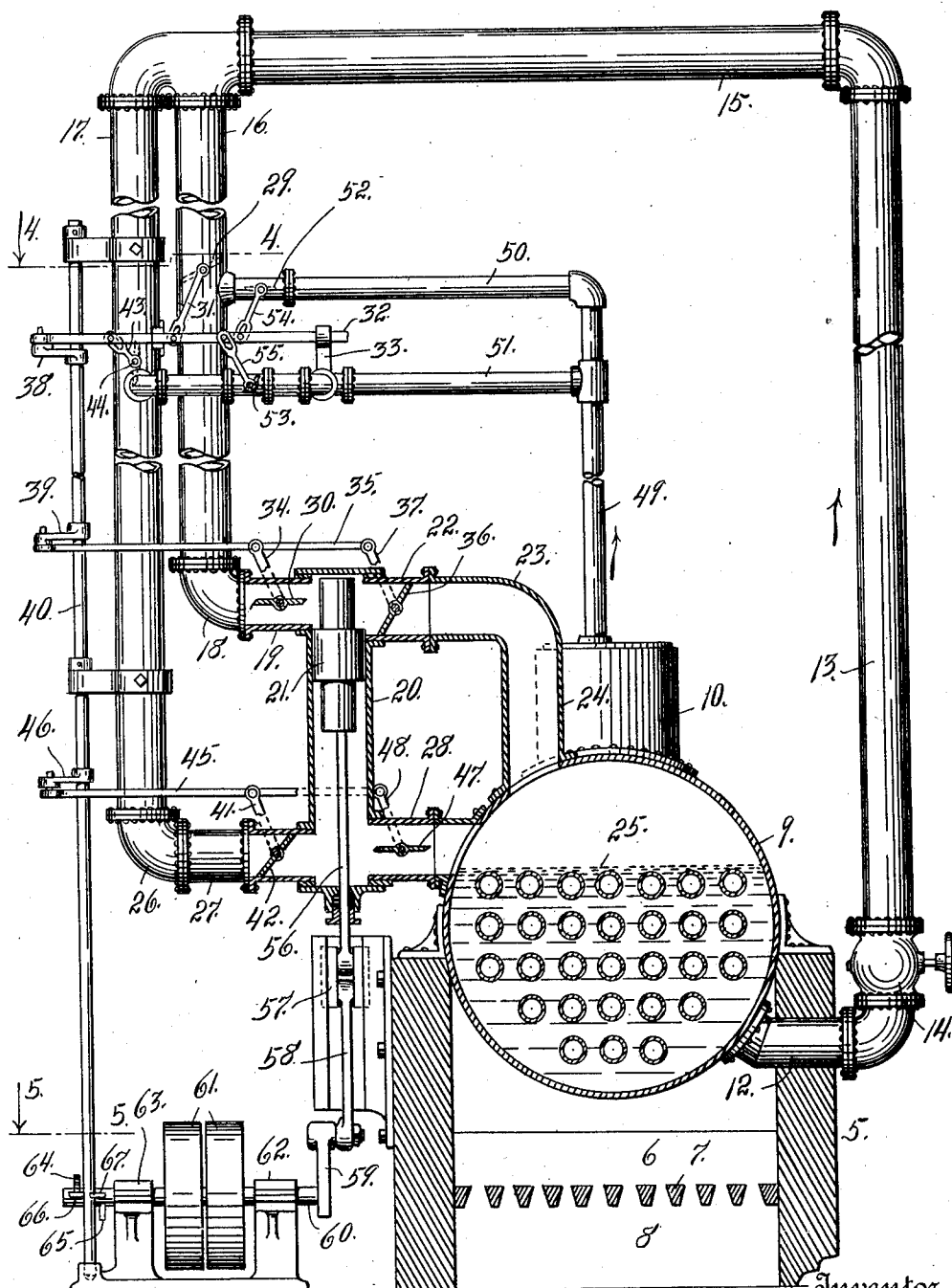


1,057,086.

2 SHEETS—SHEET 1.



Witnesses
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 APPARATUS FOR OPERATING ENGINES BY WATER PRESSURE.
 APPLICATION FILED FEB. 7, 1912.

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2 SHEETS-SHEET 2.

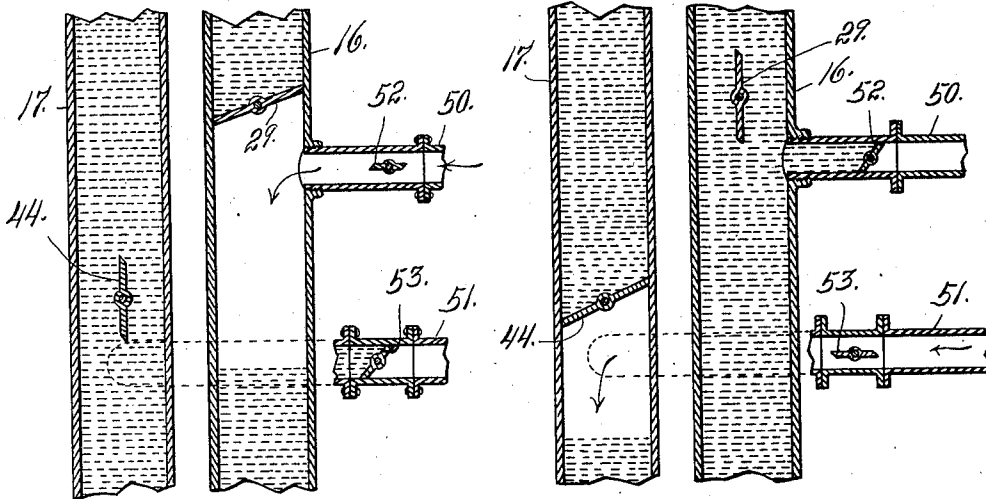


Fig. 2.

Fig. 3.

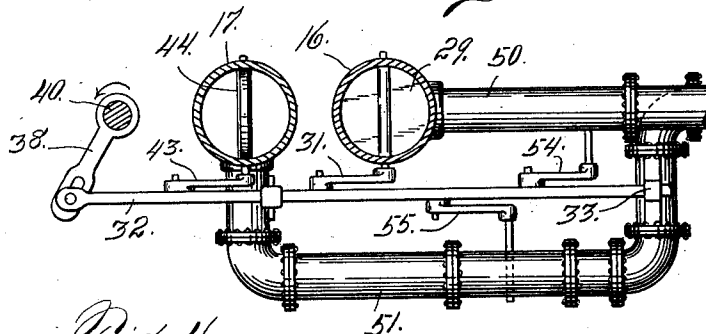


Fig. 4.

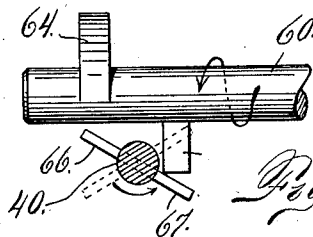


Fig. 5.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR OPERATING ENGINES BY WATER-PRESSURE.

1,057,086.

Specification of Letters Patent.

Patented Mar. 25, 1913.

Application filed February 7, 1912. Serial No. 676,104.

To all whom it may concern:

Be it known that I, LAFAYETTE M. PETTIT, a citizen of the United States, residing at Cripple Creek, county of Teller, and State of Colorado, have invented certain new and useful Improvements in Apparatus for Operating Engines by Water-Pressure; and I do 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, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

My invention relates to an apparatus for operating engines by water pressure and consists broadly in applying the weight of a column of water alternately to opposite sides of a piston.

One purpose of my invention is to provide an apparatus which is practically a closed system and will operate without any substantial loss of water or steam.

Reference may now be had to the accompanying drawing in which is illustrated an embodiment of my invention.

In this drawing: Figure 1 is a view illustrating the invention, shown partly in elevation and partly in section. Fig. 2 is a fragmentary sectional view, shown on a larger scale, illustrating two depending pipe members forming a part of the invention, and illustrating the manner of introducing steam from the generator into the respective members. Fig. 3 is a similar view, showing the valves in position the reverse of the positions shown in Fig. 2. Fig. 4 is a section taken on the line 4—4, Fig. 1, looking downwardly, the parts being shown on a larger scale. Fig. 5 is a section taken on the line 5—5, Fig. 1, looking downwardly, the parts being also shown on a larger scale.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate a furnace having a fire box 6, a grate 7 and an ash-pit 8. Suitably mounted in connection with this furnace, is a boiler, or steam generator, 9, having a steam dome 10. This generator has an outlet 12 leading from its lower portion to the lower extremity of a stand pipe 13, a normally open valve 14 being inter-

posed between the lower extremity of the stand pipe and the outlet 12. The upper extremity of the stand pipe 13 communicates with a horizontal pipe member 15, while the inner extremity remote from the stand pipe communicates with two depending pipe members designated 16 and 17, respectively. The pipe member 16 extends downwardly, and is connected by means of an elbow 18 with a horizontal pipe member 19, which is in direct communication with the upper extremity of the cylinder 20 of the engine, a piston 21 being located in said cylinder. On the opposite side of the pipe member 19, is a pipe member 22, which by an elbow bend 23 merges into a depending pipe member 24, communicating with the steam generator above the water therein, the water level being indicated by the dotted line 25. The pipe member 17 extends downwardly from the horizontal pipe member 15, and communicates by an elbow 26 with a horizontal pipe member 27, which communicates with the lower extremity of the cylinder 20. On the opposite side of the cylinder from the pipe member 27, a pipe member 28 communicates with the generator above the water level 25 in the latter.

In the pipe member 16 on one side of the cylinder, are located two valves which are respectively designated 29 and 30, the valve 29 being controlled by an arm 31, connected at one extremity with the valve, and at its opposite extremity with a rod 32, slidably mounted in a guide 33. The arm 31 is so connected with the valve 29 that the movement of the rod 12 in opposite directions will open and close the said valve. The valve 30 is connected by means of an arm 34 with a rod 35; the connection of the said arm with the valve being such that the movement of the rod in opposite directions opens and closes the said valve. On the opposite side of the engine from the cylinder, there is a valve 36, the same being located between the cylinder and the engine. This valve is connected by means of an arm 37 with a rod 35 in such a manner that the movement of the rod in opposite directions will open and close the said valve. The two rods 32 and 35, are respectively connected with cranks 38 and 39, mounted on a rock shaft 40, both cranks

occupying corresponding positions on the said shaft.

Two valves, 44 and 42 are located in the pipe 17 and the member 27, connected with the lower extremity thereof, the said valves 5 being respectively connected by means of arms 43 and 41 with the rod 32 and a rod 45, the rod 45 being connected at one extremity with a crank 46. On the opposite 10 side of the cylinder from the valve 42, is a valve 47, located in the pipe member 28, the said valve being connected in operative relation with the rod 45 by an arm 48.

From the dome 10 of the generator, a 15 pipe 49 leads upwardly and communicates by means of branch pipes 50 and 51 with the pipes 16 and 17, respectively, at points just below the valves 29 and 44 when the said valves are closed. In the branch pipe 20 50, is located a valve 52, while in the branch pipe 51 there is located a valve 53. These valves are respectively connected in operative relation with the rod 32, by means of arms 54 and 55, respectively.

25 Connected with the piston 21 is a stem 56, which is connected with a cross head 57, the latter being also connected by means of a pitman 58 with the crank 59 of a shaft 60, the latter being equipped with pulleys 61 for taking power from the said shaft for 30 doing work of any kind. This crank shaft is journaled in bearings 62 and 63. Beyond the outermost bearing 63, the crank shaft protrudes, and is equipped with cams 64 and 65, adapted to act on pins 66 and 67, 35 respectively, with which the rock shaft 40 is equipped, the pins and cranks being so arranged with reference to the travel of the engine piston and its connections, and every 40 time a half rotation is given to the crank shaft, one of the cams of the last named shaft, acts on a pin 66 or 67, carried by the shaft to impart to the latter a partial rotation sufficient for actuating the valves controlled by the rods 32, 35 and 45, the arrangement being such that the crank shaft 45 as it continues its rotary movement in one direction, will by reason of the said cams act on the rock shaft 40 through the pins 66 and 67, to impart partial rotary movement 50 to the rock shaft in reverse direction for each complete rotation of the crank shaft.

From the foregoing description, my improved process, as well as the apparatus for 55 practising or carrying out the same, will be readily understood.

If it be assumed that the valve 14 is open, and that the water in the generator 9 under the pressure of the steam therein is forced 60 upwardly through the pipe 13 and into the two depending pipes 16 and 17, and that there is a column of water in the depending pipe 16 between the valves 29 and 36, both of which are in the closed position, while 65 the valve 30 is in the open position, the op-

eration will be as follows, assuming further that the valves 44 and 47 in the pipe member 17 and its connections, are both open, while the valve 42 is closed; also that the valve 52 in the steam pipe member 50 is 70 open, while the valve 53 in the steam pipe member 51 is closed. Under the conditions assumed, steam will enter the column of water in the pipe member 16 and its continuation between the two closed valves 29 and 36, while steam from the generator will also 75 be in communication with the lower end of the piston 21 through the pipe member 28. Hence, the steam pressure on the two opposite ends of the piston will be balanced, 80 leaving the weight of the column of water in the pipe 16 above the piston to act on the upper extremity of the latter to force the piston downwardly, thus imparting a half revolution to the crank shaft 60 by virtue 85 of the connections heretofore described. This half revolution of the crank shaft will, by virtue of the construction heretofore described, impart a partial revolution to the rock shaft 40 of sufficient magnitude to re- 90 verse the positions of all of the valves controlled by the rock shaft, as heretofore explained. Under these circumstances, the valves 44, 47 and 30 will be closed, and the valves 42, 29 and 36 will be opened. The 95 water will then be allowed to enter the pipe 16 to the valve 30, but will be cut off by the last named valve from the piston of the engine cylinder while steam from the generator will be allowed to pass to the upper 100 extremity of the piston. Furthermore, there will be a column of water in the pipe 17 below the closed valve 44, acting on the lower end of the piston by reason of the fact that valve 42 is open, while the valve 47 105 is closed, cutting off the steam pressure from the lower end of the piston. As the valve 53 in the branch pipe 51 is open, steam from the dome of the generator will pass into the upper part of the column of water trapped 110 in the pipe 17 below the valve 44. This steam pressure will balance the pressure which acts on the upper extremity of the piston by virtue of the direct connection between the said piston extremity and the 115 generator, as heretofore described. Consequently, there will be an excess of pressure on the lower extremity of the piston over that on its upper extremity, due to the height of the column of water in the pipe 120 17 below the valve 44, and the weight of this water will act to impart the upward movement to the piston, whereby another half rotation will be imparted to the crank shaft 60, and the valves connected with the 125 rock shaft again reversed, after which the operation heretofore described will be repeated, there being alternately an excess of pressure on the opposite ends of the cylinder piston, due to the height of the columns 130

of water in the pipes 16 and 17, whereby the reciprocating movement is continuously imparted to the piston.

In further explanation of the operation, it may be stated that after the column of water in either pipe 16 or 17, as the case may be, has performed its function by shifting the piston in one direction or the other, as soon as the valves are reversed, whereby the valve between the generator and the cylinder and located in the connection between either pipe 16 or 17 and the generator, is open, the water between the two valves 30 and 36 will exhaust into the generator, while the same thing will happen with reference to the water in the cylinder below the piston and between the valves 42 and 47. From this it will be seen, assuming that the system is tight and free from leaks, that there will be no loss of water or steam, and that the operation may be continued indefinitely, without any necessity for replenishing the water supply in the system.

Having thus described my invention, what I claim is:

1. In combination, a boiler containing water and steam under pressure, two water columns, the upper extremities of which are in communication with the said boiler below the water level thereof and the lower extremities of which are in communication with the boiler above the water level thereof, a cylinder whose ends are in communication respectively with the passages between the lower extremities of the water columns and the boiler, a piston for said cylinder, means for delivering the weight of the columns of water alternately to the opposite sides of the piston and means for delivering equal pressures of steam simultaneously to the active water column and to the side of the piston remote from the active water column.

2. In apparatus for operating engines by water pressure, the combination with a boiler and engine, of a stand pipe connected with the water of the boiler, depending pipes in communication at their upper ends with the upper extremity of the stand pipe and receiving water therefrom, the lower extremities of the depending pipes being in communication with the opposite ends of the engine piston, means for connecting the opposite ends of the said piston with the steam of the boiler, means for simultaneously cutting off communication between the first depending pipe and the boiler on the water side, and opening communication between the boiler and the second depending pipe on the same side, means for introducing steam from the boiler into the first depending pipe just below the cut off, and cutting off steam from the second depending pipe at a corresponding point, means for opening communication between the lower end of the first depending pipe and

one end of the piston, and cutting off communication between the lower end of the second depending pipe and the opposite end of the piston, and means for cutting off communication between the steam of the boiler and the end of the piston with which the first pipe is in communication, and opening communication between the steam of the boiler and the end of the piston from which the second pipe is cut off, whereby the opposite ends of the piston are alternately under an excess of pressure equal to the weight of the water in the depending pipes below the points of cut off, for the purpose set forth.

3. In apparatus for operating engines by water pressure, the combination with a boiler and engine, of a stand pipe connected with the water of the boiler, depending pipes in communication at their upper ends with the upper extremity of the stand pipe, and receiving water therefrom, the lower extremities of the depending pipes being in communication with the opposite ends of the engine piston, means for connecting the opposite ends of the said piston with the steam of the boiler, means for automatically and simultaneously cutting off communication between the first depending pipe and the boiler on the water side, and opening communication between the second depending pipe and the boiler on the same side, means for automatically introducing steam from the boiler into the first depending pipe just below the cut off, and cutting off steam from the second depending pipe at a corresponding point, means for automatically and simultaneously opening communication between the lower end of the first depending pipe and one end of the piston, and cutting off communication between the lower end of the second depending pipe and the opposite end of the piston, and means for automatically and simultaneously cutting off communication between the steam of the boiler and the end of the piston with which the first pipe is in communication and opening communication between the steam of the boiler and the end of the piston from which the second pipe is cut off, whereby the opposite ends of the piston are alternately under an excess pressure equal to the weight of the water in the depending pipes below the cut off point, substantially as described.

4. In apparatus for operating engines by water pressure, the combination with a boiler and engine, of a stand pipe connected with the water of the boiler, depending pipes in communication at their upper ends with the upper extremity of the stand pipe, and receiving water therefrom, the lower extremities of the depending pipes being in communication with the opposite ends of the engine piston, means for con-

necting the opposite ends of the said piston with the steam of the boiler, means for automatically and simultaneously cutting off communication between either depending pipe and the boiler on the water side, and opening communication between the other depending pipe and the boiler on the same side, means for automatically and simultaneously introducing steam from the boiler into the depending pipe, which is cut off from the boiler on the water side, and cutting off steam from the other depending pipe at a corresponding point, means for automatically and simultaneously opening communication between the lower end of the depending pipe which is cut off from the boiler on the water side, and cutting off communication between the lower end of the other depending pipe and the opposite end of the piston, and means for automatically and simultaneously cutting off communication between the steam of the boiler and the end of the piston which is in communication with the water column of a depending pipe, and cutting off communication between the steam of the boiler and the end of the piston which is cut off from communication with the water of the other depending pipe, whereby the opposite ends of the piston are alternately under excess pressure equal to the weight of the water in the depending pipes below the point of cut off, whereby a reciprocating movement is imparted to the piston, substantially as described.

5. In apparatus for operating engines by water pressure, the combination with a boiler and engine, of pipes located above the engine and in communication with the opposite ends of the piston thereof, means connected with the water of the boiler and with the upper extremities of the said pipes for delivering water to the latter under boiler pressure, means for connecting the opposite ends of the said piston with the steam of the boiler, means for automatically and simultaneously cutting off communication between one of the said pipes and the boiler on the water side and opening communication between the boiler and the other pipe on the same side, means for automatically and simultaneously introducing steam from the boiler into one of the said pipes below the cut off, and cutting off steam from the other pipe at a corresponding point, means for automatically and simultaneously opening communication between the lower end of one pipe and one end of the piston, and cutting off communication between the lower end of the other pipe and the opposite end of the piston, means for automatically and simultaneously cutting off communication between the steam of the boiler and the end of the piston with which one pipe is in communication, and opening communication be-

tween the steam of the boiler and the end of the piston from which the water of the second pipe is cut off, whereby the opposite ends of the piston are alternately under an excess pressure equal to the weight of the water in the said pipes below the cut off point, substantially as described.

6. In apparatus of the class described, the combination with a boiler and engine, of pipes extending above the engine a suitable distance, and whose lower extremities lead to the opposite ends of the engine piston, means connected with the upper extremities of the said pipes for delivering water thereto under boiler pressure, means for connecting the opposite ends of the said piston with the steam of the boiler, means controlled by the movement of the piston for simultaneously cutting off communication between one of the pipes and the boiler on the water side, opening communication between the boiler and the other pipe on the same side, introducing steam from the boiler into one of said pipes just below the cut off, cutting off steam from the other of said pipes at a corresponding point, opening communication between the lower end of the pipe cut off from the boiler on the water side and one end of said piston, cutting off communication between the lower end of the other pipe and the opposite end of the piston, cutting off communication between the steam of the boiler and the end of the piston with which the water of the first pipe is in communication, opening communication between the steam of the boiler and the end of the piston which is cut off from the water of one of the pipes, whereby the opposite ends of the piston are alternately under an excess pressure equal to the weight of the water in the said pipes below the point of cut off.

7. In apparatus of the class described, the combination of a boiler and engine, of stand pipes located above the engine and having their lower extremities connected with the opposite ends of the engine cylinder, means connected with the boiler below the water level therein for delivering water under boiler pressure into the upper extremities of the stand pipes, means for connecting the opposite ends of the engine cylinder with the steam of the boiler, means operated by the reciprocation of the piston in the engine cylinder for simultaneously cutting off communication between one stand pipe and the boiler on the water side, opening communication between the boiler and the other stand pipe on the same side, opening communication between the lower end of the stand pipe which is cut off from the boiler on the water side, and one end of the piston, cutting off water communication between the lower end of the other stand pipe and the opposite end of the piston, introducing steam

from the boiler into the stand pipe cut off from the boiler on the water side just below the point of cut off, cutting off steam from the other stand pipe at a corresponding point, cutting off steam communication between the boiler and the end of the piston which is in communication with the water at the lower end of the stand pipe, opening steam communication between the boiler and the end of the piston which is cut off from water communication with the lower end of the other stand pipe, said means including valves, and a rock shaft connected in operative relation with the said valves and the cylinder piston, substantially as described.

8. In apparatus of the class described, the combination of a boiler and engine, of stand pipes located above the engine and having their lower extremities connected with the opposite ends of the engine cylinder, means connected with the boiler below the water level therein for delivering water under boiler pressure into the upper extremities of stand pipes, means for connecting the opposite ends of the engine cylinder with the steam of the boiler, means operated by the reciprocation of the piston in the engine cylinder for simultaneously cutting off communication between the stand pipe and the boiler on the water side, opening communication between the boiler and the other stand pipe on the same side, opening water communication between the lower end of the stand pipe which is cut off from the boiler on the water side, and one end of the piston, cutting off water communication between the lower end of the other stand pipe and the opposite end of the piston, introducing steam from the boiler into the stand pipe cut off from the boiler on the water side just below the point of cut off, cutting off steam from the other stand pipe at a corresponding point, cutting off steam communication between the boiler and the end of the piston which is in communication with the water at the lower end of the stand pipe, opening steam communication between the boiler and the end of the piston which is cut off from water communication with the lower end of the other stand pipe, said means including a crank shaft, cams on the crank shaft, a rock shaft having pins mounted thereon and arranged to be actuated by cams on the crank shaft, whereby as the latter is rotated, partial rotary movement in reversed direction will be imparted to the rock shaft, valves suitably located, and an operative connection between the rock shaft and the said valves, substantially as described.

10. In an engine, a boiler containing water and steam under pressure, two water columns, the upper extremities of which are in communication with the boiler below the water level thereof and the lower extremities of which are in communication with the boiler above the water level thereof, a cylinder, a piston therefor, means for alternately placing said columns of water in communication with and cutting them off from the opposite ends of the cylinder and means including the boiler for introducing equal pressures of steam simultaneously to the active water column and to the end of the cylinder not in communication with the active water column.

11. In an engine, a boiler containing water and steam under pressure, two water columns, the upper extremities of which are in communication with said boiler below the water level thereof and the lower extremities of which are in communication with the boiler above the water level thereof, a cylinder whose ends are in communication respectively with the passages between the lower extremities of the water columns and the boiler, a piston for said cylinder, and

9. In apparatus of the class described, the combination of a boiler and engine, of stand pipes located above the engine and having their lower extremities connected with the opposite ends of the engine cylinder, means connected with the boiler below the water level therein for delivering water under

boiler pressure into the upper extremities of the stand pipes, means for connecting the opposite ends of the engine cylinder with the steam of the boiler, means operated by the reciprocation of the piston in the engine cylinder for simultaneously cutting off communication between the stand pipe and the boiler on the water side, opening communication between the boiler and the other stand pipe on the same side, opening water communication between the lower end of the stand pipe which is cut off from the boiler on the water side, and one end of the piston, cutting off water communication between the lower end of the other stand pipe and the opposite end of the piston, introducing steam from the boiler into the stand pipe cut off from the boiler on the water side just below the point of cut off, cutting off steam from the other stand pipe at a corresponding point, cutting off steam communication between the boiler and the end of the piston which is in communication with the water at the lower end of the stand pipe, opening steam communication between the boiler and the end of the piston which is cut off from water communication with the lower end of the other stand pipe, said means including a crank shaft, cams on the crank shaft, a rock shaft having pins mounted thereon and arranged to be actuated by cams on the crank shaft, whereby as the latter is rotated, partial rotary movement in reversed direction will be imparted to the rock shaft, valves suitably located, and an operative connection between the rock shaft and the said valves, substantially as described.

10. In an engine, a boiler containing water and steam under pressure, two water columns, the upper extremities of which are in communication with the boiler below the water level thereof and the lower extremities of which are in communication with the boiler above the water level thereof, a cylinder, a piston therefor, means for alternately placing said columns of water in communication with and cutting them off from the opposite ends of the cylinder and means including the boiler for introducing equal pressures of steam simultaneously to the active water column and to the end of the cylinder not in communication with the active water column.

11. In an engine, a boiler containing water and steam under pressure, two water columns, the upper extremities of which are in communication with said boiler below the water level thereof and the lower extremities of which are in communication with the boiler above the water level thereof, a cylinder whose ends are in communication respectively with the passages between the lower extremities of the water columns and the boiler, a piston for said cylinder, and

means for simultaneously delivering the weight of one column of water to one side of the piston, closing the passage between that side of the piston and the boiler, opening the passage between the other side of the piston and the boiler and introducing steam to the said active column of water.

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

LAFAYETTE M. PETTIT.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."
