J. B. ALLFREE.

VALVE FOR ENGINES.

APPLICATION FILED JAN. 9, 1908.

960,616.

Patented June 7, 1910.

3 SHEETS—SHEET 1.

Fig. 2.

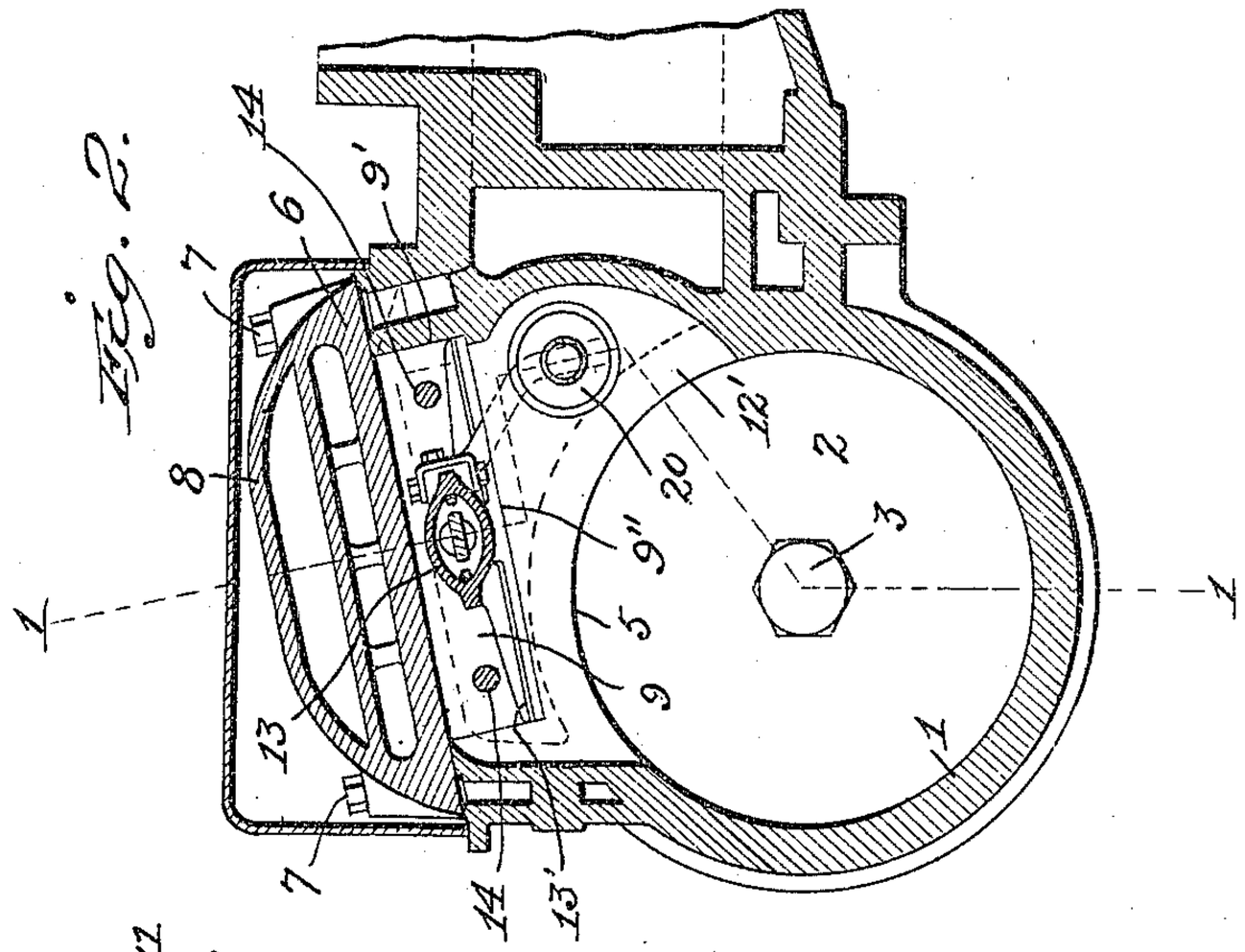
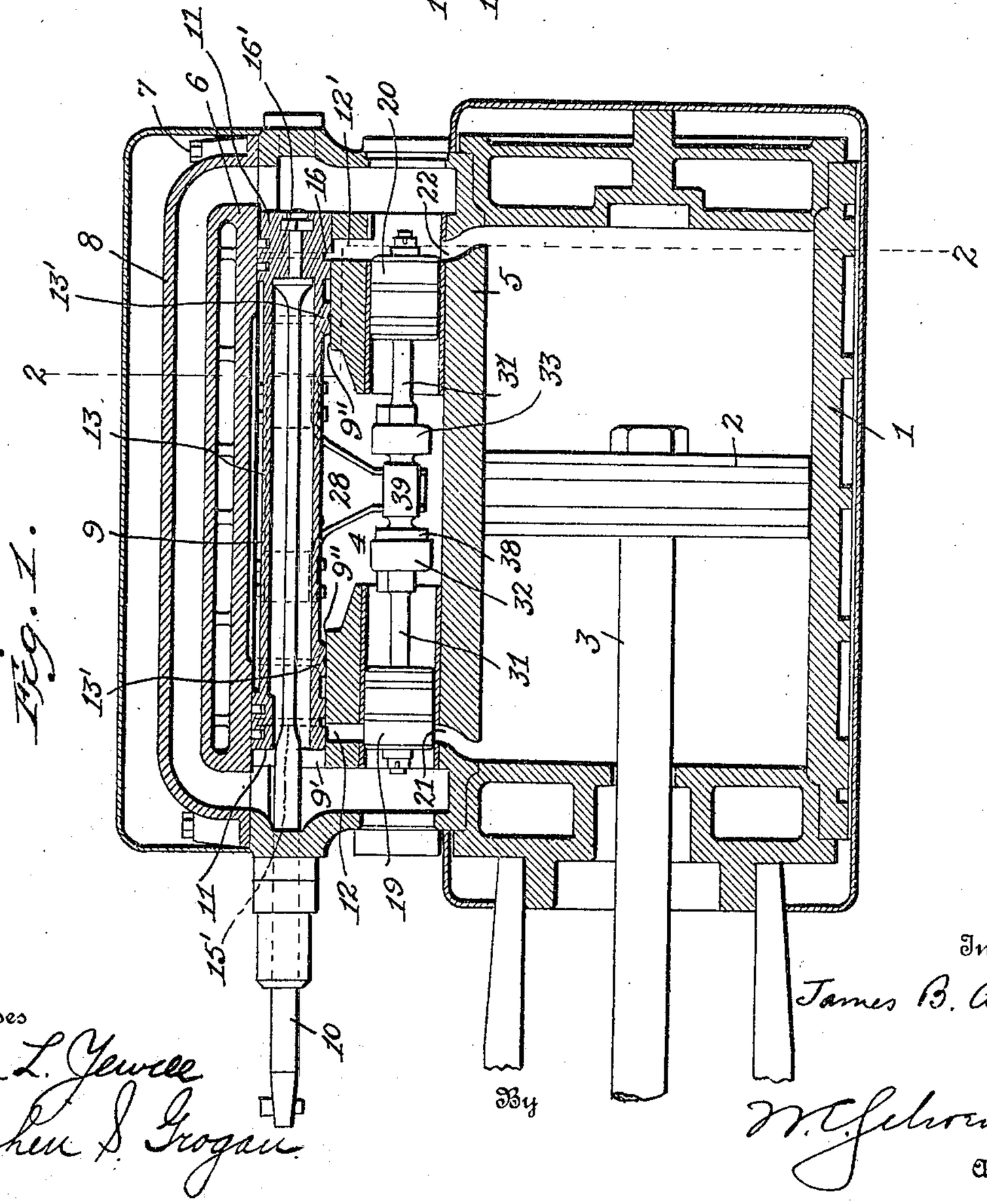


Fig. 1.



Witnesses

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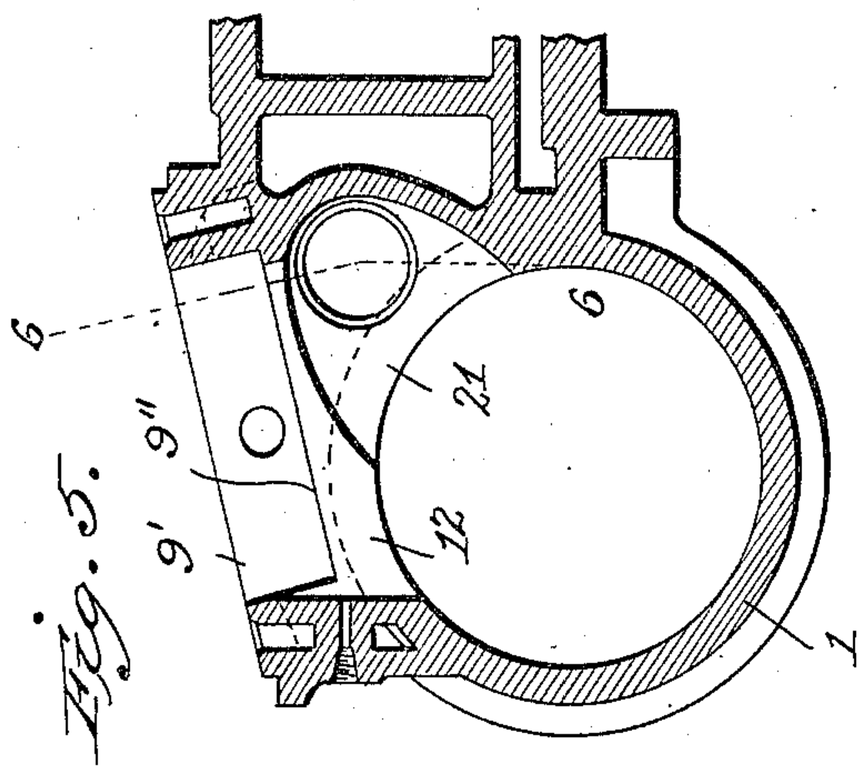

Fig. 5.

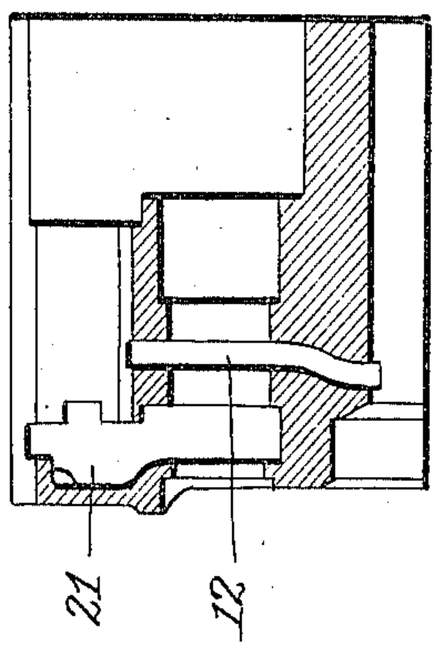

Fig. 6.

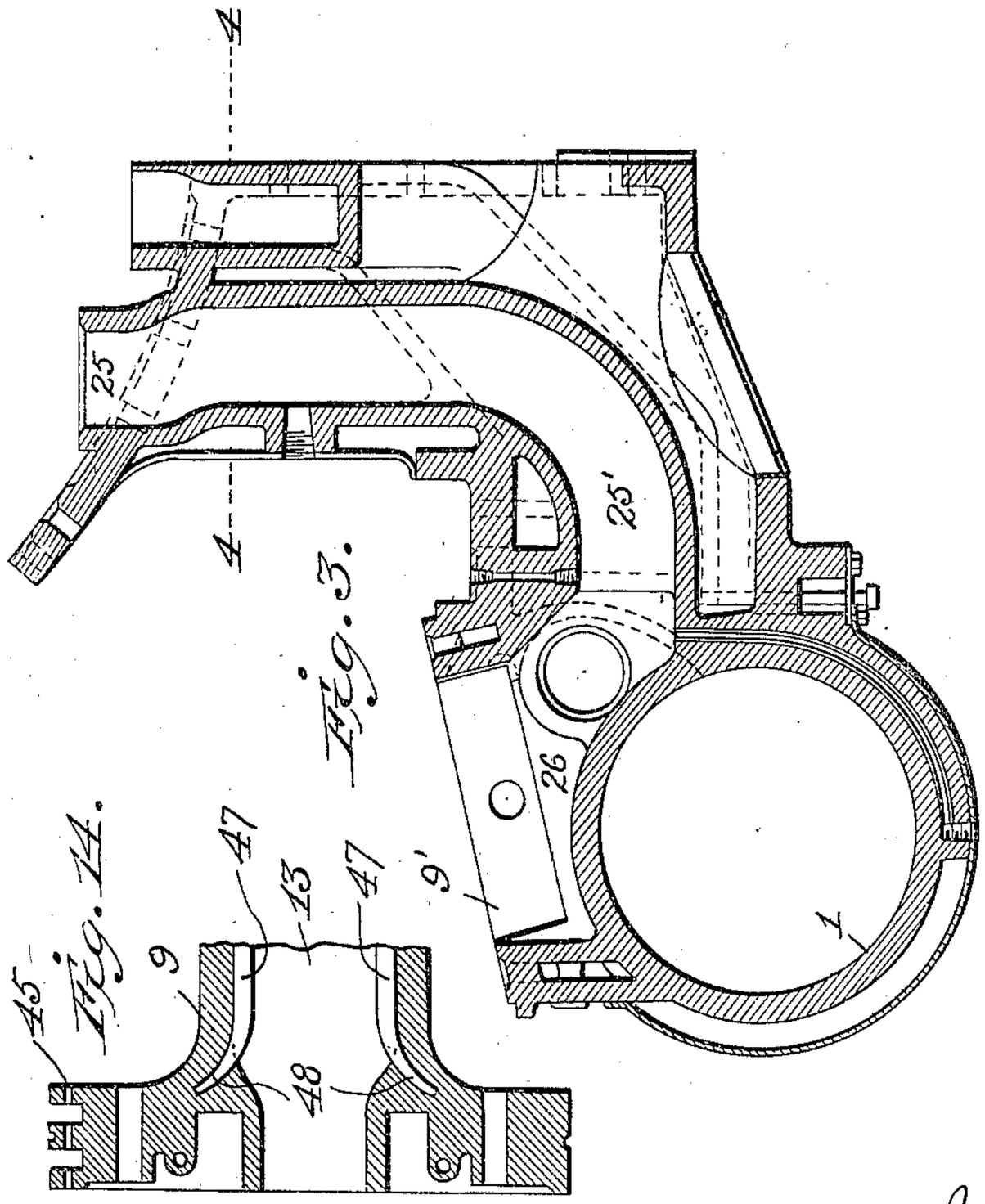

Fig. 3.

Fig. 14.

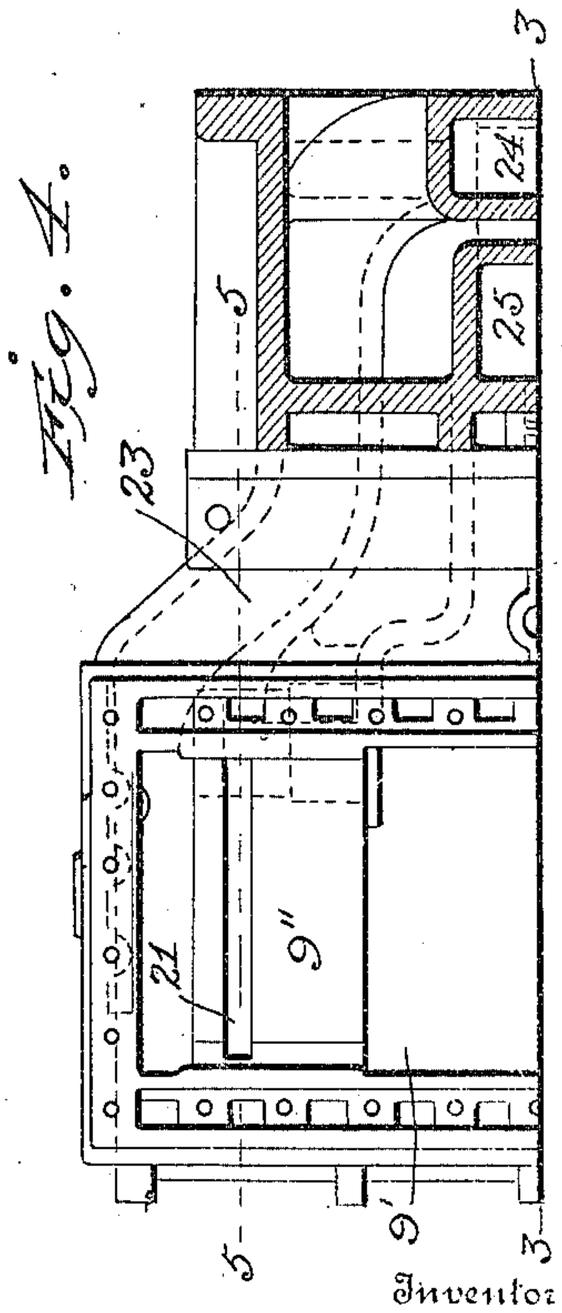

Fig. 4.

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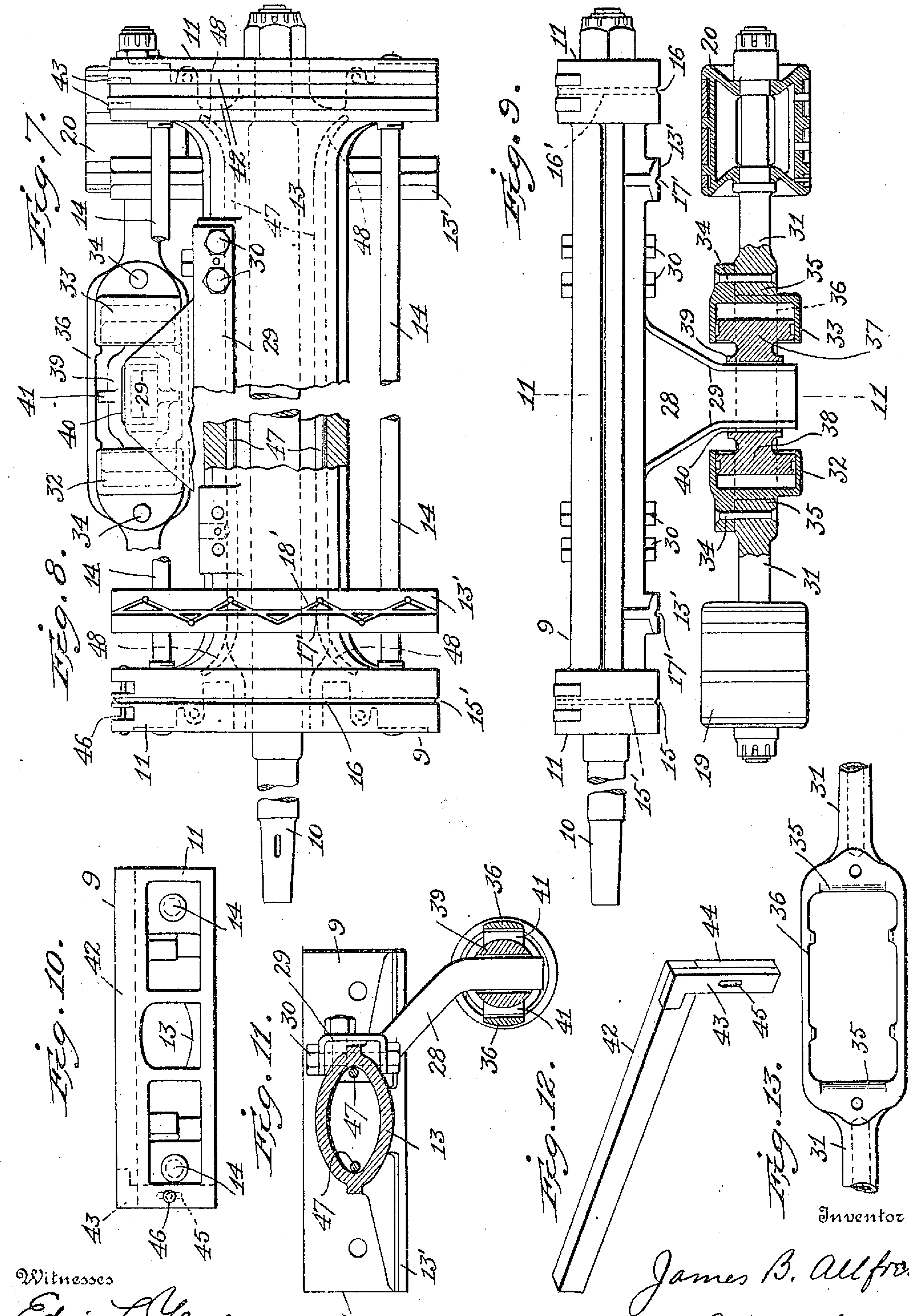
3 SHEETS—SHEET 3.



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VALVE FOR ENGINES.

960,616. Specification of Letters Patent. **Patented June 7, 1910.**

Application filed January 9, 1908. Serial No. 409,974.

To all whom it may concern:

Be it known that I, JAMES B. ALLFREE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Valves for Engines, of which the following is a specification.

The object of the present invention is to improve the valve arrangement of steam or like engines and the embodiment thereof illustrated constitutes a modification of the construction shown in U. S. Patent No. 770,671, issued to me September 20, 1904, and my application filed September 25, 1907, Serial No. 394,517.

My invention contemplates an arrangement of cylinder and steam chest with short live steam and exhaust ports with coöperating main and compression regulating valves so arranged as to insure a more economical distribution and use of the steam, in the cylinder than otherwise. This result is attained by provisions hereinafter described whereby the valves in controlling, the admission, exhaust and compression of steam provide for the highest rate of expansion, the greatest mean effective pressure with relatively low terminal pressure at exhaust for a given cut off and cylinder temperature, and at the same time attain a most important result by securing a minimum clearance both in the cylinder and the connecting ports, which will provide compression sufficient for the proper cushioning and efficient operation of the piston within the cylinder.

The cylinder and steam-chest with the connected live steam and exhaust ports are also constructed and arranged so as to prevent to the greatest extent radiation of heat, thereby tending to hold all the heat units of the live steam pressure and the mean cylinder temperature at the highest degree attainable, and reduce condensation in the cylinder steam chest, and connected ports to a minimum.

The cylinder and steam chest are provided with connecting live steam and exhaust ports which in length, condensing and frictional surfaces are reduced to a minimum and these are so arranged that the passages leading the live steam to the cylinder are within the space surrounded by the exhaust steam passages.

One of the specific purposes of the invention is to provide a novel operating mechanism for a compression controlling or regulating valve which will open said valve for exhaust simultaneously with or a little later than the main valve but cause the same to close for compression much later than the main valve.

A further specific purpose is to provide a novel form of main valve, the same being built up in a way to make an exceptionally light and at the same time strong construction, the parts thereof being preferably of cast steel. Means are provided whereby said valve is balanced and it is at the same time arranged to readily recede from its seat or float while "drifting" when used in connection with locomotive cylinders having low-clearance and compression regulating valves.

Other features of improvement in detail, will appear from the following description of the preferred embodiment of my invention.

My invention comprises the novel features of construction and relative arrangement of parts which will be hereinafter described and particularly pointed out in the appended claims.

Reference is had to the accompanying three sheets of drawing, forming a part of this specification, in which similar reference characters indicate corresponding parts throughout the several figures.

Figure 1, is a central longitudinal section and development on line 1—1, Fig. 2, the compression regulating valve being shown in elevation; Fig. 2, is a transverse and normal section on line 2—2, Fig. 1; Fig. 3, is an approximately central transverse section on line 3—3, Fig. 4, the valves and pressure plates being removed; Fig. 4, is partly a section on line 4—4, Fig. 3, and partly an elevation from the same plane; Fig. 5, is a section on line 5—5, Fig. 4; Fig. 6, is a section on line 6—6, Fig. 5; Fig. 7, is a plan view of one-half of the upper sides of the main distribution and compression regulating valve; Fig. 8, is a plan view of one-half of the under side of the main distribution valve; Fig.

9, is a side view, partly in section, of the connected main distribution valve and compression regulating valve; Fig. 10, is a front view of Fig. 8, with valve rod removed; Fig. 11, is a section on line 11—11 of Fig. 9; Fig. 12, is a perspective view showing the relation of the packing strips of main valve; and Fig. 13, is a detail view showing a section of the divided valve stem for holding the dash pots of compression regulating valve. Fig. 14, is a sectional view of one end of the main valve showing arrangement of reinforcing rods.

In said drawings, 1 is a cylinder which is provided with the usual heads, stuffing box, and other essentials which need not be further described as they form no part of the invention.

2 is a piston having connected therewith a piston rod 3, which is provided with a crosshead (not shown) the same being supported and guided in a well known manner.

4 is a steam chest located immediately adjacent and preferably above the cylinder, and extending over a considerable part of the periphery thereof, thus providing a jacketing effect. The wall 5 between the cylinder and steam chest is made of sufficient thickness to properly support the valve and withstand the pressure to which it may be subjected.

6 is a pressure plate having lateral lugs thereon through which bolts 7 pass to secure said pressure plate to the steam chest. A suitable cover 8 for the steam chest is fitted to the same and as shown such cover is made integral with the pressure plate, the necessary passages being of course formed therebetween. The pressure plate 6 is preferably constructed with double walls provided with intervening air spaces for the purpose of insulation, and said walls are braced by suitable struts so as to attain great stiffness without excessive weight.

9 is the main valve the same being preferably rectangular in outline and of a built-up construction hereinafter more particularly referred to. Said main valve is adapted to be reciprocated in a corresponding shaped space 9′ therefor in the steam chest and to closely fit upon the seat 9″ provided therefor in said steam chest. Such reciprocation is imparted as usual by a stem 10 from any ordinary valve controlling means (not shown).

The valve 9 is preferably of the rectangular type formed with two end pieces or heads 11—11, which with suitable packing form a tight joint with the walls of the pressure plate and register with and control the ports 12′—12′. Said packing strips see Figs. 8, 10 and 12, are preferably made in three sections, 42, 43, and 44, 42 resting in the groove on the top of the valve, while the sections 43 and 44 are in the side grooves of the valve. The contiguous ends of the sections are so formed as indicated in Figs. 10 and 12 that they lock each other in position. Sections 43 and 44 have registering slots 45 through which passes a pin 46, see Figs. 8 and 10, thereby holding them in place.

13 is a hollow spool forming a central tie section and as shown the actuating stem 10 has a reduced extension passing loosely through the inner end of said spool and secured to the outer end thereof by a suitable shoulder and nut thereon. This arrangement enables the valve to be raised or recede from its seat slightly when compression takes place in the cylinder.

As supports for the end pieces 11, additional to the central spool 13, lateral tie rods 14 are provided extending from end to end of the valve and suitably secured to the heads 11.

13′, 13′ are extensions on the valve near the inner sides of the end pieces or heads, which form riding-shoes or auxiliary bearing surfaces in addition to that provided for the valves proper and these are at a distance from the inner sides of the valve ends not less than the width of the ports, and provided with recesses 17′, and 18′ on their under sides as shown in Fig. 8, for the purpose of containing and evenly distributing the lubricant. By this means an abundant sliding surface is secured which prevents rapid wear and at the same time as the riding shoes are drawn back far enough on the valve seat to reach that position which is well lubricated, they will act as distributers and furnish the valve seats with lubricant which they would not otherwise receive for the reason that the valve faces especially in short travel do not reach the oiled position of the valve seat. Furthermore the steam usually blows off the oil from the valve seat near the ports in entering the cylinder and by the above arrangement and construction of riding shoes the oil is constantly replenished.

15 and 16 are transverse intercepting passages in the lower side of the valve ends 11 and which extend nearly the entire width of the valve. 15′ and 16′ are channels connecting with said passages 15 and 16 and extending upward to the top of the valve where they open into the spaces between the packing strips at the end of said valve. The purpose of these passages, as fully explained in my co-pending application Serial No. 394,517, filed September 25, 1907, is for the intercepting of the steam when passing under the valve when the port is uncovered, and therefore allowing the steam to pass up

the channels 15′ and 16′ and instantly equalize the pressure between the upper and lower sides of the valve. By this simple construction and arrangement it will be seen that I have not only devised a valve that will float, but one that will be at the same time perfectly balanced, which especially adapts the engine for locomotive and other high speed work.

19 and 20 are the auxiliary exhaust or compression regulating valves which in the embodiment shown are of the piston type, though it will be understood that other types may readily be substituted. Said valves control the short auxiliary ports 21 and 22 and as will be seen by reference to Figs. 1, 3 and 4 these valves are situated adjacent to the inner portion of the cylinder and control passages connecting with the outside exhaust passages 23 which lead to the petticoat pipe connection 24.

25 is the live steam pipe connection, which by means of passage 25′ leads steam into the space 26 of the valve chamber between the two heads 11, 11 of the main valve and surrounding the central and lateral tie members 13 and 14 thereof. It will be observed that the live steam and exhaust passages are separated by air spaces thus affording a better insulation, it being further arranged so that the live steam is on the inside and the exhaust passages on the outside thus protecting live steam from the cooling action of the atmosphere.

From the description thus far it will be apparent that by my improved arrangement and construction of live steam ports and exhaust, I have devised a cylinder in which the length of the ports is reduced to a minimum, thereby reducing the clearance, radiating surfaces, the friction of the steam in passing to the cylinder and at the same time permitting the short straight ports to be readily and easily cleaned.

It will be further noticed that by my improved built up construction of main valve the same is made light and very strong and that the several parts thereof can be provided and assembled with facility, I preferably make these valve parts of cast steel.

I will now proceed to describe the improved construction of auxiliary exhaust or compression regulating valve, and the novel actuating mechanism therefor, which feature constitutes essential elements of novelty in the present case.

The compression regulating valve comprises the two end barrels or valve sections 19 and 20 connected together by a stem 31, which stem in its middle section 36 as indicated in Figs. 7, 9 and 13, is divided whereby suitable seats are formed for the two dash pots 32 and 33 which are secured thereto by rivets 34. The distance between the two dash pots can be adjusted or regulated by removing or grinding away or adding a portion of metal at 35 on opposite sides of the middle section 36. Reciprocating in said dash pots 32 and 33 are the two connected pistons 37 and 38 which are connected together by a sleeve 39 through which is bored a hole 40.

An arm 28 is provided with flanges 29 said flanges being adapted to be secured to the central spool 13 of the main valve by means of bolts 30. Said arm 28 is attached to the two pistons by passing loosely through the opening 40 in said sleeve 39, as shown. The sleeve 39, see Figs. 7 and 11, is provided on each side with a lug or projection 41 which lugs are squared at their ends and adapted to engage the inner walls of the sides of the middle section 36 thereby preventing the pistons 37 and 38 from turning.

The operation of my improved mechanism will be readily understood from the foregoing description.

The live steam under the main valve 9 and between its ends 11, 11, passes by means of the passages between the riding shoes 13′ and the ends of the valve through the short port 12′ into the cylinder back of the piston 2 when the same is forced to the other end of the cylinder. After completely uncovering the ports 12′ the main valve returns and cuts off at a time regulated by the valve gear, the expanded steam at the other end of the cylinder having exhausted through the other port 12, uncovered by the other end of the main valve. This movement of the main valve, is through the arm 28 transmitted to the auxiliary exhaust or compression regulating valve stem 31, and with a predetermined amount of lost motion is imparted to the valve barrels 19 and 20 which control the auxiliary exhaust passages 21 and 22. It will thus be apparent that the said auxiliary exhaust ports 21 and 22 will be closed after the main exhaust through ports 12 or 12′ has been closed by the main valves 11. By this arrangement of pistons and actuating mechanism the auxiliary exhaust valves will open simultaneously with, or a little later, than the main valve, but are made to close much later than the main valve for compression and hence effect a more efficient distribution of the steam by avoiding unnecessary back pressure due to the too early closing of the main valve and at the same time having under absolute control the regulation of the compression independent of the main valve, whereby the clearance of the ports and cylinder may be reduced and consequently effect a great saving of steam.

To vary the time of closing the auxiliary exhaust passages one simply properly adjusts as above indicated, the distance between the closed ends of the dash pots 32 and 33 either by taking away or adding thickness of metal at 35 when the required minimum compression for the smooth running of the engine is effected.

It will be obvious that my invention may be applied with equal advantage for use with expansible fluids other than steam.

It will also be apparent that numerous changes may be made in details of my improved engine and in the specific means for operating and adjusting the valves without affecting the essential features, and while I have in the foregoing specification described what now appears to be a preferable embodiment of the invention, yet it will be obvious to those skilled in the art that this specific embodiment may be modified in many ways and still come within the purview of the appended claims, wherein I have pointed out the distinguishing characteristics of my said invention.

Referring especially to Figs. 7, 8, 11 and 14, it will be seen that there is inserted and cast integral with the main valve 9, two wrought iron rods 47, 47, which have their ends 48, 48, curved. These two iron rods 47 are placed in the mold before casting the main valve and being wrought iron cool slower than the cast iron section of the valve and hence when the cast iron has solidified and contracted to its maximum the wrought iron rods are still in the state of contraction and hence by means of the curved ends 48, tightly grip the ends of the valve 9 and draw them toward the center. These rods 47 act as auxiliary rods to rods 14 and in case any one of the two rods 14 break the rods 47 will tightly hold the valve together. If desired the rods 14, may be omitted but are used in order to make the valve 9 as light as possible and at the same time as a precaution should the valve split no serious results would follow.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. A steam engine comprising a cylinder, a steam chest, admission and exhaust ports connecting the steam chest and cylinder, auxiliary exhaust ports from the cylinder, a main valve in said steam chest controlling the admission and exhaust through the steam ports, a compression regulating valve controlling the auxiliary ports, and a dash pot connection from said main valve to said auxiliary exhaust valve said connection being within the steam chest.

2. A steam engine comprising a cylinder, short admission and exhaust ports leading thereto, a main valve adapted to control said ports, short auxiliary exhaust ports leading from the cylinder, an auxiliary exhaust or compression regulating valve to control said auxiliary ports, and a dash pot connection from said main valve to said auxiliary valve said connection being inclosed within the valve casing.

3. A steam engine comprising a cylinder, short admission and exhaust ports leading thereto, a main valve adapted to control said ports, short auxiliary exhaust ports leading from the cylinder, an auxiliary exhaust or compression regulating valve to control said auxiliary ports, and a dash pot connection from said main valve to said auxiliary valve, said connection being inclosed within the valve casing and including a lost motion device.

4. A steam engine comprising a cylinder, a steam chest, admission and exhaust ports connecting the steam chest and cylinder, auxiliary exhaust ports connecting the cylinder with the main exhaust, a main valve in said steam chest controlling the admission and exhaust through the steam ports, an auxiliary exhaust compression regulating valve controlling the auxiliary exhaust ports and an adjustable or variable dash pot and lost motion connection from said main valve to said auxiliary valve, said connection being within the steam chest.

5. A steam engine comprising a cylinder, main admission and exhaust ports leading to the ends thereof, main valves adapted to control said ports, auxiliary exhaust ports leading from the cylinder, auxiliary exhaust or compression regulating valves to control said auxiliary exhaust ports and a connection from said main valves and intermediate the same, to said auxiliary exhaust or compression regulating valves and intermediate the same, said connection including a dash pot and a lost motion device.

6. A steam engine comprising a cylinder, main admission and exhaust ports thereto, main valves to control said ports, auxiliary exhaust ports to said cylinder, auxiliary exhaust or compression regulating valves to control said auxiliary ports and an intermediate connection from said main valve to said auxiliary valves, the same comprising an arm secured to the main valve stem and having a dash pot and lost motion engagement with the auxiliary valve stem said parts being inclosed within the valve casing.

7. A steam engine comprising a cylinder, main admission and exhaust ports thereto, main valves to control said ports, auxiliary exhaust ports to said cylinder, auxiliary exhaust or compression regulating valves to control said auxiliary ports, a stem on which said auxiliary valves are mounted and a

dash pot and lost motion connection from said main valves to said auxiliary valve stem.

8. A steam engine comprising a cylinder, main admission and exhaust ports thereto, main valves to control said ports, auxiliary exhaust ports to said cylinder, auxiliary exhaust or compression regulating valves to control said auxiliary exhaust ports, a stem on which said auxiliary valves are mounted, adjustable dash pots on said stem, and an intermediate connection from said main valves to said dash pots on said auxiliary valve stem.

9. A steam engine comprising a cylinder, main admission and exhaust ports thereto, main valves to control said ports, auxiliary exhaust ports from said cylinder, auxiliary exhaust or compression regulating valves to control said auxiliary exhaust ports, a stem on which said auxiliary valves are mounted, means for adjustably mounting dash pots on said stem, and means for giving relatively timed movements to said main and auxiliary valves.

10. A steam engine comprising a cylinder, main admission and exhaust ports thereto, main valves to control said ports, auxiliary exhaust ports from said cylinder, auxiliary exhaust or compression regulating valves to control said auxiliary exhaust ports, a stem on which said auxiliary valves are mounted dash pots adjustably seated on said stem, and means for imparting relatively timed movements to said main and auxiliary valves.

11. A steam-engine comprising a cylinder, a steam chest, a valve-seat in the steam-chest adjacent to the wall of the cylinder, admission and exhaust ports passing through the wall and valve-seat and connecting the steam-chest with the cylinder, a slide valve on said valve-seat consisting of a central section, end pieces having surfaces parallel with the line of travel of the valve and at right angles to the central section and which control the short steam-ports, back on said end pieces, a pressure-plate of corresponding form and covering the slide-valve, means for conducting the live steam under the pressure-plate and between the end pieces of the valve, auxiliary exhaust-ports connecting the cylinder with the main exhaust and a compression-regulating valve controlling the auxiliary exhaust ports.

12. A steam-engine comprising a cylinder, a steam-chest, a valve-seat in the steam-chest adjacent to the wall of the cylinder, admission and exhaust ports passing through the wall and valve-seat and connecting the steam-chest with the cylinder, a slide-valve on said valve-seat consisting of a central section, end pieces having surfaces parallel with the line of travel of the valve and at right angles to the central section and which control the ports, tie rods connecting end pieces of valve, a riding strip or surface provided at each end of the valve at a distance from the inner edges of the valve and pieces not less than the width of the ports, a pressure-plate covering the piston slide-valve, means for conducting the live steam under the pressure-plate and between the end pieces of the valve, auxiliary exhaust-ports connecting the cylinder with the main exhaust and a compression-regulating valve controlling the auxiliary exhaust-ports.

13. A steam-engine comprising a cylinder, a steam-chest, a valve-seat in the steam-chest adjacent to the wall of the cylinder, admission and exhaust ports passing through the wall and valve-seat and connecting the steam-chest with the cylinder, a slide-valve on said seat consisting of a central section, end pieces having surfaces parallel with the line of travel of the valve and at right angles to the central section and which control the ports, means for balancing the steam-pressure on the end pieces, a pressure plate covering the slide-valve, means for conducting the live steam under the pressure-plate and between the end pieces of the valve, auxiliary exhaust-ports connecting the cylinder with the main exhaust and a compression-regulating valve controlling the auxiliary exhaust-ports.

14. A locomotive steam-engine comprising a cylinder, a steam-chest, a valve-seat in the steam-chest adjacent to the wall of the cylinder, admission and exhaust ports passing through the wall and valve-seat and connecting the steam-chest with the cylinder, a slide-valve on said seat consisting of a central section, end pieces having surfaces parallel with the line of travel of the valve and at right angles to the central section and which control the ports, tie rods under contraction connecting the end pieces, means for permitting the piston slide-valve to recede from its seat or float, a pressure-plate covering the piston slide-valve, means for conducting the live steam under the pressure-plate and between the end pieces of the valve, auxiliary exhaust-ports connecting the cylinder with the main exhaust and a compression-regulating valve controlling the auxiliary exhaust-ports.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES B. ALLFREE.

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