July 25, 1933. B. H. THOMPSON 1,919,402

STEAM DRIVEN FLUID COMPRESSOR

Filed May 22, 1930

Fig. 2

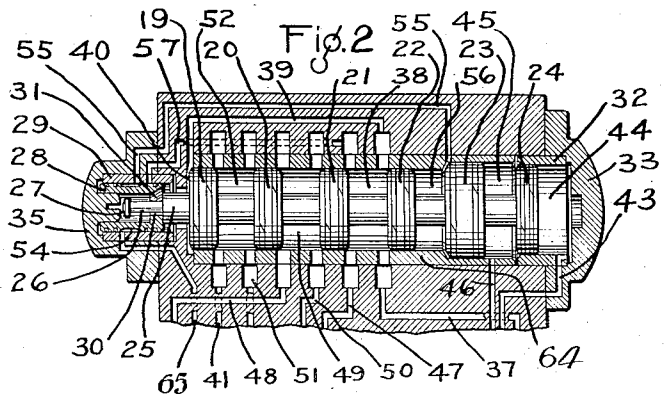


Fig. 4

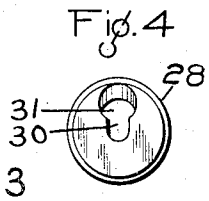


Fig. 3

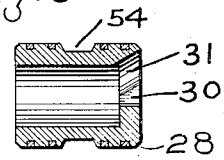
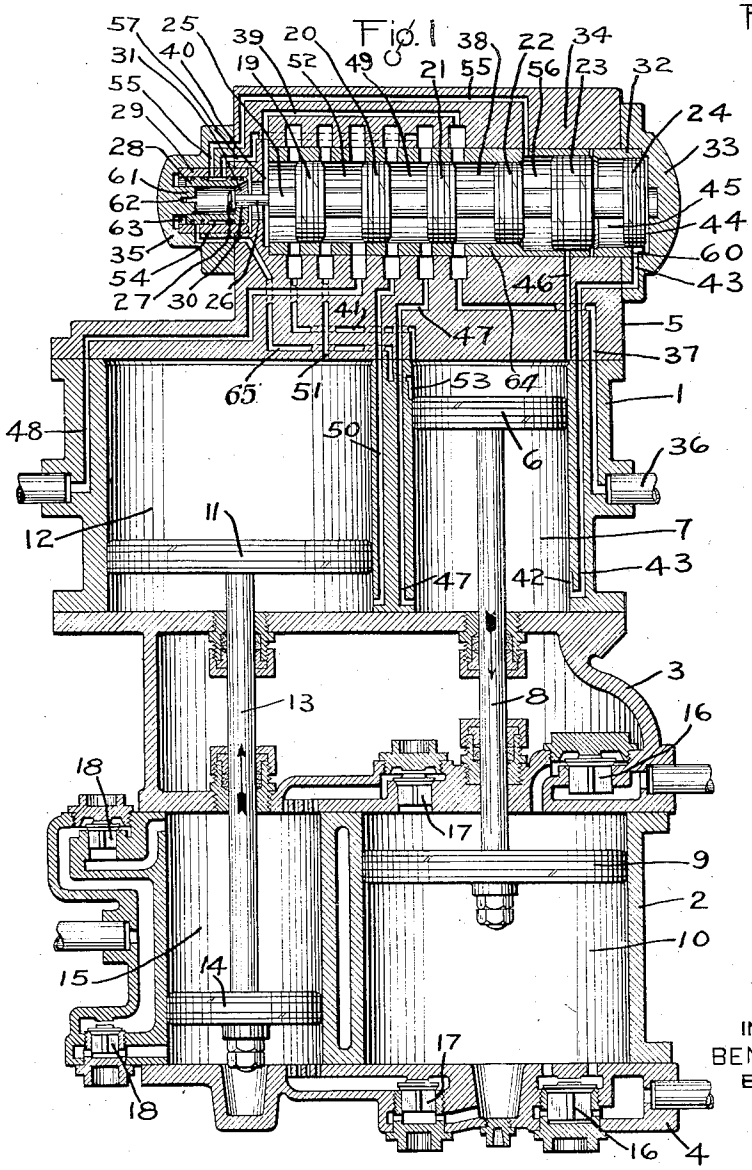


Fig. 1



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STEAM DRIVEN FLUID COMPRESSOR

Application filed May 22, 1930. Serial No. 454,555.

This invention relates to steam actuated fluid pressure compressors and more particularly to the direct acting type in which the engine pistons are directly connected to the air compressing pistons.

In the above mentioned, well known type of fluid pressure compressor, the operation of the engine pistons is governed by a control valve mechanism having a mechanical connection to one of the engine pistons for controlling the reversing movement of said pistons.

The principal object of my invention is to provide an improved valve mechanism for controlling the operation of the engine pistons of a fluid pressure compressor of the above type, and more particularly to an improved valve mechanism having no mechanical connection to the operating parts of the engine or compressor.

Other objects and advantages will appear in the following more detailed description of my invention.

In the accompanying drawing; Figure 1 is a central, vertical diagrammatic section of a compound steam actuated fluid pressure compressor embodying my invention; Fig. 2 is a diagrammatic view of the control valve portion of the compressor shown in Fig. 1 but with the operating parts shown in the opposite position; Fig. 3 is a sectional view of an auxiliary valve employed in the control valve portion of the compressor; and Fig. 4 is an end elevation of said auxiliary valve.

As shown in the drawing, the compressor comprises a casing formed of a motor portion 1, an air compressor portion 2, an intermediate section 3 interposed between the portions 1 and 2, a lower cover portion 4, and a top cover portion 5, said portions being secured together in the relation shown in the drawing.

A high pressure steam piston 6 is contained in a cylinder 7 of the portion 1 and is connected by a rod 8 with a low pressure air piston 9 contained in a cylinder 10 of the portion 2, while a low pressure steam piston 11 is contained in a cylinder 12 of the portion 1 and is connected by a rod 13 to a high pressure air piston 14 contained in a cylinder 15 in the portion 2.

The air compressing portion of the compressor is of the usual well known type having inlet valves 16 to the low pressure air cylinder 10, combined exhaust and inlet valves 17 from the low pressure air cylinder 10 to the high pressure air cylinder 15 and exhaust valves 18 from the high pressure air cylinder 15.

A control valve portion is provided in the top cover 5 for governing the supply and exhaust of steam to and from the steam cylinders and for controlling the reversing of the motor pistons 6 and 11 and comprises a series of connected piston heads 19, 20, 21 and 22 of the same area, a piston head 23 of a greater area and a piston head 24 having an area intermediate the areas of pistons 22 and 23.

The pistons heads 19, 20, 21, 22 and 23 are preferably disposed in a single bushing 64 mounted in the casing 34, but since the piston 23 is of larger diameter than piston 24, the piston 24 is disposed in another bushing 32 having an outside diameter larger than that of the piston 23. The bushing 32 is carried by a cover plate 33 and has an extension adapted to slide into a suitable recess in the control valve casing 34. With the cover 33 and the bushing 32 removed from the casing 34, the series of connected pistons 19, 20, 21, 22, 23 and 24 are adapted to be assembled in the bushing 64 of casing 34, as a unit, through the right hand end of said casing. With said pistons thus assembled, the cover 33 with the bushing 32 is mounted in place as shown in the drawing.

Projecting from the outer face of piston 19 is a boss 25, and projecting from said boss is a stem 26 of smaller diameter, said stem 26 being provided at its outer end with a button shaped head 27. The stem 26 is adapted to extend through a suitable bore 30 in the closed end of a piston type of valve 28 in such a manner that the head 27 of said stem is disposed within said valve, so that said valve will be operated by engagement with the button 27 at one time and by engagement with the boss 25 at another time, the distance between said

button and boss being greater than the thickness of the end of the valve 28 so as to provide lost motion between the valve 28 and the control pistons.

The valve 28 is mounted in a bushing 29 in a cover 35 adapted to be secured to the casing 34, said bushing being adapted to slide into a suitable recess formed in the casing, as shown in the drawing.

Adjacent the bore 30 in the valve 28 is a diagonal bore 31 of a diameter slightly larger than the diameter of the button 27 on the stem 26. With the control pistons in the position shown in Fig. 2, and with the cover 35 removed from the casing, the valve 28, which may be assembled in said cover, is connected to the stem 26 by sliding the bore 31 in the valve 28 over the button 27. When said button is thus placed within the valve, the cover 35 and said valve are centralized with the control pistons, so that stem 26 enters the bore 30 in the valve, after which the cover is secured to the casing and operating engagement between the control pistons and the valve 28 is thereby attained.

In operation, with the control valve pistons in the position shown in Fig. 1 of the drawing, steam supplied to pipe 36 flows through passage 37 to chamber 38 between the pistons 21 and 22 and from thence through passage 39 to chamber 40 at the left hand side of piston 19 and from said chamber through passage 41 to the chamber above the high pressure piston 6, thus causing said piston to move downwardly, as indicated by the arrow on the rod 8.

When the high pressure piston 6 nears the end of its downward stroke, a groove 42 in the cylinder wall, which connects with a passage 43, is uncovered by said piston and permits high pressure steam to flow from the upper side of said piston through passage 43 to chamber 44 at the outer face of the control piston 24. The piston 24 being of greater area than piston 19, which at all times is subject to high steam pressure, the unbalanced steam pressure acting on piston 24 shifts the control pistons 19, 20, 21, 22, 23 and 24 toward their left hand position, as shown in Fig. 2 of the drawing.

Due to the lost motion between the control pistons and the valve 28, the initial movement of the control pistons is independent of said valve and when boss 25 just engages said valve, the passage 41 is lapped by the control piston 19 thereby cutting off the steam supply to the upper side of the high pressure piston 6. At the same time as passage 41 is thus lapped, the passage 46 just starts to be uncovered by the piston 23, so that high pressure steam is permitted to flow from the upper side of the high pressure piston 6 to chamber 45 and therein act on the pistons 23 and 24. The piston 23 being of greater area than piston 24, the unbalanced steam pressure is thus increased just as the boss 25 engages the valve 28 and is adapted to offset the resistance to movement of the valve 28 so as to ensure positive and full reverse movement of the control pistons and valve 28 to the extreme left hand position, as shown in Fig. 2 of the drawing.

In the left hand position of the control pistons, the chamber at the lower side of the low pressure steam piston 11 is connected to an exhaust passage 48 through passage 50 and a chamber 49 intermediate the pistons 20 and 21. The chamber at the upper side of the low pressure steam piston is connected to the chamber at the upper side of the high pressure steam piston 6 through passage 51, chamber 52 intermediate the pistons 19 and 20 and passage 41, so that steam at intermediate pressure is permitted to flow from the upper side of the high pressure piston 6 to the upper side of the low pressure piston 11 and cause the piston 11 to move downwardly. At the same time, high pressure steam flows to the chamber at the lower side of the high pressure steam piston 6 by way of pipe 36, passage 37, chamber 38 intermediate the control pistons 21 and 22, and passage 47, and causes the high pressure steam piston 6 to move toward its upper position.

The movement of the valve 28 to the left hand position as effected by the control pistons, causes an annular passage 54 to connect a passage 65 from the groove 53 in the upper end of the high pressure steam cylinder to passage 55 which connects to chamber 56 between the control pistons 22 and 23, so that steam at intermediate pressure from the upper side of the high pressure steam piston 6 is permitted to be effective in the control piston chamber 56. As hereinbefore described, high pressure steam from the upper side of the high pressure steam piston is supplied through passage 46 to control piston chamber 45 to ensure movement of the control pistons to the left hand position, but upon reversal of the engine pistons, the pressure in chamber 45 becomes intermediate pressure such as acts to operate the low pressure steam piston. Thus, upon full movement of the control pistons and the valve 28 to the left hand position, the control pistons are maintained in said position by an unbalanced steam pressure equal to the difference between the high and intermediate steam pressure times the difference in area of the piston 19 and the piston 24.

With the valve 28 in its left hand position as shown in Fig. 2, when the high pressure steam piston 6 uncovers the groove 53 in the cylinder wall as the piston approaches the end of its upward stroke, high pressure steam is permitted to flow through passage 65, annular passage 54 around the valve 28 and passage 55 to control piston chamber 56 and act on the pistons 22 and 23. The piston 23 having a relatively large area, the high steam

pressure acting thereon unbalances the control pistons and causes them to move to their right hand positions, as shown in Fig. 1 of the drawing.

In the right hand position of the control pistons, the chamber at the upper side of the low pressure steam piston is connected to the exhaust passage 48 through passage 51 and control piston chamber 52, and steam at intermediate pressure is permitted to flow from the lower side of the high pressure steam piston through passage 47, control piston chamber 49 and passage 50 to the lower side of the low pressure steam piston and move said piston upwardly. At the same time, steam at high pressure flows from the supply pipe 36 through passage 37, control piston chamber 38, passage 39, chamber 40 at the outer side of the control piston 19 and passage 41 to the upper side of the high pressure steam piston 6, causing said piston to be moved downwardly in the same manner as hereinbefore described.

The movement of the control pistons to their right hand position, as shown in Fig. 1, shifts valve 28, so that the annular passage 54 around said valve connects passage 55 to a passage 57, which permits steam at intermediate pressure to flow from the lower side of the high pressure steam piston 6 to chamber 56 intermediate the control pistons 22 and 23 by way of passage 47, chamber 49 intermediate the pistons 20 and 21, passage 57, annular passage 54 and passage 55. As hereinbefore described, high pressure steam is supplied to the control piston chamber 56 to effect reverse movement of the control pistons to the right hand position but by moving the valve 28, steam at intermediate pressure is supplied to piston chamber 56 and the control pistons are maintained in their right hand position by the high steam pressure acting on the piston 19. When the high pressure steam piston 6 nears the end of its downward stroke and uncovers groove 42, steam at high pressure is supplied to chamber 44 at the outer face of the control piston 24 and said piston then operates to shift the control pistons to their left hand position, as hereinbefore described in detail.

From the above description of the operation of my improved control valve mechanism for a steam actuated motor, it will be noted that the piston 23 is the reversing element, the piston 24 being employed to start the reverse movement from the right hand position to the left hand position. Essentially, however, piston 24 is employed to permit obtaining of an unbalanced steam pressure condition for shifting the control valve mechanism from the left hand position to the right hand position, which would be impossible if high pressure steam were permitted to be effective in the control valve piston chamber 45 through passage 43 when the high pressure steam piston 6 is moving upwardly. It will further be noted that the valve 28 is employed for controlling the pressure in the control piston chamber 56 in accordance with the direction of movement of the high pressure steam piston 6 and is operative at one time to permit intermediate steam pressure to be supplied to said chamber to permit reverse movement to the left hand position and at another time to permit high pressure steam to be supplied to said chamber to cause reverse movement to the right hand position.

Lost motion between the control pistons and the valve 28 is provided so as to ensure a substantially complete reverse movement of the control pistons before said valve is moved, so as to ensure full reversing and prevent possible stalling of the motor. With this construction, there is no dead center upon which the control valve mechanism can stop which would prevent it from starting.

One particular advantage of my improved control valve mechanism is the absence of any mechanical connection between the moving parts of the air compressor or air compressor motor and the moving parts of the control valve on the top cover portion.

The passage 43 connects to a recess 60 in the bushing 32 containing the control piston 24 and the piston 24 laps the recess 60 when in the right hand position shown in Fig. 1. Due to this construction, a cushion is provided to resiliently stop the movement of the control pistons in moving to the right. A cushion is also provided to resiliently stop the control pistons in their movement to the left. It will be noted that the cover 35 containing the valve 28 is provided with a boss 61 slidably extending into a bore in said valve and said boss is provided with a slot 62, which in the position of the valve mechanism shown in Fig. 1 is partly uncovered by the open end of said valve. When said valve is being moved from the right hand position to the left hand position, steam is permitted to escape from the chamber 63 at the left hand side of said valve until the slot 62 is lapped, after which, further movement of the valve 28 compresses the remaining steam in said chamber and reduces the shock of stopping.

In the preferred form of my invention as shown in the drawing, I show the passages 43 and 52 terminating in slots or elongated openings 42 and 53, respectively, in the high pressure steam cylinder. These elongated openings are adapted to time the reversing movement of the control valve in respect to the position of the high pressure steam piston 6 in its cylinder, in the manner hereinbefore described, and may be varied in length to change said timing if desired.

For illustration, I have shown my invention associated with a steam actuated motor employed for operating a fluid pressure compressor, however, I do not desire to thus

limit its scope, since it can be equally well employed with any motor employing an expansible gas as an operating medium.

While one illustrative embodiment of the invention has been described in detail, it is not my intention to limit its scope to that embodiment or otherwise than by the terms of the appended claims.

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

1. A fluid pressure actuated motor comprising a cylinder, a motor piston mounted in said cylinder, a reversing valve comprising a plurality of connected abutments for controlling the supply and exhaust of fluid under pressure to and from said cylinder for operating said motor piston, a pair of connected pistons of different areas for moving said abutments, a passage for connecting one side of one of said differential area pistons to one side of said motor piston for initiating the reverse movement of said valve, another passage adapted to connect the adjacent sides of said differential area pistons to said one side of said motor piston for completing the reverse movement of said valve, and a valve loosely connected to and operated by said differential area pistons for controlling communication from said cylinder to the opposite side of the other of said differential area pistons.

2. A fluid pressure actuated motor comprising a cylinder having a port adjacent each end, a piston disposed in said cylinder and movable over the port at each end of said cylinder, valve means having a reverse position for controlling the supply and exhaust of fluid under pressure to and from the opposite sides of said piston, a movable abutment connected to said valve means and operative by fluid under pressure supplied through one of said ports to move said valve means to reverse position, another movable abutment connected to the first mentioned movable abutment, a passage adapted to be uncovered by movement of the second mentioned abutment for supplying fluid under pressure to one side of the second mentioned abutment for increasing the force moving said valve means to reverse position, and means operative upon movement of said valve means to reverse position to supply fluid under pressure from the other of said ports to the other side of the second mentioned abutment for returning said valve means to their initial position.

3. A fluid pressure actuated motor comprising a cylinder having a port adjacent each end, a piston disposed in said cylinder and movable over the port at each end of said cylinder, valve means having a reverse position for controlling the supply and exhaust of fluid under pressure to and from the opposite sides of said piston, a pair of movable abutments of different diameters connected to said valve means and movable by fluid under pressure supplied through one of said ports to the outer side of one of said abutments to initiate the reverse movement of said valve means and to open a passage from one side of said piston for supplying fluid under pressure to the adjacent sides of said abutments for increasing the moving force on said valve means, and means operative upon movement of said valve means to reverse position to supply fluid under pressure from the other of said ports to the outer side of the second mentioned abutment for returning said valve means to their initial position.

4. A fluid pressure actuated motor comprising a cylinder having a port adjacent each end, a double acting motor piston movably disposed in said cylinder, and means for controlling the operation of said piston, said means comprising a valve device for controlling the supply and exhaust of fluid under pressure to and from the opposite sides of said piston, a reversing piston having a chamber at one side in constant communication with one of said ports and adapted to move said valve device in one direction, another reversing piston having a chamber at one side adapted to be connected to the other of said ports for moving said valve device in the reverse direction, and a valve movable by said valve device for controlling communication to the chamber of the second mentioned reversing piston.

5. A fluid pressure actuated motor comprising a cylinder having a port adjacent each end, a double acting motor piston movably disposed in said cylinder, and means for controlling the operation of said piston, said means comprising a valve device for controlling the supply and exhaust of fluid under pressure to and from the opposite sides of said piston, a reversing piston having a chamber at one side in constant communication with one of said ports and adapted to move said valve device in one direction, another reversing piston connected to the first mentioned reversing piston for moving said valve device in the reverse direction and having a chamber at one side, a valve controlled by said reversing pistons and adapted to connect the last mentioned chamber to the other of said ports, and means for connecting a chamber intermediate said reversing pistons to one side of said motor piston upon a predetermined movement of said valve device by the first mentioned reversing piston.

6. A fluid pressure actuated motor comprising a cylinder having a port adjacent each end, a double acting motor piston movably disposed in said cylinder, and means for controlling the operation of said piston, said means comprising a valve device for controlling the supply and exhaust of fluid under

pressure to and from the opposite sides of said piston, a reversing piston having a chamber at one side in constant communication with one of said ports and adapted to move said valve device in one direction, another reversing piston connected to the first mentioned reversing piston and having a chamber at one side adapted to be connected to the other of said ports for moving said valve device in the reverse direction, and means comprising a valve loosely connected to said valve device and movable thereby for opening communication from the last mentioned chamber to the other of said ports upon a predetermined movement of said valve device by the first mentioned reversing piston.

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