J. B. ALLFREE.

VALVE FOR ENGINES.

APPLICATION FILED SEPT. 25, 1907.

960,615.

Patented June 7, 1910.

3 SHEETS—SHEET 1.

Fig. 2.

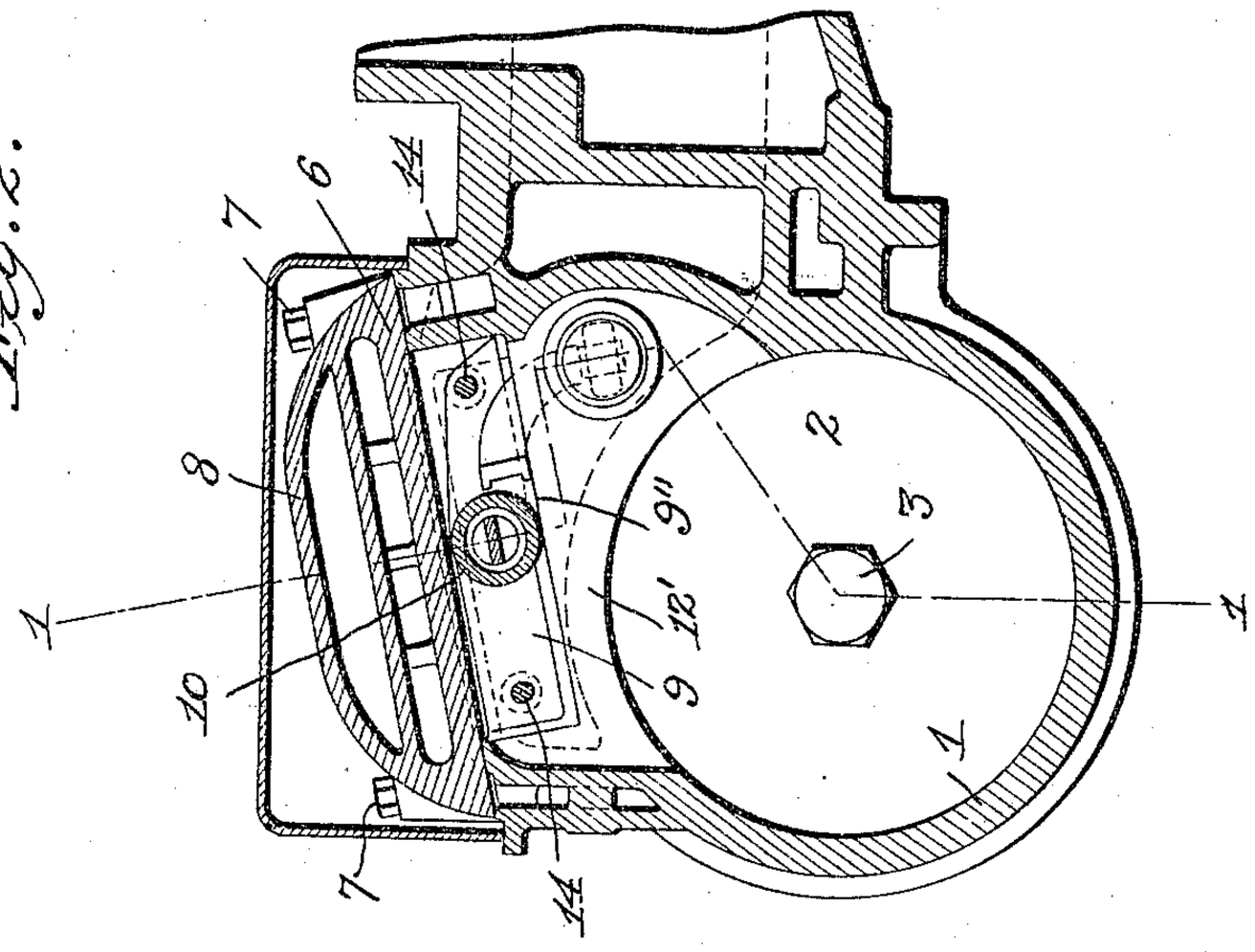
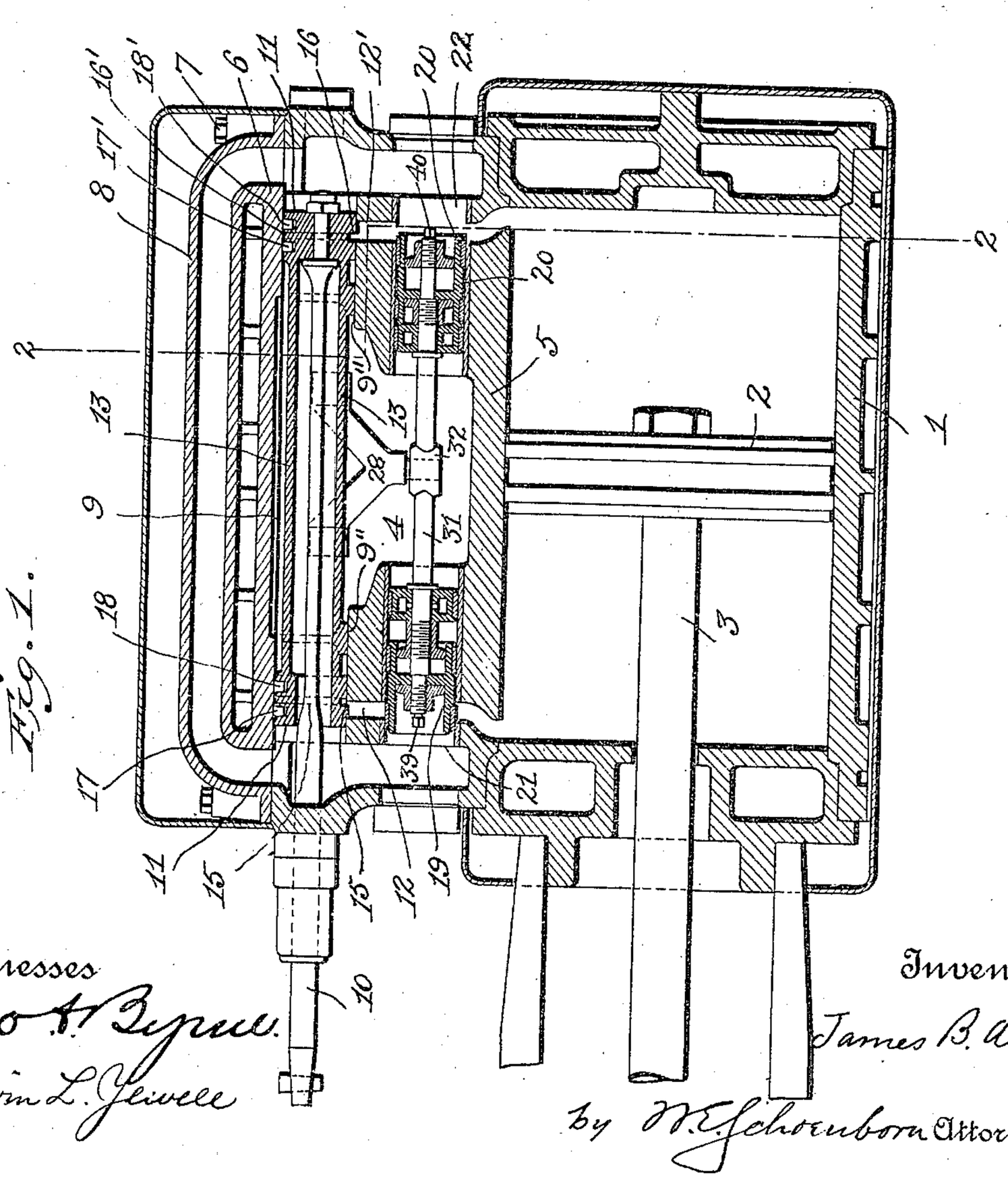


Fig. 1.



Witnesses

Geo. H. Graves.

Edwin L. Jewell

Inventor

James B. Allfree

by W. E. Schoenborn Attorney

J. B. ALLFREE.

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3 SHEETS—SHEET 2.

Fig. 5.

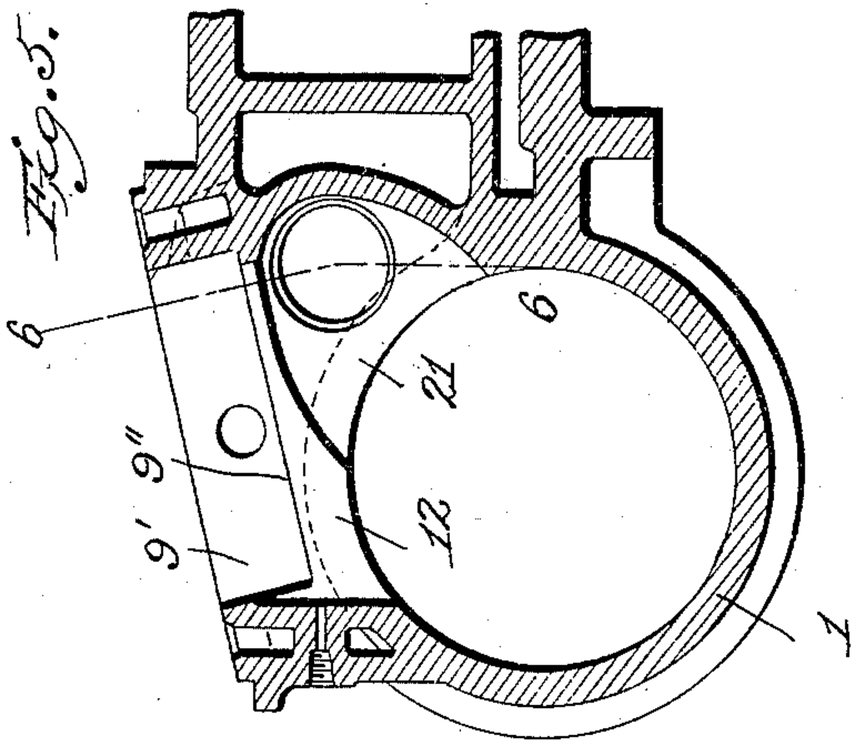


Fig. 6.

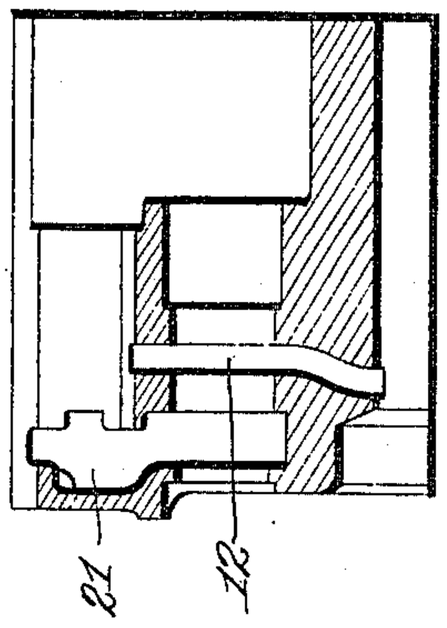


Fig. 3.

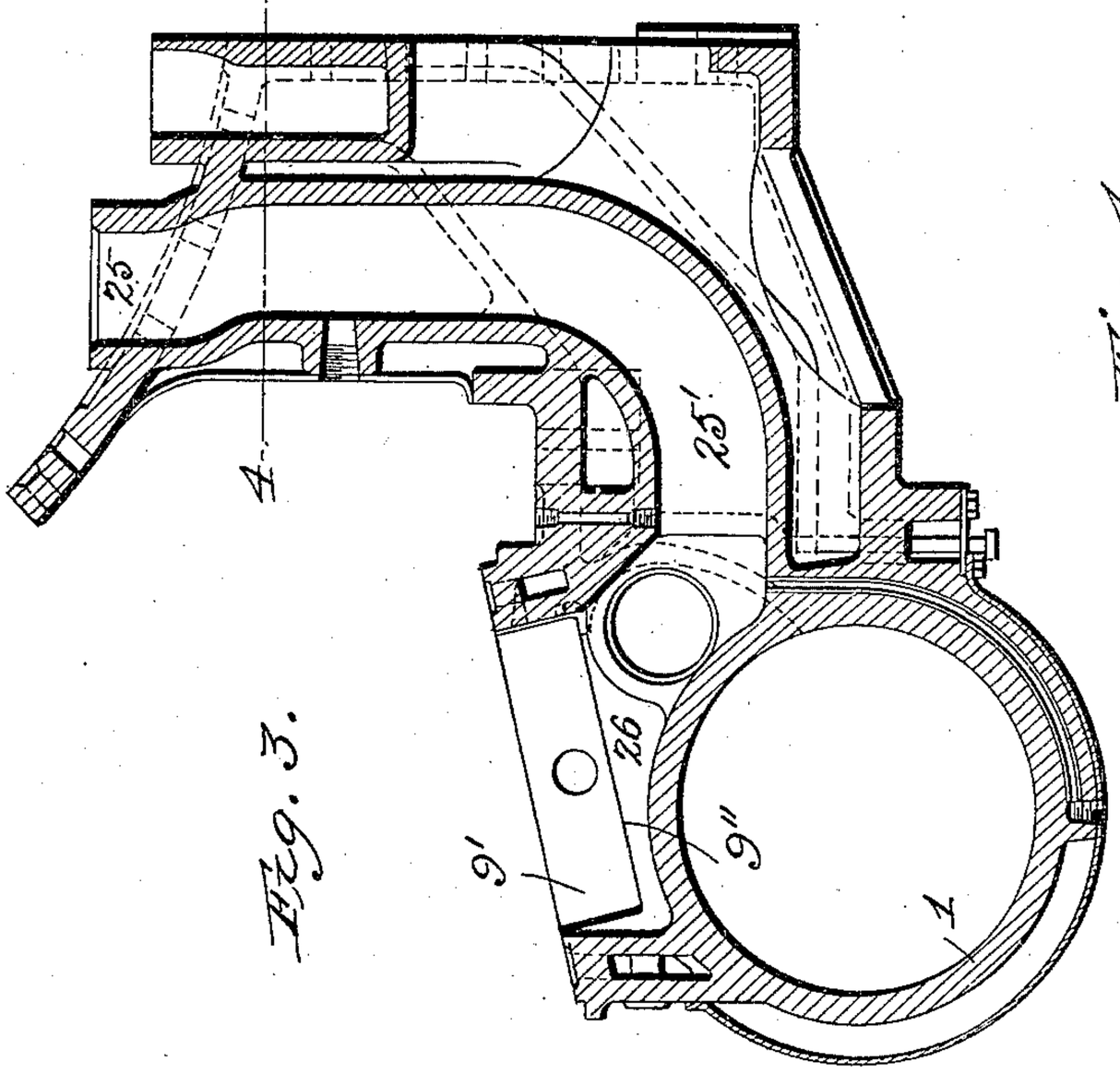
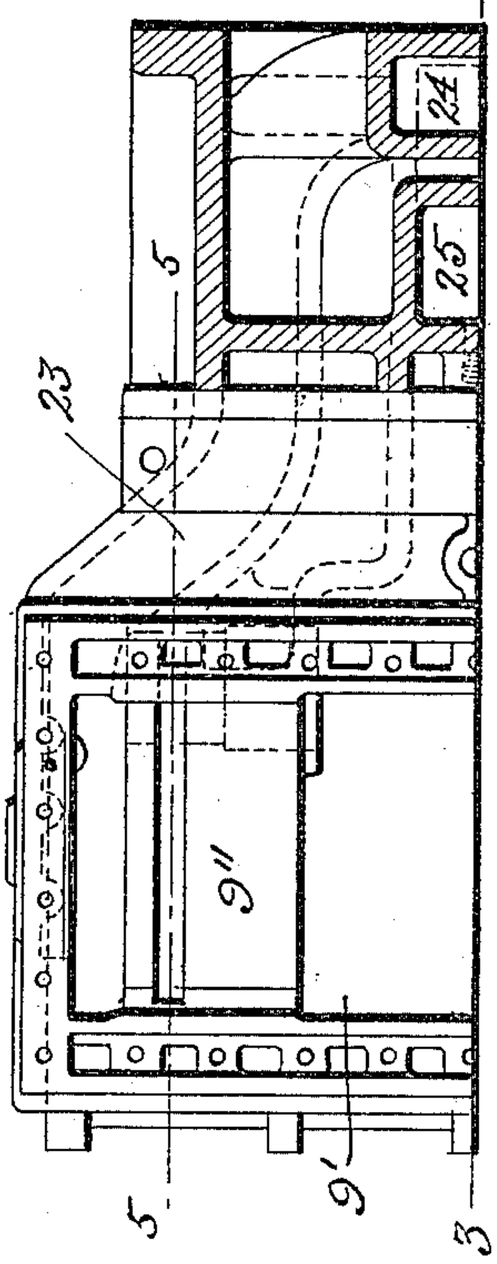


Fig. 4.



Witnesses

Geo. B. Byrne.

Edwin L. Jewell

Inventor

James B. Allfree

by W. E. Schoenborn Attorney

J. B. ALLFREE.

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3 SHEETS—SHEET 3.

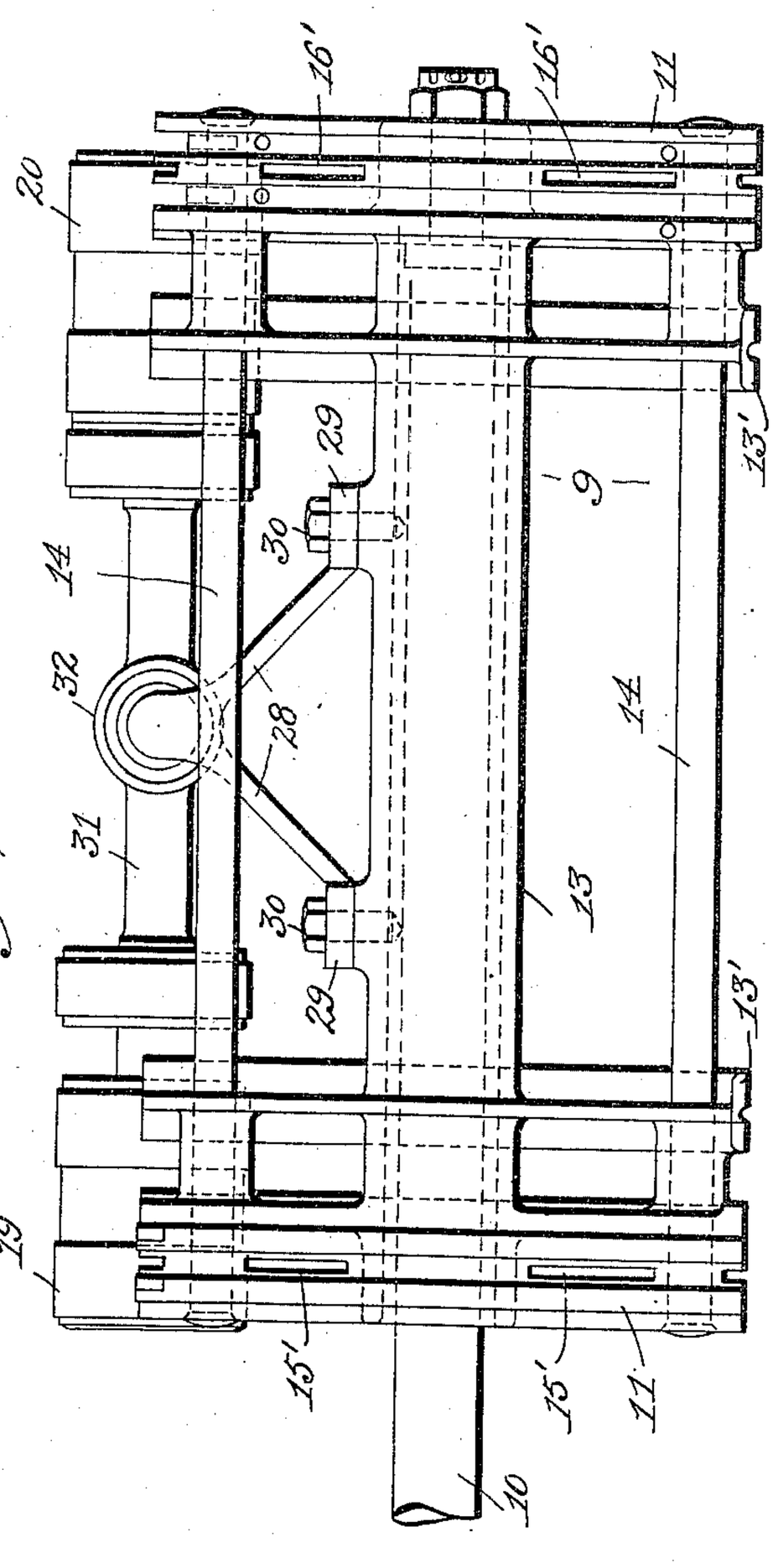

Fig. 7.

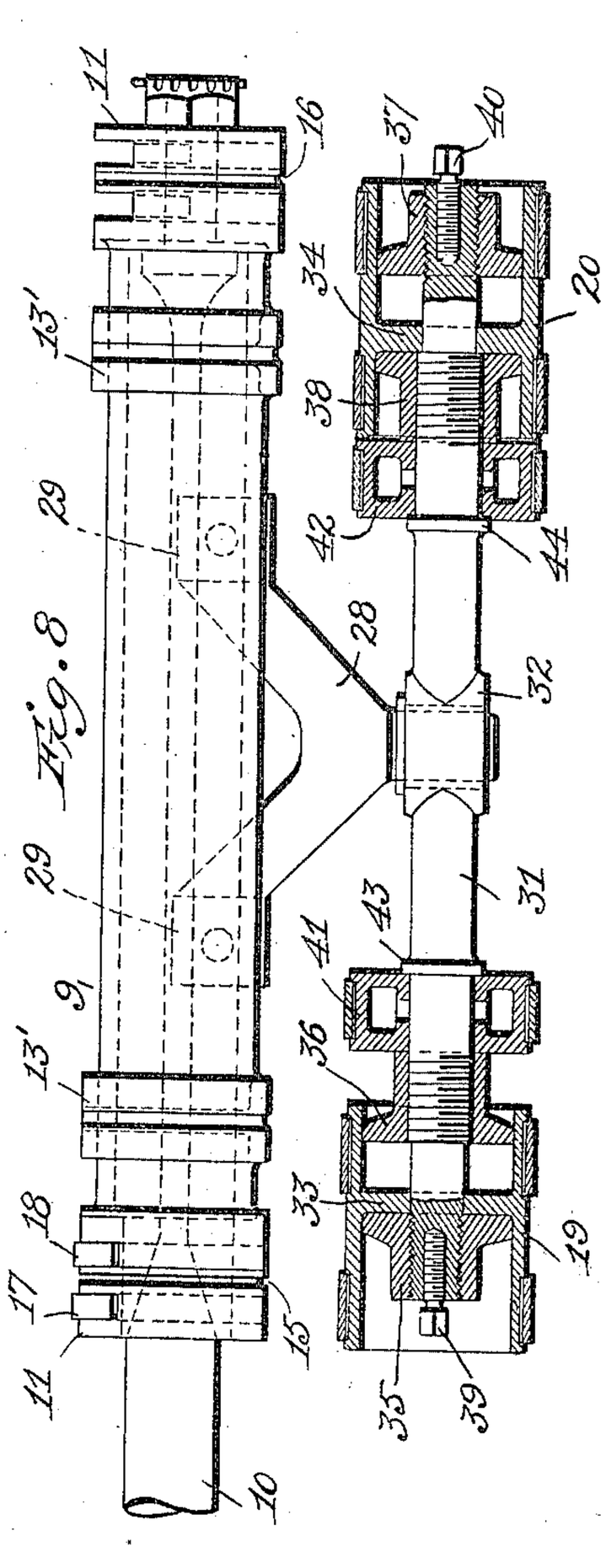

Fig. 8.

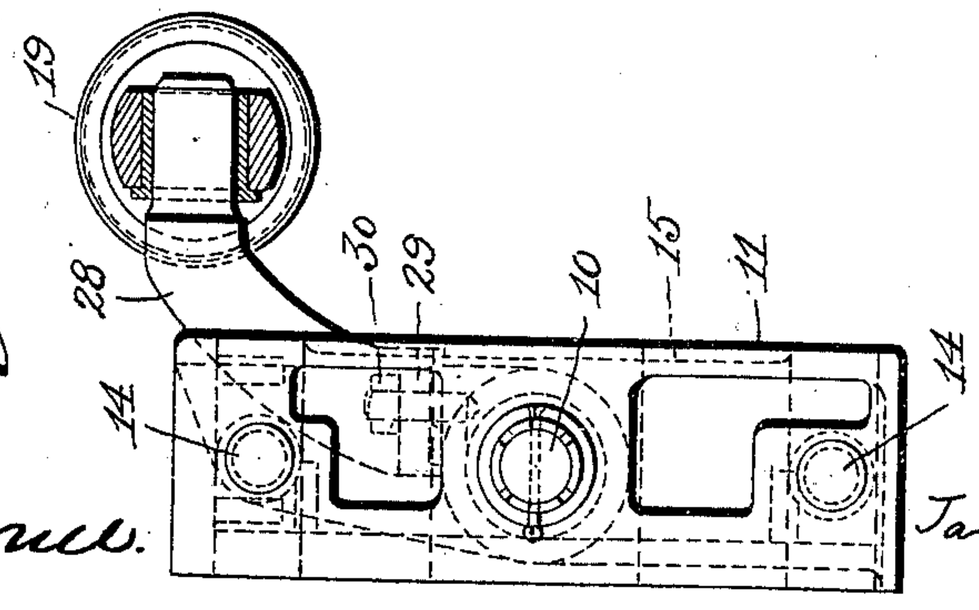

Fig. 9.

Witnesses

Geo. A. Bruce.

Edwin L. Jewett

Inventor

James B. Allfree

by W. E. Schoenborn Attorney

UNITED STATES PATENT OFFICE.

JAMES B. ALLFREE, OF CHICAGO, ILLINOIS.

VALVE FOR ENGINES.

960,615. Specification of Letters Patent. **Patented June 7, 1910.**

Application filed September 25, 1907. Serial No. 394,517.

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 Sept. 20, 1904.

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, preserve 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 ports 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 arrangements 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; 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 plate 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 showing the arrangement of the valves and details of the construction thereof; Fig. 8 is a side elevation of the valves, portions of the compression-regulating valve being shown in section; and Fig. 9 is an end view and partial section of the valves.

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 cross-head (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′.

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. 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 17, 18 and 17′, 18′ respectively of the said valve. The purpose of these passages is for intercepting 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 produced 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 features constitute essential elements of novelty in the present case.

A forked arm 28 has flanges 29 which are adapted to be secured to the central spool 13 of the main valve by means of bolts 30. Said arm 28 is loosely attached to the stem 31, of the auxiliary exhaust valves 19 and 20 by means of a suitable bored sleeve 32 or otherwise, and hence said stem 31 is caused to partake of the reciprocations of the main valve. It is however necessary that the working portions of auxiliary exhaust valves 19 and 20 have a certain amount of lost motion relative to such reciprocation and to effect this result the following means are provided. Said valves are constructed in the form of hollow barrels with suitable peripheral packing and intermediate integral webs 33 and 34, said webs having central apertures to loosely fit the reduced ends of stem 31 and thus to guide the valve barrels thereon. Pairs of collars 35, 36 and 37, 38 are mounted in screw threaded engagement with the ends of stem 31 and the collars of each pair are adapted to be adjusted by such screw threads a proper distance apart so that the webs 33 and 34 playing between the same will allow the valves 19 and 20 a predetermined amount of lost motion relative to the stem 31 in the reciprocations thereof. It will be noticed that said collars fit the interiors of the valve barrels 19 and 20 and hence serve to aid in guiding the same in such lost motion travel. The ends of the valve stem 31 may be split and internal expander screws 39 and 40 threaded therein thus to lock the outer collars 35 and 38 against accidental displacement. Suitable packing pistons 41 and 42 may be secured upon valve stem 31 adjacent the valves 19 and 20 and abutting against shoulders 43 and 44, the object of these pistons being to prevent all leakage through the valves from the live steam side to the exhaust side.

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 port 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 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 and 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 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 the collars 35, 36, 37 and 38 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.

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 exhaust ports, and a 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 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 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 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 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 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 a forked arm secured to the main valve stem and having 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 for sliding movement, means for limiting said sliding movement and a connection from said main valves to said auxiliary valve stem.

8. A steam engine comprising a cylinder, a 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 for sliding movement, adjustable stops for limiting such movement and an intermediate connection from said main valves to 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 to slide, means for adjustably limiting said sliding movement, 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 to slide, spaced collars threaded upon said stem and adapted to adjustably limit said sliding movement, said collars being also arranged to guide said valves, and means for imparting relatively timed movements to said main and auxiliary valves.

11. A steam engine comprising a cylinder, a steam chest, short admission and exhaust ports connecting the steam chest and cylinder, short auxiliary exhaust ports from the cylinder, a main valve of substantially rectangular form to control the admission and exhaust through the short steam ports having passages admitting steam to the back of said valve to balance the same, an auxiliary exhaust or compression regulating valve to control said auxiliary exhaust ports and an intermediate connection within the steam chest and from said main valve to said auxiliary or compression regulating valve.

12. A steam engine comprising a cylinder, a steam chest, short main admission and exhaust ports connecting the steam chest and cylinder, auxiliary exhaust ports from the cylinder, an auxiliary exhaust or compression regulating valve controlling said

auxiliary exhaust ports and a main valve to control said main ports the same having working portions of substantially rectangular form, rods connecting said working portions and passages to admit steam to the back of the valve to balance the same.

13. A built-up valve for steam engines comprising working portions of substantially rectangular form having steam ports therein, a central hollow spool connecting said working portions, an operating stem in said spool and connected thereto at one point, and lateral rods connecting said working portions of the valve to form a rigid structure.

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

JAMES B. ALFREE.

Witnesses:
F. W. TREGO,
F. W. STEVENS.