No. 695,891. Patented Mar. 18, 1902.

G. B. SMITH.

VALVE FOR STEAM ENGINES.

(Application filed June 26, 1901.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 1.

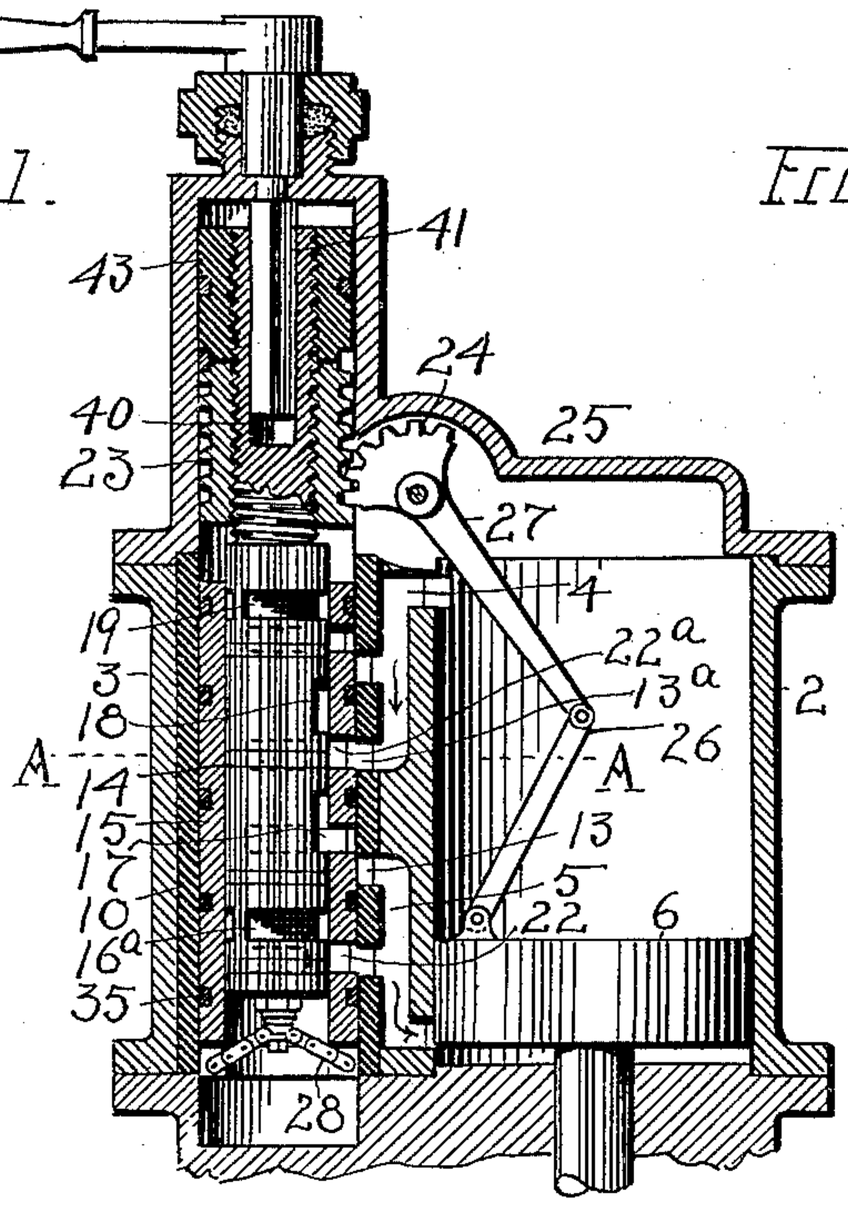


FIG. 2.

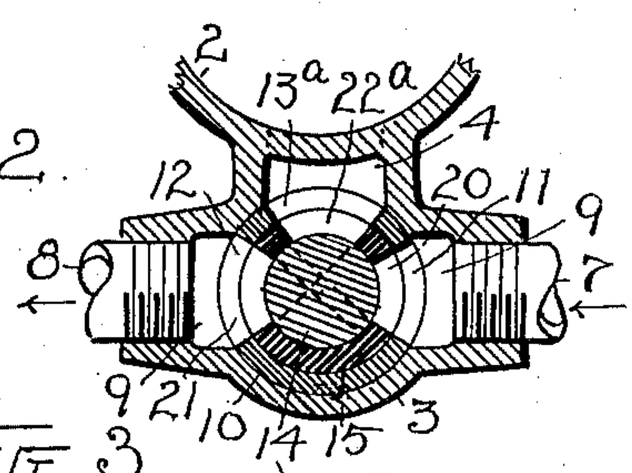


FIG. 3.

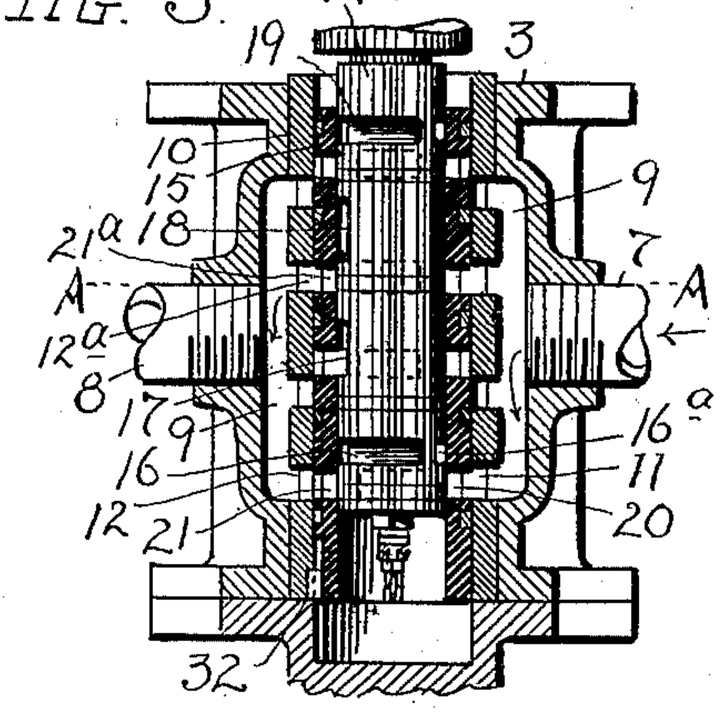


FIG. 4.

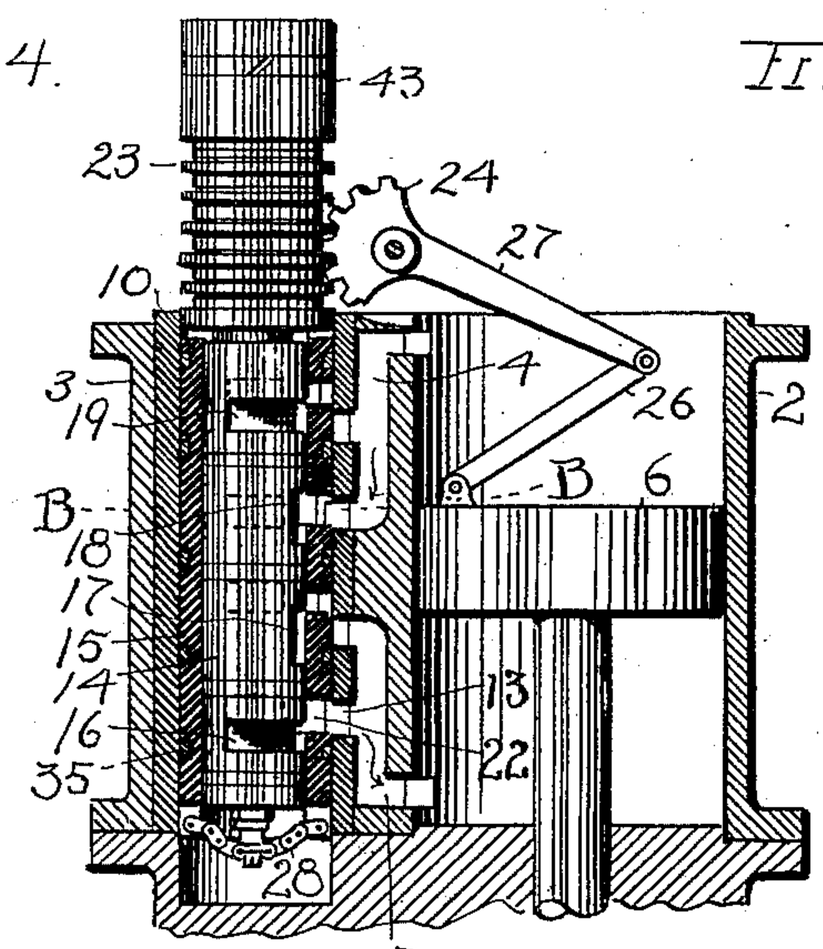


FIG. 5.

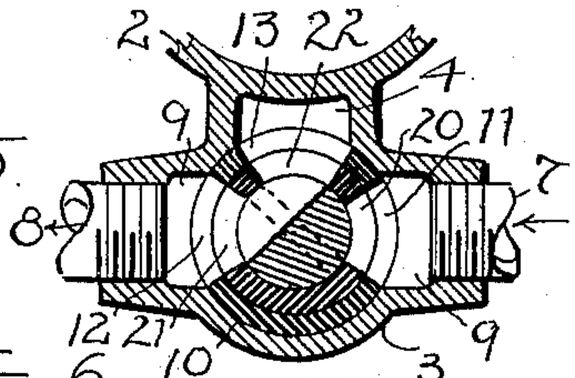
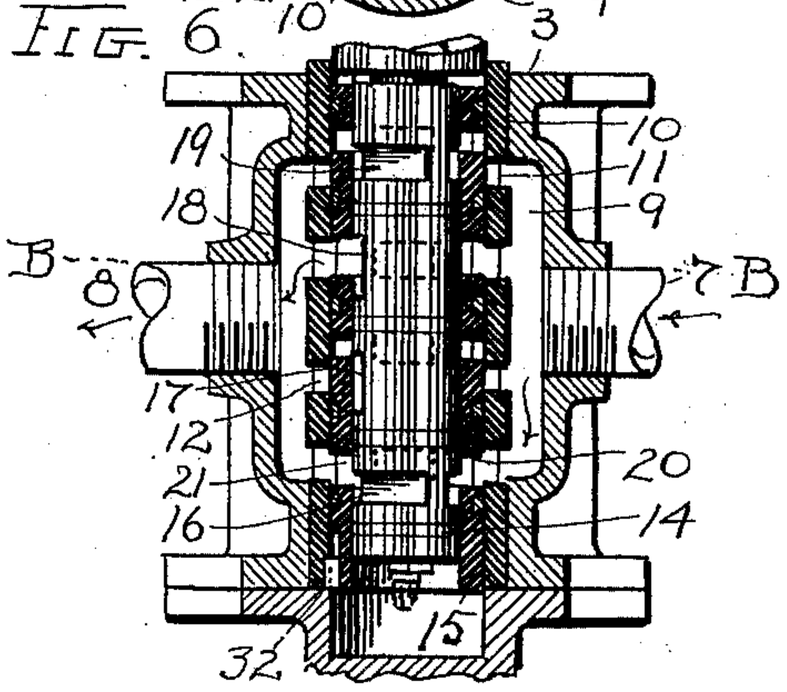


FIG. 6.



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ATTEST.

R. B. Moore

H. E. Mudra

INVENTOR.

Gary B. Smith

BY W. T. Fisher ATTY

No. 695,891. Patented Mar. 18, 1902.

G. B. SMITH.

VALVE FOR STEAM ENGINES.

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(No Model.) 3 Sheets—Sheet 2.

FIG. 7.

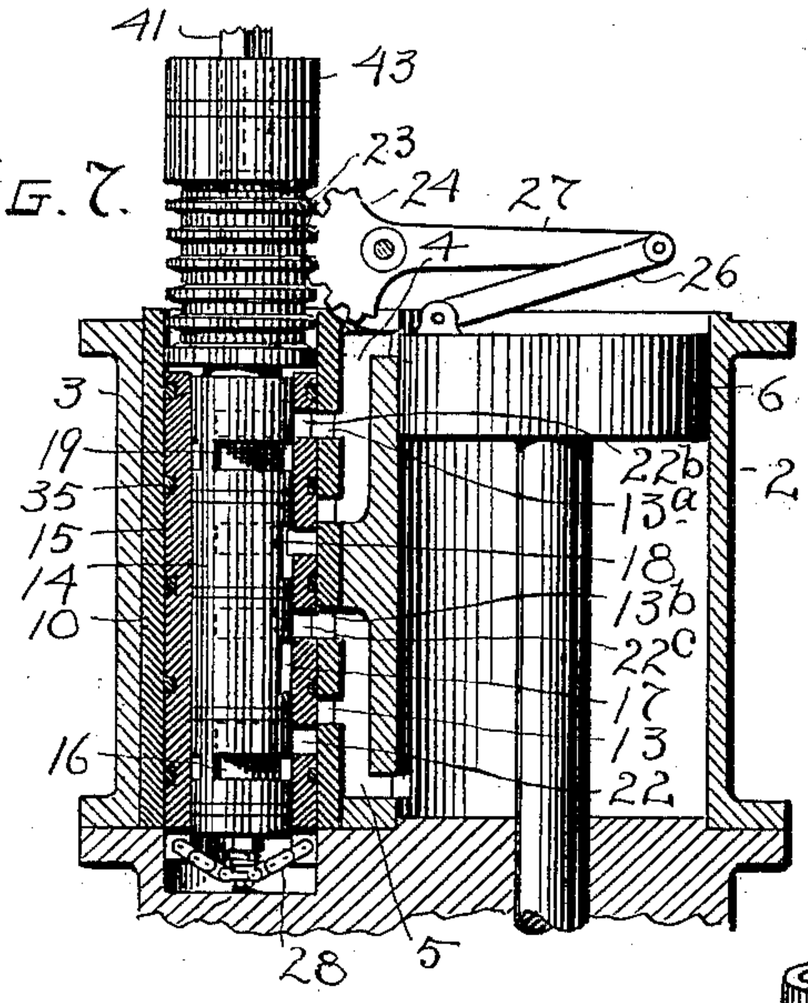


FIG. 8.

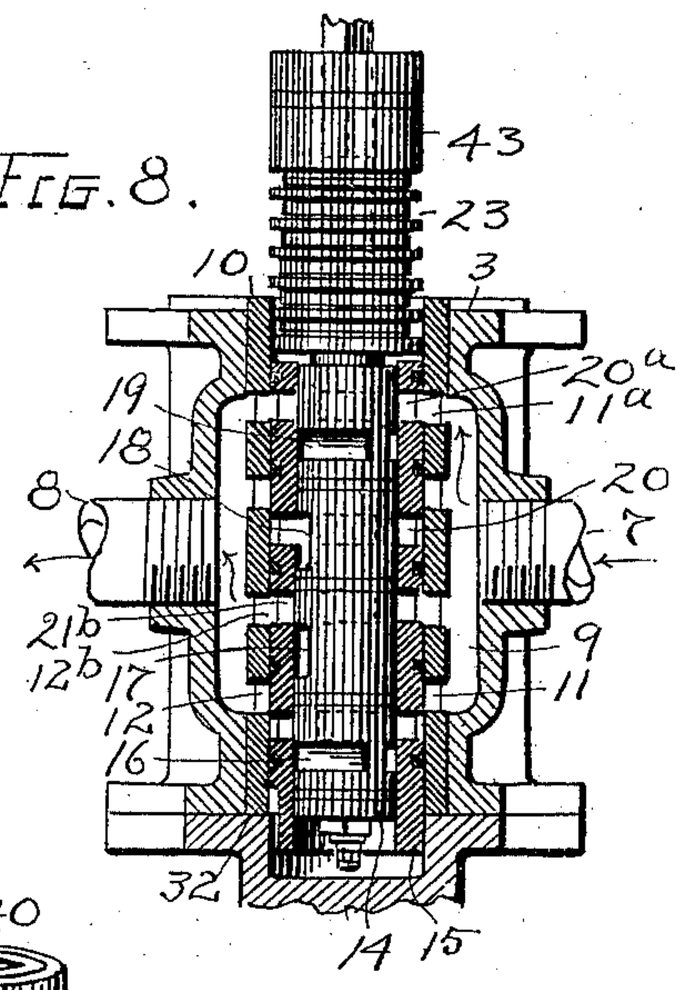


FIG. 9.

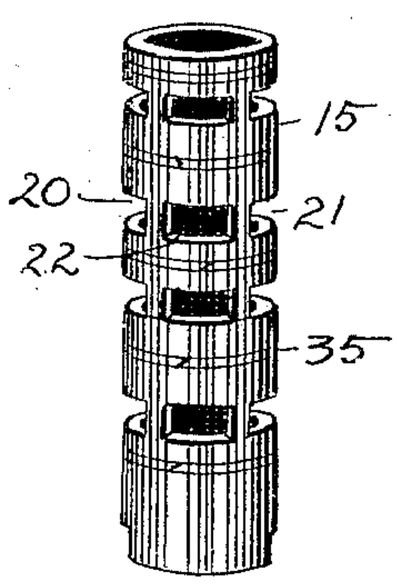


FIG. 10.

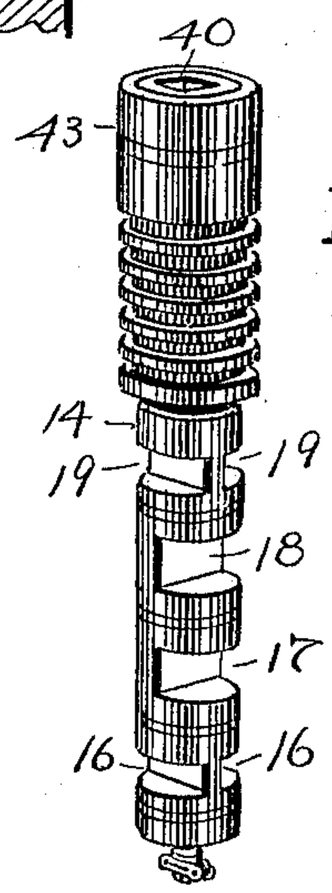
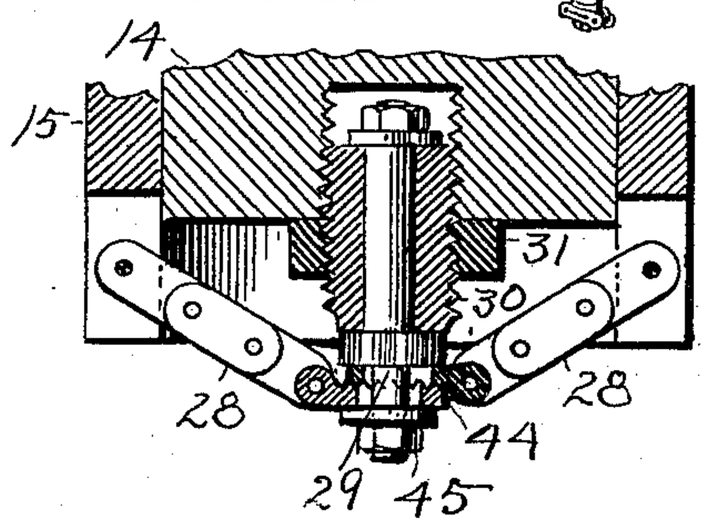


FIG. 11.



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VALVE FOR STEAM ENGINES.

(Application filed June 26, 1901.)

(No Model.) 3 Sheets—Sheet 3.

FIG. 12.

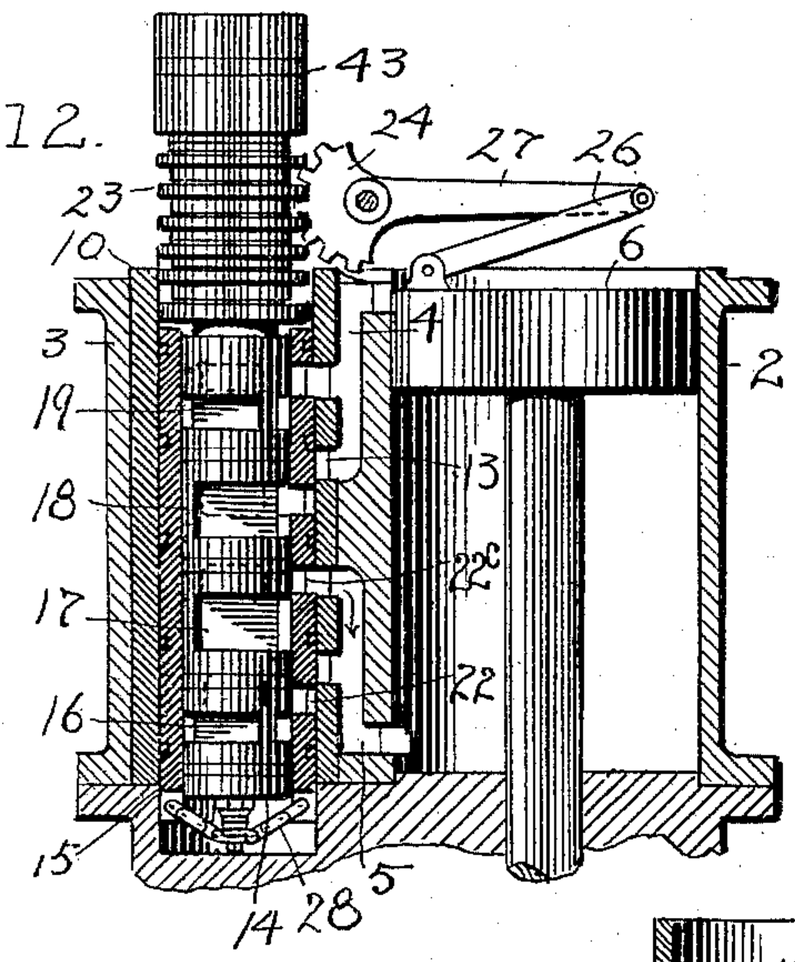


FIG. 13.

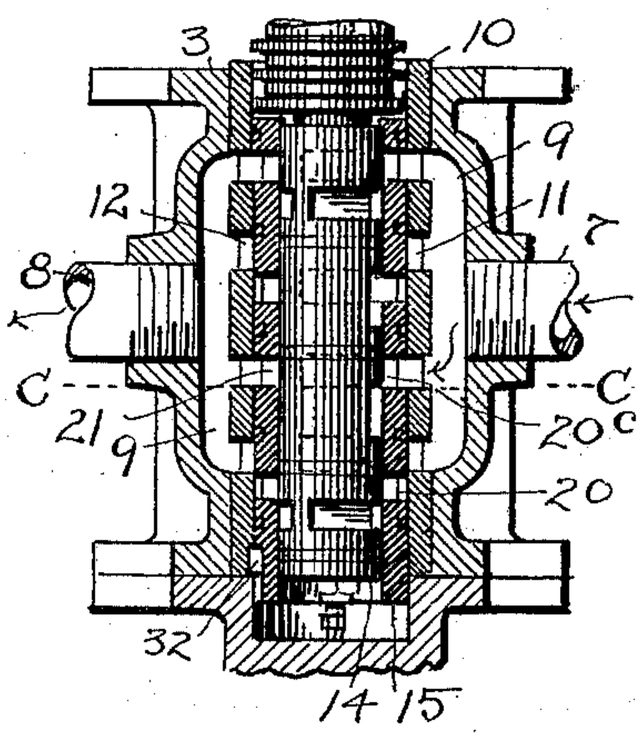


FIG. 15.

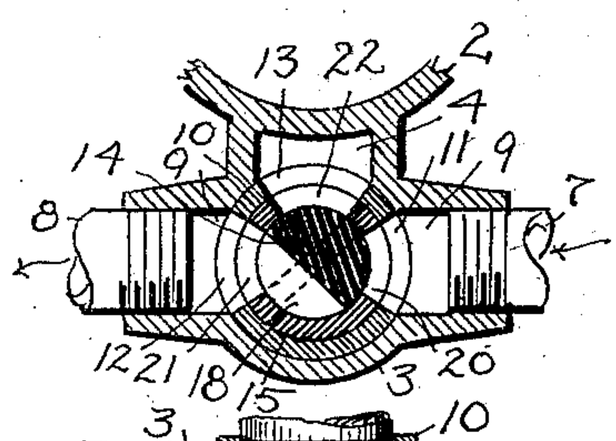


FIG. 17.

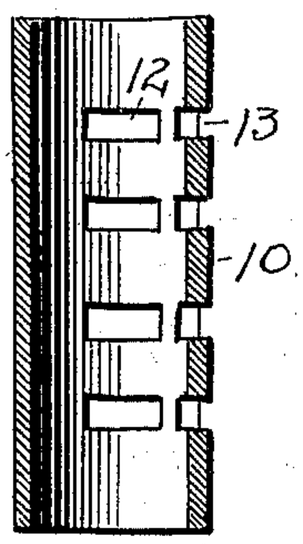


FIG. 14.

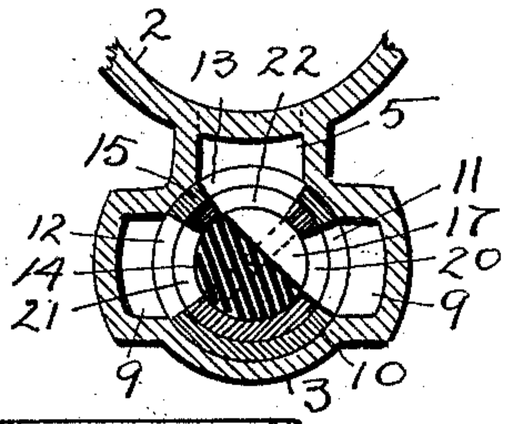


FIG. 16.

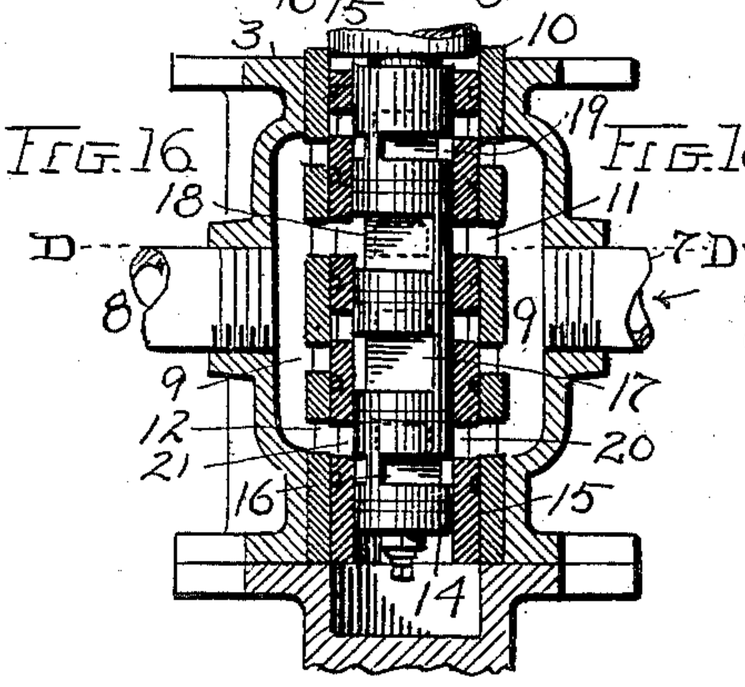
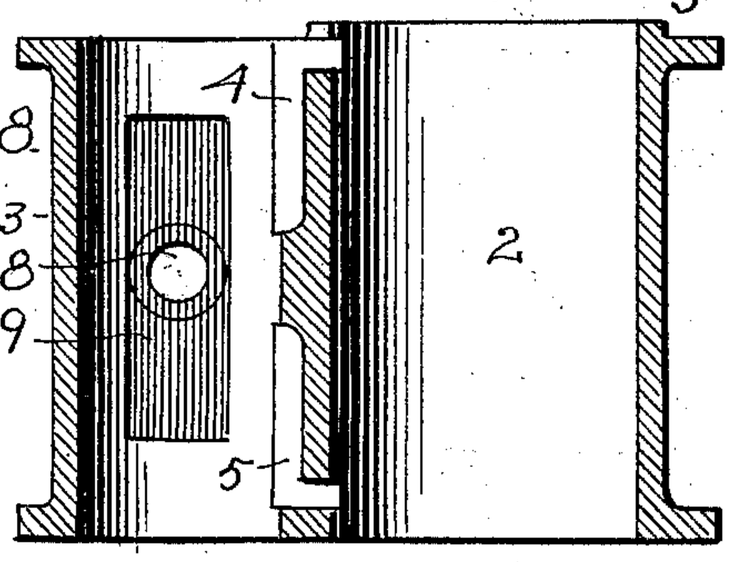


FIG. 18.



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R. B. Moore
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INVENTOR.
Gary B. Smith
BY W. T. Fisher ATTY

UNITED STATES PATENT OFFICE.

GARY B. SMITH, OF CLEVELAND, OHIO, ASSIGNOR OF TWO-THIRDS TO J. H. COLWELL AND W. H. ELLIOTT, OF CLEVELAND, OHIO.

VALVE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 695,891, dated March 18, 1902.

Application filed June 26, 1901. Serial No. 66,083. (No model.)

To all whom it may concern:

Be it known that I, GARY B. SMITH, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Valves for Steam-Engines; and I do declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in valves for steam-engines; and the improvement consists in the construction and arrangement of parts which provide for the normal running of the engine, the reversal of the same, and also the throttling or stopping and starting of the engine, all substantially as hereinafter described, and more particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a central longitudinal section through the cylinder and valve-chest with the valve-stem in elevation and showing the piston and valve at the extreme end of a stroke and at the point of return. Fig. 2 is a cross-section of the valve-chest on line A A, Figs. 1 and 3. Fig. 3 is a longitudinal section of the valve-chest at right angles to Fig. 1 and showing the valve parts in the same position as in that figure. Fig. 4 is a similar view as Fig. 1, but showing the piston and valve as it occurs at about their half-stroke and with the inlet or pressure ports nearly closed. Fig. 5 is a cross-section on line B B, Fig. 4; and Fig. 6 is a central sectional view of the valve-chest corresponding to Fig. 3, but with the valve in the position as shown in Fig. 4. Fig. 7 is a corresponding view to Fig. 1, but with the piston and valve in the opposite position as shown therein. Fig. 8 is a central sectional view of the valve-chest at right angles to Fig. 7. Fig. 9 is a perspective view of the valve-sleeve. Fig. 10 is a perspective of the valve-stem. Fig. 11 is a sectional view of the chain connection at the bottom of the valve sleeve and stem. Fig. 12 is a central longitudinal section of the cylinder and valve-chest, showing the valve-stem rotated a quarter-turn and in position to reverse the engine. Fig. 13 is a sectional view at right angles to Fig. 12, showing the relative position of the parts not seen in that figure. Fig. 14 is a cross-section on line C C of Fig. 13. Fig. 15 is a cross-section on line D D, Fig. 16, showing the valve rotated to position for throttling the engine. Fig. 16 is a vertical section of the valve-chest on the line of the inlet and exhaust ports and also showing the valve in throttling position. Fig. 17 is a vertical sectional view of the valve-bushing, and Fig. 18 is a central longitudinal section of the cylinder and steam-chest with the valve and its bushing removed.

Again referring to the drawings, 2 represents the cylinder, and 3 the valve-chest, both of which are formed in a single casting, with connecting steam-ducts 4 and 5 leading to opposite ends of the cylinder and at each side of piston 6. The inlet and exhaust pipes 7 and 8, respectively, are located centrally between the ends of valve-chest 3 and at right angles to steam-ducts 4 and 5. These pipes open into channels 9, formed in the sides of valve-chest 3, and a tubular bushing 10 for the valve is driven or fastened within the valve-chest to form the inner wall of the said ducts and channels. This bushing is provided with three vertical rows of ports 11, 12, and 13, respectively arranged equally distant on three sides to correspond with the channels 9 and ducts 4 and 5. In casting the valve-chest these ports could be formed therein and a bushing dispensed with; but I prefer to use a separate bushing for several reasons, one of which is that the ports can be more accurately cut and also fitted to the valve before placing the bushing in chest 3.

The valve comprises a valve-stem 14 and a tubular sleeve 15 thereon, both of which reciprocate within the bushing to open and close the ports leading to and from the cylinder. The valve-stem is cylindrical and has a series of slots 16, 17, 18, and 19, respectively, in its sides to form passages or ducts for the steam, and they control the ports of valve-sleeve 15. Slots 17 and 18 are located between slots 16 and 19 and are of greater width as compared with the end slots. Slots 16 and 19 are cut on both sides of stem 14, with a central vertical dividing-wall, whereas slots 17 and 18 are cut only at one side of stem 14 and at right angles to the end slots. Valve-sleeve 15 has an equal number of ports as

the bushing—that is, a vertical row of four ports on three of its sides and numbered 20, 21, and 22, respectively, and they are arranged in line with bushing-ports 11, 12, and 13. The sleeve-ports control the opening and closing of the bushing-ports, and the reciprocal movement of sleeve 15 is limited and occurs only at the latter half of the stroke of piston 6. Valve-stem 14 travels always with the piston the full stroke thereof, but in an opposite direction thereto.

The mechanism for operating the valve consists of a rack 23, adjustably screwed on the upper end of valve-stem 14, which rack is engaged by a segment-gear 24, pivotally mounted within cylinder-head 25. A link 26 connects arm 27 of segment-gear 24 with piston 6, and as the piston reciprocates valve-stem 14 is also reciprocated. After valve-stem 14 has been moved the required distance to change the position of its passages in relation to the ports in sleeve 15 the sleeve itself is carried along by means of a connecting-chain 28, which bridges the bottom end of sleeve 15 and is pivotally attached at its outer ends thereto. The inner ends of chain 28 are pivoted to ears on adjustable slotted arms which are clamped on bolt 29, which bolt is mounted within a threaded plug 30. Said plug is screwed into the end of stem 14 and locked in any adjusted position by a lock-nut 31. Stem 14 and its plug 30 are free to rotate about the bolt, which rotation is utilized to reverse the engine as well as to throttle the same. Valve-sleeve 15 is splined to bushing 10 at 32, and although held from rotation thereby provision is made for the sliding or end movement of the sleeve.

Referring to Figs. 1 to 3, inclusive, the valve and its ports are shown in one extreme position—that is, when piston 6 is at the bottom of its stroke and on the point of going up. As the momentum of the fly-wheel carries the crank of the engine over the dead-center the piston is carried up and valve-stem 14 is forced down, and the steam is directed from inlet-channel 9 through the lowest bushing-port 20 and sleeve-port 22 into and through passage or slot 16^a. The lowest port 22 of sleeve 15 is open to the lowest port 13 of the bushing, and the steam is free to pass from slot 16^a to duct 5 and into the cylinder below the piston. The exhaust-ports are also opened at the same time, and the exhaust passes from the cylinder through duct 4, port 13^a of bushing 10, port 22^a of sleeve 15, passage 18 in stem 14, then through port 21^a of sleeve 15, port 12^a of the bushing, and into the exhaust-channel 9 and pipe 8. As the piston is forced upward by the direct action of the steam passing through the ports just described valve-stem 14 is forced down until inlet-passage 16^a passes by and the stem closes lower port 22 in the valve-sleeve. When this occurs, piston 6 has traveled about one-half its stroke or slightly beyond the position shown in Fig. 4 and the balance of the stroke is under the expansion of the steam now inclosed within the cylinder beneath the piston; but the exhaust-passage 18 being wider than the inlet-passage in stem 14 is still open and remains so until piston 6 reaches about the limit of its stroke. After lower port 22 is closed stem 14 begins to carry sleeve 15 down by means of chain 28, said sleeve having been previously held stationary within bushing 10 through the frictional engagement of its packing-rings 35. When both stems 14 and 15 travel down, all the ports in the sleeve are closed by the stem except the exhaust-ports opposite passage 18. The object of shifting sleeve 15 is to change the position of its ports in relation to the ports in the bushing, so that when the opposite movement of the piston begins a new set of ports are in open communication to shift the steam-supply and exhaust to opposite sides of the piston. Thus it will be seen by referring to Figs. 7 and 8 that when this change is effected and the valve stem and sleeve are at the limit of their downstroke port 20^a of sleeve 15 is opposite the upper inlet-port 11^a in bushing 10, and the steam will pass through passage 19 as soon as the steam moves up and thence through port 22^b in sleeve 15, upper port 13^a in bushing 10 into duct 4 and cylinder 2 above the piston. The exhaust is now through duct 5, bushing-port 13^b, sleeve-port 22^c, stem-passage 17, sleeve-port 21^b, bushing-port 12^b, exhaust-channel 9, and pipe 8. Stem 14 now moves upward and sleeve 15 remains stationary as before or until the slack in chain 28 is taken up, when both stem and sleeve move together to shift the ports preparatory to the reverse movement of the piston.

The foregoing construction provides for the propulsion of piston 6 by both direct pressure and expansion of the steam and in addition provides for reversing the engine and the throttling thereof. The reversing is accomplished by rotating stem 14 within sleeve 15 a quarter-turn to the left, as seen in Figs. 12, 13, and 14. Passage 17 in stem 14 is thereby brought opposite sleeve-ports 20^c and 22^c, and these ports instead of becoming the exhaust-ports become the inlet-ports. Then as the piston is carried down by the momentum of the fly-wheel it will be against the direct pressure of the steam. The movement of said piston will be reversed before it reaches the end of its stroke. The valve-stem is immediately rotated to the normal running position and the engine is driven as before, but with the power-shaft in reverse rotation.

The throttling of the engine or cutting off of the steam is accomplished by rotating stem 14 a quarter-turn to the right—that is, to the position shown in Figs. 15 and 16. Here it will be seen that stem 14 completely closes the intermediate ports leading from inlet-channel 9 and also prevents the flow of steam to the cylinder at the end ports and stem-passages by the central vertical dividing-wall between the end slots 16 and 19 in stem 14 and which directs the steam against the in-

ner face of sleeve 15, and thereby confines it entirely to the inlet side of valve-chest 3.

The chain connection between the valve-stem and its sleeve is of especial advantage in deadening the sound or knock at the end of each stroke, and being adjustable any desired area of port-openings in the sleeve can be had by regulating the distance of travel of the stem within the sleeve. The wear or stretch of chain 28 can also thereby be taken up to readjust the relative working positions of the stem-passages and sleeve-ports. The slotted arms 44, to which the inner ends of chain 28 are attached, have serrated engaging faces, and after being adjusted laterally to shorten or lengthen the travel of stem 14 are clamped together and held rigidly upon bolt 29 by a nut 45.

The upper portion of valve-stem 14 is provided with an angular opening 40, within which an angular shaft 41 is seated. Shaft 41 is rotatably mounted in the top of the valve-chamber extension of cylinder-head 27, and a handle 42 at the upper end of said shaft is used to rotate the valve-stem to either starting, throttling, or reversing position. Valve-stem 14 is free to slide up and down on the angular end of shaft 41. Rack 23 is held in adjusted position on the threaded end of stem 14 by collar 43, and this adjustment provides for the setting of the stem and sleeve ports at any desired elevation in relation to the bushing-ports. The inlet and exhaust of the steam can thus be timed to enter and leave the cylinder at any desired period.

Spring-steel packing-rings 35 are used for sleeve 15, and these rings serve to hold said sleeve firmly in position within the bushing 10 during the independent or initial movement of stem 14 and until the slack in chains 28 is taken up.

With slight modification the valve might be adapted to operate also as a governor. In that event governing mechanism would be attached to handle-shaft 41.

What I claim is—

1. In a steam-engine, the cylinder and piston therein, a valve-chest having inlet and exhaust ports leading to and from said cylinder, a valve within the valve-chest comprising a stem having steam-passages and a slidable sleeve on said stem provided with ports, means to limit the movement of said stem within said sleeve whereby all the steam passages and ports therein, except the exhaust-ports, are closed at the limit of the movement of said stem within said sleeve, and means to reciprocate both stem and sleeve within the valve-chest, substantially as described.

2. In a steam-engine, the combination of a cylinder and piston therein and a valve-chest having steam ducts and ports leading thereto, a reciprocating and rotatable valve within said chest comprising a stem and a sleeve mounted thereon and provided with ports, and means to reciprocate and means to rotate said valve, substantially as described.

3. In a steam-engine, the cylinder and piston therein, the valve-chest and valve therein, steam-ducts between said valve-chest and cylinder, and inlet and exhaust ports in said chest and valve, said valve comprising a rotatable and reciprocating stem and a sleeve mounted to slide thereon, whereby reversing and throttling of the engine is obtained and means to operate said valve, substantially as described.

4. In a steam-engine, the cylinder and piston therein and a valve-chest having inlet and exhaust ports and ducts leading to said cylinder, in combination with a reciprocating valve comprising a stem provided with steam-passages and a sleeve mounted to slide thereon and provided with ports, and an adjustable connection between said stem and sleeve to limit the sliding movement of said sleeve, and means to operate said valve, substantially as described.

5. In a steam-engine, the cylinder and piston therein, the valve-chest, inlet and exhaust ports between said cylinder and valve-chest, a valve within said chest comprising a stem having steam-passages and a sleeve mounted to slide on said stem and provided with ports, a chain connection between said stem and sleeve to limit the movement of said sleeve upon the stem, and means to operate the valve to open and close the inlet and exhaust ports, substantially as described.

6. The combination of a rotatable and reciprocal valve for steam-engines comprising a stem provided with steam-passages, a sleeve having steam inlet and exhaust ports in its sides and mounted to slide upon said stem, means to limit the movement of said sleeve on said stem, and means to carry both stem and sleeve along together at the limit of the movement of said sleeve on said stem, substantially as described.

7. The combination of a rotatable and reciprocal valve for steam-engines comprising a stem provided with steam-passages, a sleeve provided with steam inlet and exhaust ports, and mounted to slide upon said stem, a flexible connection between said stem and sleeve whereby the movement of the stem is limited before carrying both sleeve and stem along together, and adjusting mechanism attached to said flexible connection whereby said stem and sleeve are set to work in different relations to each other, substantially as described.

8. In a steam-engine, a single casting having the piston-cylinder and valve-chest with their connecting steam inlet and exhaust ports and ducts all formed therein, and a separate bushing provided with ports and constructed to fit and fasten within said valve-chest, in combination with a reciprocating valve having ports and arranged to slide in said bushing, substantially as described.

9. In a steam-engine, a single casting having the piston-cylinder and valve-chest with their steam inlet and exhaust ports and pas-

sages all formed therein, and a separate bushing having inlet and exhaust ports and constructed to fit within said valve-chest, in combination with a reciprocating valve arranged to slide in said bushing and comprising a stem with passages and a sleeve with ports, said sleeve being mounted to slide upon said stem, substantially as described.

10. The single casting comprising a steam-engine piston-cylinder and a valve-chest with their inlet and exhaust ports and ducts all formed therein, in combination with a separate bushing adapted to fit and fasten in said valve-chest, and having inlet and exhaust ports arranged to open into said cylinder and valve-chest inlet and exhaust ports and passages, substantially as described.

11. In a steam-engine, the cylinder and piston therein, the valve-chest and its connecting-passages with said cylinder, and inlet and exhaust ports and passages to said valve-chest, in combination with a valve comprising a reciprocal stem with passages therein and a sleeve thereon with ports in its sides, said stem-passages comprising two intermediate passages arranged at one side of said stem and end passages arranged on both sides of the stem and at right angles to the intermediate passages and having a central vertical dividing-wall between them thus forming a set of two passages at either end, substantially as described.

12. The combination of a rotatable and reciprocal valve for steam-engines comprising a stem provided with steam-passages and a sliding sleeve on said stem provided with ports, a connection between said stem and sleeve providing a limited movement one with the other, means to reciprocate said stem and sleeve and spring-rings on said sleeve to retard said sleeve during part movement of said stem, substantially as described.

13. In a steam-engine, the combination of a piston and a valved stem connected to operate therewith, said stem having an adjustable rack and said piston a link-and-gear segment whereby the movement of said piston is conveyed to said stem and timed therewith, substantially as described.

14. The combination of a rotatable throttling and reversing valve for steam-engines comprising a stem having steam-passages, a sleeve having steam-ports, a flexible connection between said stem and sleeve and adjustable take-up mechanism for said connection to shorten or lengthen the movement of said stem in relation to said sleeve, substantially as described.

Witness my hand to the foregoing specification this 11th day of June, 1901.

GARY B. SMITH.

Witnesses:
R. B. MOSER,
H. E. MUDRA.