This invention relates to steam cylinder valve gears, and more particularly to a valve gear for single direct-acting pumps.

In pumps of the foregoing type, the piston of the steam cylinder is connected with the piston of the pump cylinder by a piston rod. The piston rod extends through a stuffing box in the pump cylinder and is connected with one end of the pump piston, so that the effective area of the piston at this end is materially smaller than the effective area of the other end of the piston. This results in an unbalanced load on the steam piston, since the piston rod area is not affected by the pressure in the pump cylinder, with the result that the pump piston travels faster in one direction than the other, namely, in the direction of the steam cylinder. Many pump systems require equalized velocity of the pump piston on both strokes. Heretofore it has been common practice to equip the pump with a tail rod to balance the effective area on the two ends of the pump piston. Such an arrangement is objectionable, especially on small diameter and high pressure pumps, because it requires an extra rod and stuffing box. Furthermore, the length of the pump is also increased by a little more than the length of the stroke.

Accordingly, an object of the present invention is to provide novel means for equalizing the velocity of the pump piston on both strokes.

A further object is to provide a steam chest embodying a main piston valve for controlling the admission of live steam to and the release of exhaust steam from a steam cylinder provided with a reciprocating piston having a direct connection with a pump cylinder, in which the main piston valve is provided with means for regulating the admission of live steam to one end of the steam cylinder to equalize the velocity of the pump piston.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a steam cylinder valve gear of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a view of a steam cylinder valve gear in accordance with the present invention and as applied to a steam cylinder.

Figure 2 is a view taken from the position indicated by line 2—2 of Figure 1.

Figure 3 is a longitudinal sectional view of the valve gear illustrating the sliding pilot valve in one extreme position.

Figure 4 is a view similar to Figure 3 but illustrating the pilot valve in its other extreme position.

Figure 5 is a sectional view taken along the line 5—5 of Figure 1.

Figure 6 is an inside face view of a steam chest cover which also functions as a valve plate.

Figure 7 is a sectional view taken along the line 7—7 of Figure 4.

Referring more particularly to the drawings, Figure 1 illustrates a steam cylinder valve gear 1 in association with a steam cylinder 2. A reciprocating piston 3 is contained in the cylinder 2 and is attached to a piston rod 4 which extends through a stuffing box 5 for connection with the piston contained in the liquid cylinder of a direct-acting pump (not shown). The valve gear 1 includes a sliding pilot valve 6 and a main piston valve 7. In Figure 1, a valve rod 8 is connected with the pilot valve 6 for moving the latter back and forth. One end of the valve rod 8 is pivotally connected at 9 with one end of a valve rod link 10. A tappet 11 is slidably mounted on the valve rod link 10 and is located between two collars 12 which are fixed to the link 10. However, the collars 12 are adjustably connected with the link 10 so that any desired degree of lost motion may be obtained so far as free movement of the tappet 11 relatively to the link 10 is concerned.

One end of a lever 13 is pivotally connected at 14 with the tappet 11, and the lever is pivotally connected at 15 with a cross stand 16 mounted on a tie rod 17. This tie rod is fixedly related to the cylinder 2 in the usual manner, as by a bolted connection 18. To the other end of the lever 13 is pivotally connected a link 19, as at 20, which link is pivotally connected at 21 with a support 22 carried by a piston rod spool 23 mounted on the piston rod 4. It will thus be seen that reciprocatory motion of the piston 3 is transmitted to the pilot valve 6 through the me-
The pivotal connection 9 accommodates oscillatory motion of the valve rod link 10. The pivotal connection 9 accommodates oscillatory motion of the valve rod link 10 as the latter is reciprocated back and forth from one extreme position to the other.

The main piston valve 7 controls the admission of live steam to and the release of exhaust steam from the ends of the steam cylinder 2, while the pilot valve 6 controls the admission of steam to and the exhaust of steam from the ends of the steam chest 3 for actuating the main piston valve 1. The main piston valve is slidably contained in a bore or cylinder 24 in the steam chest body 25, the latter being fixedly connected to the steam cylinder 2. Chest heads 26 are bolted at 27 to the steam chest body 25 to confine the main piston valve 7 in the bore 24.

The valve chest body 25 includes a flat face 28 against which a steam chest cover or valve plate 29 is clamped, as by bolts 30. One side of the steam chest body 25 is provided with a live steam space 31, which steam is admitted through an opening 32, as through a suitable pipe threaded into that opening. The live steam space 31 is branched at 33 and 34, which branches respectively communicate with ports 35 and 36 extending circumferentially of the bore 24 and communicating therewith. The opposite side of the valve chest body 25 is provided with an exhaust steam space 37, the latter communicating with an opening 38 into which a suitable exhaust pipe may be threaded. The space 37 communicates with an exhaust port 39 which extends circumferentially of the bore 24 and communicates therewith, as shown in Figures 3 and 4.

Ports 31 and 38 are also incorporated in the steam chest body 25, which ports respectively communicate with passages 39' and 40 in the cylinder 2 through which live steam is admitted to and exhaust steam released from the cylinder 2. Both ports 37 and 38 extend circumferentially of the bore 24 and communicate therewith, the port 37 being located between the port 35 and the exhaust port 39, while the port 38 is located between the exhaust port 39 and the port 36.

The main piston valve 7 includes a head 41 which is connected with the main body portion 42 by webs 43. The other end of the body 42 comprises a small diameter head 44 which is co-axial with the bore 24 but of considerably smaller diameter. The head 41 fits snugly within the bore 24. A false head 45 is mounted on the head 44 and has the same outside diameter as the head 41. The head 45 is provided with an annular wall 46 which extends about the head 44, and these two heads may be fixedly related by a bolt 47 which extends horizontally through an opening 48 in the false head 45 and is threaded into the head 44. A lock washer 49 is inserted between the head of the bolt and the false head 45 to prevent accidental loosening of the bolt.

The body 42 includes a longitudinal passage 50, in addition to circumferentially extending ribs 51 and 52 of the same outside diameter as the head 41. The ribs 51 and 52 are axially spaced to provide an annular space 53 between the main piston valve 7 and the wall of the bore 24. The rib 51 is also spaced from the head 41 to provide an annular space 54.

Valve openings 55 are provided in the body 42, and cooperating valve openings 56 are provided in the valve chest body 25. Communication may be established between the valve openings 55 and 56 through rotation of the false head 45 relatively to the head 44.

Referring to Figure 2, the steam chest body 25 is provided with steam ports 57 and 58 and exhaust ports 59 and 60. The ports 57 through 60 open through the flat face 28. In Figures 3 and 4, the exhaust ports 59 and 60 open into the bore 24 short distances from the chest heads 26. While the steam ports 57 and 60 open into the bore 24 in the same manner as the exhaust ports 59 and 60, the steam ports are provided with starting ports 61 which communicate with the bore 24 up to the respective chest heads 26. According to Figures 2, 3, and 4, the steam port 57 and the exhaust port 60 lead into one end of the bore 24 while the steam port 58 and the exhaust port 60 lead into the other end of the bore.

In Figures 3, 4, 5, and 6, the steam chest cover 29 is provided with passages 62 and 63 which communicate with the steam ports 57 and 60, respectively, in addition to opening through the valve face 64 on the cover 29 for communication with the live steam space 31. The cover 29 also includes passages 65 and 66 which have communication with the ports 59 and 60, respectively, in addition to opening through the valve face 64.

A fifth passage 67 also opens through the valve face 64 and communicates with an exhaust passage 68 in the steam chest body 25, see Figure 5, for delivering exhaust steam to the space 37.

In Figures 3, 4, and 5, the valve rod 3 extends through the live steam space 31 and is slidable supported in stuffing boxes 69 attached to the steam chest body 25, as by bolts 70. The valve rod 3 carries the sliding pilot valve 6, the latter bearing against the valve face 64 to control the communication between the passages 62 and 63 and the steam space 31, and for controlling communication between the passage 67 and the respective passages 65 and 66.

The sliding pilot valve 6 is provided with a passage or port 71 in its valve face 72, the latter engaging the flat face 64 on the cover 25. In the one extreme position of the sliding pilot valve 6, as shown in Figure 3, the passage 71 places the passage 66 in communication with the passage 67 so that exhaust steam may flow from the passage 66 to the passage 68 and into the exhaust steam space 37. The sliding pilot valve 6 covers the steam port 58 to cut off the flow of live steam from the space 31 to the port 58.

With the sliding pilot valve 6 in its other extreme position of Figure 4, the passage 71 places the passage 65 in communication with the passage 67 so that exhaust steam may pass from the port 59 to the passage 58 and into the exhaust steam space 37, but the valve 6 covers the steam port 57 to cut off the flow of live steam from the steam space 31 to the port 58.

Since the exhaust port 65 and 66 open into the bore 24 slight distances from the steam chest covers 26, steam is trapped between the ends of the main piston valve 7 and the covers 25 as it approaches either of its extreme positions for cushioning purposes.

A spring 73 is attached at one end to a lug 74' which comprises a fixed part of the sliding pilot valve. This spring is bent to extend between the valve 6 and the valve rod 8 to urge the valve face 72 against the flat face 64. Fingers 74 are formed on the valve 6 and slidably engage diametrically opposed slots 75 in the face 72. The faces 75 are arranged at right angles to the flat face 64 so that the spring 73 may maintain the valve face 72 in firm sealing engagement.
with the flat face 64. Thus the valve 6 is so arranged as to compensate for wear on the valve, the flat face 64 or both. A groove 75 defines the limits of the flat face 64, the limits being such that the valve 6 will engage all portions of the flat face 64 in its back and forth movement thereacross, thereby eliminating any tendency of ridge formations.

With the sliding pilot valve 6 in the position of Figure 2, live steam is delivered to the port 37 which communicates with the port 35 in the cylinder 2. The steam flows freely between the webs 43, and some steam may flow through the valve openings 55 and 56, through the passage 58 and to the port 37. The live steam admitted to the cylinder 2 will drive the piston 3 from left to right, as when viewing Figure 1.

According to Figures 1 and 3, the port 45 in the cylinder 2 communicates with the port 35 in the steam chest body 25. Steam exhausted from the cylinder 2 through movement of the piston 3 from left to right flows through the annular passage 53 and into the exhaust port 35, the latter communicating with the exhaust passage 37.

Upon movement of the piston 3 from left to right in a predetermined degree, the tappet 11 engages one of the collars 12 to shift the sliding pilot valve 6 from the position of Figure 3 to that of Figure 4. Such movement of the pilot valve 6 uncovers the steam passage 63 in the cover 29 to permit live steam to flow through the port 58 and into the bore 24 for shifting the main piston valve 7 to the left hand end of the bore 24, as shown in Figure 4. During such movement of the main piston valve 7, steam is exhausted from the left hand end of the bore 24 through the port 58, the latter communicating with the passage 65 which has communication with the passage 71, the latter communicating with the passage 61.

In Figure 4, the false head 45 closes the port 58 but live steam flows from the branch 32 through the space between the webs 43 and into the passage 50. The steam entering the passage 50 flows through the valve openings 55 and 56 and into the port 36 for delivery to the passage 46 leading to the right hand end of the cylinder 2 or 20. Upon movement of the piston 3 of Figure 1 from right to left, steam is exhausted through the passage 39, the port 37 in the steam chest body 25 and through the annular passage 53 and into the port 35, the latter having communication with the exhaust space 37.

In shifting the sliding pilot valve 6 from the position of Figure 4 to that of Figure 3, live steam flows from the live steam space 31, through the passage 62 and into the steam port 57 to drive the main piston valve 7 from left to right. Live steam will also enter the bore 24 through the exhaust port 58 right hand side of the annular passage 53 and into the port 35, the latter having communication with the exhaust space 37.

The flow of live steam to the cylinder 2 through the passage 46 may be regulated through adjustment of the head effective on the piston 3 by reason of the fact that the piston rod area in association with the pump piston is not affected by the pressure in the pump cylinder, the pump piston and the main piston 3 travel faster in one direction than the other, namely, from right to left when viewing Figure 1. Variable amounts of live steam may be caused to flow through the passages 55 and 56 through rotational adjustment of the false head 45 relatively to the head 44. Such rotational adjustment of the false head 45 will either increase the area of the co-acting valve passages 55 and 56 to admit a greater amount of live steam to the cylinder 2 or reduce the delivery of live steam to the cylinder in accordance with specific operating conditions. Reducing the area of the valve openings 55 and 56 will cause the pump to slow down in the right to left stroke, as when viewing the piston 3 of Figure 1. A false head 45 is fixedly related to the head 44 through tightening of the screw 47. The main piston valve 7 is easily accessible by merely removing one of the chest covers 26. While the heads 41 and 45 and the ribs 51 and 52 fit snugly inside the bore 24, the fit is such that the main piston valve 7 may be shifted manually inside the bore 24 as a test for determining a proper fit when assembling the parts.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a steam cylinder valve gear, a steam chest body having ports for admitting live steam to and exhausting steam from a cylinder, said body having a bore communicating with said ports, a piston valve movable in said bore and co-acting with said ports for respectively controlling the flow of live steam and exhaust steam to and from the cylinder, said piston valve being provided with a head having a valve opening, and a false head adjustably mounted on said first-mentioned head and having a Valve opening co-acting with said first-mentioned valve opening for regulating the amount of live steam admitted to one of said ports for delivery to the cylinder.

2. In a steam cylinder valve gear, a steam chest body having ports for admitting live steam to and exhaust steam from a cylinder, said body having a bore communicating with said ports, a piston valve movable in said bore and co-acting with said ports for respectively controlling the flow of live steam and exhaust steam to and from the cylinder, said piston valve having a head provided with valve openings, a false head rotatably mounted on said first-mentioned head and having valve openings co-acting with said first-mentioned valve openings for regulating the amount of steam admitted to one of said ports for delivery to the cylinder, and means for fixedly relating the false head to said first-mentioned head.

3. In a steam cylinder valve gear, a steam chest body having ports for admitting live steam to and exhausting steam from a cylinder, said body having a bore communicating with said ports, a piston valve movable in said bore and co-acting with said ports for respectively controlling the flow of live steam and exhaust steam to and from the cylinder, said piston valve having a co-axial head provided with valve openings, and the rotative false head arranged co-axially with said first-mentioned head and having valve openings co-acting with said first-mentioned openings for regulating the amount of live steam admitted to one of said ports for delivery to the cylinder, and means arranged co-axially with said false head.
and said first-mentioned head for fixedly relating the two.

4. In a steam cylinder valve gear, a steam chest body having ports for admitting live steam to and exhausting steam from a cylinder, a first valve means co-acting with said ports for respectively controlling the flow of live steam and exhaust steam to and from the cylinder, and a second valve means carried by said first valve means for regulating the amount of live steam admitted to one of said ports for delivery to the cylinder.

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