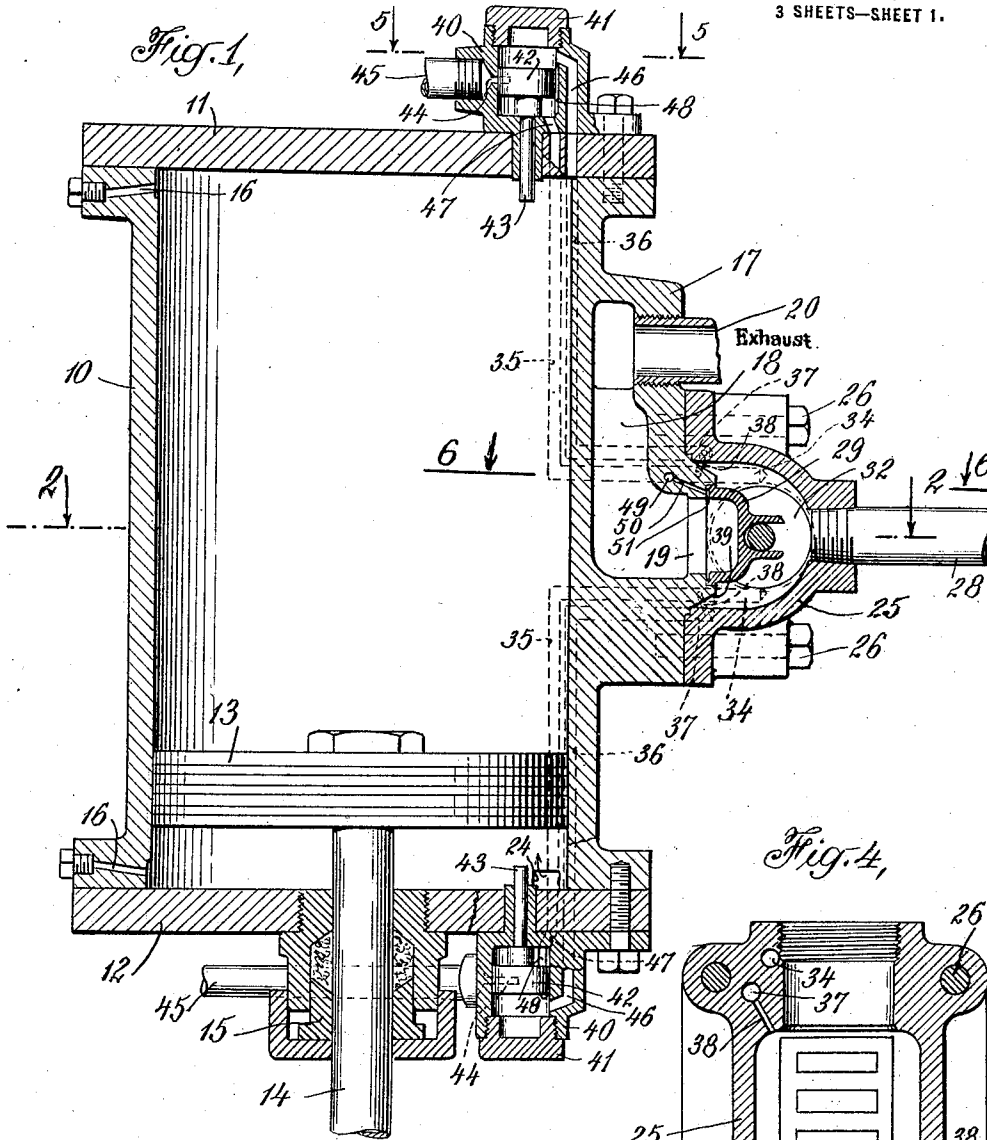
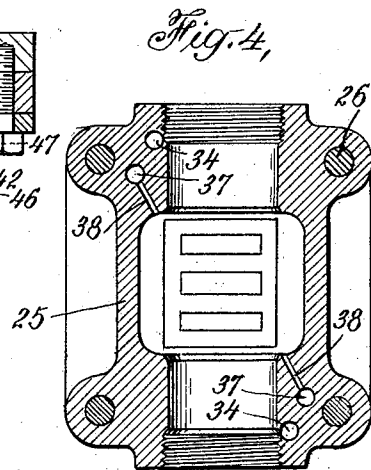
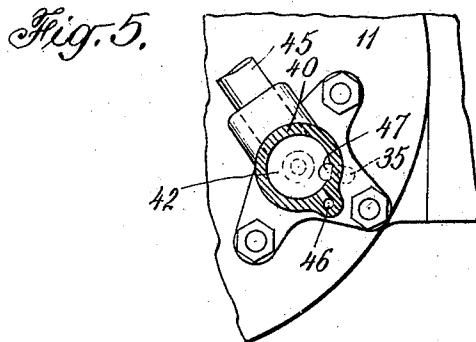


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APPLICATION FILED FEB. 24, 1919.

1,406,330.

Patented Feb. 14, 1922.

3 SHEETS—SHEET 1.



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3 SHEETS—SHEET 2.

Fig. 2,

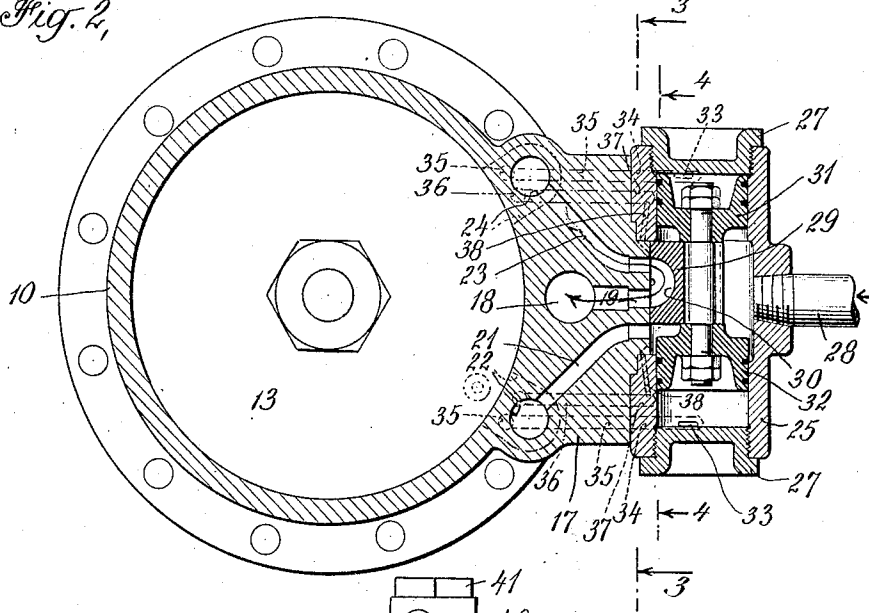
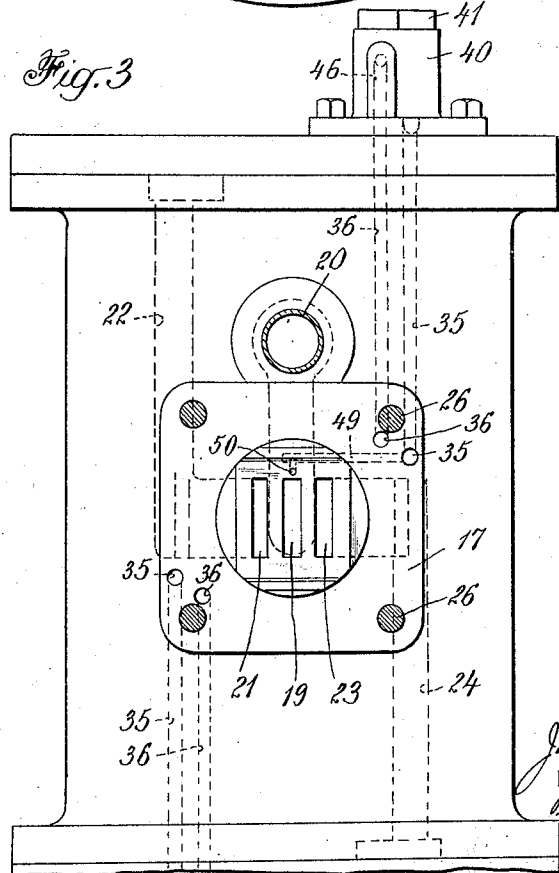


Fig. 3



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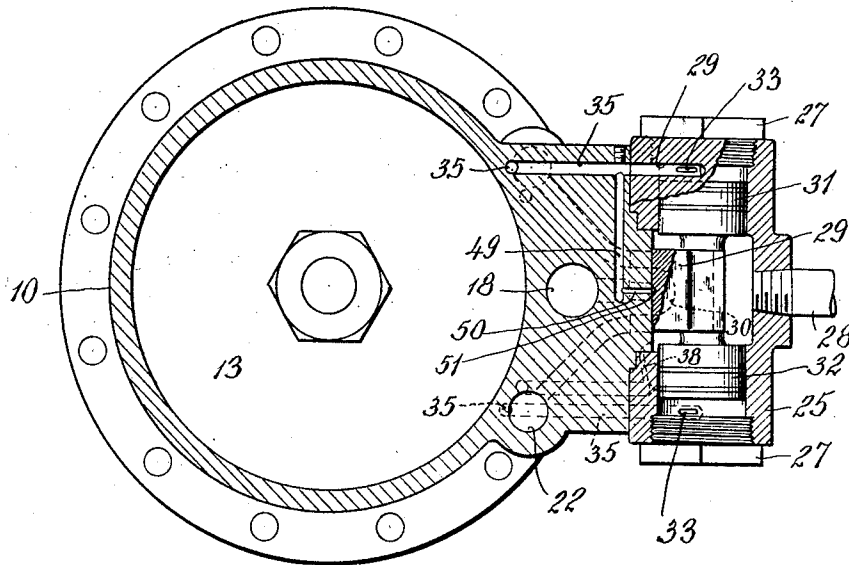
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3 SHEETS—SHEET 3.

Fig. 6.



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ENGINE.

1,406,330.

Specification of Letters Patent. Patented Feb. 14, 1922.

Application filed February 24, 1919. Serial No. 278,680.

To all whom it may concern:

Be it known that I, JOHN S. BARNER, a citizen of the United States, residing at Colver, in the county of Cambria, State of Pennsylvania, have invented certain new and useful Improvements in Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to engines of the type in which the main valve for controlling the admission of motive fluid to the cylinder and the exhaust therefrom is itself actuated by the fluid under the control of valves actuated by a moving part of the engine.

In my Patent No. 1,171,017, issued February 8, 1916, there is shown an engine of this type in combination with an air compressor of the compound type commonly employed in connection with air brake systems. The engine there shown, which is also of the compound type, comprises a high pressure cylinder provided with a main valve for controlling the admission of steam to this cylinder and its subsequent discharge into the low pressure cylinder. The main valve is provided with pistons which are actuated by the effect of unbalanced steam pressures upon opposite sides thereof. This effect is produced by tappet valves actuated by the piston of the high pressure cylinder at the ends of its stroke and which control ports of the main valve chest to cause suitable variations in pressure therein with resultant actuation of the main valve to reverse the stroke of the piston of the high pressure cylinder and at the same time control the admission to the low pressure cylinder of the exhaust from the high pressure cylinder.

With an engine having a steam actuated valve like that shown in my patent, or one of the same general type, it is possible for the main valve to assume such a position that it will lap both of the ports leading to opposite ends of the cylinder so that the piston will not be moved and hence neither of the tappet valves will be actuated to unbalance the steam pressure acting upon

the pistons of the main valve which will, therefore, remain in lap position and it will be impossible to start the engine.

It is an object of this invention to overcome this serious defect of steam actuated valves by providing an arrangement which will prevent the valve from remaining in position to lap the cylinder ports and rendering the starting of the engine impossible.

Among other advantages of the invention may be mentioned its simplicity, its applicability to existing engines without extensive alterations, and the absence of any moving parts in addition to those already present in the engine.

The particular nature of the invention will appear more clearly from a description of a preferred embodiment thereof, and for the purpose of illustration the invention has been shown in connection with an engine of the general type shown in my patent mentioned above, but for the sake of simplicity the low pressure cylinder and its connections have been omitted, as have also the cylinders of the air compressor.

In the accompanying drawings, Fig. 1 is an elevational view showing the cylinder in longitudinal section and the main valve and its chest in transverse section while the poppet valves are shown in distorted position, the upper showing as if sectioned on a diameter through the passage 48, the lower showing partly as if sectioned on a diameter, parallel to that through the cylinder, while the passage 48 is shown in normal position. Fig. 2 shows the cylinder in transverse section and the main valve and its chest in longitudinal section. Fig. 3 is a plan view of the cylinder in section along the line 3—3 of Fig. 2. Fig. 4 is a sectional view of the main valve chest along the line 4—4 of Fig. 2 with the valve removed. Fig. 5 is a transverse sectional view of a tappet valve along the line 5—5 of Fig. 1. Fig. 6 is a sectional view on line 6—6 of Fig. 1 showing the valve in the mid-position covering the main ports with the port 50 registering with the conduit 51 in such a manner as to relieve the balanced pressure on the valve.

Aside from the presence of the improvements of the present invention, the engine shown herein is substantially like the high

pressure engine of my patent mentioned above, except that the main valve is mounted upon the side of the cylinder instead of upon the head, as in the patent. In the drawings, 10 represents the cylinder provided with heads 11 and 12. The piston 13 is connected to a piston rod 14 passing through the usual stuffing box 15 attached to the head 12. The cylinder is provided with ports 16 leading to the usual drain cocks. At one side of the cylinder is an extension 17, the outer face of which forms a seat for the main valve and its chest. The interior of the extension is formed as a chamber 18 communicating with the main valve through a port 19 and provided with an exhaust pipe 20. The valve seat is also provided with a steam admission port 21 communicating with a passage 22 extending longitudinally through the wall of the cylinder and opening into the latter adjacent the head 11. A similar steam admission port 23 communicates with a corresponding passage 24 leading to the other end of the cylinder.

The main valve chest of the engine comprises a casing 25 adapted to be clamped to the seat on the extension 17 by bolts 26. The chest is provided with heads 27 at each end, and steam is admitted to the chest through a pipe 28. Slidably mounted within the chest is a main valve 29 provided with a recess 30 by which the ports 21 and 23 are alternately placed in communication with the exhaust port 19. The main valve 29 is adapted to be operated by pistons 31 and 32 fitting within cylindrical bores of the valve chest.

As is customary with steam actuated main valves the pistons 31 and 32 are operated by the effect of unbalanced steam pressures. To produce this effect in the present case, there is provided near each head of the valve chest a port 33 communicating with a conduit 34 formed in the wall of the chest and registering with a corresponding conduit 35 passing inwardly through the extension 17 of the cylinder and then longitudinally through the wall of the cylinder where it communicates with a chamber of the corresponding tappet valve. Adjacent each of the conduits 35 is a conduit 36 extending longitudinally through the wall of the cylinder and then outwardly through the extension 17 where it registers with a corresponding conduit 37 in the wall of the main valve chest. By means of ducts 38 each of the conduits 37 is in communication with the chamber of the main valve chest between the pistons 31 and 32, these ducts terminating near beveled portions 39 of the valve chest seat so as to permit steam to flow into these ducts.

The tappet valves are of identical construction and each comprises a casing 40

closed at one end by a cap 41 and containing a piston 42 provided with a stem 43 extending through the corresponding head of the cylinder in position to be engaged by the piston 13 at the end of its stroke. It should be remembered that the showing of both poppet valves is somewhat distorted in Fig. 1 as already noted in the description of said figure. The casing is provided with a port 44 communicating with a pipe 45 connected to the exhaust passage of the engine. The casing is provided also with a conduit 46 communicating with the chamber of the tappet valve between the cap 41 and the piston 42, and adapted to register with the conduit 36 in the cylinder wall when the tappet valve is in place on the head of the cylinder. The inner wall of the tappet valve casing is provided with a conduit 47, which when the tappet valve is in place, registers with the conduit 35 in the wall of the cylinder, thus providing communication between the last named conduit and the chamber formed on the other side of tappet valve piston 42. The inner face of the tappet valve casing is provided with a longitudinal slot 48, which at one end terminates near the conduit 47, and at the other end extends far enough to communicate with the outer chamber of the tappet valve when the piston 42 occupies its normal position as shown in the drawings.

The operation of the parts of the engine thus far described is as follows:

Assuming that the slide valve occupies the position with relation to the exhaust and admission ports shown in Fig. 2, steam entering the main valve chest will pass through the admission port 21 and enter the cylinder through the passage way 22 where it will act upon the piston 13 to drive it through the cylinder. At this time each of the tappet valve pistons occupies its normal position so that there is a passage way for the steam through each of the ducts 38, registering conduits 37, 36 and 46 to the outer chamber of the tappet valve. This outer chamber is in communication with the inner chamber through the slot 48 on account of the position of the tappet valve piston, so that steam may pass through the registering conduits 47, 35 and 34 and enter the chambers at each end of the main valve chest through ports 33. The steam pressures on opposite sides of the pistons of the main slide valve will thus be equalized, and the valve will remain in the position shown allowing steam to enter the cylinder through the port 21 and passage way 22 while the exhaust from the other side of the piston will take place through the passage way 24 and port 23 into the recess 30 of the main valve and thence into the exhaust chamber 18. The piston will move through the cylinder and as it reaches the end of its stroke it will engage the stem 43 of one of the

tappet valves and move its piston 42 to uncover the exhaust port 44, at the same time closing communication between the slot 48 and the outer chamber of the tappet valve.

5 The effect of this operation is to place the corresponding conduits 47, 35 and 34 and the end chamber of the main valve chest in communication with the exhaust, thereby relieving the pressure in this chamber of the main valve chest and causing the main valve to move toward this chamber owing to the preponderating effect of the steam pressure on the other side of the piston. This movement of the main valve puts the other steam admission port 23 in communication with the inner chamber of the main valve chest and connects the other port 21 to the exhaust port 18, so that a reverse stroke of the piston takes place.

20 The structures thus far described constitute a complete reversing gear, and the engine will operate properly unless the main slide valve assumes such a position that it covers both of the steam admission ports 21 and 23. It may assume such a position by being accidentally left in the wrong place after being repaired or inspected, or it may come into this position from some other cause. In any event, when it does occupy such a position it will be impossible to start the engine, for steam cannot enter the cylinder on either side of the piston, and since the latter will not be moved, neither of the tappet valves will be operated to unbalance the steam pressures upon the faces of the pistons 31 and 32 controlling the main slide valve. The engine will thus remain stalled and cannot be started until the main valve has been shifted into one or the other of its extreme positions, and in order to do this it will be necessary to take certain parts of the engine apart, which usually means that the locomotive upon which the engine may be used for operating an air compressor will have to be taken out of commission while repairs are being made.

In accordance with the present invention, the above noted defect of the engine is overcome by providing such an arrangement that even if the main valve is in a position to lap both of the steam admission ports 21 and 23, there will exist a difference of pressure in the end chambers of the main valve chest as soon as steam is supplied, so that the main valve will not remain in lap position. This result is accomplished by providing in the extension 17 of the main cylinder, a conduit 49 communicating at one end with one of the passages 35 leading to one of the tappet valves, and at the other end, opening into a port 50 which as shown most clearly in Figs. 1 and 3 terminates at the seat of the main valve near one end of the exhaust port 19. The main valve 29 is provided with a conduit 51, preferably in the form of a cavity

cut in the face of the valve. This conduit is adapted to place the port 50 in communication with the recess 30 in the main valve when the valve occupies a position lapping both of the steam admission ports. Under these conditions communication will be established between the exhaust chamber 18 and one of the end chambers of the main valve chest through conduit 51, port 50, conduit 49, corresponding conduit 35 and port 33 opening into the end chamber. The steam pressure in this chamber will thus be relieved, but the other end chamber of the main valve chest will be under full steam pressure supplied through the conduits and tappet valve as described above. Due to the effect of the unbalanced steam pressures in the end chambers, the main slide valve will not remain in lap position, but will move to one end of the valve chest thus uncovering one of the steam admission ports 21 or 23 to allow the engine to start. As soon as the main valve moves from the lap position the conduit 51 therein will no longer register with the port 50 so that communication with one of the end chambers through this port and the conduit 49 is cut off, and full steam pressure will be applied to this end chamber through the corresponding conduits leading to the tappet valve. The engine will thus be put in operative condition and will function in the manner described.

It will thus be seen that the provision of the conduit 49, port 50 and conduit 51 in combination with the other features of the engine will prevent the main valve from remaining in lap position when steam is supplied to the engine, and that as soon as this valve moves out of lap position, the improvement of this invention is rendered ineffective and does not interfere with the normal operation of the engine. The arrangement is also of the utmost simplicity, requires but slight modification of the engine structure and does not involve the use of any moving parts in addition to those already present in the engine. While the invention has been shown as applied to an engine of the general type shown in my Patent No. 1,171,017, it will be understood that it may be applied to engines of other types provided with main valves actuated by the motive fluid and which may assume a lap position in which it is impossible to start the engine.

I claim:—

1. In an engine provided with a cylinder, a piston, a main valve for controlling the admission of motive fluid to the cylinder and the exhaust therefrom and adapted to be actuated by the effect of unbalanced steam pressures thereon, and valves under the control of the piston for causing the unbalancing effect on the main valve, the combination of means for producing an unbalancing ef-

- fect on said main valve depending on the position and movement thereof when it occupies such a position that admission of motive fluid to the cylinder is prevented so that the piston cannot be actuated to control the valves, said means being so constructed as to be rendered ineffective by movement of the main valve to a position in which fluid may be admitted to the cylinder.
2. In a steam engine having a cylinder provided with admission and exhaust ports and passages, a piston in said cylinder, a piston actuated main valve for controlling said passages, conduits for admitting fluid to both sides of the pistons of the control valve to equalize the pressures thereon, tappet valves located at opposite ends of the cylinder in position to be actuated by the piston in its extreme positions and each controlling one of the conduits to relieve fluid pressure therein when the tappet valve is actuated, the combination of means independent of the tappet valves for relieving the fluid pressure in one of the conduits when the main valve occupies such a position that fluid cannot be admitted to the cylinder to actuate the piston therein.
3. In a steam engine having a cylinder provided with admission and exhaust ports and passages, a piston in said cylinder, a piston actuated main valve for controlling said passages, conduits for admitting fluid to both sides of the pistons of the control valve to equalize the pressures thereon, tappet valves located at opposite ends of the cylinder in position to be actuated by the piston in its extreme positions and each controlling one of the conduits to relieve fluid pressure therein when the tappet valve is actuated, the combination of a conduit connected to one of said conduits, and a conduit associated with the main valve and adapted to be brought into communication with the last named conduit to relieve fluid pressure in the conduit to which the said last named conduit is connected when the main valve occupies such a position that fluid cannot be admitted to the cylinder to actuate the piston therein.
4. In a steam engine, the cylinder, a piston therein, a main valve for controlling the admission of motive fluid to the cylinder and the exhaust therefrom, pistons for operating the main valve, means for obtaining a normally balanced effect of motive fluid pressure upon the valve pistons, means under the control of the cylinder piston for producing an unbalanced effect upon the valve pistons alternately as the cylinder piston reaches the ends of its stroke to cause actuation of the main valve and reversal of the stroke of the cylinder piston, and means under the control of the main valve for producing an unbalanced effect upon one of the valve pistons when the main valve occupies such a position that motive fluid cannot be admitted to the cylinder to actuate the piston therein.
5. In a steam engine, a cylinder, a piston therein, a main valve for controlling the admission of motive fluid to the cylinder and the exhaust therefrom, a casing for the main valve, pistons in the casing for operating the main valve, means for supplying motive fluid to said casing between the pistons, conduits for conveying fluid from between the pistons to the outer side of each piston whereby fluid pressures are normally equalized on both sides of the pistons, means under control of the cylinder piston for relieving fluid pressure on the outer side of the valve pistons as the cylinder piston reaches the end of its stroke to unbalance the pressures on the valve pistons and cause operation of the main valve to reverse the stroke of the cylinder piston, and means under control of the main valve for relieving fluid pressure on the outer side of one of the valve pistons when the main valve occupies such a position that motive fluid cannot be admitted to the cylinder to actuate the piston therein.
6. In a steam engine, a cylinder, a piston therein, a main valve for controlling the admission of motive fluid to the cylinder and the exhaust therefrom, a casing for the main valve, pistons in the casing for operating the main valve, means for supplying motive fluid to the chamber between the pistons for admission to the cylinder, conduits communicating with the chamber between the pistons, conduits communicating with the chambers formed between the ends of the casing and the outer faces of the pistons, connecting conduits between the above named conduits to permit the flow of motive fluid from the chamber between the pistons to the chambers in the ends of the casing, means under control of the cylinder piston for closing the connecting conduits and thereafter relieving fluid pressure in the conduits communicating with the chambers in the ends of the casing as the piston reaches the end of its stroke, and means under control of the main valve for relieving fluid pressure in the conduit communicating with one of the chambers in the end of the casing when the main valve occupies such a position that motive fluid cannot be admitted to the cylinder to actuate the piston therein.
7. In a steam engine, a cylinder, a piston therein, a main valve, conduits for the motive fluid communicating with both ends of the cylinder and terminating in admission ports in the seat of the main valve, a conduit for exhaust motive fluid terminating in the seat of the main valve, pistons connected to the main valve, conduits for supplying motive fluid to the outer side of each of the main valve pistons, a conduit communicating with one of the last named conduits and

terminating at the seat of the main valve adjacent the exhaust port therein, and a conduit in the main valve adapted to provide communication between the end of the last named conduit and the exhaust port when the main valve occupied a position lapping both of the admission ports in its seat.

8. In a steam engine, a cylinder, a piston therein, conduits for the motive fluid communicating with both ends of the cylinder, a main valve for controlling the admission of motive fluid to the conduits and slidably mounted on a seat formed on the wall of the cylinder, said main valve being provided with a cavity in the face that engages the seat, a piston connected to each end of the main valve, a casing surrounding the main valve and its pistons and forming chambers of the outer ends of the pistons, a pipe for supplying motive fluid to the main valve between the pistons, tappet valves mounted at the ends of the cylinder and each provided with an exhaust port and a piston normally covering the port and having a stem extending within the cylinder in position to be engaged by the piston therein at the ends of its stroke, conduits extending from the chamber between the pistons of the main valve to the chambers on one side of the pistons of the tappet valves, conduits extending from the chambers in the casing at the outer ends of the pistons of the main valves to the chambers on the other side of the pistons of the tappet valves, a conduit in each tappet valve for establishing communication between the chambers in opposite sides of the piston thereof, and a relief conduit communicating with one of the conduits extending from a chamber at the outer end of one of the main valve pistons, said relief conduit terminating at the seat of the main valve in position to register with the cavity in the

main valve when the latter occupies such a position that motive fluid cannot be supplied to either of the conduits communicating with the ends of the cylinder, whereby the pressure may be relieved in the conduit to which the relief conduit is connected and a condition of unbalanced fluid pressures be produced in the end chambers of the casing.

9. In an engine with a steam actuated valve, a cylinder, tappet valves and tappet valve chambers on said cylinder, a valve chest, steam passages and exhaust passages extending therebetween, auxiliary passages between said valve chest and said tappet valve chambers, a valve in said chest, and an additional auxiliary passage including a portion of one of said first named auxiliary passages extending from an exhaust passage to one side of the steam actuated valve only when the steam actuated valve covers both steam passages to the cylinder.

10. In an engine with a steam actuated valve, a cylinder, tappet valves and tappet valve chambers on said cylinder, a valve chest, steam passages and exhaust passages extending therebetween, auxiliary passages between said valve chest and said tappet valve chambers, a valve in said chest and additional auxiliary passages, including a portion of one of said first named auxiliary passages extending between an exhaust passage and one end of the steam actuated valves, at such time as the valve may cover all the steam passages to the cylinder, and means for closing said first named auxiliary passage upon movement of the said actuated valve from said position covering the steam passages.

In testimony whereof I affix my signature.

JOHN S. BARNER.