No. 612,437. Patented Oct. 18, 1898.

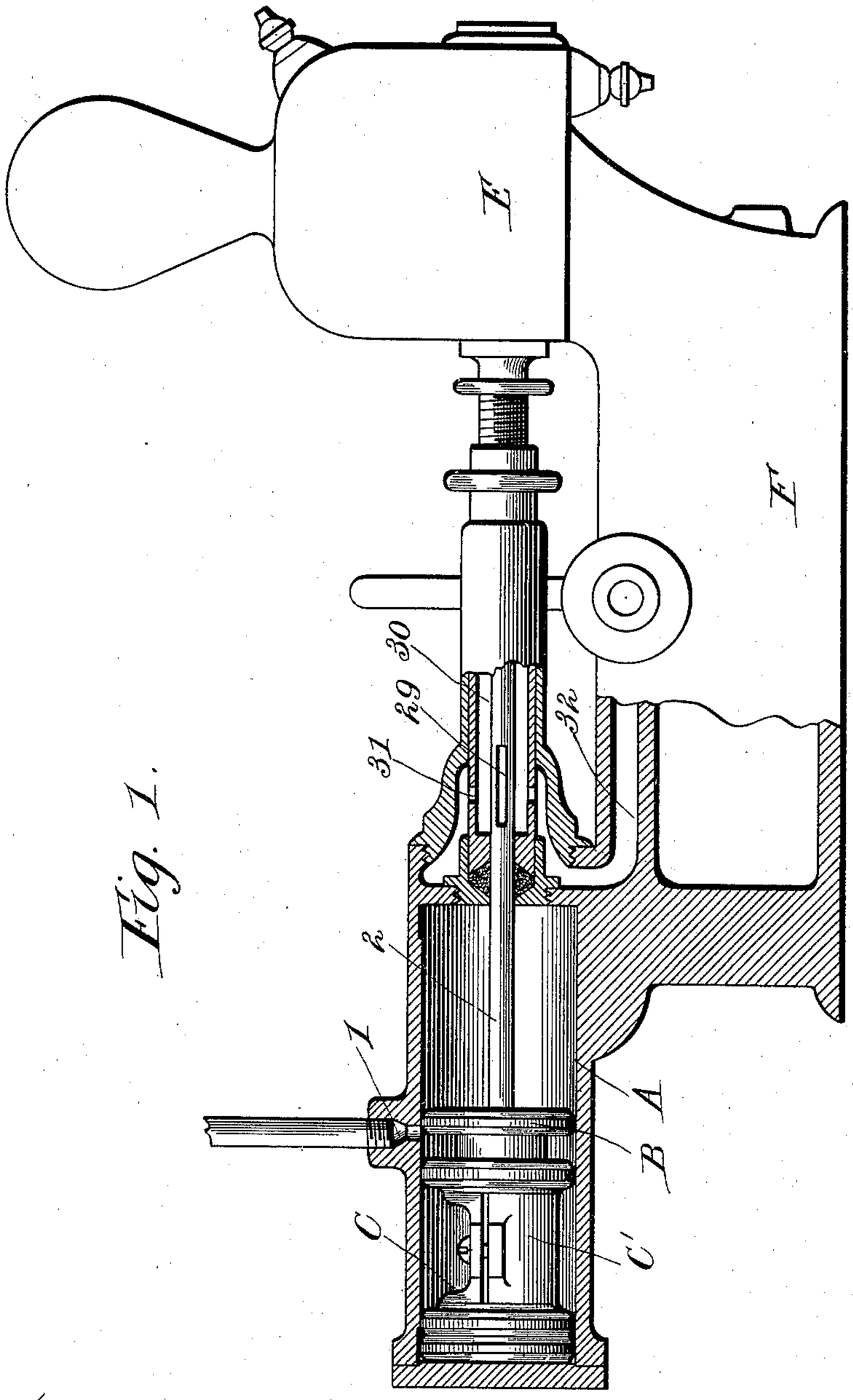
J. B. RHODES.

STEAM ACTUATED VALVE.

(Application filed Oct. 11, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

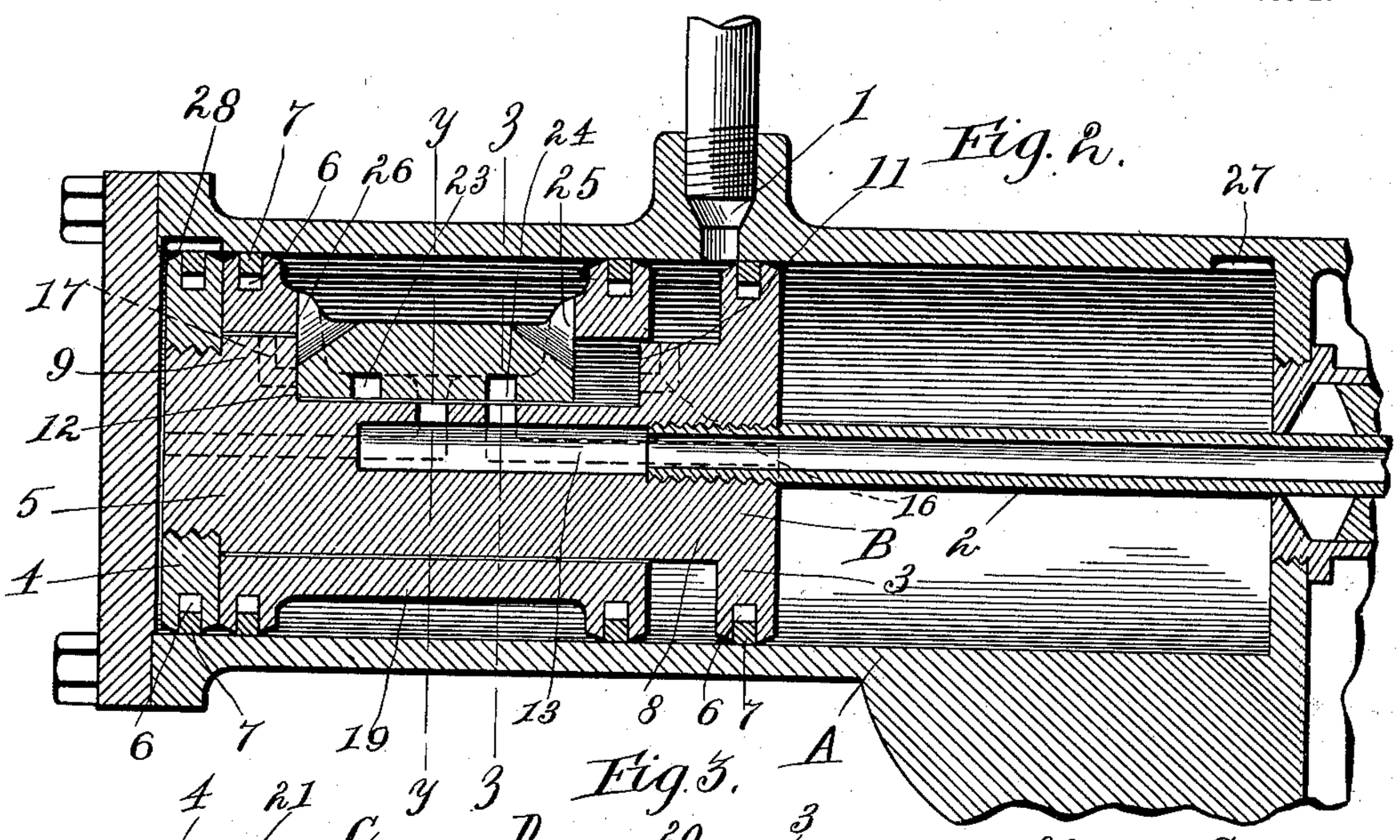


Fig. 2.

Fig. 3.

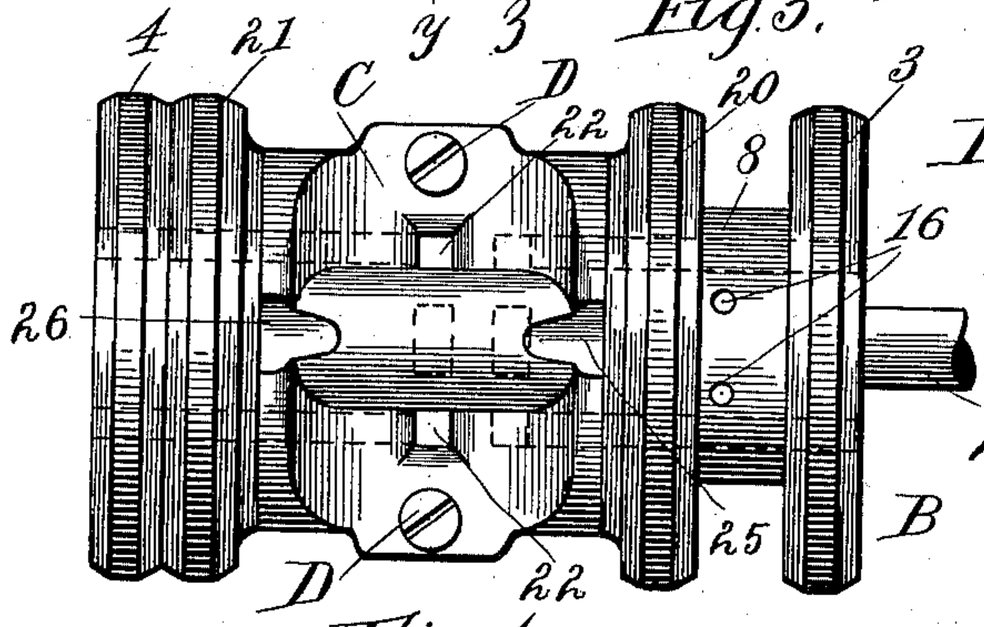


Fig. 5.

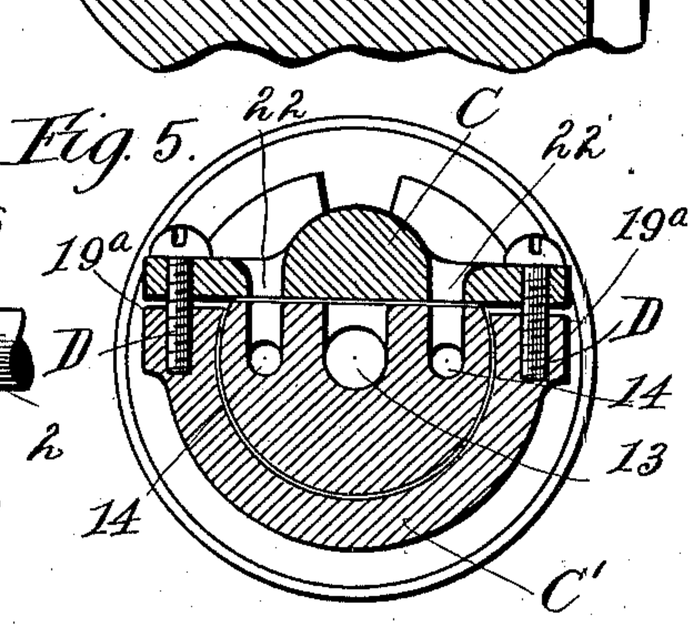


Fig. 4.

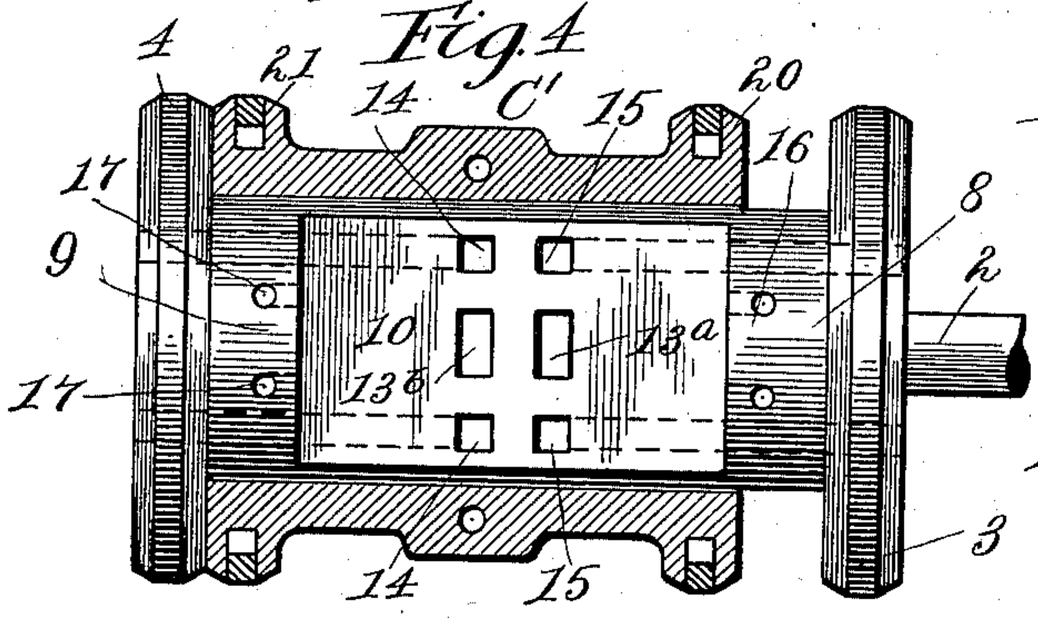


Fig. 6.

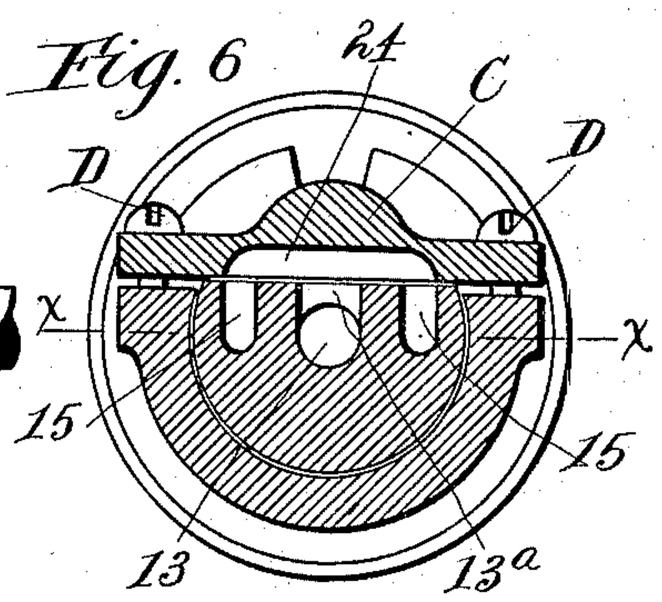
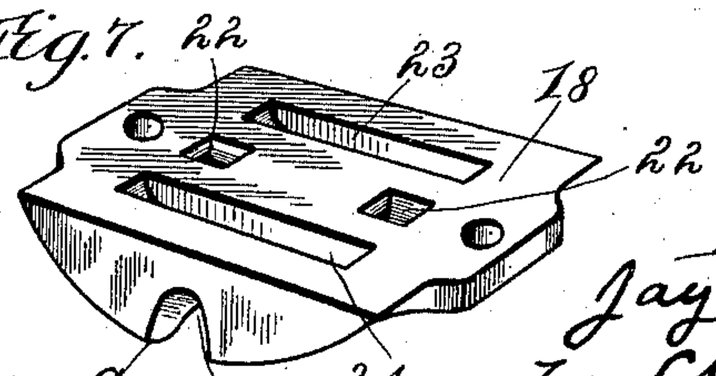


Fig. 7.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 8.

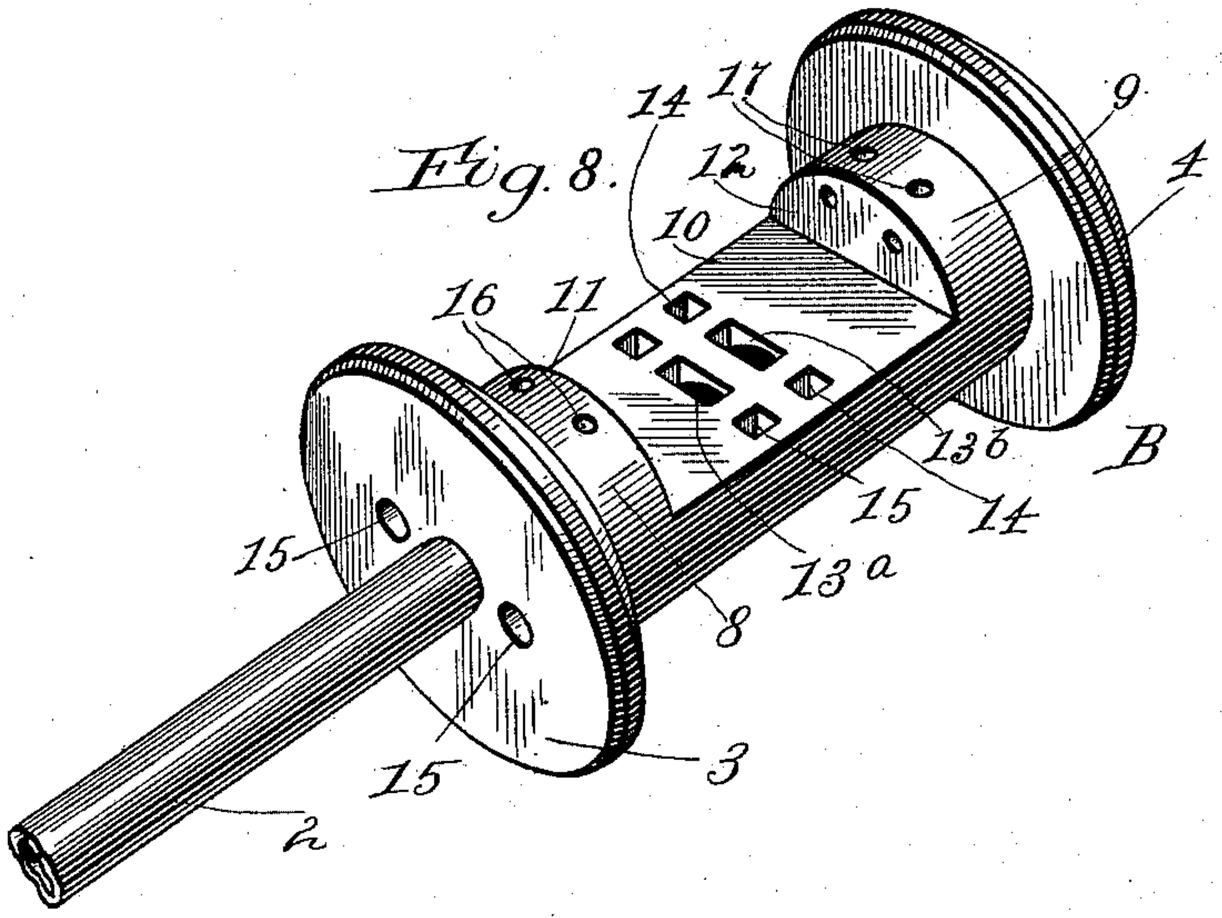
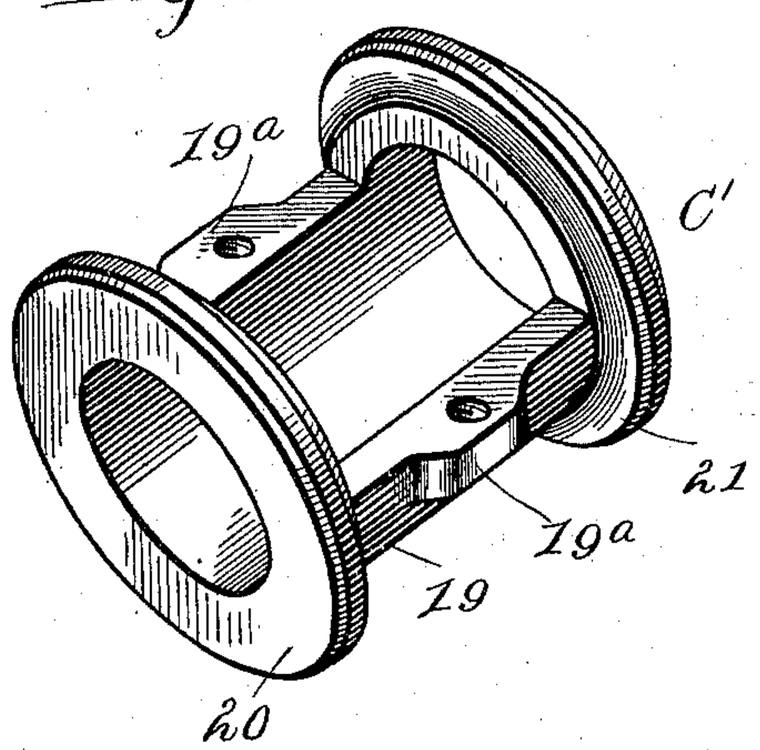


Fig. 9.



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UNITED STATES PATENT OFFICE.

JAY B. RHODES, OF CHICAGO, ILLINOIS, ASSIGNOR TO FREDERICK C. AUSTIN, OF SAME PLACE.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 612,437, dated October 18, 1898.

Application filed October 11, 1897. Serial No. 654,813. (No model.)

To all whom it may concern:

Be it known that I, JAY B. RHODES, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Steam or other Motive-Fluid Actuated Valves, of which the following is a specification.

My invention relates to steam or other motive-fluid actuated valves for pistons of the kind in which the valve is arranged within the piston-cylinder and adapted and arranged for controlling supply and exhaust ports with which the piston is provided.

My invention contemplates a steam or other motive-fluid actuated piston having a valve-seat and provided with a steam or other motive-fluid actuated valve device which comprises a valve arranged to slide along said valve-seat and capable of being maintained in suitable working contact therewith regardless of the wear of the contacting faces of the valve and valve-seat and a valve-carrier which is directly operated upon and moved by the action of the fluid-pressure, so as to move and carry the valve along the valve-seat, the valve with such arrangement being independent of the valve-carrier to the extent that in case of wear it can take up the same by moving in a direction perpendicular to its seat and toward the axis or longitudinal central line of the piston to an extent proportional to such wear. The valve may be thus adjusted either mechanically or automatically, the latter being preferable. This automatic or self adjustment of the valve in a direction to take up wear is attained by exposing the valve to fluid-pressure, which serves to maintain the valve in suitable contact with the valve-seat regardless of wear, and, as a matter of further improvement, the valve is thus subjected to fluid-pressure within an annular pressure-space, whereby the valve will be maintained in working contact with the valve-seat regardless of the position of the piston.

My invention further contemplates a simplified arrangement of piston ports or ducts serving to avoid undesirable extent of travel of live steam passing through the piston, thereby decreasing friction and condensation and producing quick action.

In the accompanying drawings, Figure 1 is a side elevation of a steam-operated hydraulic pump, the piston-cylinder and certain adjuncts being shown in central longitudinal section, while the piston and valve device are shown in elevation. Fig. 2 is an enlarged view of the cylinder, piston, and valve device, showing the same in central longitudinal section. Fig. 3 is a plan of the piston and valve device. Fig. 4 is a like view, but with the valve device in section on line $x\,x$ in Fig. 5 for the purpose of showing the valve-seat. Fig. 5 is a cross-section of the piston and valve device on line $y\,y$ in Fig. 2. Fig. 6 is a cross-section of the piston and valve device, taken on line $z\,z$ in Fig. 2. Fig. 7 is a perspective of the valve. Fig. 8 is a perspective of the piston with the valve device removed. Fig. 9 is a perspective of the valve-carrier, which is comprised in the valve device.

The piston-cylinder A is provided with an inlet-port 1, arranged intermediate of its ends, and is exhausted by way of a port or duct formed by the bore of the hollow stem 2 of a reciprocating spool-shaped piston B, arranged to fit and work within the piston-cylinder.

The spool-shaped piston B comprises a cylindric body portion provided with annular end flanges or heads, whereof one may be integral with such body portion, the arrangement shown being an end flange 3, integral with one end of the body of the piston, and a flange 4, removably screwed upon a threaded end portion 5 of the piston at the opposite end of the latter. These flanges are desirably provided with annular peripherally-arranged grooves 6 for packing-rings 7, which latter contact with the inner cylindric wall of the piston-cylinder.

The cylindric body of the piston is reduced in diameter or recessed at one side for a portion of its length, thereby leaving it with short cylindric end portions 8 and 9 arranged back of its end flanges. The bottom face of said recessed portion of or offset in the piston-body is made flat, so as to provide a flat valve-seat 10. With such arrangement the recess or offset in the piston has a couple of segmental end walls 11 and 12 respectively arranged at opposite ends of its flat bottom, which forms the flat valve-seat 10.

The piston is provided with a centrally-

arranged exhaust port or duct 13, coincident and connecting with the bore of the piston-stem 2 and extending for a portion of the length of the piston, as shown in Fig. 2, wherein the back or inner end portion of the duct 13 extends a short distance beyond the middle of the piston. This centrally-arranged exhaust-port 13 opens through the flat valve-seat 10 by way of a couple of apertures or subports 13^a and 13^b, arranged at the inner end portion of the port or duct 13 and positioned adjacent to but at opposite sides of the longitudinal middle of the piston. The piston is also provided with longitudinally-arranged ports or ducts 14 and 15, respectively extending back from opposite ends of the piston and opening through the flat valve-seat 10 at opposite sides of the pair of apertures 13^a and 13^b, as best shown by full and dotted lines in Fig. 4, wherein it will be seen that the ducts 14 and 15 do not pass the center or middle point of the piston—that is to say, they do not pass a point midway of the ends of the piston. By such arrangement I employ comparatively short ports or ducts for alternate supply and exhaust service, and hence, for example, economize in steam for driving the piston, since by having such short ports or ducts the steam employed will have a comparatively limited extent of travel through the piston, and thereby avoid friction and objectionable condensation. The piston is also provided with small ports or ducts 16 and 17, respectively extending from opposite ends of the recess or offset therein to the faces of its cylindric end portions 8 and 9, by which arrangement the ports 16 extend between and open through both the face of the cylindric end portion 8 of the piston and the end wall 11, which rises from one end of the flat valve-seat 10, while ports 17 similarly extend between and open through both the corresponding wall 12 at the opposite end of the flat valve-seat and the face of the cylindric end portion 9 of the piston.

The valve C is arranged to slide and reciprocate upon the piston between the end flanges of the latter and is provided with a flat face portion 18, Fig. 7, which is fitted to slide upon the flat valve-seat 10 and adapted for governing the ports of the latter. In order to permit the mechanical or automatic adjustment of the flat face portion of the valve relatively to the flat valve-seat, so as to take up wear, I provide a reciprocating sliding valve device comprising a couple of members, whereof the one member C, which constitutes the valve proper, is provided with the flat valve-face 18, while the other member C′ serves as a reciprocating carrier for the valve C. As a simple and efficient construction the member C′ is in the nature of a sleeve arranged to slide upon the piston and composed of a part-cylindric shell or body 19, having annular end flanges 20 and 21. By such arrangement the valve C can be in the nature of a plate adapted to fit between the end flanges 20 21 of the valve-carrier C′, and when so located it will bear flatwise upon the flat valve-seat 10, along which it will slide when the valve device as a whole, comprising the valve C and valve-carrier C′, is operated. The valve C will preferably be held down upon the seat by steam or any fluid pressure within an annular pressure-space formed between the end flanges of the valve-carrier, in which case it can be confined between a couple of stops or shoulders formed by the flanges 20 21, which, however, will not interfere with the automatic or self adjustment of the valve in taking up wear. In other words, the valve device may comprise a flanged sleeve or carrier which is arranged to reciprocate upon the piston and which is reciprocated or shifted at suitable times by the action of fluid-pressure and a valve which is moved over the ported valve-seat by such carrier, but which is desirably free to have a limited movement independent of its carrier in a direction perpendicular to the plane of the valve-seat. The valve thus arranged is subject to fluid-pressure within an annular pressure-space which is formed between the annular end flanges of the valve-carrier, which latter works within an annular space afforded between the flanged ends of the piston. The valve is therefore subject to fluid-pressure, which serves to hold it down upon its seat regardless of wear of the opposing and contacting faces of the valve and seat, and hence the valve may be termed an "automatic" or "self-adjusting" valve. It is of course essential to prevent the valve from accidentally shifting sidewise on the seat, and to such end it is guided so as to avoid such displacement. As a simple arrangement guide pins or screws D D can be inserted through holes in the valve and screwed into suitable sockets 19^a in the valve-carrier. Of course should it be desirable to mechanically adjust the valve in case of wear on the part of the seat and contacting valve-face these screws could be adjusted so as to tighten the valve down upon the seat; but I prefer to so arrange and form them that while their heads will prevent the valve dropping away from the seat should the piston be turned so as to bring the seat underneath instead of above the longitudinal central line of the piston the valve can in case of wear, as aforesaid, be still held in contact with the seat by fluid-pressure, and hence move slightly or as far as necessary upon the guide pins or screws in a direction toward the seat whereon it is to slide.

The valve C is provided with a couple of ports 22 22, arranged for covering and uncovering the ports 14 and 15 of the piston. It is also provided with a couple of parallel channels or ports 23 and 24, each of a length to register with the three ports 14 13^b 14 or the corresponding ports 15 13^a 15. Said valve is also provided with end notches or channels 25 and 26, which likewise form ports.

The use of the several ports with which the valve is thus provided can best be explained in describing the general operation of both the piston and the valve device, as follows:

In Fig. 1 the piston and valve device are both at the left. Steam entering the cylinder through port 1 passes into the annular space between flange 3 of the piston and flange 20 of the valve-carrier, thence through ports 16 at one end portion of the piston into an end portion of the recess or offset in the piston, which at such juncture provides a temporary space or chamber having for its end walls one end of the valve C and wall 11 at one end of such recess and having for its top and bottom walls a portion of the flat valve-seat and a portion of the inner side of the flange 20 of the valve-carrier. From this temporary space or chamber the steam passes through port 25 at one end of the valve C, and thereby enters an annular space formed by a portion of the piston-cylinder between the end flanges 20 and 21 of the valve-carrier and surrounding the part of the valve device between such flanges. With the parts in the relative positions shown in said figure the ports 22 22 of the valve are in register with ports 14 14 of the piston, and hence the steam will then pass through ports 22 22 into ports 14 14 and thence to the left-hand end of the piston, thereby causing the piston to make a stroke to the right, it being understood that conversely the stroke from right to left is attained in like way through medium of ports 17 17 in the piston, thence through a temporary space between one end of the valve C and wall at one end of the flat valve-seat, thence through port 26 in the valve C, and thence through ports 22 in the latter and ports 15 in the piston, the valve device of course having shifted so as to bring ports 22 of the valve into register with ports 15 of the piston. The exhaust is governed in an exceedingly simple and effective way. Thus when the parts are in the relative positions shown in Fig. 2 ports 22 of the valve are in register with ports 14 of the piston to permit live steam to pass to the left-hand end of the piston, while at the same time port 24 of the valve is in register with ports 15 and 13^a of the piston, and hence exhaust-steam can pass through ports 15 in the piston to port 24 in the valve, thence through subport 13^a to port 13, and thence to and through the bore of the piston-stem 2. On the other hand, exhaust from the left end of the piston-cylinder is at a proper time similarly effected through ports 14 in the piston, thence through port 23 in the valve, thence through part 13^b to port 13 in the piston, and thence to and through the bore of the hollow piston-stem, as follows: When the piston moves from the position shown in Fig. 2 to the right, the valve device maintains the relative position shown at the left-hand end of its shift or movement independent of the piston until the end of such stroke on the part of the piston, at which time the valve device shifts to the right, so as to bring ports 22 of the valve in register with ports 15 of the piston and also bring port 23 of the valve in register with ports 14 and 13^b of the piston. At such juncture it is of course desirable to exhaust any steam confined between an end flange of the valve-carrier and an end flange of the piston—for example, flange 20 of the valve-carrier and flange 3 of the piston when the latter is at the right-hand end of the cylinder. To secure such exhaust, I provide the inner wall of the cylinder with a groove 27, through which steam from such space between flanges 20 and 3, respectively, of the valve-carrier and piston can escape into the cylinder and thence exhaust in the manner hereinbefore described. For a like purpose the opposite end of the cylinder is provided with an internally-arranged groove 28, through which steam between any space existing between flange 21 of the valve-carrier and flange 4 of the piston can escape into the cylinder when the piston arrives at the left-hand end of the cylinder.

It will be seen that the ports 16 and 17 of the piston are alternately covered and uncovered by the valve-carrier, according to the position of the valve device. Thus in Fig. 1 ports 16 are uncovered, while ports 17 are covered. The valve is shifted for the purpose of governing the several ports of the piston at a time when the piston is in position to permit live steam entering through port 1 to force its way between an end flange of the valve-carrier and a contiguous end flange of the piston. For example, when the piston in Fig. 1 has moved to the right the line of separation between end flange 21 of the valve-carrier and end flange 4 of the piston will be brought opposite port 1, and hence steam from such port will force its way between such flanges, and thereby throw the valve device as a whole to the left. To facilitate such action, the flanges are beveled, as illustrated, so as to provide an annular space when a couple of such flanges are together, as hereinbefore described.

In Fig. 1 the hollow piston-stem has a lateral opening 29, through which the exhaust can pass into a chamber 30 and thence through ports 31 into a passage 32, which may either conduct the exhaust to the open air or to a body of matter, as may be desired. In said figure, E indicates a casing which can contain a pump mechanism operated by the piston, and F denotes a bed or base upon which the piston-cylinder and pump-casing are conveniently supported.

It is understood that while the motive fluid for actuating the valve and the piston may be steam other motive fluid—for example, compressed air or gas—can be employed; also, that the valve-seat could be transversely curved and be either concave or convex, the seating-face of the adjustable valve being in such case correspondingly formed, and that for the broader purpose of my invention I de-

sire to cover all of the foregoing-described forms.

From the foregoing it will be seen that the spool-shaped piston serves to provide within the piston-cylinder an annular space extending around the body portion of the piston and that the valve device which slides along the body portion of the piston, while having end flanges which form sliding partitions within such annular space, is otherwise diametrically contracted to an extent to provide an annular pressure-space between its flanges. The valve proper will therefore be exposed to pressure within such annular pressure-space, and hence should the piston become turned to any extent about its longitudinal axis or center line the valve will still be maintained in working contact with the valve-seat during operation by fluid-pressure within such annular pressure-space. Likewise by forming the valve-carrier with annular end flanges the valve device will be operated by fluid-pressure admitted through the inlet-port 1 of the piston-cylinder regardless of any extent to which the piston may have been turned about its longitudinal axis; also, the entire top or outer side of the valve will be subject to fluid-pressure.

What I claim as my invention is—

1. A steam or other motive-fluid actuated ported piston reciprocating within a piston-cylinder and having a valve-seat; and a steam or other motive-fluid actuated valve device comprising a valve-carrier arranged to slide upon the piston and provided with a valve which slides upon the valve-seat and which is adjustable independently of the valve-carrier in a direction to take up wear incident to the sliding contact between the contacting surfaces of the valve and valve-seat, substantially as described.

2. A steam or other motive-fluid actuated ported piston reciprocating within a piston-cylinder and having a valve-seat; and a steam or other motive-fluid actuated reciprocating valve device comprising a valve-carrier arranged to slide upon the piston and provided with a valve which is automatically adjustable upon the valve-seat independently of the valve-carrier and to such end subject to fluid-pressure acting to maintain the valve in working contact with the valve-seat regardless of wear, substantially as described.

3. A steam or other motive-fluid actuated piston reciprocating within a piston-cylinder and provided with a couple of annular flanges and an intervening valve-seat, and having longitudinally-extending ports or ducts arranged for supply and exhaust and opening laterally through the valve-seat; and a steam or other motive-fluid actuated valve device comprising a reciprocating valve-carrier provided with annular flanges and having between such flanges a valve which controls the ports of the piston and which is adjustable independently of the valve-carrier in a direction to take up wear, substantially as described.

4. A steam or other motive-fluid actuated piston reciprocating within a piston-cylinder and provided with a couple of flanges and an intervening valve-seat, and having ports or ducts opening through such valve-seat; and a reciprocating steam or other motive-fluid actuated valve device comprising a valve-carrier provided with annular flanges and having between such flanges a valve which is adjustable independently of the valve-carrier and which is provided with ports arranged to take fluid-pressure from a fluid-pressure space between the flanges of the valve-carrier and deliver the same to the piston-ports, substantially as described.

5. A steam or other motive-fluid actuated reciprocating piston provided with a pair of flanges which move along the inner wall of the piston-cylinder, and an intervening body portion provided with a recess terminating short of the flanges and having its bottom adapted to form a valve-seat; and a reciprocating, steam or other motive-fluid actuated valve device comprising a valve-carrier constructed with flanges and fitted to slide upon the non-recessed part of said body portion of the piston, and an adjustable valve arranged between the flanges of the valve-carrier and fitted to slide upon the valve-seat; the piston and valve device being ported to permit fluid-pressure delivered between the end flanges of the valve-carrier and the flanges of the piston to pass to a pressure-space between the flanges of the valve-carrier, substantially as described.

6. A steam or other motive-fluid actuated spool-shaped piston provided with suitable supply and exhaust ports and having in one side of its body portion a recess having its bottom adapted to form a valve-seat and having its ends terminating short of the end flanges of the piston so as to provide the latter with cylindric portions 8 and 9 back of its said end flanges, and a steam or other motive-fluid actuated valve suitably ported and comprising a sleeve having annular end flanges arranged to slide upon the cylinder portions 8 and 9 of the piston and provided with a ported adjustable part or member arranged between its flanges and having a seating side which slides upon the valve-seat, substantially as described.

7. A spool-shaped steam or other motive-fluid actuated piston provided with suitable supply and exhaust ports and having a valve-seat formed by the bottom of a recess arranged to leave cylindric portions 8 and 9 between the ends of the recess and the end flanges of the piston; ports extending from such recess to and through the surface of the cylindric portions 8 and 9 of the piston; ports extending from opposite ends of the piston to and through the valve-seat; an exhaust-port extending part way of the length of the piston and having its inner end portion opening through said valve-seat; and a suitably-ported valve arranged to slide upon the piston and

comprising a sleeve having a body portion 19 provided with annular end flanges, and an independent, adjustable part or member fitted to and arranged to slide upon the valve-seat, substantially as described.

8. A steam or other motive-fluid actuated piston having a centrally-arranged exhaust-port 13 extending part way of the length thereof and opening through one side of the middle portion of the piston by way of a couple of branches or subports 13^a and 13^b, and ports for alternate supply and exhaust extending back from opposite ends of the piston and opening through one side thereof adjacent to the subports or branches 13^a and 13^b of the centrally-arranged exhaust-port; and a steam or other motive-fluid actuated valve arranged to slide upon the piston and suitably ported for controlling said ports of the piston, substantially as described.

9. The combination with the cylinder having an inlet-port 1 intermediate of its ends, of the spool-shaped piston provided with the longitudinally-arranged exhaust-port 13 opening through one side of the piston at the middle thereof by way of a couple of branches or subports 13^a and 13^b, the longitudinally-arranged ports 15 and 16 extending back from opposite ends of the piston and opening through said side of the piston adjacent to the branches or subports 13^a and 13^b, of the centrally-arranged exhaust-port; and a steam or other motive-fluid actuated valve arranged to slide upon the piston and provided with ports 22, 23 and 24, arranged for controlling said ports of the piston, substantially as described.

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