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H. C. MAY ET AL
DOOR OPERATING MECHANISM

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Fig. 1

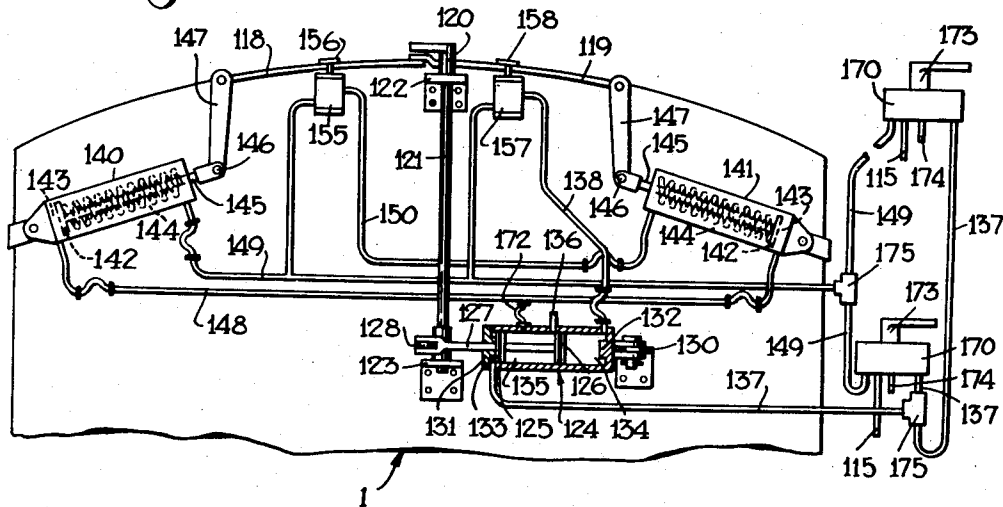


Fig. 2

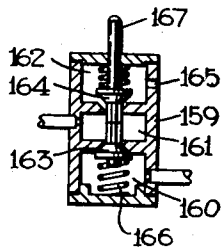
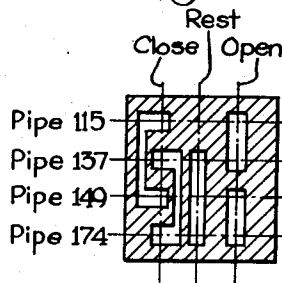


Fig. 3



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DOOR OPERATING MECHANISM

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4 Claims. (Cl. 268-64)

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This invention relates to door operating mechanism and more particularly to apparatus for controlling operation of such as coal bunker doors, the present being a division of our copending application, Serial No. 22,208, filed April 20, 1948.

The principal object of the invention is the provision of apparatus for controlling remotely, opening of a pair of doors, one of which overlaps the other, and closure of same sequentially.

Other objects and advantages will become apparent from the following more detailed description of the invention, taken in connection with the accompanying drawing, wherein: Fig. 1 is a schematic view, partly in outline and partly in section, of door operating mechanism and control apparatus for same; Fig. 2 is a vertical sectional view showing details of an interlock device employed in the control apparatus shown in Fig. 1; and Fig. 3 is a schematic diagram for operation of a selector valve device, several of which are employed in the control apparatus shown in Fig. 1.

Description

The coal bunker 1, a portion of which is shown in elevation in Fig. 1, may be in the form of a substantially rectangular tank for storing coal therein. Doors 118, 119 are provided at the top of the bunker, hinged at their outer edge, and arranged to be swung upwardly on their hinges to open the bunker for adding coal. To provide a weather-tight seal, the bunker door 119 overlaps the door 118 in their closed position. To lock the bunker doors closed, a latch 120 engages the overlapping edges of said doors in closed position. Latch 120 may be secured to one end of a rod 121 pivotally mounted in brackets 122, 123 spaced apart and secured to an end wall of the bunker. By turning movement of rod 121, the latch may be brought into and out of engagement with the uppermost overlapping bunker door 119 for respectively locking and unlocking same. For actuating the rod 121 a latch operating cylinder 124 is provided which may contain two pistons 125, 126 spaced apart and rigidly secured one with the other by means of an operating rod 127 common to both. The rod 127 extends outwardly from the cylinder 124 and may be pivotally connected to a lever 128 attached to the end of rod 121, so that reciprocal movement of rod 127 will cause turning movement of rod 121. The casing of the cylinder 124 may be pivotally connected to an arm 130 secured to the bunker wall to allow necessary freedom for turning movement of lever

128. The pistons 125, 126 are so adapted and arranged that when latch 120 is in its locked position, in which it is shown in the drawing, piston 125 lies adjacent an end wall 131 of cylinder 124, with piston 126 disposed away from an opposite end wall 132 of said cylinder. Within the cylinder 124, the wall 131 serves to define, with piston 125, a latch-unlocking pressure chamber 133, and end wall 132 serves to define a latch-locking pressure chamber 134 with piston 126. An atmospheric chamber 135 is formed within the cylinder intermediate the two pistons, a port or pipe 136 being provided to open said chamber to the atmosphere. A control pipe or line 137 is provided for supplying and releasing fluid under pressure to and from the latch-unlocking pressure chamber 133, and another pipe or line 138 is provided for supplying and releasing fluid under pressure to and from the latch-locking pressure chamber 134. While chamber 134 is vented to the atmosphere, if fluid under pressure is supplied to the chamber 133, the pistons 125, 126 and rod 127 are caused to move in the direction of the first mentioned chamber to effect unlocking of the latch 120. Conversely, if chamber 133 is vented to the atmosphere and chamber 134 supplied with fluid under pressure, the pistons 125, 126 and rod 127 are caused to move in the direction of the first mentioned chamber for moving the latch 120 back to its locked position.

To operate the bunker door 118, a fluid pressure cylinder device 140 may be provided, while a similar cylinder device 141 may be provided for operating the door 119. Cylinder devices 140, 141 may comprise a piston 142 (shown in broken outline) having a door-opening chamber 143 at one side and a door-closing chamber 144 at the opposite side. A rod 145 attached to piston 142 is pivotally connected at 146 to a lever 147 secured to the respective bunker door. Assuming the bunker doors to be unlatched, and with the door closing chambers 144 vented to atmosphere, by supply of fluid under pressure to the door opening chambers 143 in the cylinder devices 140, 141 the pistons 142 and attached rods 145 are caused to move outwardly, and acting through levers 147, open the bunker doors 118, 119. By subsequently venting the door opening chambers 143 to atmosphere and applying fluid under pressure to the door closing chambers 144 in cylinder devices 140 and 141, in a similar manner, the bunker doors 118, 119 are caused to close. A control pipe or line 148 is connected to the opening chambers 143 in both cylinder devices 140, 141 at each side of the bunker for conveying fluid under pressure

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thereto and therefrom. For conveying fluid under pressure to and from the door closing chamber 144 in the cylinder device 140, a pipe or line 149 is provided, and to serve the same purpose with respect to cylinder device 141, a pipe or line 150 is provided.

According to the invention, we provide controls which assure the proper sequence of operation of the door latch 120 and door operating cylinder devices 140, 141 on each side of the coal bunker in effecting opening and closing of the bunker doors.

An interlock valve device 155 is provided at the end of the bunker door 118. Valve device 155 may be secured to an end wall of the bunker in such a manner as to be operable by a projecting element 156 carried by the door 118. Similarly, an interlock valve device 157 is disposed at the end of the bunker door 119 and secured to the end wall of the bunker. A projecting element 158 is provided on the door 119 and secured thereto for operating the valve device 157.

Referring to Fig. 2, each of the interlock valve devices 155, 157 may comprise a casing having a chamber 160, a chamber 161, and an exhaust chamber 162 formed therein. A valve 163 is provided for controlling communication between the chamber 160 and the chamber 161, and a valve 164 is provided for controlling communication between the chamber 161 and the exhaust chamber 162 which is open to atmosphere via an exhaust port 165 in the casing. A control spring 166 is arranged to urge the valve 163 to a normally closed position, while the exhaust valve 164 is held in a normally open position. An operating stem 167 is secured to the exhaust valve 164 and projects outside the casing. The valves 163, 164 are so arranged that when the stem 167 is displaced inwardly of the casing 159, the valve 164 is seated and the valve 163 unseated. Chamber 160 of interlock valve device 155 is connected to the pipe 149. The chamber 161, of the interlock valve device 155, is connected to the pipe 150. When door 118 is closed, stem 167 of device 155 will be depressed, valve 164 will be closed, valve 163 will be open, and therefore pipe 149 will be connected to pipe 150 via said device 155. When the door 118 is opened, element 156 secured to said door will leave stem 167 of device 155 and allow valve 163 to close and valve 164 to open so that pipe 150 is opened to atmosphere via chambers 161, 162 and exhaust port 165.

The chamber 160 of interlock valve device 157 is connected to the pipe 149, but the delivery chamber 161 of said device is connected to the pipe 138. A pipe 172 is connected to the pipe 148 and via a port 172 to the cylinder device 124 in such a manner that after piston 125 is caused to move a distance away from end wall 131 sufficient to cause the latch 120 to move out of locking position, said pipe will open to chamber 133.

For controlling operation of the bunker door operating mechanism, two selector valve devices 170 are provided which may be located at any convenient position remote one from the other. Either of the selector valve devices is operable manually by a respective operator's handle 173 to control communication between the pipes 149, 137 and a fluid pressure supply pipe, such as a branch of the control supply pipe 115 and an exhaust pipe 174. Details of the valve devices 170 are not shown, but each may be of the well-known rotary valve type.

Referring to Fig. 3, the rotary valve may be moved by handle 173 to any one of three positions

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which may be called "open," "rest," and "close." In "open" position, the valve device 170 connects pipe 115 to pipe 137 and pipe 149 to pipe 174. In "rest" position, device 170 connects pipes 137, 149 to pipe 174, while pipe 115 is blanked off. In "close" position, device 170 connects pipe 149 to pipe 115 and pipe 137 to pipe 174.

With the selector valve devices 170 in "rest" position, the doors 118, 119 closed, and the latch 120 in locked position, if it is desired to open the doors to supply coal to the bunker 1, for example, the operator's handle 173 of either selector valve device 170 may be moved to "open" position, whereupon fluid under pressure from the line 115 is supplied to the line 137 while pipe 149 remains open to the exhaust pipe 174. Fluid under pressure thus supplied to the line 137 flows into chamber 133 in the latch operating cylinder device 124 where it acts on position 125 to cause its movement in the direction of chamber 135 for effecting movement of latch 120 to an unlocked position. At the same time, chamber 134 is open to the atmosphere via pipe 138, valve device 157 and pipe 149. In thus moving, piston 125 opens pipe 172 to chamber 133, so that fluid under pressure then flows from said chamber into pipe 148 via said pipe 172, whence it flows into the door opening chambers 143 in the cylinder devices 140, 141. At this time, chamber 144 in device 140, will be open to atmosphere by way of pipe 149 and the respective selector valve device 170, and chamber 144 in device 141 will be open to the atmosphere by way of pipe 150, valve device 155, and pipe 149, so that fluid under pressure thus supplied to chambers 143 in the devices 140, 141 causes the bunker doors 118, and 119 to open. As the doors open, the interlock valve devices 155 and 157 assume positions in which respective pipes 138 and 150 are vented to the atmosphere locally by way of ports 165 in said devices.

When it is desired subsequently to close the bunker doors 118, 119, the respective selector valve device 170 is moved to "close" position, opening pipe 137 to exhaust pipe 174 and connecting pipe 149 to the supply line 115. Fluid under pressure in the door opening chambers 143 of cylinder devices 140, 141 is thus vented to the atmosphere via pipes 148, 172, chamber 133 in cylinder device 124, pipe 137, and pipe 174 in the selector valve device 170. Fluid under pressure supplied as above to the pipe 149, will flow directly to the chamber 160 of interlock valve device 155, to the corresponding chamber 160 in interlock valve device 157, and to the door closing chamber 144 of cylinder device 140. With both doors 118 and 119 open at this time it will be appreciated that in interlock valve devices 155 and 157, since their respective stems 167 will be fully extended, their respective valves 163 will be closed so that fluid under pressure supplied to their respective chambers 160 will not reach pipes 150 and 138 which will remain vented by way of the respective unseated valves 164 in said interlock devices. The chamber 144 in cylinder device 141 and chamber 134 in latch operating cylinder 124 will remain vented via pipe 138 so that door 119 and latch 120 will remain open at this time. Pressure of fluid thus supplied to chamber 144 in cylinder device 140 will act on the piston 142 therein to effect closure of the door 118 through action of the lever 147 and rod 145. With closure of door 118, the projecting element 156 carried by said door is brought into engagement with stem 167 of device 155, displacing said stem inwardly. As previously de-

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scribed, the valve 164 in device 155 is closed by inward movement of stem 167 while the valve 163 is opened, so that pipe 149 is now connected to pipe 150 by way of chambers 160, 161. Fluid under pressure from pipe 149 will now flow into pipe 150 to the door closing chamber 144 in cylinder device 141 to effect closure of the door 119 in manner similar to that previously described, overlapping door 118. It will be seen that by means of the control means herein disclosed, closure of the bunker doors is effected sequentially so that door 119 overlaps door 118 in order to obtain the proper closure. When door 119 is closed, through displacement of stem 167 in interlock valve device 157 by the projecting element 158 carried by said door, as was previously described, the pipe 149 is connected via said device 157 to the pipe 138. Fluid under pressure will then flow from pipes 149, 138 into chamber 134 of the cylinder device 124, whereupon the pressure of said fluid acting on piston 126 will effect movement of the latch 120 to locked position. The handle 173 in the respective selector valve device 170 may then be returned to "rest" position, venting both pipes 149 and 137 to the atmosphere.

It will thus be seen that means are provided whereby unlocking and opening, and closing and locking of the bunker doors is automatically effected in the proper sequence by selective positioning of an operator's selector valve device 170.

By means of double check valves 175 inserted in branches of the pipes 149 and 137 connected to the respective valve devices 170, one of said devices 170 is isolated from the system when the other of said devices 170 is operated.

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

1. Apparatus for controlling opening and closing of a door comprising a first pipe, a second pipe, a second pipe, a selector valve for supplying fluid under pressure to either one of said pipes while venting the other, a double acting fluid pressure operated door cylinder operable by fluid under pressure in a door opening chamber to open said door and by fluid under pressure in a door closing chamber connected to said second pipe to close said door, a latch for holding said door closed, a double acting latch operating cylinder having one pressure chamber open to said first pipe and having a second pressure chamber and responsive to supply of fluid under pressure to said one pressure chamber to release said latch and then establish communication between said first pipe and said door opening chamber and responsive to supply of fluid under pressure to said second pressure chamber to lock said latch, and interlock means operable by closing of said door to connect said second pipe to said second pressure chamber.

2. Apparatus for controlling opening and closing of a door, comprising a first fluid pressure pipe, a second fluid pressure pipe, a fluid pressure supply pipe, a fluid pressure exhaust pipe, a selector valve device operable to establish fluid pressure connection between said supply pipe and either said first fluid pressure pipe or said second fluid pressure pipe and between said exhaust pipe and either said second fluid pressure pipe or said first fluid pressure pipe, respectively, a fluid pressure reciprocable piston operatively connected to said door and subject opposingly to pressure of fluid in a door-opening chamber and in a door-closing chamber connected to said

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second fluid pressure pipe, a latch movable into and out of locking engagement with said door when closed, a latch operating cylinder comprising two spaced-apart reciprocable pistons operatively connected to said latch and subject opposingly to pressure of fluid in a latch-locking chamber and in a latch-unlocking chamber connected to said first fluid pressure pipe, said pistons being movable to a latch-locking position in response to supply of fluid under pressure to said latch-locking chamber and to a latch-unlocking position in response to supply of fluid under pressure to said latch-unlocking chamber, said cylinder having an atmospheric port located to constantly vent the space between said spaced-apart pistons and having a second port located to open to said space in latch-locking position of said pistons and to open to said latch-unlocking chamber substantially upon attainment of said pistons to their latch-unlocking position, said second port being connected to said door-opening chamber, an interlock valve device operable to one position or another position to selectively establish fluid pressure connection between said latch-opening chamber and either the atmosphere or said second fluid pressure pipe, respectively, and an element attached to said door to actuate said interlock device to its said other position upon closing of said door and to its said one position upon opening of said door.

3. The combination with a pair of doors, one door of which is adapted to overlap the other door in closed position of both, a first and second fluid pressure door operating means operatively connected to said one door and to said other door, respectively, to open and close same, fluid pressure latch means operable to lock and unlock said doors, operator's valve means controlling unlocking, locking and opening, closing operation of said latch means and said door operating means, respectively, first interlock means interposed between said operator's valve means and said first door operating means operable by movement of said other door to prevent door closing operation of said first door operating means until said other door is closed, and second interlock means interposed between said operator's valve means and said latch means operable by movement of said one door to prevent locking operation of said latch means until said one door is closed.

4. Apparatus for controlling opening and closing of a pair of doors, one door of which overlaps the other door in closed position of both, comprising a fluid pressure supply pipe, a fluid pressure exhaust pipe, a first control pipe, a second control pipe, a selector valve device operable to establish fluid pressure connection between said supply pipe and either said first control pipe or said second control pipe and between said exhaust pipe and either said second control pipe or said first control pipe, respectively, a first reciprocable piston operatively connected to said one door and exposed to a first door-opening chamber at its one side and to a first door-closing chamber at its opposite side, a second reciprocable piston operatively connected to said other door and exposed to a second door-opening chamber at one side and to a second door-closing chamber at its opposite side connected to said second control pipe, a latch movable into and out of locking engagement with said one door when closed, a latch operating cylinder comprising two spaced-apart reciprocable pistons operatively connected to said latch, said pistons being subject oppos-

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ingly to pressure of fluid in a latch-locking chamber and in a latch-unlocking chamber connected to said first control pipe, said pistons being movable to a latch-locked position in response to supply of fluid under pressure to said latch-locking chamber and to a latch-unlocked position in response to supply of fluid under pressure to said latch-unlocking chamber, said cylinder having an atmospheric port located to constantly vent the space between said pistons and having a second port located to open to said space in said latch-locked position of said pistons and to open to said latch-unlocking chamber substantially upon attainment of said pistons to their latch-unlocked position, conduit means connecting said second port to both said first door-opening chamber and to said second door-opening chamber, a first interlock valve device operable by movement of said other door to establish or disestablish fluid pressure connection between said first

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door-closing chamber and said second control pipe according to whether said other door is closed or open, respectively, and a second interlock valve device operable by movement of said one door to establish or disestablish connection between said latch-unlocking chamber and said second control pipe according to whether said one door is closed or open, respectively.

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