

No. 770,671.

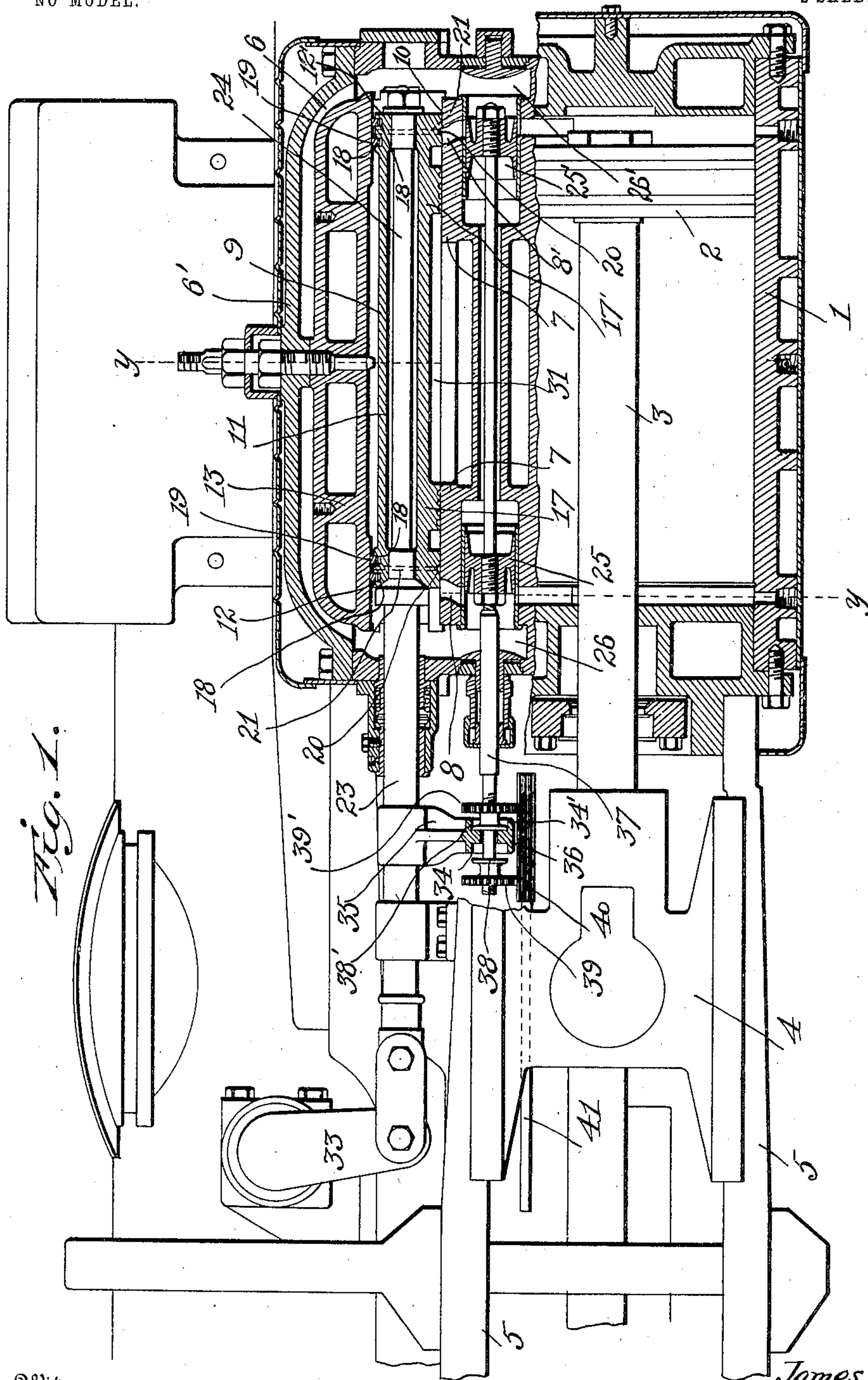
PATENTED SEPT. 20, 1904.

J. B. ALLFREE.  
VALVE FOR ENGINES.

APPLICATION FILED JULY 30, 1904.

NO MODEL.

2 SHEETS—SHEET 1.



Witnesses

Edwin L. Jewell

*J. H. Zingaro*

 $\mathbb{Z}_p$ 

Inventor

James B. Allfree

W. J. Schornborn  
Attorney

Attorney

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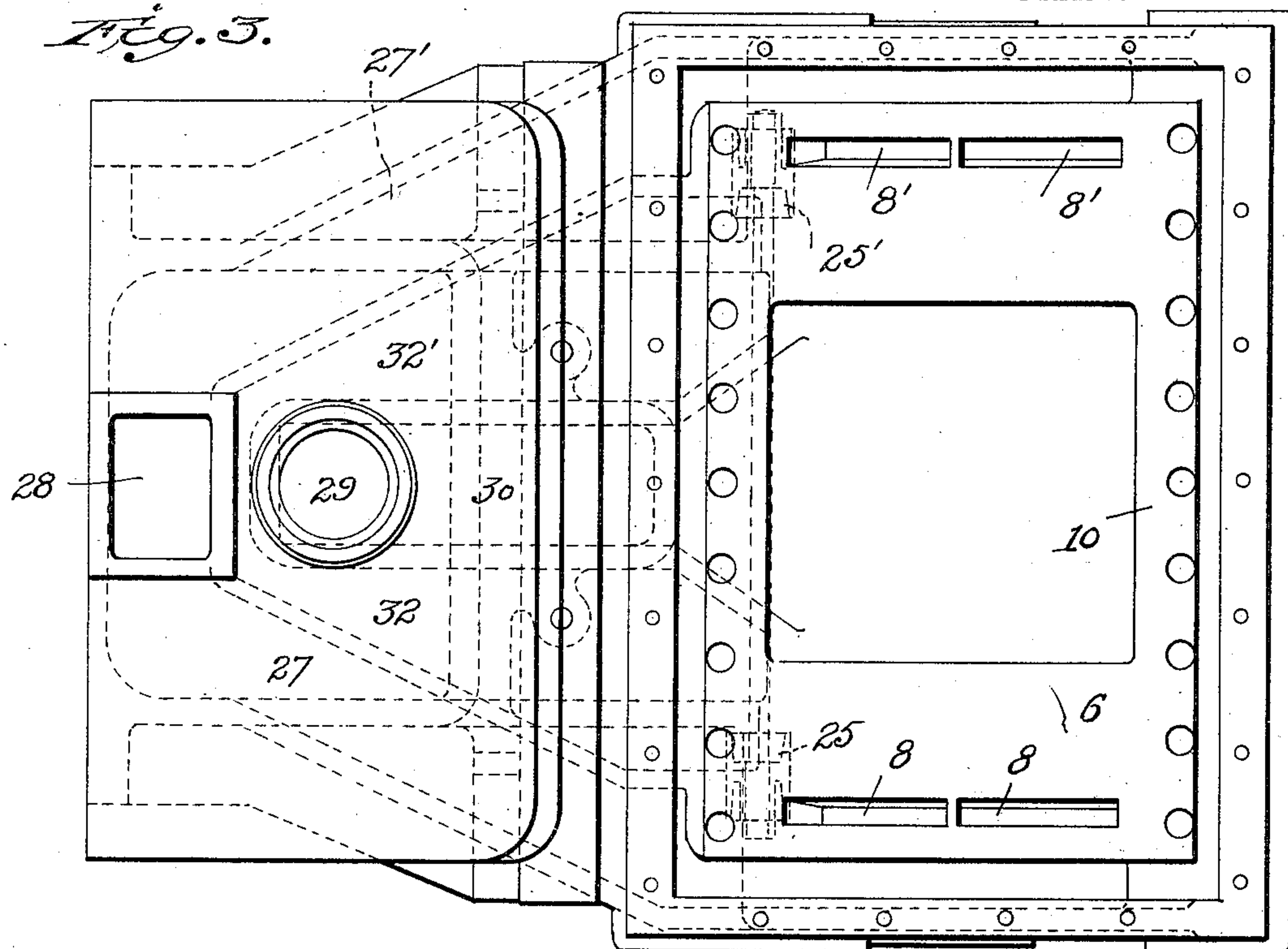
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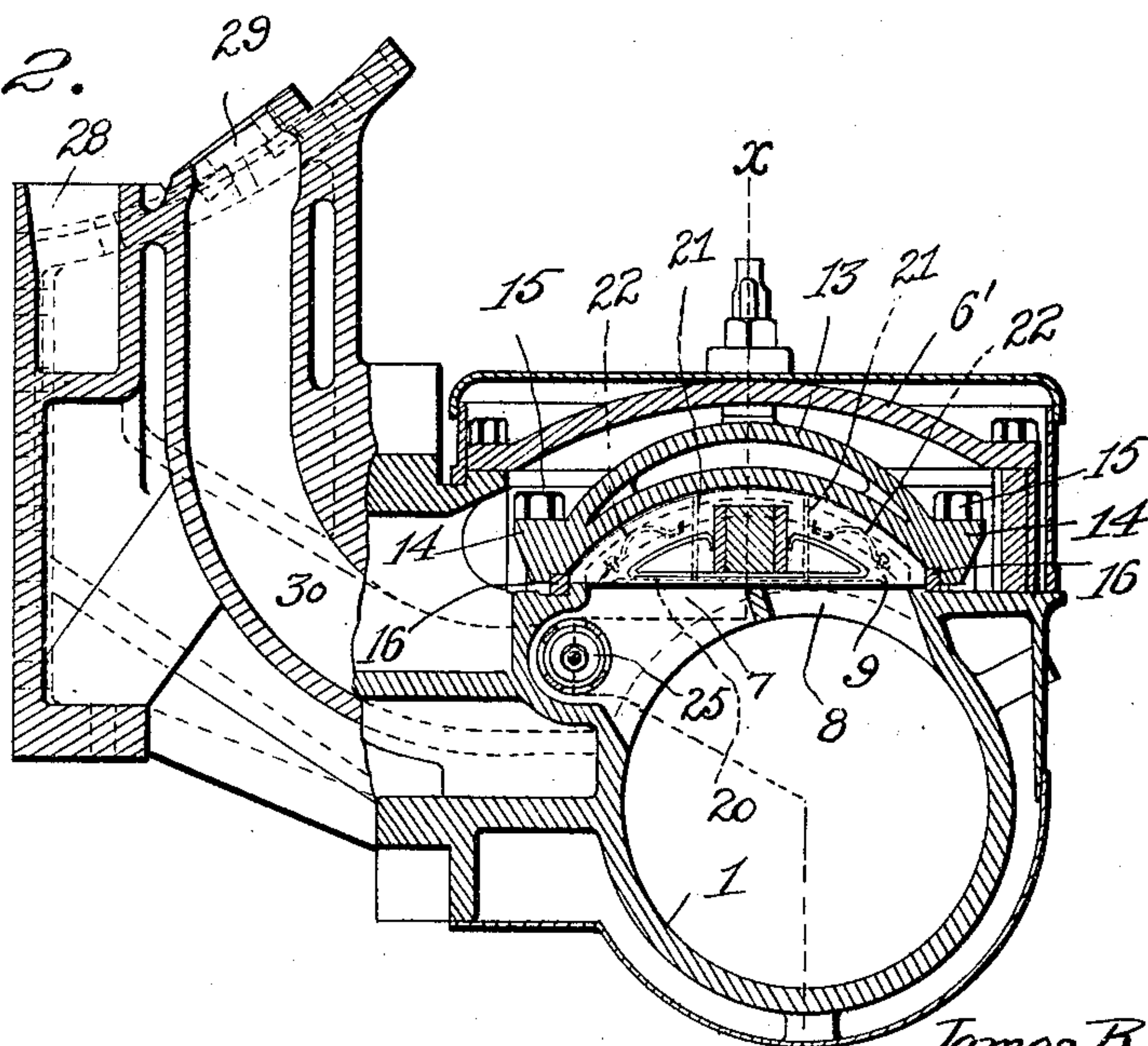
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2 SHEETS—SHEET 2.

*Fig. 3.*



*Fig. 2.*



Inventor

James B. Allfree

By

X

W. E. Schornborn

Attorney

Witnesses

Edwin L. Jewell

J. H. Burges



# UNITED STATES PATENT OFFICE.

JAMES B. ALLFREE, OF IRONTON, OHIO.

## VALVE FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 770,671, dated September 20, 1904.

Application filed July 30, 1904. Serial No. 218,852. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES B. ALLFREE, a citizen of the United States, residing at Iron-  
ton, in the county of Lawrence and State of  
5 Ohio, have invented certain new and useful  
Improvements in Valves for Engines, of which  
the following is a specification.

My invention relates to improvements in  
valves for steam-engines or other engines of a  
10 similar type.

The objects of my invention are, first, to so  
construct and arrange a cylinder, steam-chest,  
short live-steam or exhaust ports, and auxil-  
iary exhaust-ports with coöperating main and  
15 compression-regulating valves in order to in-  
sure a more economical distribution and use  
of the steam in the cylinder by having the  
"events" of the valves or the admission, ex-  
haust, and compression of the steam give the  
20 highest rate of expansion, greatest mean ef-  
fective pressure with relatively low terminal  
pressure at exhaust for a given cut-off and cyl-  
inder temperature, and at the same time attain  
a most important feature by securing a mini-  
25 mum clearance both in the cylinder and the  
connecting parts, which will provide compres-  
sion sufficient for the proper cushioning and  
efficient operation of the piston within the cyl-  
inder; second, to construct and arrange a cyl-  
30 inder and steam-chest with the connected live-  
steam and exhaust ports, which will prevent  
to the greatest extent radiation of heat, there-  
by tending to hold all the heat units of the  
live steam, preserve the mean cylinder tem-  
35 perature at the highest degree attainable, and  
reduce condensation in the cylinder, steam-  
chest, and connected ports to a minimum;  
third, to provide a cylinder and steam-chest  
with connecting live-steam and exhaust ports,  
40 which in length, condensing, and frictional  
surfaces are reduced to a minimum and also  
so arranged that the passages leading the live  
steam to the cylinder are within the space sur-  
rounded by the exhaust-steam passages;  
45 fourth, to construct a main valve in relation  
to the details of the cylinder, steam-chest, and  
ports in order that its seat may always be lu-  
bricated, the valve at the same time being ex-  
ceptionally light in weight and balanced, so as  
50 to adapt it particularly for high-speed work,

and at the same time arranged to readily re-  
cede from its seat or float while "drifting"  
when used in connection with locomotive-cyl-  
inders having low-clearance and compres-  
sion-regulating valves; fifth, to provide a com- 55  
pression controlling or regulating valve which  
will open for exhaust simultaneous with or a  
little later than the main valve, but made to  
close for compression much later than the  
main valve; sixth, to provide an arrangement 60  
by which the compression may be varied or  
regulated independently of the main valve by  
separate adjustment of the compression con-  
trolling or regulating valve and also means  
whereby the regulation may be controlled 65  
within or out of the cab and while in opera-  
tion when used in connection with a loco-  
motive-engine; seventh, other evident functions  
and advantages of the specific construction  
and arrangement of the parts, which will here- 70  
inafter appear from the detailed description  
of the invention and the manner of applying  
the same.

My invention comprises novel features of  
construction and relative arrangements of the 75  
parts, which will be hereinafter described in  
the detailed description, and particularly  
pointed out in the appended claims.

Reference is had to the accompanying two  
sheets of drawings, forming a part of this 80  
specification, in which similar reference char-  
acters indicate corresponding parts through-  
out the several figures.

Figure 1 is a longitudinal section on line  
*x x* of Fig. 2 of the cylinder, steam-chest, and 85  
valves of my invention as applied to a loco-  
motive. Fig. 2 is a transverse section on the  
line *y y* of Fig. 1 on a reduced scale from  
that shown in Fig. 1. Fig. 3 is a plan view  
with the steam-chest cover and main valve 90  
removed and showing in dotted lines the re-  
lation of the compression-regulating valve,  
the live-steam and exhaust ports with the cyl-  
inder, and their main inlet and exhaust con-  
nections. 95

In the use of steam in the cylinder of a re-  
ciprocating steam-engine, whether it be used  
as a locomotive, stationary, or marine, it is  
well-known that the steam required to fill the  
clearance-space, which comprises all the vol- 100



ume of the ports and cylinder between the piston and valve when the piston is at the extreme limit of its movement or stroke, is detrimental to the economy of the engine, and  
 5 aside from the little space necessary for striking room may be said to be waste. It is well known that in the use of any sort of variable-stroke slide-valve a considerable amount of clearance-space must be provided for, for the  
 10 reason that any valve of this class when operated so as to provide an early cut-off will close the exhaust-port far too soon, especially so if it is provided with sufficient exhaust-lap to retain the steam in the cylinder until its maximum ex-  
 15 pansion is obtained. The steam or vapor thus entrapped will be compressed by the piston oftentimes considerably in excess of the boiler-pressure constituting negative work, thus depriving the engine of its normal power and  
 20 creating undue vibration, increasing the cost of running repairs, as well as creating greater liability for accident. The means employed by my invention to overcome these difficulties and effect the objects stated above will  
 25 now be specifically described as used in connection with a locomotive, and while so described I wish it to be distinctly understood I do not care to limit myself to this specific use, as will be readily understood by those skilled  
 30 in the art. It may be applied to other forms of engine—as, for example, stationary or marine type.

Referring to the drawings, 1 is a cylinder which is provided with the usual heads, stuffing-box, threaded openings for drain-valves,  
 35 and other essentials, which need no description to be fully understood.

2 is a piston provided with a piston-rod 3, connected to the cross-head 4, which is supported and guided by suitable rods 5 5 in the  
 40 well-known manner.

6 is a steam-chest, preferably located above the cylinder and partially surrounding or jacketing the cylinder 1. The wall 7 between  
 45 the chest and cylinder is of sufficient thickness to confine the pressure therein and resist the stresses to which it may be subjected.

8 8' are short ports passing through the wall 7 at the ends of the cylinder.

50 6' is a cover of the steam-chest and secured by bolts in the usual manner.

The specific construction and relation of the cylinder with its short ports for reducing the clearance and efficiently conveying the live  
 55 steam to the steam-chest, main valve, and the interior of the cylinder, and finally leading the exhaust-steam to the atmosphere, form one of the important features of this invention and will be hereinafter fully described.

60 13 is a pressure-plate, preferably constructed with double walls provided with intervening air-spaces for the purpose of insulation, and at the same time having great stiffness with moderate weight. Said pressure-plate  
 65 is provided at the two sides corresponding to

the length of the steam-chest with lugs 14, (see Fig. 2), through which screws 15 take into the valve-seat 10, whereby the side fitting-strips 16 16, which extend the full length of the pressure-plate and fit in suitable recesses  
 70 therein, are firmly held between the seat and pressure-plate. As will be seen in referring to Fig. 2, the fitting-strips 16 extend into rectangular recesses in the pressure-plate 13 to such a depth that the line of their inner  
 75 vertical surfaces intersect with the inner wall of the pressure-plate, which is preferably an arc of a true circle, so that it may be bored out on an ordinary engine-lathe, and thereby  
 80 cheapen its manufacture. The valve-chamber thus formed with the valve-seat below, the pressure-plate above, and the fitting-strips at the sides comprises in cross-section the arc of a true circle, a base-line represented  
 85 by the valve-seat at a suitable distance below and parallel with the cord-line proper of the arc, and the vertical sides bounded by the fitting-strips.

9 is a main valve sliding on the valve-seat 10 in the above-described valve-chamber. 90 This valve is preferably of the piston type, formed with two end pieces or heads 12 12', which with suitable packing form a tight joint with the pressure-plate and register with and control the ports 8 8'. 11 is a hollow rod or  
 95 central tie-section connecting the ends or heads of the valve, by which arrangement I am enabled to construct a very light valve.

While I have herein shown and described a main slide-valve having two sections connected  
 100 together for controlling the admission and exhaust ports, it can be readily seen, and I wish it to be distinctly understood, that I do not limit myself to this exact form or construction of valve, as any other common and well-known  
 105 form of valve could be substituted—as, for example, one or two of the oscillating or rotary type.

17 17 are extensions on the valve near the inner sides of the end pieces or heads, which form  
 110 riding-shoes or auxiliary bearing-surfaces in addition to that provided for the valve proper and 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  
 115 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 portion which is well lubricated will act as a distributor and furnish the valve-  
 120 face with lubricant that it would not otherwise receive, for the reason that the valve-faces, especially in short travel, do not reach the oiled portion of the valve-seat. Furthermore, the steam usually blows off the oil from  
 125 the valve-seat near the ports in entering the cylinder or during exhaust, and by the above arrangement and construction of riding-shoes the oil is constantly replenished.

In the back or rounded surface of the heads 130



or ends 12 12' of the valve are preferably two packing-strip grooves 18 18 of even depth. 19 19 are packing-strips properly shaped and arranged in said grooves 18 to make a steam-tight joint between the valve ends and the inner surface of the pressure-plate.

22 22 are springs for forcing the packing-strips against the pressure-plate.

The upper curved surfaces of the valve-heads are so constructed and proportioned to be separated from the inner surface of the pressure-plate by such a space as to permit the valve to recede sufficiently from its valve-seat to relieve compression when the valve ends are in a position to close the ports while the engine is drifting and no live-steam pressure is in the steam-chest. However, it may be stated in the use of the auxiliary exhaust-valve or compression-regulating valve to be presently described the tendency to accumulate compression is very much less than it would be with the ordinary or standard gear and valve.

20 20 are intercepting grooves, one in the lower side of each of the valve ends 12 12', and which extend nearly the entire width of the valve within one-fourth to three-eighths of an inch of each side, one-eighth to one-fourth of an inch in depth, and from one-half to three-fourths of an inch in width. 21 21 are holes drilled through the valve ends and which connect the groove 20 with the space between the two strips 19 19 in the upper side of each of the valve ends. The purpose of these grooves is for intercepting the steam when passing under the valve when the port is uncovered, and therefore allow the steam to pass up the holes 21 21 and instantly equalize the pressure between the two strips and the upper and lower sides of the valve. By this simple construction and arrangement it will be seen I have not only devised a valve which will float, but at the same time perfectly balanced, which especially adapts the engine for locomotive and high-speed work.

In order to permit the valve to recede from its seat, there is provided a valve stem or rod 23 with a reduced section 24, which passes through and is smaller than the internal diameter of the tube or central tie-section 11, thus permitting the valve to be raised or leave its seat when compression takes place in the cylinder.

25 25' are the auxiliary exhaust or compression-regulating valves, and while I have shown them of a piston type any other form may be readily substituted and one continuous valve construction, as that shown in the main valve 9, or one or more oscillating or rotary valves may be used, if so desired.

26 26' are the short auxiliary ports, which are controlled by the compression-regulating valves 25 25'. As will be seen by reference to Fig. 2, the compression-regulating valves are situated adjacent to the inner portion of

the cylinder and connect with the outside exhaust-passages 27 27', which lead to the petti-coat-pipe connection 28.

29 is the live-steam pipe connection, which by means of passage 30, separated by air-spaces 32 32' and between the exhaust-passages 27 27', leads the live steam into the space 31 (see Fig. 1) of the valve-chamber, situated between the two heads or ends 12 12' of the valve and above and below the central tie-section 11.

From the foregoing description of the construction and arrangement of live-steam ports and exhaust I have devised a cylinder in which the length of the ports are brought 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 easily cleaned. Furthermore, with this form and arrangement of cylinder and its ports the live steam is brought in contact with a large portion of the center of the cylinder, while the exhaust and live steam passages are separated by air-spaces, the live steam being on the inside and the exhaust on the outside, which act as a very effectual insulation against the cooling influence of the atmosphere. It will also be noticed that the live steam within the steam-chest is first insulated by the exhaust-steam and then by an air-space, and only a portion of the cylinder being exposed to atmospheric influences.

The main valve 9 is reciprocated through the valve stem or rod 23, which is connected to the usual rocker-arm 33 of a valve-gear. Connected with and depending from this valve-rod 23 is an arm 35, having an enlargement at its end and so constructed as to have oppositely-disposed dash-pots 34 34', with an opening 36 connecting them for the passage of a valve-stem 37, connected with the compression-regulating valves 25 25'. Supported on said valve-stem 37 are two adjustable pistons 38 38', which engage right and left hand screw-threads on the valve-stem and cooperate with the dash-pots 34 and 34', respectively, as will presently be described.

While I have herein shown and specifically described pistons and dash-pots for the purpose of operating the compression-regulating valve, the expedient is used, preferably, for the purpose of deadening the sound of impact of the two parts; but I wish it to be understood that a simple and ordinary cam construction could be adopted without departing from the invention, or, if so desired, separate and independent means from that which controls the main valve could be made to operate the compression-regulating valve.

In order to quickly and readily adjust the position of the cams with respect to the dash-pots by separating or bring them closer together while the engine is in motion, I have provided each of the pistons with an integral



gear 39 39', which engages with a pinion 40, suitably supported and in engagement with the gears 39 39' in all positions of the compression-regulating valves 25 25'. A rod 41, whose rotation may be controlled from the cab, is suitably connected to the pinion 40, so that when the same is rotated it will turn the gears 39 39' and adjust the position of the pistons 38 and 38'.

The operation of the compression-regulating valves may be accomplished in many ways; but I have found the above-described arrangement a simple and efficient one in that the dash-pots entrap sufficient air when engaging the piston to prevent a noise or jar.

While I have shown the pinion 40 and gears 39 and 39' for adjusting the pistons 38, it can be readily seen that these parts can be omitted and the engine be made to operate in the same manner after having adjusted the pistons by hand and locking them by any common and well known means. I wish it also to be understood that any other means may be employed for actuating the compression-regulating valves, so as to preserve the relation of having them close the exhaust after the exhaust by the main valve is cut off.

The operation of the invention is as follows: Assuming the piston and valves in the position indicated in Fig. 1, the live steam under the valve and between its ends passes, by means of the passage between the riding-shoes and the ends of the valve, into the short port 8' into the cylinder back of the piston 2, when the same is forced to the other end of the cylinder. During this travel of the piston the main valve completely uncovers the port 8' and cuts off on its return at a time regulated by the valve-gear, the expanded steam at the other end of the cylinder having exhausted through the other port, 8, uncovered by the other end, 12, of the main valve. This movement of the main valve by means of the valve-rod 23 and depending rod 35 acts against the cam 38, thereby operating the valve 25, which closes the auxiliary exhaust-ports 26 after the exhaust through port 8 has been closed by the main valve 12. 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 for compression much later than the main valve and 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.

While I have shown and described my engine and valve arrangement being used in connection with steam, it can be used with the

same efficiency and manner with any other expansible fluid.

Various changes may be made in the details of my engine and in the means for operating or adjusting the valves, and while I have in the foregoing specification described one form to accomplish the results aimed at yet it will be obvious to those skilled in the art that the specific construction and arrangement may be modified in many ways without changing in any way the operation of the mechanism or varying the invention.

From the detailed description and the mode of operating the same it will be clearly seen that I have devised an apparatus in which the objects set out in the statement of invention are fully and efficiently carried out.

Having now 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 with the 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 and a compression-regulating valve controlling the auxiliary exhaust-ports.

2. A steam-engine comprising a cylinder, a steam-chest, admission and exhaust ports connecting the steam-chest with the 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, means for balancing the said main valve and a compression-regulating valve controlling the auxiliary exhaust-ports.

3. A locomotive steam-engine comprising a cylinder, short admission and exhaust ports connecting the steam-chest with the 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 short steam-ports, means for permitting the said main valve to recede from its seat or float while drifting and a compression-regulating valve controlling the auxiliary exhaust-ports.

4. A steam-engine comprising a cylinder, a steam-chest, short admission and exhaust ports connecting the steam-chest with the cylinder, auxiliary exhaust-ports connecting the cylinder with the main exhaust, a main valve having two heads or ends controlling the said short admission and exhaust ports, a riding strip or surface at each of the two heads or ends of the valve and at a distance therefrom not less than the width of a short admission and exhaust port and a compression-regulating valve controlling the auxiliary exhaust-ports.

5. A steam-engine comprising a cylinder, a



steam-chest, short admission and exhaust ports connecting the steam-chest with the cylinder, auxiliary exhaust-ports connecting the cylinder with the main exhaust, a main valve in  
 5 said steam-chest controlling the admission and exhaust through the short steam-ports, a compression-regulating valve controlling the auxiliary exhaust-ports and means connected to the main-valve-operating mechanism for actuating the said compression-regulating valve.  
 10

6. A steam-engine comprising a cylinder, a steam-chest, short admission and exhaust ports connecting the steam-chest with the cylinder, auxiliary exhaust-ports connecting the cylinder with the main exhaust, a main valve in  
 15 said steam-chest controlling the admission and exhaust through the short steam-ports, a compression-regulating valve controlling the auxiliary exhaust-ports, means connected to the main-valve-operating mechanism for actuating the said compression-regulating valve and means for adjusting the connections to vary the movement of the compression-regulating valve.  
 20

7. A steam-engine comprising a cylinder, a steam-chest, short admission and exhaust ports connecting the steam-chest with the cylinder, auxiliary exhaust-ports connecting the cylinder with the main exhaust, a main valve in  
 25 said steam-chest controlling the admission and exhaust through the short steam-ports, means for operating the main valve, a compression-regulating valve controlling the auxiliary exhaust-ports, means for operating the compression-regulating valve and closing the auxiliary exhaust-ports after the main valve closes the exhaust through the short admission and exhaust ports and means for varying the movement of the compression-regulating valve.  
 30  
 35

8. A steam-engine comprising a cylinder, a steam-chest, a valve-seat in the steam-chest adjacent to the wall of the cylinder, short admission and exhaust ports passing through the wall and valve-seat and connecting the steam-chest with the cylinder, a slide-valve on said  
 40 valve-seat consisting of a central or tie section, end pieces having surfaces parallel with the line of travel of the valve and at right angles to the central or tie section and which  
 45 control the short steam-ports, a curved or segmental back on said end pieces, a pressure-plate of corresponding segmental form and covering the slide-valve, means for conducting the live steam under the pressure-plate  
 50 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.  
 55

9. A steam-engine comprising a cylinder, a steam-chest, a valve-seat in the steam-chest adjacent to the wall of the cylinder, short admission and exhaust ports passing through the wall and valve-seat and connecting the steam-

chest with the cylinder, a piston slide-valve  
 65 on said valve-seat consisting of a central or tie section, end pieces having surfaces parallel with the line of travel of the valve and at right angles to the central or tie section and which control the short ports, a riding strip  
 70 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  
 75 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.  
 80

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

11. A locomotive steam-engine comprising  
 100 a cylinder, a steam-chest, a valve-seat in the steam-chest adjacent to the wall of the cylinder, short admission and exhaust ports passing through the wall and valve-seat and connecting the steam-chest with the cylinder, a  
 105 piston slide-valve on said seat consisting of a central or tie section, end pieces having surfaces parallel with the line of travel of the valve and at right angles to the central or tie section and which control the short ports,  
 110 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,  
 115 auxiliary exhaust-ports connecting the cylinder with the main exhaust and a compression-regulating valve controlling the auxiliary exhaust-ports.

12. A locomotive-engine comprising a cylinder, a steam-chest, a valve-chamber in the steam-chest, short admission and exhaust ports connecting the valve-chamber with the cylinder, a main valve within the said valve-chamber, an exhaust-chamber surrounding the  
 120 valve-chamber, exhaust-passages extending to one side of the cylinder and having their ends connected to the ends of the exhaust-chamber  
 125



and a main exhaust-pipe, auxiliary exhaust-ports on the same side of the cylinder as the said exhaust-passages and connecting the cylinder with the exhaust-passages, compression-regulating valves controlling the auxiliary exhaust-ports, a live-steam supply-passage between the exhaust-passages and so arranged to partially surround the cylinder and convey the live steam into the valve-chamber.

10 13. A steam-engine comprising a cylinder, a steam-chest, admission and exhaust ports connecting the steam-chest with the cylinder, auxiliary exhaust-ports connecting the cylinder with the main exhaust, a main valve in  
15 said steam-chest controlling the admission and exhaust through the steam-ports, means for operating said main valve, a compression-regulating valve controlling the auxiliary exhaust-ports and means for operating the compression-regulating valve.  
20

14. A steam-engine comprising a cylinder, a steam-chest, short admission and exhaust ports through the wall of the cylinder and connecting the steam-chest with the 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 said short steam-ports and a compression-regulating valve controlling the auxiliary exhaust-ports. 25 30

15. A steam-engine comprising a cylinder, a steam-chest, short admission and exhaust ports through the wall of the cylinder and connecting the steam-chest with the 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 said short steam-ports, means for operating the main valve, a compression-regulating valve controlling the auxiliary exhaust-ports and means for operating the compression-regulating valve. 35 40

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

JAMES B. ALLFREE.

Witnesses:

A. G. HEGGEM,  
E. B. HETZEL.