B. O. GAGE.

STEAM PUMP.

APPLICATION FILED FEB. 1, 1911.

999,642.

Patented Aug. 1, 1911.

4 SHEETS—SHEET 1.

Fig. 4.

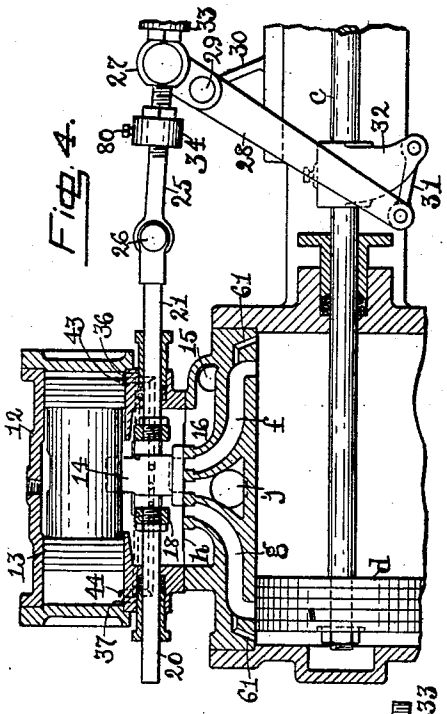
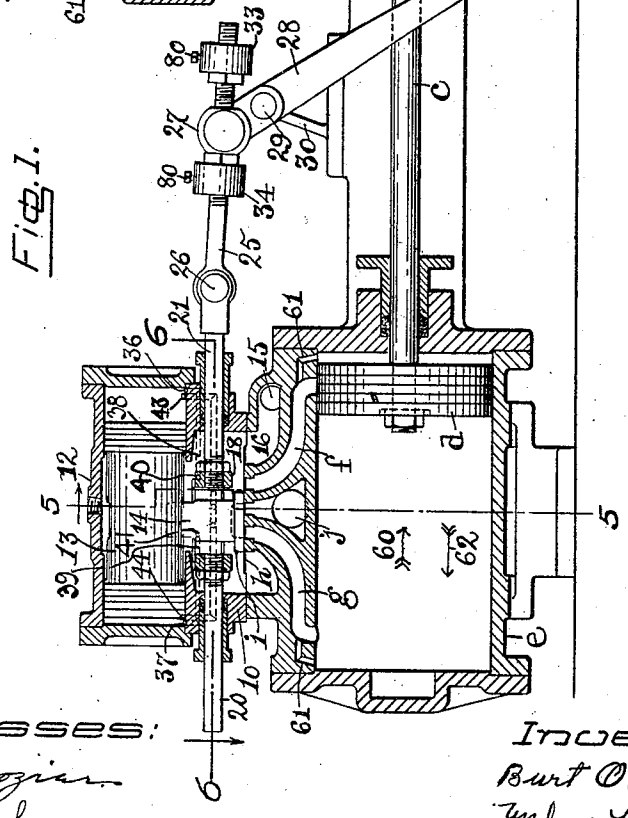


Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 3.

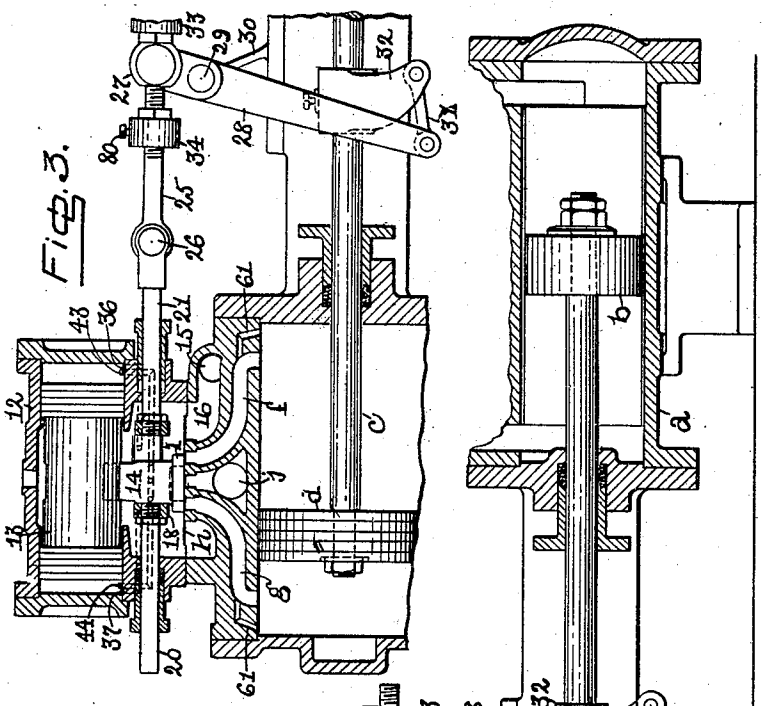
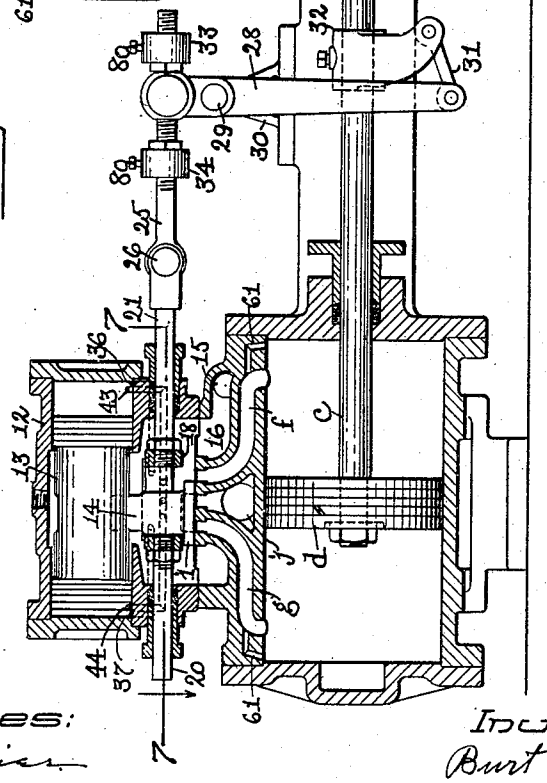


Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 5.

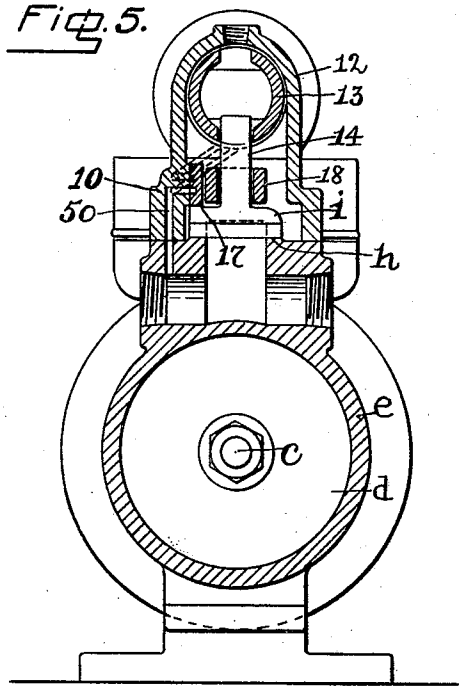


Fig. 6.

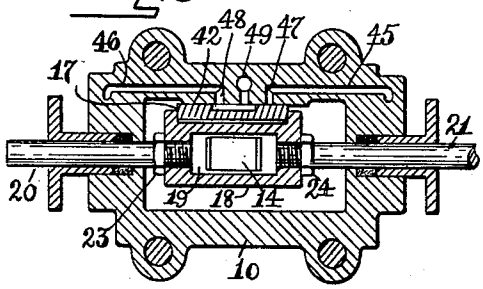
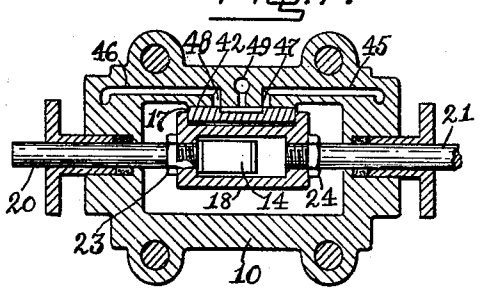


Fig. 7.



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STEAM PUMP.

APPLICATION FILED FEB. 1, 1911.

999,642. **Patented Aug. 1, 1911.**

4 SHEETS—SHEET 4.

Fig. 8.

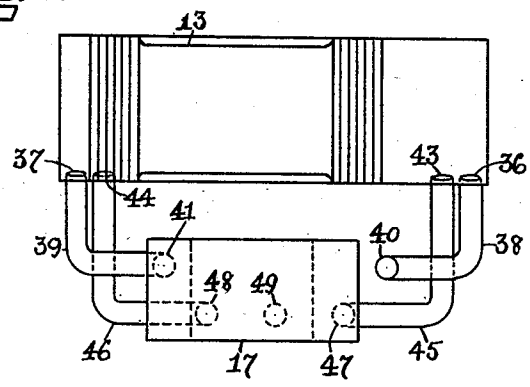


Fig. 9.

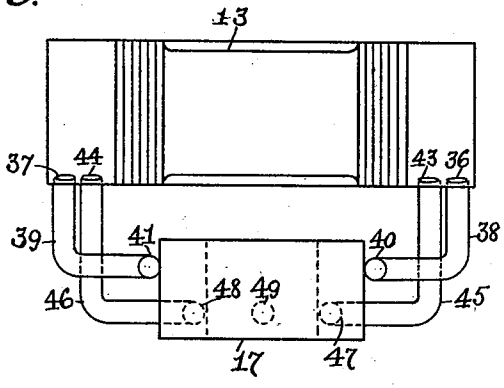
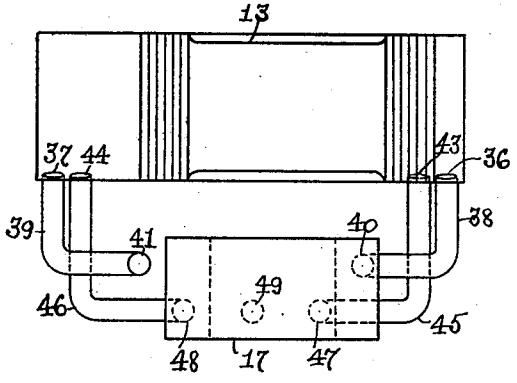


Fig. 10.



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STEAM-PUMP.

999,642. Specification of Letters Patent. **Patented Aug. 1, 1911.**

Application filed February 1, 1911. Serial No. 605,986.

To all whom it may concern:

Be it known that I, BURT O. GAGE, a citizen of the United States, residing in Warren, county of Worcester, and State of Massachusetts, have invented an Improvement in Steam-Pumps, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to steam pumps and more particularly to a novel construction and arrangement of valve mechanism, with which shocks and blows to the operating parts may be avoided and a smooth and noiselessly running pump obtained.

The invention further has for its object to obtain the results desired with simple and efficient mechanism as will be described.

These and other features of this invention will be pointed out in the claims at the end of this specification.

Figure 1 is a section and elevation of one form of pumping engine embodying this invention. Fig. 2, a like view with the parts in a different position. Figs. 3 and 4, details in section showing the parts in other positions. Fig. 5, a vertical section on the line 5—5, Fig. 1. Fig. 6, a detail in horizontal section on the line 6—6, Fig. 1. Fig. 7, a like section on the line 7—7, Fig. 2, and Figs. 8, 9 and 10, diagrammatic views to be referred to.

Referring to the drawings, *a* represents the cylinder of a pump of any suitable or known construction, and *b* the piston therein, whose rod *c* is directly connected with the piston *d* of a steam cylinder *e* also of usual or known construction and provided with the steam ports *f*, *g*, leading from near the ends of the cylinder *e* toward the center thereof and to the seat *h* for a main valve *i*, which is of the well-known D-form and controls communication of the ports *f*, *g*, with the exhaust port *j*.

The main valve *i* is located in a valve casing or chest 10, which is suitably secured steam-tight to the main steam cylinder *e*, and supports a cylinder 12 containing a piston 13, which is connected intermediate of its ends with the stem 14 of the main valve *i*. The valve chest 10 is in open communication with the steam supply 15 as herein shown by means of a port or passage 16. The valve chest 10 contains within it an auxiliary valve 17 (see Figs. 3, 4 and 5), which controls the passage of steam into and from the cylinder 12 as will be described, and which is secured to or forms part of an oblong yoke or carrier 18 having an elongated slot or opening 19 through which the stem 14 of the main valve *i* is extended, said slot or opening being longer than the said stem to enable the auxiliary valve to be moved independently of the main valve and vice versa, for a purpose as will be described.

The auxiliary valve carrier 18 is supported as herein shown by rods 20, 21, which are screwed into the opposite ends of the said carrier and locked by the nuts 23, 24, said rods extending through the opposite end walls of the valve chest 10. One of the rods as 21 is connected with the piston rod *c* to be moved thereby as will be described, and in the present instance, one form of connection is shown, it comprising a rod 25 pivotally connected at 26 with the rod 21 and loosely extended through a hole in the block or ball 27 pivotally connected with the upper end of a lever 28, which is pivoted at 29 to a stationary part 30 of the framework of the pump, and has its lower end joined by a link 31 with a cross head 32 fast on the piston rod *c*. The block 27 constitutes a sliding tappet device and is located between nuts or tappets 33, 34, in engagement with a threaded portion of the rod 25 and secured in their adjusted positions by the set screws 80. The tappets 33, 34, are arranged with relation to the ball or block 27 so as to enable the main piston rod *c* to mechanically move the auxiliary valve 17 and its carrier 18, and through the latter effect movement of the main valve *i* and the piston 13, and to permit the piston rod *c* to be moved for a portion of the stroke of the steam piston *d* without moving the auxiliary valve and its carrier.

The auxiliary valve controls the inlet and exhaust of steam into and from the opposite ends of the cylinder 12, which is provided at each end with separate inlet and exhaust ports, the steam inlet ports 36, 37, being located in close proximity to the end walls of the cylinder 12 and connected by passages 38, 39, with ports 40, 41, arranged in line with each other on one side of the longitudinal center of the seat 42 for the auxiliary valve 17. The exhaust ports 43, 44

are located away from the end walls of the cylinder 12 and are connected by passages 45, 46, with ports 47, 48, in the seat 42 for the auxiliary valve on the opposite side of the longitudinal center of said seat and are nearer the exhaust port 49 in said seat than the ports 40, 41.

By providing the cylinder 12 with separate exhaust ports 43, 44, and locating them away from the end walls of the cylinder 12, steam cushions are formed in closed chambers at the ends of the cylinder 12, when the exhaust ports 43, 44 are covered by the piston 13, whereby the said piston is cushioned on its movement in opposite directions by the steam confined in said closed chambers, which avoids contact of the said piston with the end walls or heads of the cylinder 12 and thereby avoids a hammer blow and the noise thereof from this source.

The steam outlet or exhaust ports 47, 48 are designed to be connected by the auxiliary valve 17 with the exhaust port 49 in the seat of the auxiliary valve, which exhaust port is connected by a passage 50 (see Fig. 5) with the exhaust port *j* of the main steam cylinder *e*.

The arrangement of the steam inlet ports 40, 41 and of the exhaust ports 47, 48, 49, in the seat of the auxiliary valve is represented in Figs. 6, 7 and 8, and by reference thereto, it will be seen that the exhaust ports 47, 48, are located between the steam inlet ports 40, 41, so that when the auxiliary valve 17 is moved so as to cover one of the exhaust ports as 47, (see Figs. 6 and 8) and to connect the exhaust ports 48, 49, the steam inlet port 40 leading to one end of the cylinder 12 will be open for the admission of live steam to one end of the said cylinder, and the steam inlet port 41 leading to the other end of the cylinder 12 will be closed, with the result that the piston 13 becomes unbalanced and will be moved by the steam admitted to one end of the cylinder 12 through the port 40, so as to move the piston 13 and with it the main valve *i* to complete the movement of the latter in one direction so as to effect movement of the piston *d* of the steam cylinder *e* in the reverse direction.

The auxiliary valve 17 is mechanically actuated from the piston rod *c* of the pump and during a portion of its movement in opposite directions, its carrier 18 engages the stem 14 of the main valve *i* and mechanically moves the latter so as to close the steam inlet port leading to one end of the steam cylinder and the exhaust port leading to the other end of the steam cylinder, before the piston in the steam cylinder *e* reaches the end of its stroke, whereby the said steam piston is cushioned by steam between it and the end of its cylinder and sudden stopping of the steam piston is prevented, thereby avoiding a water hammer in the pump, and consequently avoiding noise from this source and enabling the steam piston to be easily and smoothly stopped and then started in the opposite direction or on its return stroke by the main valve *i* being moved by the piston 13, which latter during the greater portion of the movement of the main valve is balanced by steam admitted into the opposite ends of the cylinder 12, as represented in Figs. 3 and 9.

The tappets 33, 34, are adjusted on the rod 25 with relation to the tappet device or block 27, so as to permit the desired movements of the main valve, its actuating piston and the auxiliary valve to be effected, whereby the main valve is mechanically operated by the main piston rod *c* so as to be moved thereby for the greater portion of its stroke or movement and substantially close the ports in the main valve seat, and whereby the movement of the main valve is completed by unbalancing its actuating piston.

The operation of the pump may be briefly described as follows:—Assume the parts in the position shown in Fig. 1. In this case, the piston *d* has reached the end of its stroke in the direction indicated by the arrow 60 and is beginning its return stroke. At such time, live steam is being admitted behind the piston *d* through the port *f* and auxiliary port 61, which moves the piston in the direction indicated by the arrow 62. The steam in front of the piston is forced out through the port *g*, which is connected by the main valve *i* with the main exhaust port *j*. The auxiliary valve in the position shown in Figs. 1 and 6, closes the exhaust port 47 and uncovers the inlet port 40, closes the steam inlet 41 and connects the exhaust port 48 with the main exhaust *j* by the port 49 and passage 50. On the movement of the main piston *d* for substantially one half of its stroke in the direction of arrow 62 (see Fig. 2), the auxiliary valve is not moved, but at or about the time the main piston *d* begins the second half of its stroke in the direction of the arrow 62, the block 27 engages the tappet 33 and moves the auxiliary valve in the direction of the arrow 60 to cover the exhaust port 48 and uncover the inlet port 41, which admits steam to the cylinder 12 through the port 37 to balance the piston 13, which is then moved with the main valve *i* in the direction of the arrow 60 by the auxiliary valve carrier engaging the stem 14 of the main valve, (see Fig. 3), until the main piston *d* has reached the end of its stroke in the direction of the arrow 62, at which time the main valve *i* has been moved so as to close the exhaust port *g*, and nearly closes the inlet port *f*, and at or about this time, the auxiliary valve 17, closes the inlet port 40 and connects the exhaust port 47 with the main exhaust through the port 49 and passage 50, thereby unbalancing the pis-

ton 13, which is moved substantially in an instant toward the end of the cylinder in the direction of the arrow 60 and carries with it the main valve so as to complete the movement of the latter to connect the port *f* with the exhaust port *j* and to open the port *g* to the valve chest 10 (see Fig. 4), and thereby admit live steam into the main cylinder *e* through the port *g* to move the piston *d* in the direction of the arrow 60. On the movement of the piston *d* in the direction of the arrow 60, the action of the main and auxiliary valves is the reversed so as to form steam cushions at the right hand end of the steam cylinder *e* and at the left hand end of the cylinder 12 (viewing Fig. 1). It will thus be seen that the auxiliary valve, which, as above described, may be secured to or form part of its carrier is mechanically connected with the piston rod *c* of the steam piston *d*, so that movement of the latter is imparted to the auxiliary valve and its carrier, which coöperate with the stem 14 of the main valve to mechanically move the latter and its attached piston 13 for substantially the first half of their movement in one direction while the piston 13 is balanced, and to permit the main valve to be further moved in the same direction independently of the auxiliary valve by the unbalancing of the piston 13.

The ports 36, 37, 43, 44 in the cylinder 12 are located in the bottom of the cylinder and by reference to Fig. 5, it will be seen that any moisture in the cylinder 12 can readily drain by gravity to the main exhaust, thereby freeing the cylinder 12 of water of condensation and facilitating the easy running of the pump. It will thus be observed that a steam cushion is provided in the main steam cylinder *e* for the piston *d* as the latter reaches the end of its stroke in opposite directions, and that a steam cushion is provided in the cylinder 12 for the piston 13 therein as the latter reaches the end of its stroke in opposite directions, and as a result a noiseless and smooth running pump is obtained. It will further be observed that by interposing the auxiliary valve between the cylinder 12 and the main steam cylinder, the pump is simplified and its cost reduced, inasmuch as only a single connection is needed between the auxiliary valve and the piston rod *c* of the pump.

I have herein shown one embodiment of the invention which I may prefer, but I do not desire to limit the invention to the particular construction and arrangement herein shown.

Claims.

1. The combination with the main valve of a steam pump, of a piston connected with said main valve to move it, a cylinder in which said piston is located having separate inlet and exhaust ports leading to the opposite ends of said cylinder, said exhaust ports being located a greater distance from the ends of said cylinder than said inlet ports, an auxiliary valve interposed between said cylinder and the seat for the said main valve and controlling said inlet and exhaust ports, a carrier for said auxiliary valve having an opening through which the stem of the main valve is extended, and means to connect said carrier with the piston rod of the steam pump, substantially as described.

2. The combination with the main valve of a steam pump, of a piston connected with said main valve to move it, a cylinder in which said piston is located, a valve chest for said main valve interposed between said cylinder and the seat for the said main valve, an auxiliary valve located in said valve chest and coöperating with said main valve to mechanically move the latter and to permit the main valve to be moved by its piston independently of said auxiliary valve, and coöperating with a valve seat having ports connecting said valve seat chest with said cylinder, and means to connect said auxilary valve with the piston rod of said pump, substantially as described.

3. The combination with the main valve of a steam pump, of a piston connected with said main valve to move it, a cylinder in which said piston is located, a valve chest for said main valve interposed between said cylinder and the seat for the said main valve, an auxiliary valve located in said valve chest and coöperating with said main valve to mechanically move the latter and to permit the main valve to be moved by its piston independently of said auxiliary valve and coöperating with a valve seat having ports connecting said valve chest with said cylinder, and means to operate said auxiliary valve, substantially as described.

4. The combination with the main valve of a steam pump, of a piston connected with said main valve to move it, a cylinder in which said piston is located, a valve chest for said main valve interposed between said cylinder and the steam cylinder of said pump, ports connecting said valve chest with the opposite ends of the said cylinder, an auxiliary valve in said valve chest coöperating with said ports, a carrier for said auxiliary valve having an opening through which the stem of the main valve is loosely extended to permit the main valve to be moved by said carrier and independently of said carrier, and means to connect said carrier with the piston rod of the pump, substantially as described.

5. The combination with the main valve of a steam pump, of a piston connected with said main valve to move it, a cylinder in which said piston is located, a valve chest provided with steam inlet ports leading to the opposite ends of said cylinder and with

separate exhaust ports leading to the opposite ends of the cylinder and terminating at a greater distance from the end walls of said cylinder than said inlet ports, an auxiliary valve in said valve chest between the main valve and its actuating piston and controlling said ports and coöperating with the main valve to mechanically move the latter for a portion of its movement in one direction and to permit the main valve to be moved by its piston independently of the auxiliary valve for another portion of its movement in said direction, and means to operate said auxiliary valve, substantially as described.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

BURT O. GAGE.

Witnesses:
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FRANK F. PHINNEY.