(No Model.) 2 Sheets—Sheet 1.

I. H. SPENCER.

FLUID ENGINE.

No. 533,616. Patented Feb. 5, 1895.

Fig. 1.

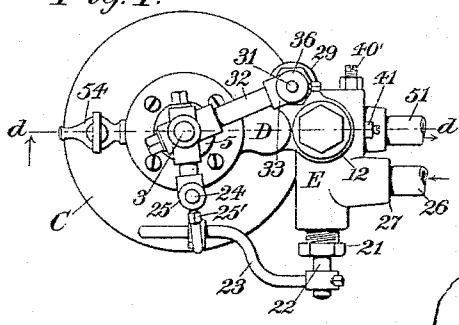


Fig. 3.

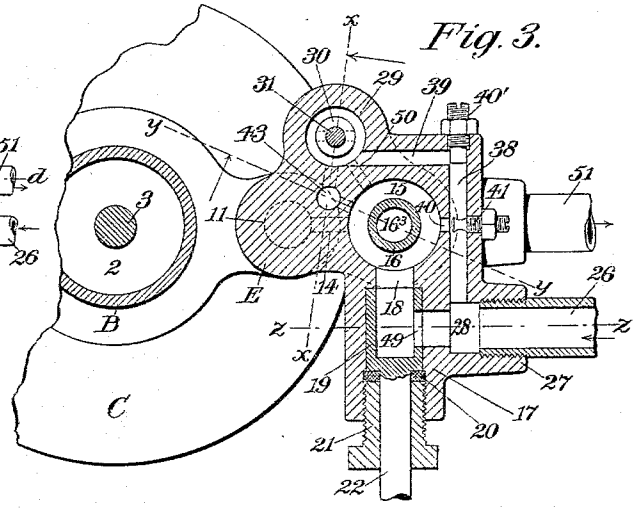


Fig. 2.

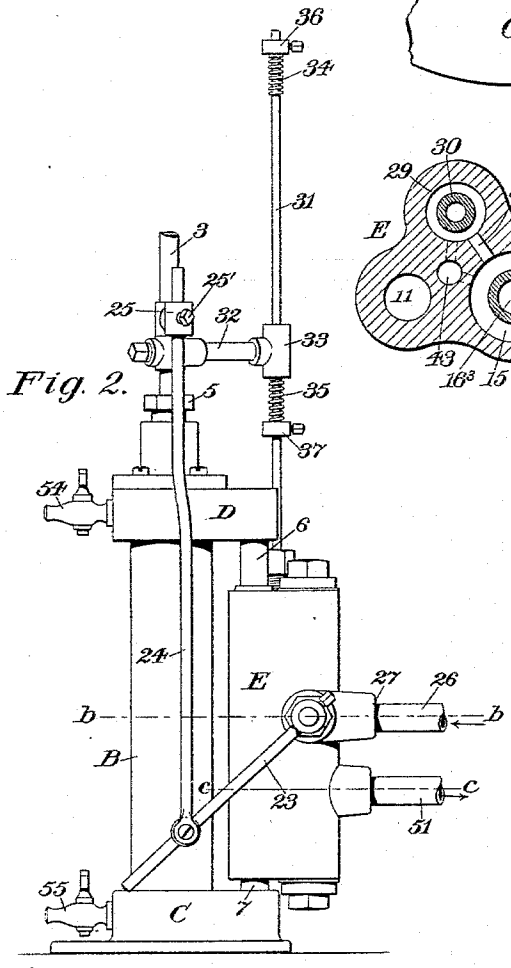
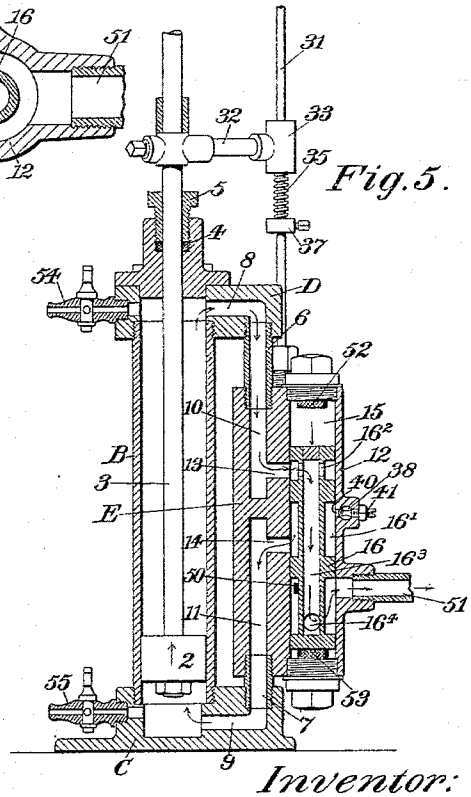


Fig. 4.

Fig. 5.



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(No Model.) 2 Sheets—Sheet 2.

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FLUID ENGINE.

No. 533,616. Patented Feb. 5, 1895.

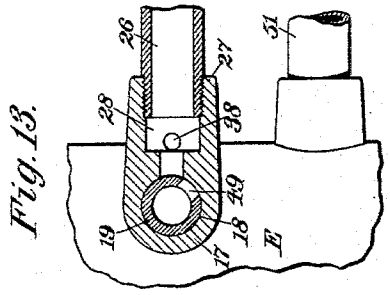

Fig. 13.

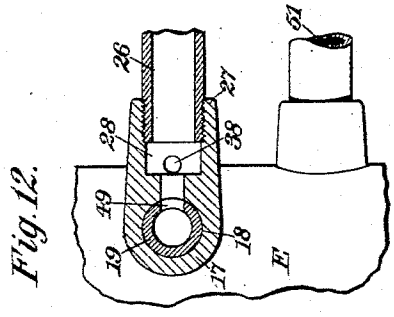

Fig. 12.

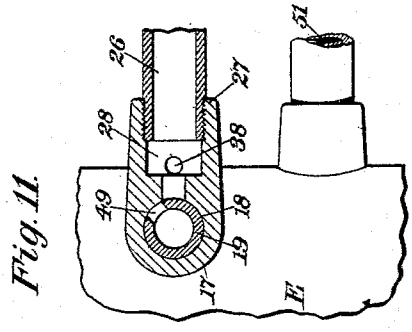

Fig. 11.

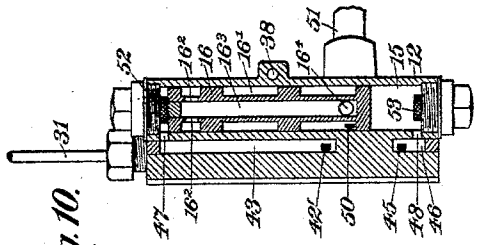

Fig. 10.

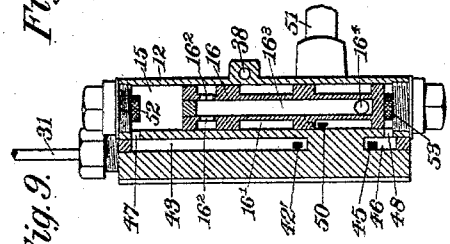

Fig. 9.

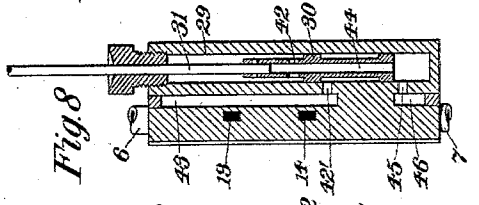

Fig. 8

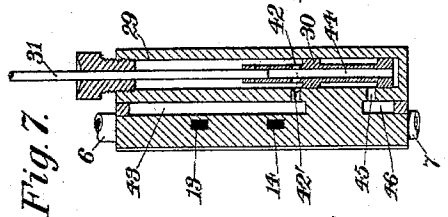

Fig. 7.

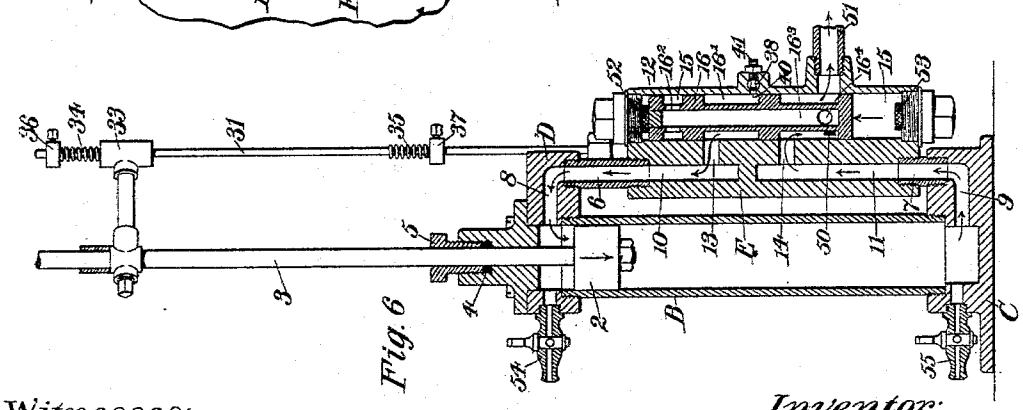

Fig. 6

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UNITED STATES PATENT OFFICE.

IRA H. SPENCER, OF HARTFORD, CONNECTICUT.

FLUID-ENGINE.

SPECIFICATION forming part of Letters Patent No. 533,616, dated February 5, 1895.

Application filed June 20, 1894. Serial No. 515,098. (No model.)

To all whom it may concern:

Be it known that I, IRA H. SPENCER, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Fluid-Engines, of which the following is a specification.

This invention relates to fluid-engines or motors, and especially to water-engines; the object being to provide a motor of this character in which hammering or pounding of the operating parts is prevented, and even and noiseless working of the piston and valve-operating mechanism assured, under constant or variable conditions of speed or pressure, by a construction having the important characteristics of simplicity, compactness, and readiness of regulation.

In the drawings accompanying and forming a part of this specification, Figure 1 is a plan view of a fluid-motor constructed in accordance with my present invention. Fig. 2 is a side elevation thereof. Fig. 3 is a transverse section in line *b—b*, Fig. 2. Fig. 4 is a similar view in line *c—c*, Fig. 2. Fig. 5 is a central vertical section in line *d—d*, Fig. 1, showing the piston rising at the beginning of a stroke. Fig. 6 is a similar view, showing the piston descending at the beginning of the opposite stroke. Fig. 7 is a vertical section in line *x—x*, Fig. 3, showing the auxiliary valve in a position corresponding to Fig. 5. Fig. 8 is a similar view corresponding with Fig. 6. Fig. 9 is a vertical section in line *y—y*, Fig. 3, corresponding to Fig. 5. Fig. 10 is a similar view corresponding to Fig. 6; and Figs. 11, 12 and 13 are transverse sections in line *z—z*, Fig. 3, showing different positions of the main valve.

Similar characters designate like parts in all the figures.

According to my present invention, I mount the main cylinder B, which comprises also a piston and means for connection with the apparatus to be driven, upon a bed-plate, C, which also forms one of the heads of the cylinder, the other or upper head being designated in a general way by D. The piston 2, mounted within this cylinder in the usual manner, is actuated by a piston-rod, 3, passing through the head D, and surrounded by packing rings, 4, having an adjusting-follower 5. A body-portion or casting, designated in a general way by E, is mounted between the heads C and D, and has connection with the upper and lower ends of the cylinder through the short-sections of piping, 6 and 7, opening, respectively, into the channels 8 and 9 in said cross-heads. The vertically-disposed passages or ways 10 and 11, in said casting, are connected with, and in line with, said pipe-sections, and open into the valve-chest or casing 12, through the ports 13 and 14. Within the main-valve cylinder, 15, formed by this casing, the vertically-disposed piston-valve 16 works. Within a transverse portion, 17, of the casting E, is a valve-seat, 18, in which the valve 19, controlling the main fluid-supply, is adapted to oscillate. Packing rings, 20, and an adjusting-follower, 21, are provided to compensate for wear upon the valves. The stem 22 of this valve is firmly secured to an actuating-link or lever, 23, controlled from the piston-rod 3 by means of the connecting-rod 24, secured to said piston-rod by the collar 25 and the adjusting-screw 25′. The supply-pipe 26 enters the casting E at the point 27, and controls the channel or way, 28, leading to the ports 13 and 14, and also controls the smaller passages or ducts, 38 and 39, leading to an auxiliary valve-casing, 29. Within this valve-casing is an auxiliary or starting valve, 30, controlled, through its stem 31, by the main piston-rod 3. The connection for said valve-stem comprises a connecting-rod 32, firmly secured to the piston-rod 3, and having a sleeve 33 upon its end, within which the valve-stem 31 reciprocates. Buffer-springs 34 and 35, having adjustable stops, 36 and 37, control the movements of the auxiliary valve 30 and prevent the occurrence of shocks at the end of the movements thereof. A pin- or needle-valve, 40′, controls the passages or ducts 38 and 39, while a port, 40, also supplied from the main pipe 26, is controlled by a second pin- or needle-valve, 41. The port 40 opens into the main-valve cylinder 15, and is adapted to continuously supply a small head of water or other fluid to the way 16′ between the main valve 16 and its cylinder 15. This head of

water, it will be observed, will not flow into the piston-cylinder B until the main valve 16 has been moved sufficiently far to clear one of the ports, 13 or 14, controlling the admission of water to the piston-cylinder. The movement of said valve 16 is controlled by the auxiliary valve 30, which acts to reverse the direction of movements of the valve 16, the main exhaust being either through ports 13 and 16^2, bore 16^3 and port 16^4, or directly through port 14.

When a supply of water is admitted through the pipe 26, a portion of it will flow through the seat 28 into the way 38, from which it will pass partly through the port 40 and partly through the way 39. That portion of the stream which goes by way of channel 39 will enter the auxiliary valve-cylinder 29, and, in accordance with the position in which said auxiliary valve may be at the time, will either flow through the ports 42 and duct 42′ into the vertically-disposed channel or way 43, or else through said ports and the longitudinal bore 44 of the valve, port 45 and the shorter vertically-disposed channel or way 46 in line with the way 43, whence the stream will go by way of one of the ports 47 or 48 into the corresponding end of the valve-cylinder 15. As soon as the water enters this cylinder 15, the valve 16 will move in a corresponding direction, and will uncover one of the ports 13 or 14 leading into the piston-cylinder B by way of the passages 6 and 8, or 7 and 9. As soon as the water enters this piston-cylinder, the piston 2 will begin to correspondingly rise or fall, and will gradually uncover the port 49 in the valve 19, whereupon the flow of water into the cylinder will be gradually increased by the corresponding increase of the port-area. As before stated, the uncovering of the port in the valve 19 is effected by means of the link or lever 23, operated from the piston-rod 3 by means of the connecting-rod 24. When the piston 2 reaches the median line of the cylinder, the port will have been entirely uncovered, as shown in Fig. 12, the link 23 then lying in a horizontal position. If the piston is rising, the further upward movement thereof will gradually decrease the port-area 49 until the port is entirely closed, as shown in Fig. 13. When the end of the stroke is reached, the sleeve 33, acting upon the buffer-spring 34, will raise the valve-stem 31 and with it the valve 30, thereby reversing the direction of flow of the stream entering the auxiliary-valve cylinder 29. The inflowing stream will then go by way of the ports 42 and the bore 44 of the valve 30 into the lower end of the cylinder 29, through the port 45, vertical way 46, and port 48 under the lower end of the piston-valve 16, and will raise said valve to the position shown in Fig. 6, cutting off the supply from the port 14 and causing the port 13 to be uncovered. As soon as the direction of flow into the cylinder B has thus been reversed, the piston 2 will fall gradually, by reason of the flow of the small stream entering the port 40 into the upper part of the cylinder B through the port 13. At the same time the water above the piston-valves 16 will be forced through the port 47, vertical passage 43 and duct 42′, into the valve-cylinder 29, and through port 50 to the lower part of the cylinder 15, and thence out into the main exhaust 51. As the piston 2 gradually falls, the port 49 will be uncovered, until the full port-area is presented to the head of water entering through the main supply channel 18; and the port, upon the continued fall of the piston, will then be as gradually covered again and the port-area diminished until it reaches zero; the speed of the piston, of course, correspondingly and gradually decreasing until the end of its stroke is reached, when the auxiliary valve will then be carried by the sleeve 33, acting upon the buffer-spring 35, from its upper to its lower position, and the entering stream will then go through ports 42, duct 42′ and vertical way 43, to port 47, and into the upper end of the main-valve cylinder 15, causing the valve 16 to descend, close the port 13 and uncover port 14. At the same time the body of water under the piston 16 is forced through port 48, vertical way 46, port 45, cylinder 29 and port 50, back into the cylinder 15 and out through the main exhaust 51.

From the foregoing it will be seen that the beginning of movement of the operating-piston 2 is not dependent upon the supply of water thereto through the main port 49, but that a fine stream, entering the cylinder 15 through the port 40, and entering the cylinder by way of one of the ports 13 and 14, is sufficient to start the piston, and to carry it in its stroke from one end of the cylinder to the other, if necessary, so long as the small head of water is supplied to the cylinder. It is not necessary, however, that the entire stroke be effected by the smaller head entering at the port 40, for, when the piston has advanced a certain distance from either cylinder-head, the main port 49 is gradually uncovered by the link 23, and increased pressure applied to the piston to carry it forward to the end of its stroke. It will also be seen that after the maximum speed is attained, the pressure gradually decreases, owing to the correspondingly gradual reduction of the area of the port 49, until the port 49 is entirely closed and the only pressure applied to the piston is the momentary pressure of the smaller head of water entering through port 40, until the reversal of the main valve 16 by the reversal of the auxiliary valve 30 due to the action of the sleeve 33 upon the buffer-spring. It will also be observed that the exhaust-ports in the main and auxiliary valves are so disposed that there can be no back-pressure in the various ways and channels.

A very perfect control of pressure is obtained by means of the two needle-valves 40′

and 41, each independently regulable, acting in conjunction with the port 49, automatically regulable from the main piston-rod.

I prefer to cushion the cylinder-heads of the main-piston valve 16, as shown at 52 and 53, in order to prevent shocks upon the main valve. An additional cushioning effect is also obtained, in connection with the auxiliary valve 30, by means of the adjustable buffer-springs. I also provide valves, 54 and 55, connecting with opposite ends of the main cylinder B, in order to draw off accumulated spent fluid when the motor is not in use.

A very compact, noiseless and easy-running motor is obtained by this construction, entirely automatic in operation, self-adjusting for wear and requiring no attention.

By means of the described organization of cylinders and pistons, valves, main ports, auxiliary ports and means for adjusting the auxiliary ports or passages, I produce a motor of the class specified which is capable of adjustment to operate smoothly and without jar or shock at one speed under different pressures, and also at different speeds under the same pressure. By this means, therefore, the motor is adapted for general use, and does not require to be specially constructed or proportioned for the particular work and pressure of water-supply under which it is to be used.

Having thus described my invention, I claim—

1. In a fluid-engine, the combination with the main cylinder and its piston, of main and auxiliary supply-ports, a main valve controlling the port-area of the main supply-port and connected with and actuated by the main piston, a piston-valve controlling the direction of the main- and the auxiliary-supply, an auxiliary valve, means connected with the main piston for controlling the movements of said auxiliary valve, and piston-valve-controlling passage-ways leading from the auxiliary supply-port and passing through the auxiliary valve and alternately in communication with opposite ends of the piston-valve in accordance with the movements of said auxiliary valve, substantially as described.

2. In a fluid-engine, the combination with the main cylinder and its piston, of a main supply-port for said cylinder, a progressively-opening and -closing valve connected with and actuated by the main piston and controlling the main supply-port and having its maximum port-area at the middle of each stroke, two auxiliary supply-ports, a piston-valve controlling the direction of the main supply and of the first auxiliary supply, an auxiliary valve, means connected with the main piston for controlling the movements of said auxiliary valve, and piston-valve-controlling passage-ways leading from the second auxiliary supply-port and passing through the auxiliary valve and alternately in communication with opposite ends of the piston-valve in accordance with the movements of the auxiliary valve, substantially as described.

3. In a fluid-engine, the combination with the main cylinder and its piston, of a main supply-port, an auxiliary supply-port, a main valve controlling the port-area of the main supply-port and connected with and actuated by the main piston, a piston-valve controlling the direction of the auxiliary supply, an auxiliary valve, means connected with the main piston for controlling the movement of said auxiliary valve, and piston-valve-controlling passage-ways leading from the auxiliary supply-port and passing through the auxiliary valve and alternately in communication with opposite ends of the piston-valve in accordance with the movements of the auxiliary valve, substantially as described.

4. In a fluid-engine, the combination with the main cylinder and its piston, of main and auxiliary supply- and exhaust-ports, a piston-valve controlling the direction of the main- and the auxiliary-supply and controlling also the main exhaust, an auxiliary valve, means connected with the main piston for controlling the movements of said auxiliary valve, piston-valve-controlling passage-ways leading from the main supply-port and passing through the auxiliary valve and alternately in communication with opposite ends of the piston-valve in accordance with the movements of said auxiliary valve, auxiliary exhaust passages leading from each end of the piston-valve and alternately having communication with a passage-way extending around the auxiliary valve, a passage-way extending around the piston-valve and in constant communication with the main exhausts, and a channel connecting said passage-ways of the auxiliary and piston valves, substantially as described.

5. In a fluid-engine, the combination with the main cylinder and its piston, of a main supply-port and auxiliary supply-ports, a piston-valve controlling the direction of the main-supply and of the first auxiliary-supply, an auxiliary valve, means connected with the main piston for controlling the movements of said auxiliary valve, and piston-valve-controlling passage-ways leading from the second auxiliary supply-port and passing through the auxiliary valve and alternately in communication with opposite ends of the piston-valve in accordance with the movements of the auxiliary valve, substantially as described.

6. In a fluid-engine, the combination with the main cylinder and its piston, of a main supply-port and auxiliary supply-ports, a piston-valve controlling the direction of the main-supply and of the first auxiliary-supply and controlling also the main exhaust, an auxiliary valve, means connected with the main piston for controlling the movements of said auxiliary valve, piston-valve-controlling

passage-ways leading from the second auxiliary supply-port and passing through the auxiliary valve and alternately in communication with opposite ends of the piston-valve in accordance with the movements of said auxiliary valve, auxiliary exhaust passages leading from each end of the piston-valve and alternately having communication with a passage-way extending around the auxiliary valve, a passage-way extending around the piston-valve and in constant communication with the main exhaust, and a channel connecting said passage-ways of the auxiliary and piston valves, substantially as described.

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