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PNEUMATIC GATE ACTUATING DEVICE FOR CONCRETE BUCKETS

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Fig. 1.

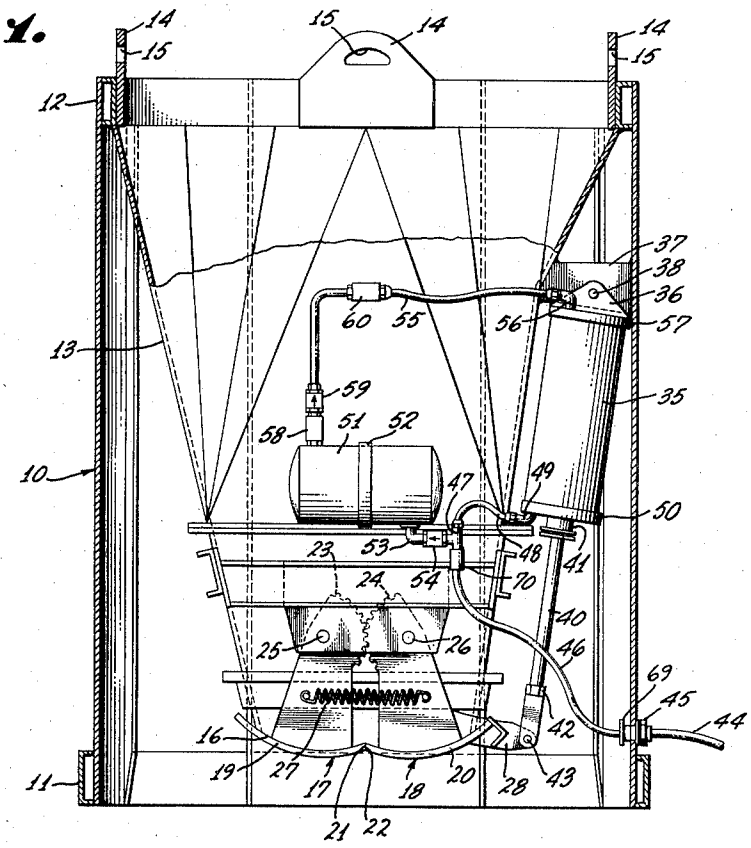
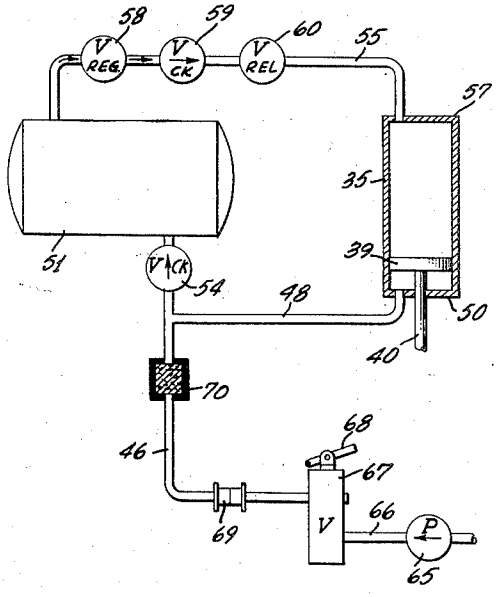


Fig. 2.



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PNEUMATIC GATE ACTUATING DEVICE FOR CONCRETE BUCKETS

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1 Claim. (Cl. 294—71)

The invention relates to pneumatic motors and more particularly a system adapted to the control of reversible pneumatic motors whereby the motor may be operated in a forward or reverse direction through control of a single supply line through which pneumatic pressure is conducted to the motor. The system is most effective under circumstances where the pressure of the pneumatic supply for operating the motor in one direction can be greater than the pressure of the pneumatic supply for operating the motor in a reverse direction.

In the art relating to fluid motors it has been common practice to utilize double acting cylinders, whether hydraulic or pneumatic, whenever both forward and reverse motion is needed as a result of the output of the hydraulic or pneumatic motor. Obviously for the operation and control of double-acting motors of this kind two supply lines under pressure are necessary, one for the forward motion and one for the reverse motion. Obviously also there must be a control for both lines capable of synchronization so that when one supply line is turned on the other supply line is turned off and vice versa. Although very satisfactory control is possible with fluid motors operating in this manner the equipment in the nature of supply lines and valves must be doubled in every instance. Moreover, there is a certain amount of delay in the reaction of the motor when the shift is made in the valve settings from forward motion through a neutral position to reverse. On certain occasions there is a material advantage in a very rapid response of the motor to operation in a reverse direction and there is under all circumstances a great advantage reducing the number of fluid pressure lines and valves both from the point of view of minimizing the number of moving parts and reducing the cost. Although air brake systems may suggest a variation from the double line expedient the fact that they must be maintained under pressure demands expensive piping and heavy valves accompanied by control tanks. Such systems are suited only to very specialized requirements where small movement of the piston will perform the work and where reverse operation at all stages and at any time is not demanded.

It is therefore among the objects of the invention to provide a new and improved reversible pneumatic motor which is quick in its response to either forward or reverse operation and which at the same time is substantially less costly than motors heretofore devised for both forward and reverse operations.

Another object of the invention is to provide a new and improved concrete placing bucket operated by a reversible pneumatic operated motor which is especially responsive to operation by use of air as a pressure medium and wherein the gate of the bucket can be operated in both opening and closing directions by manipulation of a single pressure supply line incorporating a single three-way valve.

Still another object of the invention is to provide a new

and improved concrete placing bucket operated by a reversible pneumatic motor which can be efficiently and quickly shifted from opening to closing operation and from closing operation to opening operation at virtually any point within the extremes of open and closed position of the gate and which is economical from the point of view of power consumption as well as from the point of view of minimizing the amount of piping and valves necessary for complete operation of the device.

Still further among the objects of the invention is to provide a new and improved concrete placing bucket operated by a pneumatic ram and a control system therefor wherein by use of a single air supply line and a reservoir connected thereto the ram can be operated in one direction at one pressure head and in the opposite direction under a pressure head different from the first pressure head but still of sufficient magnitude to produce the desired results.

An important object also is to provide a pneumatic motor device for bin gates wherein the force required for opening is prone to vary over wide limits due to particles jamming the gate, whereby when the force resisting opening movement is suddenly released the pneumatic motor will not suddenly shift the gate to extreme position but will maintain a steady cushioned force whereby there may be maintained a relatively steady but gradual progress to a full open position.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claim and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a side elevational view partially in section showing the pneumatic motor and appropriate control system in use for operating gates at the bottom of a hopper.

Figure 2 is a schematic view of the pneumatic motor and control system illustrating the principle of operation and applicable to producing any opening and closing movement.

This is a continuation of our co-pending application Serial No. 92,064, filed May 7, 1949.

The embodiment of the invention described herein involves the control of gates at the bottom of a concrete hopper. In the instance shown the hopper is one commonly identified as a portable concrete bucket which is adapted to be loaded, lifted and emptied in any position desired and returned at will for reloading. Requirements for the control of gates on a device of this kind are particularly rigid, the circumstances under which the device is used require the operation of a system particularly rugged and resistant to abuse and a reduction in the number of working parts is of a very material advantage when the device is to be used successfully in the field. As shown in the drawings there is disclosed a portable concrete bucket comprising a frame **10** including a lower rim **11**, an upper rim **12**, a bin, hopper or hollow container **13** and brackets **14** at the upper rim **12** having apertures **15** therein to which may be attached a cable sling for lifting the device about.

In the embodiment illustrated the hopper has a lower opening at the point **16** which in this example is illustrated as being closed by a pair of clamshell gates **17** and **18** which rotate to and away from each other in response to the power mechanism comprising the invention. For effective operation the clamshell gates may be provided with rounded plates **19** and **20** having edges **21** and **22** which close tightly against each other when the opening in the bottom of the hopper is to be com-

pletely closed. Furthermore in this embodiment the gates are provided respectively with segmental gears 23 and 24 intermeshing with each other and rotating respectively about shafts 25 and 26. The gates are normally urged toward each other in a closed position by means of a heavy tension spring 27.

For manipulating the gates a bracket arm 28 is attached to the gate 18 and by shifting the bracket arm in an oblique direction up and down both of the gates are moved simultaneously toward an opening or closing position.

The power system for operating the gates in the embodiment illustrated includes an air motor or ram 35, which is here shown as a hollow cylinder, having a bracket 36 by means of which the ram is attached to a support 37 comprising part of the frame 10. The point of attachment is preferably by means of a pivot 38 so that the ram is free to swing a certain limited angular distance about the pivot.

Within the ram is a piston 39, shown schematically in Figure 2, and attached to the piston is a rod 40 including a packing gland 41 and an adjustable collar 42, the rod being attached by a pivot pin 43 to the arm 28.

A main supply line for air under pressure is shown at 44 and this line is preferably a flexible line anchored by means of a fitting 45 to the frame 10. An extension 46 of the main supply line is shown joined to a T47 joined by a length of line 48 to a fitting 49 at one end 50 of the ram 35.

A closed air container or pressure reservoir 51 is shown attached by means of a strap 52 to the frame and an auxiliary supply line 53 is connected between the T47 and the reservoir. A check valve 54 is included in the auxiliary supply line 53 and prevents air under pressure from passing through the auxiliary supply line 53 in a direction reverse to the arrow illustrated in Figure 1.

From the reservoir a secondary, counteracting or reverse supply line 55 extends to a fitting 56 connected to the end 57 of the ram remote from the end 50. In the counteracting supply line there is included a pressure regulating or pressure reducing valve 58 here shown located immediately above the reservoir, a check valve 59 here shown located immediately adjacent the fluid regulator and a pressure relief or pop-off valve 60 shown located between the pressure regulator and the ram or more especially between the check valve 59 and the ram.

As is more readily apparent from an examination of the schematic diagram in Figure 2 pneumatic pressure may be supplied by means of a pump 65 through a primary line 66 to a three-way valve 67 provided with a control 68. This valve may be of conventional construction such as a piston and cylinder which is capable of being set at any one of three positions, namely, a position connecting the primary line 66 with the main supply line 46, a position neutral wherein the main supply line 46 is entirely shut off and an exhaust position wherein the main supply line 46 is exhausted to the atmosphere. For convenience there may be provided in the main supply line 46 a quick disconnect coupling 69. The main supply line may also preferably include a filter 70, the latter being also shown in Figure 1.

In operation the system herein described may be utilized to either open or close the clamshell gates 17 and 18. Assuming the initial position of the gates to be closed, as illustrated in Figure 1, the next operation of the device may be considered as an opening movement for the motor or ram 35. To open the gates the valve 67 is adjusted to open position, a position wherein pneumatic fluid pressure from the primary line 66 is allowed to pass to the main supply line 46 which in turn directly supplies the line 48 connected to the end 50 of the ram 35. If, for example, the pressure be 100 pounds per square inch, then the pressure against the piston 39 will be of

the magnitude of 100 pounds per square inch and the piston will be moved from a lowermost position as illustrated in Figure 2 to an uppermost position as there ilustrated. A motion in this direction of the piston and the attached rod 40 serves to shift the position of the arm 28 thereby moving the position of the gates to successive opening positions for as long as the valve 67 remains open. If no further adjustment is made in the valve 67 the opening movement will continue until the piston 39 bottoms against the end 57 of the ram.

In the meantime fluid pressure from the main supply line 46 is likewise permitted to pass through the check valve 54 into the fluid pressure reservoir 51 thereby building up a fluid pressure of, in the example chosen for the purpose of illustration, 100 pounds per square inch. The reservoir is made in sufficient volume so that fluid therein under a pressure equal to the pressure in the main supply line 46 is capable of filling the cylinder of the pneumatic ram 35. When reference herein is made to a fluid it is directed to a compressible fluid, air being the fluid most readily available.

In the counteracting supply line 55 the pressure regulating or reducing valve 58 is set for a pressure less than the pressure in the main supply line 46 and for purposes of example let it be assumed that the setting is for a pressure of 30 pounds per square inch. By this device fluid is adapted at all times to pass from the reservoir 51 to the counteracting supply line under a pressure of 30 pounds per square inch. The check valve 59 admits passage of fluid outwardly from the reservoir but prevents passage in a return direction. When the cylinder is being moved through an opening cycle there will of course be air, gas or other fluid under a 30-pound pressure at the end 57 of the ram. As the piston 39 moves toward the end 57 there will be a tendency to compress the air in that part of the system where it is maintained by operation of the check valve 59. In order to relieve air thus compressed, the relief valve 60 is set to release at a pressure of 30 pounds per square inch or slightly higher, and the action of the relief valve will, therefore, prevent undue compressing of any gaseous medium in that portion of the system during a forward stroke.

It becomes immediately apparent therefore that there is always present a fluid pressure at the end 57 of the ram but that the pressure at the end 57 is always less than the pressure at the end 50 during the initial stroke. This differential in pressures reduces the effective initial pressure upon the piston to a net pressure of the difference between 100 pounds per square inch and 30 pounds per square inch in the example chosen, namely, 70 pounds per square inch. The net pressure will of course be chosen so that it is sufficiently great to efficiently operate the gates 17 and 18 in the embodiment shown or any other work element which may be attached to the piston rod 40.

Whenever the valve 67 is shifted to exhaust position, pressure in the main supply line 46 is immediately reduced to zero which means that the pressure at the end 50 of the ram 35 is also reduced to zero, or for practical purposes zero gauge pressure. Inasmuch as the pressure at the end 57 of the ram 35 is already 30 pounds per square inch, also gauge pressure, there is immediately effective a substantial pressure on the corresponding side of the piston 39 which is sufficient to move the piston 39 and the piston rod 40 in a direction contrary to the direction of the initial stroke. Movement of the piston in this direction will continue as long as the valve 67 stays in exhaust adjustment or if the piston 39 bottoms on the end 50 of the ram 35. The pressure at the end 57 of the ram will never be greater than the pressure at which the regulator valve 58 is set so long as all of the devices are in proper working order. If the regulator valve 58 gets out of adjustment, pressure in the counteracting supply line 55 will be released at the setting of the pres-

sure relief valve 60. The wide pressure differential produces a strong positive pressure in both opening and closing directions, cushioned against the high pressure movement and wherein the ample volume of air assures a long stroke in both directions.

There are, however, occasions where it may be desired to stop movement of the piston 39 intermediate the extremes of position. When this is desirable it is necessary only to shift the adjustment of the valve 67 to a neutral position. In this position no more fluid under pressure will be admitted to the end 50 of the ram 35 and the piston 39 will therefore remain still for as long as the adjustment continues. From still position the piston 39 may be moved either further in the initial direction by again shifting the valve 67 to open adjustment or it may be reversed by shifting the valve 67 to exhaust adjustment. Whenever the valve 67 is moved to exhaust adjustment the pressure of 30 pounds per square inch which is always present in the end 57 of the ram 35 will become immediately effective to move the piston 39 toward the end 50. The sensitiveness of the fluid motor to reversal in direction therefore becomes immediately apparent. By the system thus described, therefore, both forward and reverse direction can be achieved by a single acting fluid motor by manipulation of the single valve control. On some occasions, as for example in the embodiment illustrated, the weight of the gates assists in the closing movement wherein less pressure is available in the ram 35 than during the opening movement. Other uses of the system, however, may not necessitate amplifying or assisting movement of the operating portion of the fluid motor in a reverse direction. Moreover, by use of a system of this kind, particularly when adapted to the control of the gates of a portable concrete bucket, only one pressure supply line need be attached between the pump and the fluid motor. This is particularly helpful when it is realized that buckets of this kind may be lifted to considerable heights away from ground control and supply and to make possible the successful operation by the use of only one pressure line instead of two results to a very material degree in the reduction of weight and quantity of necessary parts. It also greatly facilitates the operation and movement of the device since only one supply line or hose need be carried about and around obstructions which are almost always present when the device is operated in the field. Reduction in the number of working parts in the present embodiment also reduces the weight of elements which have to be carried upon the frame which bears the hopper and the gates and this results in an additional economy both from the point of view of initial weight and from the point of view of weight which needs to be shifted about when the device is in operation. The advantages of the simplified system herein described are equally great when the fluid motor and control system is applied to many other types and varieties of work whether the work may be portable or stationary and whether or not the piston rod be held stationary with the ram adapted to be movable or under reverse conditions like those illustrated in the embodiment shown in Figure 1.

An outstanding advantage of this control system is that at all times when operating by use of compressed air the maintenance of a back pressure against the piston 39 during a forward stroke provides a smooth, controllable motion for the piston. This control is in contrast to the jerky uncontrollable motion invariably present in an air cylinder operating a device such as a bin gate on which the force reguired to open the gate varies. This condition is true of virtually all bin gates particularly where a granular substance is being discharged. Under such circumstances particles of the granular substance are prone to be caught between the sliding gate portion and the body of the gate, thereby temporarily increasing to a great amount the force required to move the sliding gate portion until these small particles are forced out of position. The instant such particles are forced out of position and the pressure against the sliding gate portion relieved, the force required to move the sliding gate portion is materially reduced. At that point in the ordinary air cylinder the built-up pressure in the piston will cause the piston to jump and open or close the gate to its extreme position. In the system herein described, wherein there is always a constant back pressure against the piston while it is moving in the gate opening direction, there is practically no jump in the piston when the force required to open the gate is suddenly reduced. Although this cushioning effect may not be present in the arrangement disclosed when the gate is being closed, in practically all operations of this general sort the quicker the gate is moved to a closed position, the more effective is the operating system.

While we have herein shown and described our invention in what we have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of our invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claim so as to embrace any and all equivalent devices.

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

In a bucket for depositing concrete having a frame, a bottom opening hopper in the frame and a pair of oppositely opening and closing clam shell gatees rotatably mounted on the frame in interconnected relationship one gate with the other, the combination of a pneumatic gate opening and closing system comprising a cylinder mounted on the frame, a reversible piston in the cylinder having a piston rod extending into engagement with one of said gates, a flexible high pressure air line having one end secured to the frame and having an operating valve at the other end, said valve being remote from and unconnected to the frame and having open, neutral and exhaust positions, means on said valve for connection to a source of air under pressure, an air storage tank on the frame, said air line having one branch on the frame connected directly to the cylinder at a high pressure end and having another branch connected to the tank, said last identified branch having a back flow check comprising the only air control means between said valve and the tank, and a continuous free-flowing lower pressure air line from the tank directly to the cylinder at a lower pressure end thereof, a continuously open pressure regulating device in said low pressure air line having a pressure setting at substantially one-half the pressure in the high pressure air line and a relief valve in said low pressure air line between the regulating device and the cylinder having a pressure release setting substantially equal to the setting of said pressure regulating device, said operating valve having a gate-opening adjustment at open position and a gate-closing adjustment at exhaust position.

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