No. 612,596. Patented Oct. 18, 1898.

I. H. SPENCER.

WATER MOTOR.

(Application filed Feb. 16, 1898.)

(No Model.)

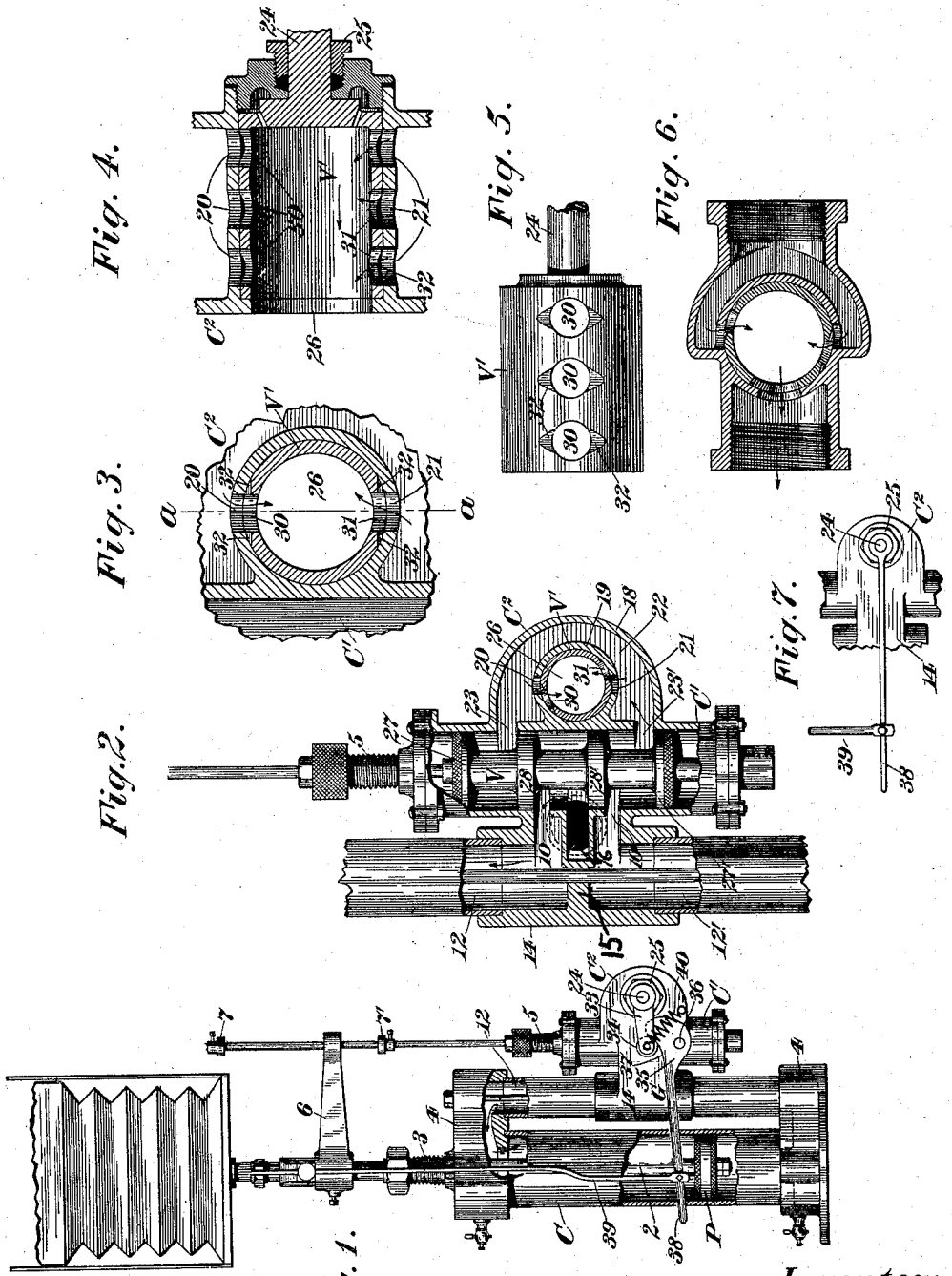

Fig. 1.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 3.

Fig. 7.

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WATER-MOTOR.

SPECIFICATION forming part of Letters Patent No. 612,596, dated October 18, 1898.

Application filed February 16, 1898. Serial No. 670,482. (No model.)

To all whom it may concern:

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

This invention relates to fluid engines or motors, and more particularly to water-motors, one object of my present invention being to provide an improved fluid-motor comprehending means whereby during operation the movements of the working parts will be practically noiseless, obviating the disagreeable whistling or groaning noises incidental to motors of ordinary construction during exhaust, and to so construct and organize the constituent elements that the motor will be compact and easy of regulation, and thereby to especially adapt the same for use in connection with organs for operating the bellows thereof and in other places where a noiseless and efficient motor is required.

A further object of the invention is to furnish an improved fluid-motor embodying, in connection with the main valve and piston, an auxiliary-valve chamber having a substantially tubular valve-seat and also having a waterway surrounding two sides of said seat and communicating with opposite ends of the main-valve chamber, an auxiliary valve seated in the auxiliary-valve seat and so constructed and supported as to be accurately balanced circumferentially, and an actuating-connector between said valve and piston.

A further object of the invention is to provide, in connection with the main-valve chamber and main valve of a fluid-motor, an improved auxiliary valve embodying means, in connection with the ports thereof, for disseminating or spreading the fluid as it enters said ports, whereby to prevent noises incidental to valves of ordinary construction in fluid-motors.

In the drawings accompanying and forming part of this specification, Figure 1 is a side elevation, partially in section, of a water-motor embodying my invention in one form thereof, the actuating-connector between the piston and auxiliary valve being shown in this figure as embodying a cam for securing variable movements of said valve during the operation of the piston and the piston being shown in operative connection with a bellows. Fig. 2 is a similar side elevation, partially in section and on an enlarged scale, of a portion of the water-motor, showing the main and auxiliary-valve chambers, the main valve and auxiliary valve, and the ports leading from the main-valve chamber to the main cylinder and from said valve-chamber to the auxiliary-valve chamber, the main valve being in this figure shown as a spool-valve and in position to admit fluid to the upper end of the main cylinder and the auxiliary valve being shown in the position it occupies when the piston has passed the center of its stroke. Fig. 3 is an enlarged sectional view, similar to Fig. 2, of a portion of the exhaust-chamber, showing the auxiliary valve thereof in its wide-open position. Fig. 4 is a longitudinal section of the auxiliary valve and seat, taken on a line corresponding with the dotted line *a a*, Fig. 3, looking toward the right in said figure. Fig. 5 is a plan view of a portion of the auxiliary valve detached. Fig. 6 is a longitudinal section of a slightly-modified form of tubular auxiliary valve and the casing therefor; and Fig. 7 is a side view, similar to Fig. 1, of a portion of the water-motor, showing a slightly-modified form of actuator for the auxiliary valve.

Similar characters designate like parts in all the figures of the drawings.

In the drawings I have shown only so much of one type of water-motor as is deemed necessary to fully illustrate the application and mode of operation of my present improvements, and it is desired to state that with the exception of the auxiliary-valve casing, auxiliary valve, auxiliary-valve actuator, and closely-allied elements constituting the subject-matter of the claims herein I do not wish to limit myself to any particular form, construction, or organization of fluid-motor, as my improvements are applicable to motors of various kinds.

Briefly stated, the motor illustrated in the accompanying drawings comprises in a general way the main cylinder C; a main-valve chamber C', communicating with opposite ends of the main cylinder, as hereinbefore

described; a piston P, working in the main cylinder and having a piston-rod 2 extending through a suitable stuffing-box 3 in one cylinder-head 4; a main valve V, having a valve-stem extending through a stuffing-box 5, secured in one end of the head of the valve-chamber; a cross-head or valve actuating arm 6, fixed to the piston-rod and coöperating with stops 7 and 7′ on the valve-stem to actuate said valve; an auxiliary-valve chamber or casing C^2, having two ports communicating with the valve-chamber C′; an auxiliary valve V′, supported in the auxiliary-valve chamber in such a manner and of such construction as to be longitudinally and circumferentially balanced by the fluid contained in said chamber, and an actuating-connector (designated by G) between the auxiliary valve and piston.

The main cylinder C is shown as a tube seated at opposite ends in annular grooves in the castings or heads 4 and 4′, and the valve-chamber C′ is shown as a cylinder parallel to the main cylinder and having at one side thereof two ports 10 and 10′, which communicate with port passages or conduits 12 and 12′, respectively leading to opposite ends of the piston-cylinder, the passage-ways 12 and 12′ being formed by tubes disposed in parallelism with the cylinder C between the valve-chamber and cylinder and seated the one 12 at its upper end in an annular groove formed in an extension of the cylinder-head or casting 4 and the one 12′ at its lower end in an annular groove formed in the cylinder-head or base-casting 4′, passage-ways being formed in the heads 4 and 4′, respectively, for establishing communication between the passage-ways 12 and 12′ at opposite ends of the main cylinder. The inner ends of the conduits 12 and 12′ are seated in a casing or bracket 14, formed, preferably, integral with the central portion of the valve chamber or casing C′, this casing being divided horizontally at the central portion thereof by a partition 15, having an inlet-passage 16 communicating with the valve-chamber C′ and which is located between and separates the two ports 10 and 10′ of the valve-chamber, said inlet-passage 16 in practice communicating with any suitable supply-pipe (not shown) through the medium of a supply-valve (not shown) or in any suitable manner.

In the form thereof illustrated in Figs. 1, 2, and 3 of the drawings the auxiliary-valve chamber C^2 is formed integral with the main-valve chamber C′ and comprises an outer wall 18 (shown parti-cylindrical) and a substantially tubular valve-seat 19 of less radius than and in concentric relation with the wall 18 and which seat 19 has diametrically opposite passage-ways or ports 20 and 21 communicating with the space or waterway 22, formed between the valve-seat and outer wall 18, which waterway communicates at opposite sides of the valve-seat with opposite ends of the main-valve chamber C′ through ports 23 and 23′, respectively, these ports 23 and 23′ constituting, in the organization illustrated in said figures, exhaust-ports for the valve-chamber C′, and the chamber C^2 constituting an exhaust-chamber. The auxiliary valve V′ is mounted in the valve-seat 19 for oscillatory movement, with its axis preferably at right angles to the axis of the valve V, and is shown (see Figs. 4 and 5) as a tube of uniform diameter its entire length, it being open at one end and having its opposite end closed and provided with a valve-stem 24, which extends through a stuffing-box 25 in the end wall of the valve-chamber C^2, the open end of said valve communicating with an outlet-passage 26 in the opposite end wall of said chamber C^2, as will be readily understood by reference to Fig. 4 of the drawings.

The main valve V is shown as a spool-valve having two circumferential flanges or heads 27 and 27′ at opposite ends, respectively, thereof and having two intermediate circumferential flanges 28 and 28′, respectively, which control the supply and exhaust, through the ports 10 and 10′, to and from the main cylinder in the usual manner.

The auxiliary valve V′ in the organization thereof shown in Figs. 1 to 5, inclusive, of the drawings has its outlet at one end thereof and has two series of inlet-ports 30 and 31 formed through diametrically opposite portions thereof, there preferably being three inlet-ports in each series, and said ports being in position for registering with the exhaust-ports 20 and 21 of the valve-seat 19.

As a means for changing the natural course of the fluid in its passage from the waterway 22 of the auxiliary-valve chamber C^2 into the auxiliary valve V′, whereby to disseminate or spread the fluid and prevent the obnoxious whistling or groaning noises incidental to motors having unbalanced auxiliary valves of ordinary construction, said valve V′ has formed in the periphery thereof, contiguous to each inlet-port, one or more depressions, indentations, or grooves 32, each of which merges at one end into each port and terminates at its opposite end intermediate this port and the diametrically opposite port, or, in other words, one or more portions of the side walls or edges of the ports are inclined or tapered inwardly for a short distance, so that the one or more portions of the extreme inner edges of the port will be of considerably less thickness than the adjacent main body portion of the valve. These grooves or indentations may be formed in the valve by milling or in any other suitable manner, and preferably extending from a point only slightly remote from the extreme edge of the valve-port to said edge, preferably in a plane substantially at right angles to a line drawn through the center of said port, as will be understood by reference to Fig. 3 of the drawings.

In Fig. 6 of the drawings the auxiliary-valve casing is shown somewhat in the nature of a pipe-coupling having internally-screw-

threaded inlet and outlet ends, whereby the same may be fitted to a supply or exhaust pipe section (not shown) communicating with the main-valve chamber and also having a substantially annular valve-seat formed intermediate its ends to receive the valve V′ and having a waterway-passage or way extending around slightly more than one-half of the valve-seat, the valve being shown in connection with this casing being of substantially the same general construction and organization as the valve illustrated in Figs. 3, 4, and 5, the only difference being that the opposite ends of the valve will be closed and the outlet for said valve will be formed in one side thereof and will be in position to communicate with an outlet-port in the side of the valve-seat, which is preferably in axial alinement with the opposite tubular ends of the casing, each inlet-port of the valve and valve-seat being shown in said figures of substantially the same construction and organization as each of those shown in Figs. 2 to 5.

The actuating-connector G, between the auxiliary valve V′ and the piston-rod 2 of the piston P, comprises in the preferred form thereof (shown most clearly in Fig. 1 of the drawings) a crank-arm 33, fixed to the valve-stem 24 outside the casing C^2 and having at the outer end thereof a roller 34, a valve-actuating cam 35, pivotally supported at 36 on a portion of the valve-casing and having a working face 37 in bearing engagement with the roller 34 of the crank-arm 33 and also having an outwardly-extending arm 38, and a connecting-rod 39, preferably adjustably secured at the lower end thereof to the outer end of the cam-arm 38 and pivotally secured at its upper end to the cross-head or arm 6 of the piston-rod 2, the crank-arm 33 being held in positive engagement with the working face 37 of the cam 35 preferably by a spring 40, secured at one end to the outer end of the crank-arm and at its opposite end to a part on the casing C^2.

The cam 35 may have a working surface of any suitable construction capable of securing the requisite variations in movements of the valve V′ at different points in the stroke thereof and the requisite ratio of movement between said valve and the piston.

I do not wish to limit myself to the particular construction and organization of actuating-connector between the valve V′ and piston, as these may be variously modified within the purview of my invention.

In Fig. 7 of the drawings I have shown the connection between the connecting-rod 39 and the valve-stem 24 as a crank-arm fixedly secured at its inner end to said valve-stem and at its outer end to the connecting-rod, the cam 35 (illustrated in Fig. 1) being in this instance dispensed with.

By constructing and organizing the valve V′ as hereinbefore described said valve is positively balanced within the valve-chamber circumferentially. Furthermore, the construction thereof is such that the fluid in entering the valve will be so disseminated or spread as to obviate obnoxious noises, such as whistling and groaning, inherent in valves of motors of ordinary construction.

By practical experiment I have discovered that a motor-valve which is not perfectly balanced will during operation be subjected to great wear and also that a well-balanced motor-valve will, unless means are provided in connection therewith for disseminating or spreading the fluid during its entrance to said valve, emit a groaning or whistling noise; and it is one of the principal objects of my present invention to obviate these disadvantages and to also provide a valve mechanism which will positively prevent detrimental reactionary influences especially noticeable in an organ when the motor is used in connection with the bellows of said organ and which are principally due to the vibratory action of the bellows.

The positive-stroke motor herein described has several points of advantage over ordinary motors—to wit, a noiseless action, the elimination of the throb or jar inherent in motors of ordinary construction by the gradually checking of the piston near the ends of the strokes, and the positive obviation of groaning and whistling noises before referred to.

By the construction and organization of the parts of the motor as hereinbefore described, and illustrated in the accompanying drawings, the piston can be operated at different speeds at different parts of the stroke and the auxiliary valve may have variable velocities at different points in its stroke.

The operation of the motor will be readily understood by any one skilled in the art on reference to the several figures of the drawings, it being understood that water or other fluid will, in practice, be admitted to the inlet-port 16, whence it is delivered, when the valve V is in the position shown in Fig. 3 of the drawings, to the upper end of the cylinder through the port 10 and passage or conduit 12, the water below the piston P being exhausted through the passage-way 12′, through the port 10′, into the valve-chamber C′, and thence into the exhaust-chamber C, whence it passes through the opposite ports 30 and 31 of the auxiliary valve and through the outlet 26, communication between the port 23 of the waterway 22 being cut off from the main cylinder by the flange 28 of the main valve.

By constructing the valve V, its valve-chamber C′, and the auxiliary-valve chamber C^2 in the manner illustrated most clearly in Fig. 2 of the drawings it will be seen that the valve V will also be balanced in its cylinder.

Having described my invention, I claim—

1. A water-motor embodying a main cylinder; a piston working in said cylinder; a main-valve chamber having port-passages leading to opposite ends, respectively, of said cylinder; a valve in said chamber; means in connection with the piston for operating the

valve; an auxiliary-valve chamber having ports leading to the main-valve chamber; a tubular and balanced valve supported for oscillatory movement in the auxiliary-valve chamber and having ports leading from the interior of said valve and in position for communicating with the ports of the valve-chamber, said valve having a series of fluid-spreading grooves formed in its periphery adjacent to and merging in the respective ports, said grooves being adapted to disseminate the fluid as it passes through the ports; and an actuating-connector between this last-mentioned valve and piston.

2. A water-motor comprising a main cylinder having a piston working therein; a communicating valve-cylinder having a spool-valve therein; means carried by the piston-rod for imparting an opening-and-closing movement to the spool-valve at predetermined points in opposite strokes, respectively, of the piston; an exhaust-chamber having a tubular valve-seat with a waterway partially surrounding the same, and said seat also having diametrically opposite ports; a tubular auxiliary valve of uniform diameter from end to end having a central exhaust-opening and also having diametrically opposite ports leading from said exhaust-opening to the exhaust-chamber; and a valve-actuator connecting the last valve and piston and constructed to impart a variable movement to said valve to decrease or increase the volume or exhaust at predetermined points, whereby to control the action of said piston.

3. A water-motor embodying a main cylinder; a piston working in said cylinder; a main-valve chamber having port-passages leading to opposite ends, respectively, of said cylinder; a valve in said chamber; means in connection with the piston for operating the valve; an auxiliary-valve chamber having ports leading to the main-valve chamber; a tubular valve supported for oscillatory movement in the auxiliary-valve chamber and having ports leading from the interior of said valve and in position for communicating with the ports of the valve-chamber, the construction of said tubular valve being such that the same will be balanced circumferentially; and an auxiliary-valve actuator operatively connecting the said valve and piston and embodying a cam for effecting relatively-variable movements of the valve and piston, whereby to secure predetermined variations in the velocity of said valve at predetermined points in the movements of the piston and control the operation of said piston.

4. A fluid-motor comprising a main piston-cylinder having a piston; a main-valve cylinder having port-passages leading to the piston-cylinder and also having a valve; an exhaust-chamber embodying a substantially annular valve-seat having ports at diametrically opposite sides thereof, and a fluid-passage extending partially around said seat and communicating with opposite ends of the main-valve cylinder; an auxiliary valve located in said valve-chamber and having diametrically opposite ports disposed to register with the ports of said seats, and also having in the periphery thereof contiguous to said ports indentations or grooves each of which merges at one end into one port and terminates at its opposite end intermediate this port and the diametrically opposite port, and the construction thereof being such as to spread or disseminate the fluid as it passes through the ports, whereby to prevent noise; and an actuating-connector between the auxiliary valve and piston.

5. A water-motor comprising a main piston-cylinder having a piston; a main-valve cylinder communicating with the main piston and also having a valve; means for operating said piston and valve; an exhaust-chamber communicating with the main-valve cylinder; and a tubular balanced exhaust-valve open at one end and having one or more peripheral ports, and also having on its periphery one or more grooves merging into said port or ports, said grooves serving to disseminate or change the course of the water as it passes through said ports; and means for operating said exhaust-valve.

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