This invention relates to new and useful improvements in coal cleaning machines generally, and in particular to improved air operated means for operating the slat discharge gate in response to the water level in the hydrator of a coal breaker unit equipped with hydrator cones, spirals, and so forth.

The primary object of this invention is to maintain the slat discharge gate open during the period that the water level is falling in the hydrator, and closed when the water level is rising with the gate being operated in response to and at the time the water level in the hydrator rises and falls to predetermined limits.

Another important object of the present invention, in conformity with the preceding object, is to provide a machine which includes a double acting cylinder for effecting the opening and closing of the discharge gate, and in which the reciprocating piston thereof will reverse its stroke in response to the water level in the hydrator having reached either of its predetermined levels.

Still another important object of this invention is to provide a machine of this character in which the discharge gate will only be operated in one direction at either of the water level limits in the hydrator, that is, the gate will only be closed when the water level in the hydrator is at its lower limit.

A meritorious feature of the present invention resides in the means provided for controlling the reciprocation of the piston rod in the double acting cylinder, such means being of such a character that an intervening independent occurrence is required between the completion of one stroke and before the following stroke can be initiated.

Another important feature of the present invention, closely allied to the features set forth in the preceding paragraph, resides in the means responsive to the water level in the hydrator reaching a predetermined limit for initiation of a succeeding stroke, so as to constitute the change of water level from one limit to the other as the intervening occurrence.

A final important feature to be specifically set forth herein resides in the linkage system between the piston rod and the valve control, and the sliding blocks that are disposed in the travel path of a portion of a linkage so as to act on and to be acted upon by the linkage.

These, together with various ancillary objects and features of the invention which will become apparent as the following description proceeds, are attained by the present invention, a preferred embodiment of which has been illustrated by way of example only in the accompanying drawings, wherein:

Figure 1 is a side elevational view of the invention with portions of the same being broken away and shown in section;

Figure 2 is a fragmentary top plan view of the invention, with portions of the same being broken away and shown in section upon the plane of the section line 2—2 in Figure 1;

Figure 3 is a vertical sectional view of the invention taken upon the plane of the section line 3—3 of Figure 2;

Figure 4 is a fragmentary vertical sectional view, this view being taken upon the plane of the section line 4—4 of Figure 2;

Figure 5 is a fragmentary sectional view taken upon the plane of the section line 5—5 of Figure 4; and,

Figure 6 is an enlarged detailed sectional view taken upon the plane of the section line 6—6 of Figure 4.

Reference is now made more specifically to the accompanying drawings, wherein like numerals designate similar parts throughout the various views, and in which the invention is designated generally at 10.

Mounted upon a platform 12 that rests upon horizontal frame members 14 is a double-acting cylinder 16 having a piston 18 slidable therein. Means is provided to selectively exhaust and introduce fluid under pressure adjacent the opposite ends of the cylinder 16 to cause reciprocation of the piston 18, such means consisting of a valve 20 formed of a tubular valve body 22 having spaced lateral ports 24 and 28. The cylinder 16 has ports 23 and 30 adjacent its opposite end, and conduits 32 and 34 are provided to respectively, afford communication between the ports 24 and 28, and ports 26 and 30. A valve core member 35 is slidable in the tubular valve body 22, and as clearly shown in Figure 2, the valve core 35 has provided therein L-shaped passages 38 and 40 at its opposite ends, and a generally V-shaped passage 42 intermediate its ends.

In addition, an air pressure line 44 communicates with the interior of the body 22 intermediate its ends and exhaust lines 46 and 48, communicate with the interior of the same adjacent its opposite ends, the arrangement being such that the pressure line 44 has communication with the passage 42 irrespective of the position of the core member, and as will be readily understood the core member may be moved between positions...
in which the passage 42 has selective communication with one of the conduits 32 and 34 to selectively apply pressure to the opposite end of the piston 18. It will of course be appreciated that when the air pressure line 44 has communication with one of the conduits 32 and 34, the other conduit has communication with one of the exhaust lines through one of the L-shaped passages 38 and 40. As thus far described, the piston 18 may be selectively driven to either one of the ends of the cylinder 16 by controlling the position of the valve core member 36.

The piston 18 carries a piston rod 50 that slidably extends through one of the end walls of the cylinder 16. As best shown in Figures 2 and 3, posts 52 and 54 extend upwardly from the platform 12, the post 52 having pivotally mounted upon its upper end a link 56, the link 56 being pivoted to the post 52 intermediate its ends and having one end pivoted to the piston rod 50 as at 58. Another link 60 has one end pivoted to the upper end of the post 54, and the adjacent ends of the links 56 and 60 are formed with eyes that are rotatably received on a sleeve 62 best shown in Figure 4. The ends of the links 56 and 60 received on the sleeve 62 are disposed between a pair of roller bearings 64 also received on the sleeve 62, and the roller bearings 64 as well as the adjacent ends of the links 56 and 60 are retained in assembled relation on the sleeve 62 by means of a bolt 66 and washers 68.

Guide blocks 70 and 72 are secured to the platform 12 by means of suitable fasteners 74 below the pivotal connection of the links 56 and 60, and have disposed slidably thereon the slide blocks 76 and 78. As best shown in Figure 5, the lower portion of the slide blocks 76 and 78 are of an inverted T configuration 80 that slide in complementary channels 82 in the blocks 70 and 72. The slide blocks 76 and 78 are disposed on opposite sides of the pivotal connection between the links 56 and 60, and are each urged or biased toward the pivotal connection by means of backing members 84 suitably secured to the blocks 70 and 72 and extending upwardly therefrom, with compression springs 86 and 88 being seated between the backing members 84 and the slide blocks 76 and 78 respectively. Guide rods 90 are secured to the slide blocks 76 and 78 which extend through the springs 86 and 88 and slidably extend through suitable apertures provided in the backing members 84. The outer ends of the rods 90 are threaded and adjustment nuts 92 provided thereon to limit the movement of the sliding blocks toward the pivotal connection. It will be noted that annular bosses 94 are provided on the adjacent faces of the backing members 84 to slidably embrace the rods 90 and to space the outer ends of the compression spring from the rods 90.

Close proximity to the adjacent faces of the blocks 70 and 72, so as to be urged upwardly by the springs 104 into the travel path of the sliding blocks 76 and 78. A rock shaft 110 is engaged in bearings 112 secured below the platform 12, which shaft 110 extends between the tubular housings 96 and 98. The shaft 110 has suitably keyed thereon a rocker lever 114, the opposite ends of which slidably project through elongated slots 116 provided in the adjacent faces of the tubular housings 96 and 98. In addition, the latch members 100 and 102 are provided with transverse openings 118 intermediate their ends which receive the opposite ends of the rocker lever 114, the arrangement being such that by rocking the shaft 110, one of the latching members may be moved downwardly while the other latching member is permitted to move upwardly through the action of its associated spring 104. It will be appreciated that the shaft 110 and the rocker lever 114 are for the purpose of releasing the latching members from the sliding block and that the openings 118 may be made sufficiently large to allow as much independent motion to the latching members as may be desired and which will yet permit the shaft 110 to be rotated to a position to disengage the latching members from the sliding blocks.

Means is provided for rocking the shaft 110. At 120 is designated generally a portion of the hydrator in which is disposed a float 122. The float 122 carries an upright 124 that at 126 has pivotal connection to a lever arm 128 intermediate its ends at 130 to the body of the float 122. The end of the lever arm 128 remote from the upright 124 is secured to a cable 132, such cable 132 being entrained over a pulley 134 carried by a suitable support 130, and the lower ends of the cable 132 are suitably secured to the opposite extremities of a rocker lever 136 fixedly secured to the shaft 110.

It will be evident upon consideration of Figure 2 that upon movement of the piston 50 to the right that the pivotal connection between the links 56 and 60 will move in the opposite direction or to the left, and vice versa.

This motion in the linkage is transmitted to the valve core member 36 by an actuator rod 140 having one end connected to the valve core member 36 and its other end pivotally coupled to the link 60 intermediate its end as at 142. It being noted that the valve body 22 is closed at one end by a plate 144 and at the other end by an apertured plate 146 through which the rod 140 slidably extends.

It is believed that the operation of the invention will be readily understood. As an initial condition of the machine, it will be assumed that the same is in the position shown in Figures 2 and 3 with the slide block 76 in its limiting position towards the pivotal connection, and the slide block 78 retained by the latch member 102. It will be understood that upon the level of the water in the hydrator being lowered to a predetermined level, the shaft 110 will be rotated clockwise as shown in Figure 4 to an extent sufficient to free the latch member 102 from the slide block 78, whereupon the slide block 78 through the action of the spring 88 urges the pivotal connection between the links 56 and 60 to the left as shown in Figure 4. Such movement of the pivotal connection to the left is accompanied by a corresponding movement to the left of the rod 140 which serves to push the valve core member 36 to a position in which air pressure through the line 44 is admitted to the

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left of the piston 18 to force the same into a position to the right. It will be noted that when the piston 18 moves to the right, the pivotal connection is moved to the left so that the same will engage the slide block 78 and urge the same against the action of the compression spring 88 until the latch member 100 engages the same through the action of the spring 104. It will now be seen that the relative positions of the slide blocks 76 and 78 and the latch members 100 and 102 has been reversed from that shown in Figure 4. Proceeding further, assume that the water level in the hydrator has risen to an extent sufficient to release the latch member 100 from the slide block 76, whereupon the slide block 76 urges the pivotal connection to the right as shown in Figure 2, such motion being accompanied by a shift of the valve core member to the left so that pressure is now admitted to the right hand side of the piston 18 to force the same to the left. Such motion of the piston 18 to the left will act through the link 56 to force the pivotal connection to the right so as to force the slide block 78 back to its initial position with the latch member 102 retaining the same in its initial position. It will now be appreciated that the machine has proceeded through an entire cycle and is in condition for a repeat operation.

At 140 is designated generally the slate discharge chute in which is disposed a gate 150 pivoted intermediate its ends at 152. As clearly shown in the drawings, the gate 150 is provided with a depending arm 154, such arm 154 having pivotal connection at 156 to one end of the piston rod 50 that projects into the chute 140. Of course, in the pivotal connection between the arm 154 and the piston rod 50, means is provided for lost motion such as the slots 158 provided in the other pivotal connections throughout the machine.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art after a consideration of the foregoing specification and accompanying drawings, it is not desired to limit the invention to the exact construction shown and described, but all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

While it is believed that the general nature of the coal cleaning machine with which the above invention is associated will be obvious to those skilled in the art when the drawings are considered in conjunction with the description thereof; however, it is believed a brief statement explaining the same will not render this specification unduly lengthy. In this type of machine, the coal is cleaned and separated from slate and the like hydraulically by periodic upward surges of water in the mixture of coal and slate, such surges washing the coal and causing the slate to settle below the coal. In the drawings, such washing and separation takes place above the valve 150 in the chute 148, conventional means being provided, not shown, to cause the water to surge upward and the surface level thereof to fluctuate in the chute 148. The portion of the hydrator designated at 120 has water communication with the chute 148 by conventional means, not shown, so that the water level therein also fluctuates to actuate the float 122.

Obviously means, not shown, are provided as customary in machines of this type for removing slate from below the valve 150, and also for introducing uncleaned coal and removing cleaned coal from positions above the valve 150. With this brief explanation it is believed that the general nature of the machine to which the present invention is applied will be evident to those unfamiliar in the art, and that further description thereof will not be needed inasmuch as such machines are common place and form no part of this invention.

Having described the invention, what is claimed is:

1. In a coal cleaning machine of the type including a hydrator float and a slate discharge gate, a cylinder having a piston and a piston rod slidable therein, means operatively connecting the piston rod to the discharge gate, valvular means for selectively exhausting and admitting fluid under pressure at the opposite ends of the cylinder, means for actuating said valvular means comprising first and second links having a pivotal connection at their adjacent ends, the first link having a fixed pivot intermediate its ends and its remote end pivoted to the piston rod, the second link having a fixed pivot at its remote end, movable elements disposed on opposite sides of and in the travel path of said pivotal connection, means yieldingly urging said elements towards the pivotal connection, means for latching each of said elements against movement towards the pivotal connection, an actuator rod connecting the second link to the valvular means, and means operatively connecting the hydrator float to the latch means for selectively releasing each of said movable elements whereby when one of the movable elements is released in response to movement of the float, it will move the pivotal connection towards the other movable member and through the second link and actuator rod actuate the valvular means.

2. In a coal cleaning machine of the type including a hydrator float and a slate discharge gate, a cylinder having a piston and a piston rod slidable therein, means operatively connecting the piston rod to the discharge gate, valvular means for selectively exhausting and admitting fluid under pressure at the opposite ends of the cylinder, means for actuating said valvular means comprising first and second links having a pivotal connection at their adjacent ends, the first link having a fixed pivot intermediate its ends and its remote end pivoted to the piston rod, the second link having a fixed pivot at its remote end, movable elements disposed on opposite sides of and in the travel path of said pivotal connection, means yieldingly urging said elements towards the pivotal connection, means for latching each of said elements against movement towards the pivotal connection, an actuator rod connecting the second link to the valvular means, and means operatively connecting the hydrator float to the latch means for selectively releasing each of said movable elements, said latch means including a pair of latch members, each of which is slidable into and biased towards the travel path of one of said movable elements, said means connecting the float to the latch means including a rock shaft having a rocker lever thereon connected to the latch members.

3. In a coal cleaning machine of the type including a hydrator float and a slate discharge gate, a cylinder having a piston and a piston rod slidable therein, means operatively connecting
the piston rod to the discharge gate, valvular means for selectively exhausting and admitting fluid under pressure at the opposite ends of the cylinder, means for actuating said valvular means comprising first and second links having a pivotal connection at their adjacent ends, the first link having a fixed pivot intermediate its ends and its remote end pivoted to the piston rod, the second link having a fixed pivot at its remote end, movable elements disposed on opposite sides of and in the travel path of said pivotal connection, means yieldingly urging said elements towards the pivotal connection, means for latching each of said elements against movement towards the pivotal connection, an actuator rod connecting the second link to the valvular means, means for selectively releasing each of said movable elements, said latch means comprising a pair of latch members, each of which is slidable into and biased towards the travel path of one of said movable elements, said means connecting the float to the latch means including a rock shaft having a rocker lever thereon connected to the latch members, a lever arm on the rocker shaft, a pulley mounted on a support, an elongated flexible element entrained over the pulley and having its opposite ends secured to the opposite ends of the lever arm, a further lever having a fixed pivot intermediate its ends with one of its ends secured to the hydrator float and its other end secured to the flexible element.

4. In a coal cleaning machine, a cylinder having a piston and a piston rod slidably therein, valvular means for selectively exhausting and admitting fluid under pressure at opposite ends of the cylinder, means for actuating said valvular means comprising first and second links having a pivotal connection at their adjacent ends, the first link having a fixed pivot intermediate its ends and its remote end pivoted to the piston rod, the second link having a fixed pivot at its remote end, movable elements disposed on opposite sides of and in the travel path of said pivotal connection, means yieldingly urging said elements towards the pivotal connection, means for latching each of said elements against movement towards the pivotal connection, and an actuator rod connecting the second link to the valvular means.

5. In a coal cleaning machine of a cylinder having a piston and a piston rod slidably therein, valvular means for selectively exhausting and admitting fluid under pressure at opposite ends of the cylinder to cause reciprocation of the piston rod, means for controlling said valvular means comprising first and second links having a pivotal connection at their adjacent ends, the first link having a fixed pivot intermediate its ends and its remote end pivoted to the piston rod, the second link having a fixed pivot at its remote ends, a base disposed adjacent the pivotal connection, blocks slidably mounted on the base on opposite sides of the pivotal connection, compression springs interposed between the backing members and the blocks urging the blocks towards the pivotal connection, latch members slidably mounted in the base and movable into and out of the travel path of the blocks, means for selectively moving said latch members, and an actuator rod connecting the second link to the valvular means.

6. In a coal cleaning machine of a cylinder having a piston and a piston rod slidably therein, valvular means for selectively exhausting and admitting fluid under pressure at opposite ends of the cylinder to cause reciprocation of the piston rod, means for controlling said valvular means comprising first and second links having a pivotal connection at their adjacent ends, the first link having a fixed pivot intermediate its ends and its remote end pivoted to the piston rod, the second link having a fixed pivot at its remote ends, a base disposed adjacent the pivotal connection, blocks slidably mounted on the base on opposite sides of the pivotal connection, spaced backing members on the base, helical compression springs interposed between the backing members and the blocks urging the blocks towards the pivotal connection, a guide rod secured to each of the blocks, said guide rod extending through one of the compression springs and slidably extending through one of the backing members, a stop carried by the guide rod engageable with the backing member to limit movement of the block associated therewith towards the pivotal connection, latch members slidably mounted in the base and movable into and out of the travel path of the blocks, means for selectively moving said latch members, and an actuator rod connecting the second link to the valvular means.

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