

April 25, 1961

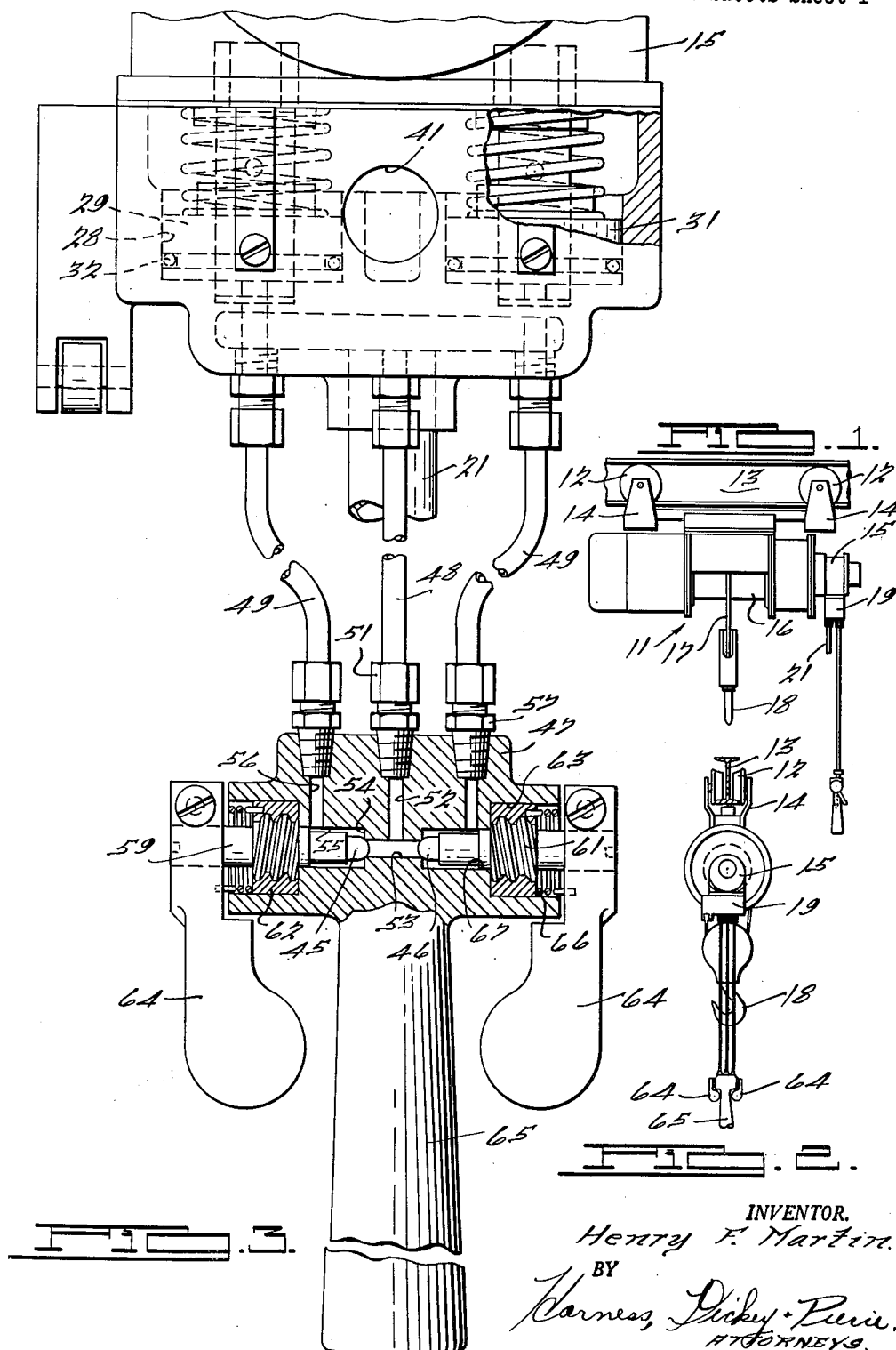
H. F. MARTIN

2,981,289

HOIST

Filed July 22, 1959

2 Sheets-Sheet 1



INVENTOR.

Henry F. Martin.

BY

Karner, Dickey & Purdie.
ATTORNEYS.

April 25, 1961

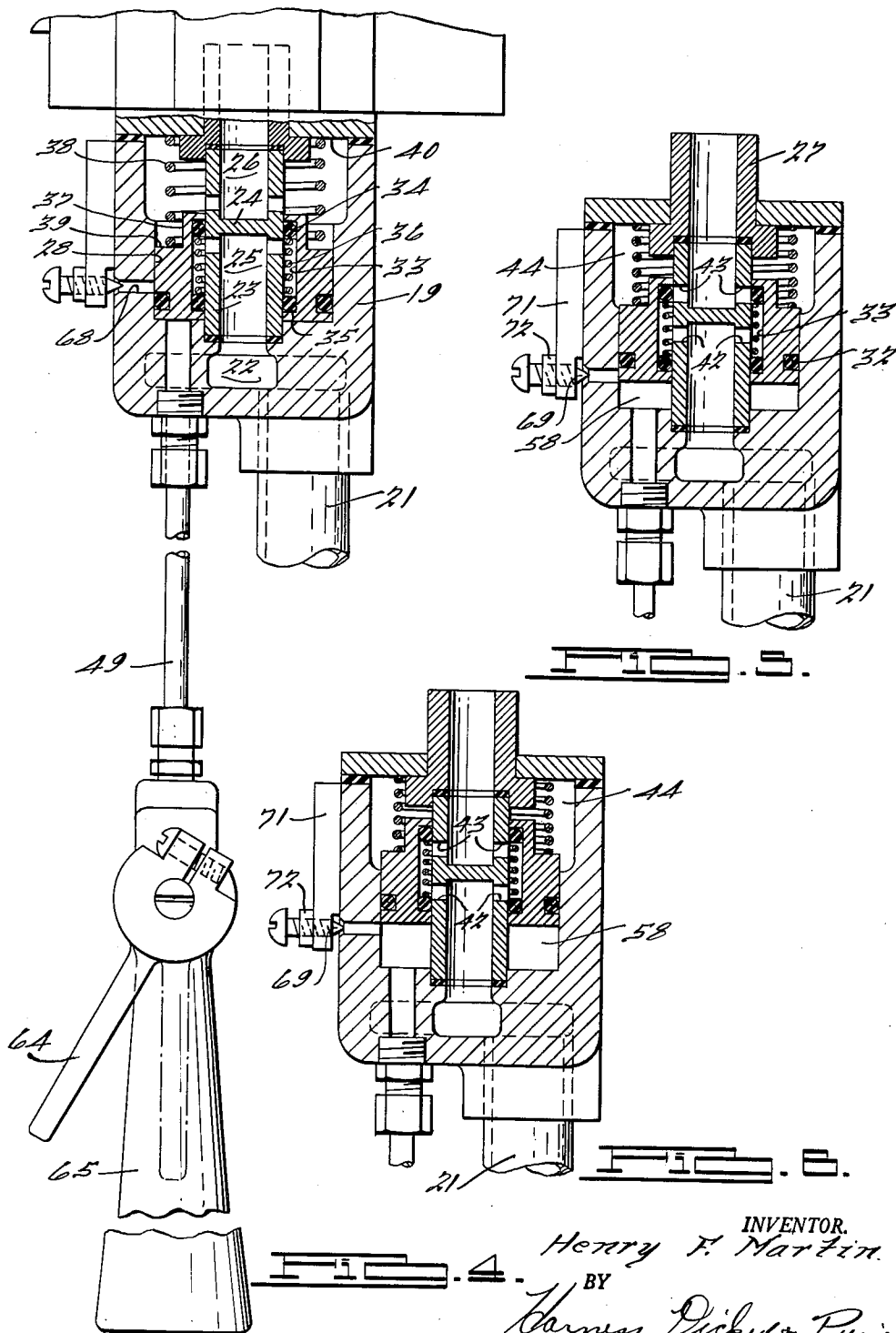
H. F. MARTIN

2,981,289

HOIST

Filed July 22, 1959

2 Sheets-Sheet 2



INVENTOR.
Henry F. Martin.
BY
Harnes, Dickey & Purcell
ATTORNEYS.

1

2,981,289

HOIST

Henry F. Martin, Centerline, Mich., assignor to Detroit Hoist and Machine Co., Detroit, Mich., a corporation of Michigan

Filed July 22, 1959, Ser. No. 828,791

11 Claims. (Cl. 137—622)

This invention relates to hoists, and more particularly to means for controlling the movement and speed of pneumatically actuated hoists or cranes by remote control.

It is an object of the invention to provide a novel and improved control for air operated hoists which may be easily operated with one hand and which permits the operator to position the hoist in an infinite variety of positions and at various speeds, his other hand being free to handle the load.

It is another object to provide an improved motor control of this nature which is safe in operation and permits quick reversal of the direction of drive as well as prolonged driving in one direction without inconvenience to the operator.

It is also an object to provide an improved hoist control of the above character which is of simple and foolproof construction, has relatively few moving parts and is economical to manufacture and easy to install and maintain.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description, taken in conjunction with the accompanying drawings.

Figure 1 is an overall side elevational view of an air operated hoist incorporating the improved control of the present invention;

Figure 2 is an end elevational view of the hoist showing the relative positions of the hoist and control;

Figure 3 is an enlarged view of the valve chest and push-button valves, parts being sectioned for clarity;

Figure 4 is an end elevational view partially in cross-section showing the main valve construction, the parts being in closed position;

Figure 5 is a fragmentary view similar to Figure 4, showing one of the main valves on the verge of opening; and

Figure 6 is a view similar to Figures 4 and 5 showing the main valve in its fully opened position.

In general terms, the invention comprises a control for feeding air to a pneumatically operated hoist motor which in the illustrated embodiment is of the vane type. This control comprises a pair of main valves mounted in a valve chest below the motor and connected to opposite sides thereof. Each valve is movable between an exhaust position in which the corresponding side of the motor is connected to exhaust, and a supply position in which compressed air is connected to that side of the motor. The main valves are controlled by a pair of pilot valves mounted in a housing suspended below the main valve chest by such means as flexible air conduits. These pilot valves are controlled by push-button levers and are so arranged that an operator may grip the pilot valve housing in one hand and operate either of the push-button controls with his thumb.

Each pilot valve when depressed will supply pilot air pressure to one side of the corresponding main valve at a rate in accordance with the amount of depression on the push-button. An escape orifice of adjustable size is provided for each main valve operating chamber through

2

which this pilot air may escape, the orifice being so located that if pilot air is supplied at less than a predetermined rate the main valve will move to the verge of but not sufficiently to shift to its supply position. However, if the rate of pilot air supply is increased, the main valve will be further moved so that air will be supplied to that side of the motor. The driving rate of the motor will be determined by the amount of movement of the main valve which in turn may be accurately controlled by the degree of movement of the push-button pilot control. The other main valve will meanwhile be in its exhaust position so that spent air may be exhausted after passing through the motor. Upon release of the pilot valve push-button, the pilot valve will be returned to its closed position, permitting the main valve to return to its exhaust position. Leakage means are provided in the connection between the pilot and main valves to insure quick return of the main valve so that a quick reversal of the hoist drive may be accomplished.

Referring more particularly to the drawings, the hoist is generally indicated at 11 and comprises wheels 12 mounted on a track 13 and secured to a frame 14, a vane type of pneumatic hoist motor 15 being carried by frame 14 and driving a drum 16 carrying a cable 17 and a hook 18 secured to the end of the cable. It will be understood that the principles of the invention could also be applied to other driving arrangements such as those for cross-travel of the hoist.

A valve chest 19 is secured below motor 15, this chest being of generally rectangular shape and having a compressed air supply connection 21 in the lower portion thereof. This supply connection leads to an intake manifold 22 formed as a flat chamber in the lower portion of chest 19. A pair of vertically disposed tubular members 23 are disposed at opposite ends of manifold 22 and extend upwardly therefrom. A transverse wall 24 is formed on the interior of each tubular members 23, thus dividing this member into a lower chamber 25 connected to manifold 22 and an upper chamber 26. This upper chamber is connected by a sleeve 27 to one side of vane motor 15, so that the two chambers 26 of tubular member 23 are connected to opposite sides of the motor.

Chest 19 is provided with a pair of valve bores 28 concentric with and spaced outwardly from tubular members 23, and a pair of valves 29 and 31 are mounted within the bores and are slidable on tubes 23. A toroidal seal 32 is provided in a groove on the outer surface of each valve 29 and 31 adjacent the lower end thereof, and the internal bore of each valve is provided with an annular space 33. A pair of toroidal seals 34 and 35 are disposed at opposite ends of each space 33, the seals being urged to their inner positions by a helical compression spring 36. The upper end of each spool valve 29 and 31 is relieved as indicated at 37, and a helical compression spring 38 is disposed between shoulder 39 of the valve and the bottom 40 of the air motor.

Each tube 23 is provided with a plurality of circumferentially spaced supply ports 42 immediately below wall 24 and a plurality of working ports 43 immediately above wall 24. Ports 42 serve to connect chamber 25 of each tube 23 with the corresponding chamber 33 of valve 29 or 31. Ports 43 serve to connect chamber 26 with an exhaust chamber 44 which is formed in the upper portion of chest 19 and leads to an exhaust port 41 in one side wall of the chest. The relative positions of ports 42 and 43 with respect to the size of the chamber 33 is such that when valve 29 or 31 is in its lower position as shown in Figure 4, chamber 26 will be connected to chamber 44 while chamber 25 is connected to chamber 33. As valve 29 or 31 slides upwardly, it will reach its position as shown in Figure 5 in which chamber 33 begins to be connected to ports 43, the latter being cut off from chamber 44.

3

From there until the position of Figure 6 is reached, a gradually increasing supply of compressed air will be transmitted by annular chamber 33 from ports 42 to ports 43, so that motor 15 will be driven at a progressively faster rate.

In order to control the position of valves 29 and 31, each valve is provided with a pilot valve, these being indicated at 45 and 46, respectively, in Figure 3. Pilot valves 45 and 46 are mounted in a housing 47 which is suspended at an appropriate distance below chest 19 by a supply line 48 for compressed air and pilot lines 49 leading from valves 45 and 46, respectively, to the undersides of their main valves. More specifically, supply line 48 is connected to inlet manifold 22 and extends downwardly from the central portion thereof, its lower end being connected by a coupling 51 to a vertical central passage 52 in pilot valve housing 47. A transverse passage 53 is connected at its intermediate portion to the bottom of passage 52, and valves 45 and 46 are engageable with shouldered portions 54 at opposite ends of passage 53. Enlarged passages 55 lead from the valves to vertical passages 56 which are in turn connected by couplings 57 to pilot lines 49. The upper ends of pilot lines 49 are connected to chambers 58 formed in bores 28 by the undersides of valves 29 and 31.

Valves 45 and 46 are formed at the ends of stems 59 which have enlarged threaded portions 61 mounted in inserts 62, the latter being carried within counterbores 63 of housing 47. The outer ends of shafts 59 carry push-button levers 64, and the central portion of housing 47 has a depending handle 65 disposed between the push-buttons. The arrangement is therefore such that an operator gripping handle 65 with one hand may engage either push-button 64 with his thumb. The push-buttons are normally held in an inclined position with respect to handle 65, as seen in Figure 4, by torsion springs 66 connected between the push-buttons and inserts 62, but may be depressed to their dot-dash line position as shown in Figure 4. When push-buttons 64 are in their solid line position, valves 45 and 46 will be closed, and rotation of shafts 59 by depression of the push-buttons will gradually open these valves so that compressed air may be led from central passage 52 to either passage 56. It is important to note that a leakage fit is provided in the areas marked 67 as well as along threaded portions 61, so that any compressed air trapped in chambers 58, lines 49 or passages 56 when valves 45 and 46 are closed will be permitted to escape.

A pair of restricted escape orifices 68 are provided in the side wall of chest 19, these passages leading from chambers 58 to the atmosphere. The purpose of escape orifices 68 is to control the movement of valves 29 and 31 when pilot valves 45 and 46 are opened. For this purpose, the orifices are so located with respect to the bottoms of their respective chambers 58 that when the orifices are opened to their chambers, supply ports 42 will be on the verge of being connected to working ports 43. This is best seen in Figure 5. It will be noted that air will begin to escape from orifice 68 as valve 29 or 31 approaches a position in which motor 15 will be supplied with air for driving purposes. In order to control the rate of escape of air from orifices 68, each orifice is provided with a restriction member, this being shown in the form of a tapered screw 69 which is threadably supported by a bracket 71 secured to chest 19 and may be held in its adjusted position by lock nut 72. Each restriction member 69 may be adjusted so that when air is being supplied to chamber 58 at a relatively low rate, its corresponding valve 29 or 31 may not move upwardly against the force of spring 38 a sufficient distance to supply motor 15 with driving air. However, when air is supplied at a greater rate to chamber 58, it will build up in chamber 58 more rapidly than it can escape through orifice 68, thereby moving valve 29 or 31 upwardly. Motor 15 will thus be supplied with air for driving purposes, and assuming that

4

pilot valve 45 or 46 is held constant in its new position, valve 29 or 31 will arrive at a balanced position since the increased pressure in chamber 58 will permit greater escape through orifice 68. It should be observed that the presence of adjustable restriction 69 will permit selection of the proper orifice size for a particular compressed air supply pressure, this pressure varying in different localities and industrial plants. The escape areas of orifices 68 will of course be substantially greater than those of leakage fits 67, 61.

The operation of the air motor control may now be described. Assuming a starting position in which both valves 29 and 31 are in their exhaust position, as shown in Figure 4, and both pilot valves 45 and 46 are closed, pressure will be present in inlet manifolds 22 as well as central pilot housing passage 53 and at ports 42. Assuming that hook 18 is in its upper position and that the left hand side of motor 15, as viewed in Figure 3, when supplied with air will cause hook 18 to be lowered, lowering of the hook may be accomplished by depressing push-button lever 64 connected to pilot valve 45. If only slow movement is desired, pilot valve 45 will be only partially opened and air will be supplied to the underside of main valve 29, forcing the main valve upwardly until its orifice 68 is uncovered. Air will then begin to escape from chamber 58, but assuming that valve 45 is opened sufficiently, valve 29 will move slightly above the position shown in Figure 5 until slight portions of ports 43 are connected to chamber 33. Supply air will then flow from inlet manifold 22 to chamber 26 and from there to motor 15, causing the motor to rotate slowly so as to lower hook 18. The exhaust air from the motor will pass through the other chamber 26 and outwardly through ports 43 above valve 31, into exhaust chamber 44 from where it will be exhausted into the atmosphere. If it is desired to lower the hook at a faster rate, push-button lever 64 will be further moved, thus opening pilot valve 45 until main valve 29 has been further raised as shown in Figure 6. When it is desired to stop the motor, push-button 64 will be released, so that spring 66 may close pilot valve 45. Spring 38 will immediately return valve 49 to its exhaust position, the air in chamber 58 escaping through orifice 68 and then through the leakage path past area 67 and threads 61 as previously described. Ports 43 will thus be cut off from supply ports 42 and connected to exhaust chamber 44.

Should it be desired to raise hook 18, pilot valve 46 may be opened in a manner similar to that described with respect to pilot valve 45. It should be observed that main valves 29 and 31 will be quickly returned to their exhaust positions when their respective pilot valves are closed, so that the reversal of motor 15 may be effected. It should also be noted that since in operation air will be blown through orifices 68 and leakage paths 67 and 61, these flow paths will be continually kept clear of dirt or other obstructions. The relatively close, accurate and sensitive control afforded by the push-button and pilot valve arrangement together with the presence of orifices 68 has been found to be especially desirable in cases where gradual changes in movement are desired, such as in the lifting of sand molds.

While it will be apparent that the preferred embodiment of the invention disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a pneumatic motor control a pair of main valves connected to opposite sides of said motor, each of said valves being movable between a supply and an exhaust position, means urging each of said valves to its exhaust position, a pilot valve for each of said main valves, a manually grippable housing for said pilot valves, independently movable operating elements for each of said pilot

5

valves accessible to the hand of an operator gripping said housing, and means responsive to variable opening of either of said pilot valves for causing its corresponding main valve to move to variable supply positions, said last-mentioned means including a restricted orifice adjacent each of said main valves, each orifice being connectable to the outlet of its corresponding pilot valve in response to movement of the main valve to a position immediately adjacent its supply position.

2. In a system for controlling a variable speed reversible air motor, a housing below said motor, a pair of main valves slidably mounted in said housing, a supply port in said housing for each of said main valves, a working port in said housing for each of said main valves, said working ports being connected to opposite sides of said motor, an exhaust chamber in said housing, each of said main valves being slidable in a continuous manner between an exhaust position in which its working port is connected to said exhaust chamber and a supply position in which the flow areas of said supply port and working port are connected to each other, means urging said main valves toward their exhaust positions, a pilot valve housing suspended below said main valve housing and adapted to be gripped by the hand of an operator, a pair of pilot valves carried by said pilot valve housing and having independently operable control means engageable by the hand of an operator gripping said pilot valve housing, each of said pilot valves being movable between a closed position and a variable open position, a pilot supply line leading from said main valve housing to said pilot valve housing, a pair of conduits leading from the outlets of said pilot valves to said main valves, whereby opening of either of said pilot valves will cause movement of its main valve toward its supply position, and a restricted orifice adjacent each of said main valves and openable in response to movement of the main valve to a position immediately preceding the connection between said supply and working ports.

3. In a system for controlling a variable speed reversible air motor, a housing below said motor, a pair of main valves slidably mounted in said housing, a supply port in said housing for each of said main valves, a working port in said housing for each of said main valves, said working ports being connected to opposite sides of said motor, an exhaust chamber in said housing, each of said main valves being slidable in a continuous manner between an exhaust position in which its working port is connected to said exhaust chamber and a supply position in which the flow areas of said supply port and working port are connected to each other, a pilot valve housing suspended below said main valve housing, a hand gripping portion on said pilot valve housing, a pair of rotatably mounted pilot valves coaxially disposed within said pilot valve housing, a pair of thumb-engageable members secured to said pilot valves and disposed at opposite sides of said hand gripping portion, means for opening each of said pilot valves a variable distance in response to depression of its corresponding thumb-engageable member, means urging said pilot valves toward their closed position, a pilot supply line leading to said pilot valve housing, a pair of conduits leading from the outlets of said pilot valves to said main valves, whereby opening of either said pilot valves will cause movement of its main valve towards its supply position, and a restricted orifice adjacent each of said main valves and openable in response to movement of the said main valves toward its supply position.

4. In a system for controlling a variable speed reversible air motor, a housing below said motor, a pair of main valves slidably mounted in said housing, a supply port in said housing for each of said main valves, a working port in said housing for each of said main valves, said working ports being connected to opposite sides of said motor, an exhaust chamber in said housing, each of said main valves being slidable between an exhaust

6

position in which its working port is connected to said exhaust chamber and a full supply position in which the flow areas of said supply port and working port are connected to each other, a pilot valve housing adapted to be gripped by the hand of an operator, a flexible pilot pressure supply conduit and a pair of flexible pilot valve outlet conduits extending between said housings and serving to suspend said pilot valve housing below the main valve housing, a pair of pilot valves carried by said pilot valve housing and having independently operable control means engageable by the hand of an operator gripping said pilot valve housing, each of said pilot valves being movable between a closed position and a variable open position, and means responsive to the position of each main valve for causing graduated movement of each main valve toward its full supply position proportional to opening movement of its corresponding pilot valve.

5. In a system for controlling a variable speed reversible air motor, a housing below said motor, a pair of main valves slidably mounted in said housing and forming valve actuating chambers therewith, a supply port in said housing for each of said main valves, a working port in said housing for each of said main valves, said working ports being connected to opposite sides of said motor, an exhaust chamber in said housing, each of said main valves being slidable between an exhaust position in which the working port is connected to said exhaust chamber and a supply position in which the flow areas of said supply port and working port are connected to each other, a pilot valve housing suspended below said main valve housing and adapted to be gripped by the hand of an operator, a pair of pilot valves carried by said pilot valve housing and having independently operable control means, each of said pilot valves being movable between a closed position and a variable open position, a pilot supply line leading to said pilot valve housing, a pair of conduits leading from the outlets of said pilot valves to said main valves, whereby opening of either of said pilot valves will cause movement of its main valve towards its supply position, a restricted orifice adjacent each of said main valves and openable in response to partial movement of its corresponding main valve toward its supply position, and a leakage connection of smaller size than said orifice between each of said main valve actuating chambers and the atmosphere whereby said main valves may be returned to their exhaust position.

6. The combination according to claim 5, said pilot valves having loose threaded mountings comprising said leakage connections.

7. In a system for controlling a variable speed reversible air motor, a main valve housing below said motor, a supply inlet chamber formed in the lower portion of said housing, an exhaust chamber in the upper portion of said housing, a pair of tubular members extending upwardly in spaced parallel relation from said chamber, an intermediate wall in each of said tubular members, a main valve slidable on each of said tubular members, a supply port in each tubular member below said intermediate wall, a working port in each tubular member above said intermediate wall, an annular chamber formed in each of said main valves, each main valve being movable between an exhaust position in which said working port is connected to said exhaust chamber and a full supply position in which the flow areas of said supply and working ports are connected to said annular chamber, a pilot valve housing below said main valve housing, a pair of pilot valves carried by said pilot valve housing and having independently operable control means, each of said pilot valves being movable between a closed position and a variable open position, and means responsive to the position of each main valve for causing graduated movement of each main valve toward its full supply position proportioned to opening movement of its corresponding pilot valve.

8. The combination according to claim 7, said last-

7

mentioned means including a main valve operating chamber formed on one side of each of said main valves and connected to its corresponding pilot valve outlet, and a restricted orifice extending from the atmosphere through said main valve housing to each of said operating chambers, each orifice being so positioned as to be connected to its corresponding pilot valve outlet conduit when the corresponding main valve is on the verge of connecting said supply and working ports.

9. The combination according to claim 8, further provided with means for adjusting the size of each restricted orifice.

10. The combination according to claim 8, further provided with an atmosphere leakage connection for the bottom of each operating chamber of smaller size than said restricted orifices.

11. In a pneumatic motor control, a pair of main valves connected to opposite sides of said motor, each

8

of said valves being movable between a supply and an exhaust position, means urging each of said valves to its exhaust position, a pilot valve for each of said main valves, and means responsive to variable opening of either of said pilot valves for causing its corresponding main valve to move to variable supply positions, said last-mentioned means including a restricted orifice connected to atmosphere adjacent each of said main valves, each orifice being connectable to the outlet of its corresponding pilot valve an amount proportional to movement of the main valve toward a position immediately adjacent its supply position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,743,708	Lungerhausen	May 1, 1956
2,831,554	Reynolds	Apr. 22, 1958