid of the secondary motor. As already stated, this liquid is preferably naphtha. This liquid is forced from the tank 13 into the coils 12 by means of a suitable force-pump, which may be driven from the crank-shaft of the engine, and inasmuch as it is not desirable to permit leakage of naphtha, because of its smell and because of its combustible nature, this pump is preferably placed within the tank 13 itself. 14 is the said pump. It is preferably an ordinary plunger-pump of simple construction. A plunger-rod 15 passes through a stuffing-box in the top of the tank 13 and is connected by a connecting-rod 16 to a crank-pin 17 on the crank-shaft 5 of the engine. The discharge-pipe 18 of this pump is connected to an automatically-operated regulating-valve 19, the operation of which will be described hereinafter. From this regulating-valve a pipe 20 leads to the lower end of the coils 12 in the vaporizer. The pipe 20 has in it a return-bend, as shown, to allow for expansion and contraction, and it has also a check-valve 21.

Naphtha or other suitable liquid forced by the pump 14 into the coils 12 and there vaporized passes through a pipe 22 at the top of the vaporizer into the valve-chest of the cylinder 6. When exhausted from this cylinder, the naphtha-vapor passes through a pipe 23 into cooling-coils in a condenser 24, and the condensed liquid flows back into the tank 13 through a pipe 25. If desired, the exhaust-steam after passing through the vaporizer 10 may be passed through other coils of the condenser 24 and condensed therein. The capacity of the vaporizer and of the cylinder 6 may be so proportioned, however, that practically all of the exhaust-steam may be condensed in the vaporizer 10, its heat being transferred to the naphtha.

It is important that the rate of flow of the naphtha or other secondary fluid through the coils of the vaporizer 10 shall be regulated automatically, according to the work being done by the engine—that is to say, according to the quantity and temperature of the exhaust-steam or primary working fluid which passes through the vaporizer—or else more or less unvaporized liquid will be carried over into the secondary motor. For this purpose I employ a highly-expansible rod 26, located within the vaporizer, secured to the upper end thereof, passing through a stuffing-box in the bottom of the vaporizer, and connected to the multiplying-lever 27. The rod may be of copper. The lever 27 is connected to the valve-stem 28 of the automatic regulating-valve 19. This regulating-valve has a by-pass passage 29, adapted to be closed partly or completely by a plunger 30, connected to the valve-stem 28. When comparatively little exhaust-steam is flowing into the vaporizer, so that the temperature therein is comparatively low and the rod 26 comparatively short, this by-pass passage is practically open and comparatively little naphtha is forced by the pump 14 into the coils 12, the greater portion of the naphtha returning idly to the tank 13 through the by-pass passage 29; but as the quantity of exhaust-steam flowing into the tank 10 increases and the temperature therein rises the rod 26 expands, moving the plunger 30 downward and partly or completely closing the by-pass passage 29, thus increasing the quantity of naphtha flowing into the coils of the vaporizer 10.

Passing the entire exhaust of the primary motor through the heating-jacket surrounding the cylinder of the secondary motor before such exhaust-steam enters the vaporizer is an important feature of my invention, because it permits a maximum exchange of heat between the naphtha and the steam, and, moreover, insures the maintenance of the naphtha-gas at the highest temperature at the place where it is most essential that the naphtha shall have its highest temperature—viz., in the cylinder of the secondary motor. I am aware that it is old to jacket a secondary motor and to pass into the jacket a portion of the exhaust from a primary motor; but heretofore only a comparatively small proportion of the exhaust of the primary motor has been passed into the jacket of the secondary motor, the greater portion of the exhaust passing directly into a vaporizer, nor has provision been made heretofore for securing continuous and rapid circulation in the jacket of the secondary motor. In my engine, since the entire exhaust of the primary motor passes through the jacket of the secondary motor, the cylinder of the secondary motor is heated to the maximum temperature possible, and the circulation through the jacket is rapid and continuous.

The operation of the engine is as follows: When steam is first admitted into the cylinders 1 and 2, the crank-shaft 5 commences to revolve, the exhaust-steam passing through the jacket of cylinder 6 into the interior of the heater or vaporizer 10. The heat of the steam causes the rod 26 to expand somewhat, and so to close partially the by-pass passage 29 of the valve 19. The pump 14 therefore forces naphtha into the coils 12 of the vaporizer. The naphtha in said coils being vaporized by the heat of the exhaust-steam passes into the cylinder 6 and performs work therein, exhausting into the condenser 24 and flow-

ing back into the tank 13. The naphtha-motor will commence to do work effectively after the crank-shaft has made two or three revolutions. When the naphtha-gas enters the cylinder 6, it is heated to a considerable extent by the exhaust-steam in the surrounding jacket, so that the mean effective pressure in said cylinder is maintained as high as possible, and any particles of liquid naphtha carried over with the gas are vaporized.

In motors employing naphtha which is vaporized by passing through coils heated by a flame trouble is often experienced because the intense heat of the coils converts a portion of the naphtha into a fixed gas; but the more moderate heat of exhaust-steam does not produce this difficulty. Consequently a vacuum-pump may be used in connection with the naphtha-motor, just as such a pump is ordinarily used in condensing steam-engines.

The rod 26, by expanding or contracting according to the quantity of exhaust-steam flowing through the vaporizer and according to the temperature in the vaporizer produced by such steam, adjusts the valve-plug 30 and so regulates the amount of naphtha flowing into the cylinder 6 in accordance with the work being done by the engine. The passage of too great a quantity of naphtha into the vaporizer is thus prevented.

The naphtha-cylinder 6 and its valve-chamber have double stuffing-boxes 31, each having a small chamber between the glands. A pipe 32 carries any naphtha which may collect in these chambers into the exhaust-pipe 23. This construction is important, as it prevents leakage of naphtha around the piston-rod. The lower stuffing-box being free from pressure effectively prevents leakage.

A pipe 33, connected with tank 13, serves to convey any gas which may collect in the top of said tank into the furnace of the boiler supplying steam to cylinders 1 and 2.

I do not limit myself to the use of steam in the primary motor or to the use of naphtha in the secondary mortor, nor do I limit myself to the use of motors of the reciprocating type or of the same type or connected to the same crank-shaft or with cylinders arranged side by side, nor do I limit myself to the use of the particular device described for regulating the flow of naphtha into the vaporizer. The primary motor may be a motor of the explosive or internal-combustion type.

Having thus completely described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with a primary fluid-pressure motor, a heater arranged to be heated by the exhaust of said primary motor, and means for passing through said heater a substance capable of developing pressure when heated by said exhaust, of a secondary fluid-pressure motor which receives the substance so heated in said heater, and is provided with a heating-jacket connected with the exhaust-opening of the primary motor, through which jacket the entire exhaust of said primary motor passes, substantially as described.

2. The combination, with a primary fluid-pressure motor, a heater connected to the exhaust-opening of the primary motor, and means for passing through said heater a liquid which, when heated by the exhaust of the primary motor, is vaporized, of a secondary motor operated by the vapor so produced and having a heating-jacket interposed between the exhaust-outlet of the primary motor and the heater, through which jacket the entire exhaust of said primary motor passes, substantially as described.

3. The combination, with primary and secondary fluid-pressure motors having working cylinders placed side by side, the secondary motor being jacketed and having its jacket connected to the exhaust-opening of the primary motor, of a heater arranged to be heated by the exhaust from said primary motor, and means for passing through the heater into the secondary motor a fluid which, when heated by the exhaust from the primary motor, is vaporized, substantially as described.

4. The combination, with primary and secondary fluid-pressure motors, and a heater which is heated by the exhaust from the primary motor, of means for passing through said heater into the secondary motor a secondary working fluid, and means for regulating the flow of said secondary working fluid in proportion to the work of the engine, substantially as described.

5. The combination, with primary and secondary fluid-pressure motors, and a heater which is heated by the exhaust from the primary motor, of means for passing through said heater into the secondary motor a secondary working fluid, and a regulating-valve, regulating the flow of working fluid to the secondary motor, and adjusted by variations in pressure therein, substantially as described.

6. The combination, with primary and secondary fluid-pressure motors, and a vaporizer which is heated by the exhaust from the primary motor, and is connected to the secondary motor, means for passing a liquid into said vaporizer, a valve, connected with the supply-pipe of said vaporizer, having a by-pass, and means for regulating the flow of liquid through said by-pass in inverse proportion to the work of the engine, substantially as described.

7. The combination, with primary and secondary fluid-pressure motors, and a heater which is heated by the exhaust from the primary motor, of means for passing through said heater into the secondary motor, a secondary working fluid, an expansible member, the length of which varies in accordance with the variations in temperature in the heater, and means operated thereby for regulating the supply of working fluid to the secondary motor, substantially as described.

8. The combination, with primary and sec-

ondary fluid-pressure motors, and a vaporizer which is heated by the exhaust from the primary motor and is connected to the secondary motor, of a supply-tank, means for passing fluid therefrom into the heater, a valve, connected with the supply-pipe of said vaporizer, having a by-pass, a valve-plug controlling said by-pass, and an expansible rod located within the heater, and connected with and adapted to operate said valve-plug, substantially as described.

9. The combination, with a fluid-pressure motor, and a vaporizer which is connected thereto, of a supply-tank, and a pump, within said tank, and driven by said motor, and arranged to force fluid from the tank into the vaporizer, substantially as described.

10. The combination, in a fiuid-pressure engine, with a chamber exposed to pressure of the working fluid, and having a movable member projecting therefrom, of a double packing-box surrounding said movable member and having a chamber adapted to receive leakage from the inner packing-box, and a waste-pipe connected with the latter chamber and arranged to carry off leakage from said chamber, substantially as described.

In testimony whereof I hereunto affix my signature in the presence of two witnesses.

AUGUST W. OFELDT.

Witnesses:
H. M. MARBLE,
RITA BRADT.