

July 26, 1932.

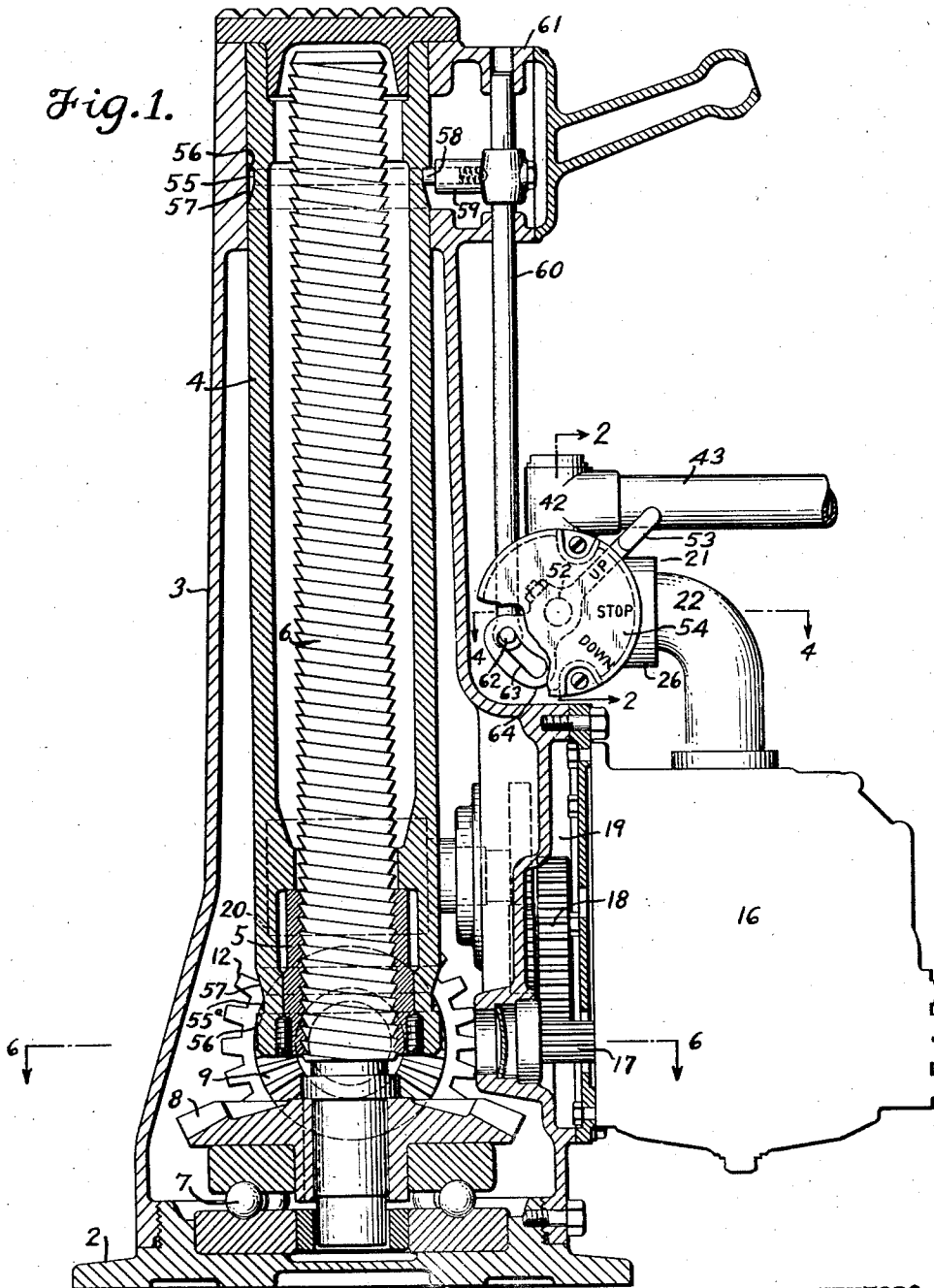
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1,868,922

AIR MOTOR JACK

Filed May 17, 1930

3 Sheets-Sheet 1



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Fig. 2.

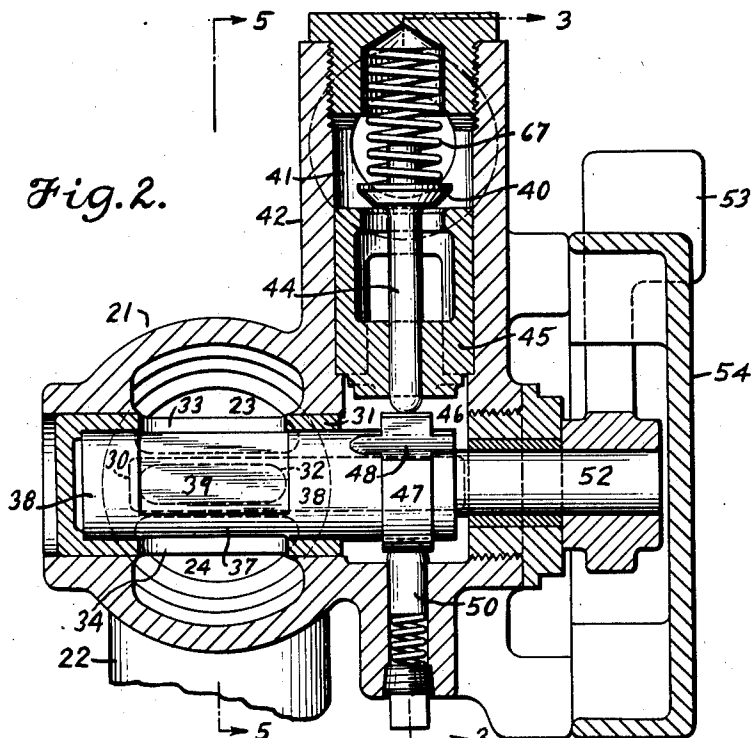


Fig. 3.

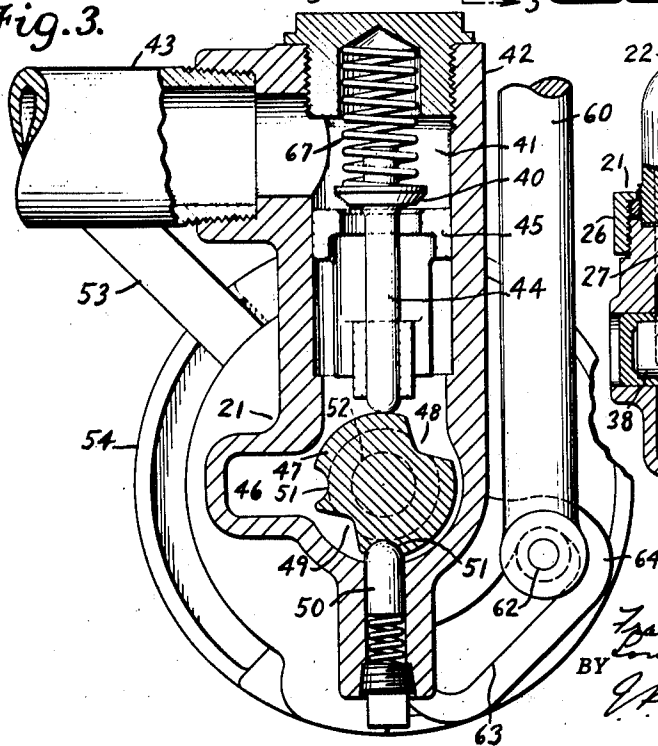
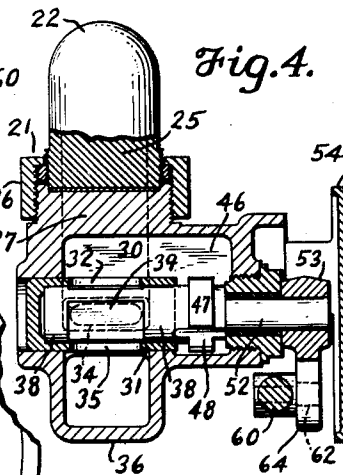


Fig. 4.



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Fig. 5.

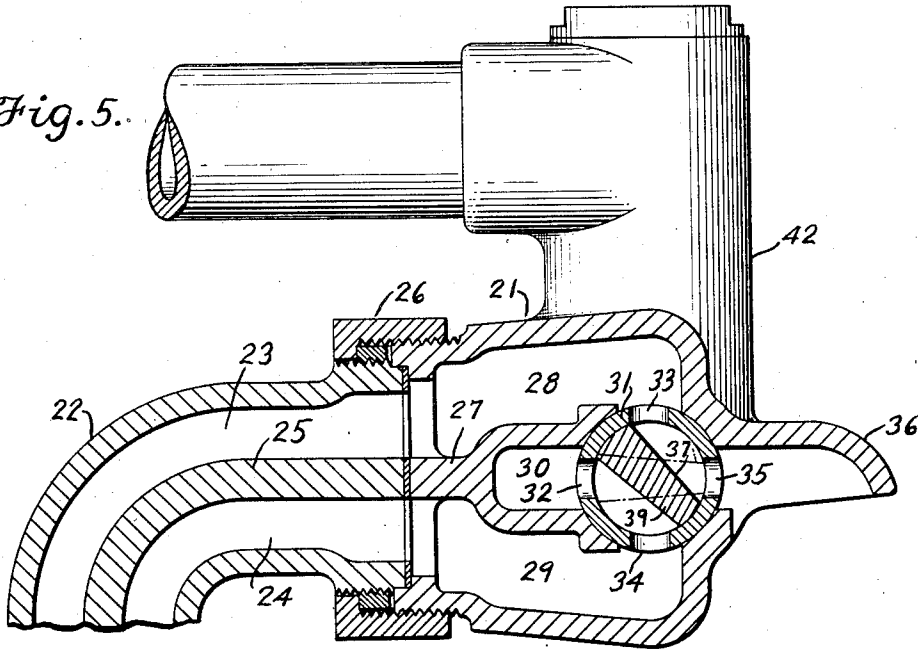
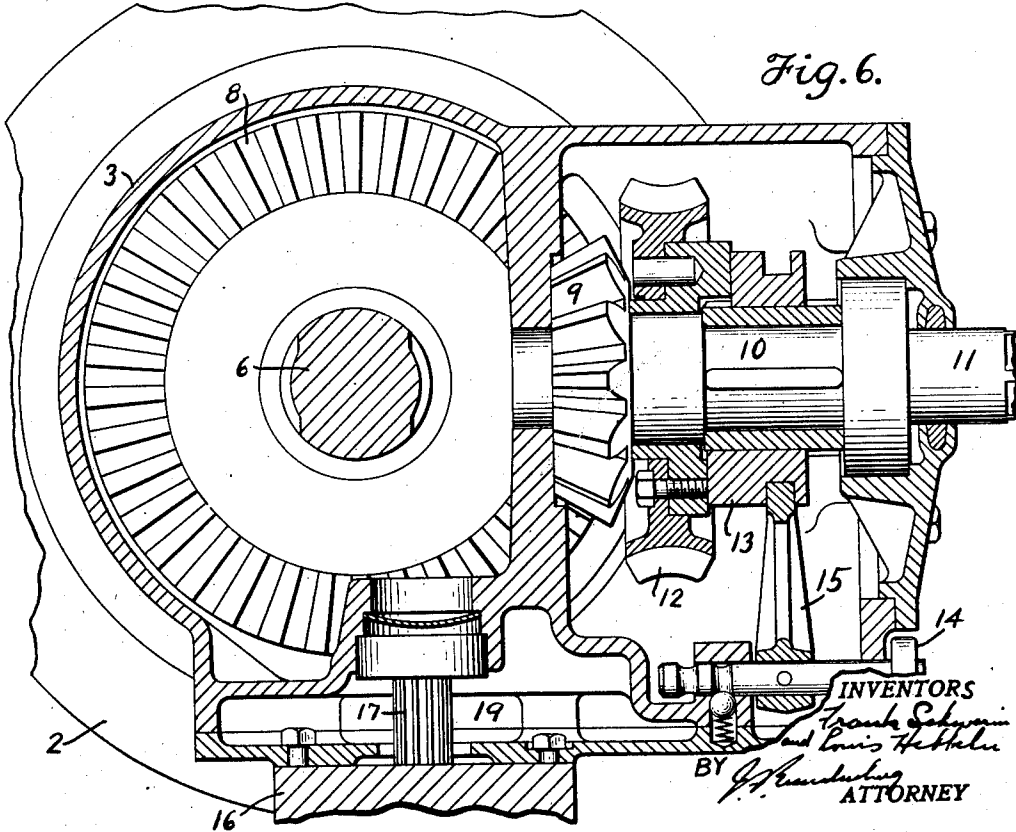


Fig. 6.



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UNITED STATES PATENT OFFICE

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AIR-MOTOR JACK

Application filed May 17, 1930. Serial No. 453,136.

In known lifting jacks which are operated by air-motors, the motive fluid is controlled by a reversing throttle valve which is movable in opposite directions by a hand lever to start the jack either up or down and is automatically restored by the jack itself to a neutral or stop position when the lifting element of the jack reaches the full-raised or full-lowered position.

Various types of air-motors are used in assembly with such jacks, and heretofore the reversing throttle forming part of the commercial air-motor has been used as the throttle valve for the jack, connections being provided between this valve and either the gearing or the lifting element of the jack to accomplish the automatic shut-off of power.

We have found that, for the purposes of such jacks, the regular throttle valves furnished on the air-motors are unsatisfactory, in that they do not shut off completely when the jack has been raised or lowered as far as it should go for safety, and then leak air, that they resist operation after they are in this use for a short while, due to gumming up, and also that they are not satisfactorily applicable to mechanical connections for automatic operation by the jack or adapted for a standard form of such control mechanism.

The valve mechanism and the combination thereof with the jack and its motor herein described have been designed to overcome these difficulties and to provide a lifting jack in which the motive fluid is not only controllable by hand but is also controlled definitely and with certainty by the jack itself. Other objects are to provide a valve mechanism in a separate unit, in such combination with the jack and the motor that the valve mechanism is applicable to all usual types of motor and to all sizes of jacks, and can be used with a standard or easily modified form of control mechanism.

It thus becomes practicable to give a customer of the jack manufacturer a choice of the popular makes of air motors for application to the jacks which he orders, and affords assurance that the combination which he selects will operate satisfactorily, both manually and automatically. This is a great ad-

vantage over standardizing on one make of motor and using the regular valve supplied with the motor, such valves being designed for manual shut-off only and giving much trouble when connected with linkage for automatic shut-off.

A further feature of the invention comprises a combination of instrumentalities whereby the control valve or valve mechanism is started by the jack, and more specifically by the lifting element, toward its neutral condition as the lifting element closely approaches the point of extreme lift or complete lowering, and is then definitely moved to neutral independently of the jack motion by a spring-pressed positioning device.

In its complete embodiment the invention employs a combination of a flow-reversing throttle valve of a kind which moves easily and will remain in good working condition indefinitely, with an inlet valve to cut off air from the reversing valve, all as more fully set forth hereinafter. These two valves are interconnected so as to work in conjunction, and this is advantageously accomplished by providing or connecting the spindle of the rotary oscillatory reversing valve with a recessed cam which opens the inlet valve when the reversing valve is turned either way from neutral, to cause the jack to move up or down, and which causes the inlet valve to close under spring pressure or the pressure of the motive fluid, or both, when the reversing valve is automatically restored to neutral.

The same cam, or another cam, connected with the reversing valve has two slopes at the sides of a recess, which are acted upon by a positioner, preferably a spring-pressed plunger, to drive the valve mechanism to the precise neutral point, when the plunger is released by the turning of the cam for a certain distance under the action of the jack. The cam is also preferably provided with holding notches which are engaged by the plunger when the valve mechanism is moved by hand to the lifting or the lowering position.

The solution of the problem to which the invention is addressed involves the provision of a duplex connection conduit extending

from the air motor which is applied to or incorporated with the lower part of the shell of the jack, at one side. This conduit contains two ducts through which air is alternately conducted to the motor and exhausted therefrom, for operation of the motor in one direction or the other to raise and lower the jack. To this conduit, and interposed between the same and a supply conduit the body of the valve is connected. The valve is standard and is applicable to the various makes of motor, the duplex connection conduit, however, being preferably interchangeable with others having different bends. The valve body has two passages to communicate with the ducts of the connection conduit, a supply passage or space, and an exhaust outlet. The reversing valve in this body connects the two communicating passages alternately with the supply passage and with the exhaust outlet, and in neutral position shuts off both communicating passages from the supply passage, so that no air reaches the motor. As a further safeguard, the reversing valve is interconnected with a poppet inlet valve controlling the supply passage.

One of the objects of the invention is to guard against damage to the automatic connection for operating the valve from the jack when the lifting member reaches or approaches one or both limits of its movement. Heretofore, the automatic shut-off mechanisms devised for use with the valves supplied with air motors have required operating links or connections extending laterally for a considerable distance and in an exposed condition from the shell or standard of the jack to the valve, and these connections have been subject to injury, with consequent hazard that the jack would not be stopped automatically when it should stop in order to avoid serious accident. The duplex connection conduit forming part of this invention is bent close in to the side of the shell, so that a direct vertical connection, not subject to injury, may be used to operate the valve automatically from the lifting member.

In the accompanying drawings forming part hereof:

Fig. 1 is a vertical section of a jack embodying the invention, the air-motor, the valve and the conduits being in elevation, and a portion of a guard-plate being broken away;

Fig. 2 is a vertical section through the valve structure taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 2;

Fig. 4 is a horizontal section on the line 4—4 of Fig. 1;

Fig. 5 is a vertical section taken on the line 5—5 of Fig. 2; and

Fig. 6 is a horizontal section taken through the lower part of the jack, approximately on

the line 6—6 of Fig. 1, the motor and certain other portions being broken away.

The jack illustrated is of the screw type having a base 2, a shell 3 rising therefrom, and a lifting element 4 slidably guided in the shell, this element having a nut 5 which is engaged by a rotary lifting screw 6 supported through a ball-bearing 7 on the base. A bevel gear 8 is united with the screw and is meshed by a bevel pinion 9 on a horizontal shaft 10, the outer portion 11 of which projects outward from the shell of the jack to receive a conventional lever and ratchet mechanism for operation of the jack by hand (this portion of the shaft being broken off in Fig. 6 because of lack of space).

A worm-wheel 12 is mounted on the shaft 10 so as to be capable of rotating freely thereon, and this wheel can be clutched to the shaft, and thereby to the bevel pinion 9, or unclutched therefrom, by a sliding clutch element 13, feathered on the shaft and operable by an accessible handpiece 14 which operates a shifter fork 15. This enables the jack screw to be disconnected from the motor for manual operation when desired.

The air-motor 16 is applied to the side of the shell of the jack and is bolted in position. The mechanism of the motor has not been shown since it forms no part of the invention and any one of a number of air motors may be employed. The motor delivers its power through a shaft bearing a spur pinion 17 which drives other spur gears of a reducing train 18 located in a recess 19 in the outer side of the jack shell which is closed by the application of the air-motor casing, and the last shaft of this train carries a worm 20 inside the jack enclosure, which worm meshes with the worm-wheel 12 previously referred to. This constitutes the drive from the air-motor to the lifting mechanism of the jack.

The valves for controlling flow of compressed air to the motor are contained in a valve body 21, located above the motor and adjacent the side of the jack. This valve body is connected with the air motor by a conduit section 22, which is a duplex conduit having two ducts 23 and 24 separated by a septum 25 and adapted to serve alternately for intake and exhaust. This conduit is detachably connected on the one hand to the motor and on the other hand to the valve body, which it supports, and is bent or curved inward toward the shell of the jack so that the valve is close to the shell. When compressed air is supplied to the motor through the duct 23, the motor is operated in the direction to lower the jack, whereas when the air flows in through the duct 24 the motor is operated in the reverse direction to raise the jack.

The conduit 22 is connected to the valve body by a coupling 26, and this portion of the valve body has a septum 27 forming two

chambers 28 and 29 which are in open communication with the ducts 23 and 24 respectively.

The inner part of the septum 27 spreads and partially encloses an air supply chamber 30. A cylindrical liner 31 is fitted into the valve body at the front of this chamber, this liner having four ports 32, 33, 34, 35. The port 32 communicates with the supply chamber 30, the ports 33 and 34 at right angles thereto communicate with the chambers 28 and 29, and the port 35 opens beneath an exhaust hood 36.

A rotary valve 37 of the Corliss type turns within this liner, the valve having cylindrical bearing portions 38 (Fig. 4) and an intermediate portion 39 slabbed off at both sides. This valve moves through an angle of 90°. In the position shown in Fig. 5, it connects the inlet chamber 30 with the chamber 29 and the conduit duct 24, at the same time connecting the conduit duct 23 and chamber 28 with the exhaust outlet. When this valve is in its other extreme position it connects the chamber 28 and conduit passage 23 with the inlet chamber, and connects the duct 24 and the chamber 29 with the exhaust outlet. In the intermediate or neutral position, 45° away from each extreme position, the valve blanks the port 30 and cuts off the supply of air to either duct 23 or 24.

But even though this easy operating valve should not be absolutely tight in the neutral position, when the motor is at rest and the lifting member of the jack has stopped at either the upper or the lower limit of its motion, or has been stopped at any intermediate position, leakage of air is prevented. For this purpose an inlet valve 40 of the poppet type is provided, the disc of this valve operating in a chamber 41 of an extension 42 of the valve body, which extension is connected with a supply conduit 43 which is connected with the compressed air hose line. This valve seats on and its stem 44 is guided in a bushing 45, which is cut away to permit the compressed air to pass freely to a space 46, which is in direct communication with the supply chamber 30 already referred to.

The inlet valve is preferably urged to its seat by a spring 67, in addition to which it is urged closed and held closed by the pressure of the air.

There is an interconnection between the two valves which have been described, so that when the reversing throttle valve 39 is in either of its open positions the inlet valve 40 is likewise open, and when the reversing valve is in neutral position the inlet valve is closed.

The body of the stem of the oscillatory reversing valve has a cam 47 which is formed with a wide V recess 48. When the reversing valve is in neutral position, the bottom of this recess is in line with the stem 44 of the inlet valve, and the recess is deep enough so that

the valve 40 is then shut tightly against its seat. When the reversing valve is turned in either direction from neutral position the end of the valve stem is cammed by one sloping side or the other of the recess 48, so as to open the inlet valve, and when the reversing valve is freely turned to either of its extreme positions the inlet valve is held open by reason of the end of its stem bearing against a circular portion of the cam.

Diametrically opposite the recess 48; the cam has another wide V recess 49 to cooperate with a spring-pressed plunger 50 which is guided in a bore of the valve body. This plunger acting in connection with the reversely sloping sides of the recess 49 not only serves to hold the reversing valve non-positively in neutral position, but to force it to that position. When the reversing valve 37 is in either of its extreme positions, for movement up or down of the jack, the plunger bears on the cam at one side or the other of the recess 49, and preferably then engages with one of two rounded holding notches 51. When the reversing valve is turned a certain distance from either of these positions toward the neutral or mid-position, and the high point of one or other of the cam slopes formed by the sides of the recess 49 passes the center of the plunger, the pressure of the plunger then acting on such slope throws the reversing valve to the neutral position, and there stops it. When the reversing valve is turned in either direction away from its neutral position, one slope or the other of the recess 49 cams the plunger away from the axis of the cam until it finally drops into one of the recesses 51. This positioning and actuating device controls the closing of the inlet valve 40 in addition to bringing the reversing valve to its neutral position, this being due to the interconnection between the valves which has been described.

The spindle of the reversing valve has a shaft portion 52, which projects through a bearing in the side of the valve body, and to its end is fixed a hand lever 53 which is movable behind a guard plate 54, the latter bearing on its face "Up", "Stop" and "Down" designations as shown in Fig. 1. By means of this handle, the reversing throttle valve is moved from neutral position to either the position which passes compressed air to drive the lifting element 44 of the jack upward, or to the position in which air is conducted to the jack so as to lower the lifting element. Such operation of the handle likewise opens the inlet valve 40. This handle can also be operated to restore the reversing valve to neutral position and the inlet valve to closed position to stop the movement of the lifting element at any elevation.

The automatic control mechanism for shutting off the motive fluid from the motor when the jack reaches the full-raised or full-

lowered position will now be described. The mechanism which is shown is a simplification and improvement on existing control devices for this purpose of the class which cooperate directly with the lifting element of the jack, and it constitutes a specific feature of the invention, though not a general limitation.

The lifting element 4 is formed in accordance with known practice with two limit control recesses 55 and 55^a spaced apart in the vertical direction, each of these recesses having an abrupt side or shoulder 56 and a sloping side 57.

The recesses are engageable by a spring-pressed plunger or dog 58 in a fitting 59 on a rod 60. The position of this control rod is vertical, that is to say parallel with the lifting element, and it is guided in bearing openings in an extension 61 projecting from the top of the shell 3 of the jack. The lower end of the rod carries a lateral pin 62 which lies in an elongated slot 63 in an arm 64, which arm is connected with the spindle of the reversing valve and preferably integral with the hand lever 53.

The drawings illustrate the condition at the moment when the hand lever has been moved to the "Up" position, causing air to pass to and through the motor in the direction to raise the lifting element 4 and the load which may rest thereon. The lifting element is shown all the way down, just at the instant of starting upward.

The recess 55^a in the side of the lifting element is to be so located that it comes into engagement with the dog 58 at about the extreme point of the raise which is considered permissible. The abrupt shoulder 56 then raises the dog, thereby raising the rod 60 and causing the pin 62 acting against one end of the slot 63 to move the reversing valve 37 toward neutral position. When the high point of one or the other of the sloping sides of the recess 49 of the cam 47 passes the center of the extremity of the plunger 50, this spring-actuated element takes control and cams the reversing valve to exact neutral position. At the same time the recess 48 of the cam is brought beneath the stem of the inlet valve 40, and this valve closes.

The handle 53 is then in the "Stop" position. To cause the lifting element to move downward, the operator moves the handle to the "Down" position, thereby moving the reversing valve to the corresponding position and re-opening the inlet valve. When the lifting element has descended almost to its lowest position, the shoulder of the recess 55 acts on the dog 58 to push the rod 60 downward, thereby turning the reversing valve 37 back to neutral and causing the inlet valve 40 again to close. The handle 53 is then once more in the "Stop" position.

In the neutral or stop position of the valve 37, which is shown in dotted lines in Fig. 5,

the inlet port 32 is completely covered but the exhaust port 35 is not entirely closed. The purpose of this is to vent any leakage past the poppet valve and the reversing valve, if there should be any leakage, so as to avoid any possibility of the jack being operated when the valve is in the neutral position.

After the lifting element of the jack has moved the valve to neutral position, the valve can not be returned to a position to operate the motor and jack in the direction from which it has just been shut off. This is due to the abrupt sides of the notches 55, 55^a blocking movement of the dog 58 and rod 60, the latter in turn blocking movement of the hand lever 53. Therefore, after the end of the stroke in either direction, the jack can then be operated only in the reverse direction.

While the preferred embodiment of the invention has been described in detail, it will be understood that various changes may be made without departing from essentials.

We claim:

1. The combination with a lifting jack and an air-motor for operating the same, a conduit extending from the motor and containing two ducts for conducting air to said motor to operate the same to raise or lower the jack, a supply conduit, an oscillatory reversing valve interposed between said supply conduit and said ducts, a poppet valve in said supply conduit, a cam portion connected with said oscillatory valve and cooperating with the stem of said poppet valve so that the poppet valve closes when the reversing valve comes to neutral position and is opened when the oscillatory valve is turned in either direction from neutral position, a handle for turning said oscillatory valve, and means controlled by the jack for automatically turning the oscillatory valve to neutral position.

2. The combination with a lifting jack and an air-motor for operating the same, a conduit extending from the motor and containing two ducts for conducting air to said motor to operate the same to raise or lower the jack, a supply conduit, an oscillatory reversing valve interposed between said supply conduit and said ducts, a poppet valve in said supply conduit, a cam portion connected with said oscillatory valve and cooperating with the stem of said poppet valve so that the poppet valve closes when the reversing valve comes to neutral position and is opened when the oscillatory valve is turned in either direction from neutral position, a handle for turning said oscillatory valve, a slotted arm connected with said oscillatory valve, a dog cooperating with the lifting member of the jack, a movable rod with which said dog is connected, and a projection connected with said rod and cooperating with said slotted arm to move said oscillatory valve toward neutral position.

3. The combination with a lifting jack

and an air-motor for operating the same, a conduit extending from the motor and containing two ducts for conducting air to said motor to operate the same to raise or lower the jack, a supply conduit, an oscillatory reversing valve interposed between said supply conduit and said ducts, a poppet valve in said supply conduit, a cam portion connected with said oscillatory valve and cooperating with the stem of said poppet valve so that the poppet valve closes when the reversing valve comes to neutral position and is opened when the oscillatory valve is turned in either direction from neutral position, a handle for turning said oscillatory valve, means operated by the jack for turning said oscillatory valve toward neutral position, and means then active to bring said oscillatory valve to neutral position.

4. The combination with a lifting jack and an air-motor for operating the same, a conduit extending from the motor and containing two ducts for conducting air to said motor to operate the same to raise or lower the jack, a supply conduit, an oscillatory reversing valve interposed between said supply conduit and said ducts, a poppet valve in said supply conduit, a cam portion connected with said oscillatory valve and cooperating with the stem of said poppet valve so that the poppet valve closes when the reversing valve comes to neutral position and is opened when the oscillatory valve is turned in either direction from neutral position, a handle for turning said oscillatory valve, means operated by the jack for turning said oscillatory valve toward neutral position, a second cam portion connected with said oscillatory valve having a recess with reversely sloping sides, and a spring actuated plunger adapted to cooperate with said sloping sides to restore the valve to neutral position.

5. The combination with a lifting jack and an air-motor for operating the same, a conduit extending from the motor and containing two ducts for conducting air to said motor to operate the same to raise or lower the jack, a supply conduit, an oscillatory reversing valve interposed between said supply conduit and said ducts, a poppet valve in said supply conduit, a cam portion connected with said oscillatory valve and cooperating with the stem of said poppet valve so that the poppet valve closes when the reversing valve comes to neutral position and is opened when the oscillatory valve is turned in either direction from neutral position, a handle for turning said oscillatory valve, means operated by the jack for turning said oscillatory valve toward neutral position, a second cam portion connected with said oscillatory valve having a recess with reversely sloping sides and a holding notch at either side of said recess, and a spring-actuated plunger adapted to cooperate with said holding notches to hold said valve

in its extreme positions and also with said sloping sides to restore the valve to neutral position.

6. The combination with a lifting jack and an air-motor for operating the same, an oscillatory valve controlling flow of air to said motor to operate the same to raise or lower the jack, a handle for moving said valve in either direction from neutral position, means operated by the jack for turning said oscillatory valve toward neutral position, and a spring-actuated positioner adapted to bring said oscillatory valve to neutral position.

7. The combination with a lifting jack and an air-motor for operating the same, an oscillatory valve controlling flow of air to said motor to operate the same to raise or lower the jack, a handle for moving said valve in either direction from neutral position, means operated by the jack for turning said oscillatory valve toward neutral position, a cam portion connected with said valve and having a recess with reversely sloping sides, and a spring-actuated plunger adapted to cooperate with the sides of said recess to bring said valve to neutral position.

8. The combination with a lifting jack and an air-motor for operating the same, an oscillatory valve controlling flow of air to said motor to operate the same to raise or lower the jack, a handle for moving said valve in either direction from neutral position, means operated by the jack for turning said oscillatory valve toward neutral position, a cam portion connected with said valve and having a recess with reversely sloping sides and a holding notch at either side of said recess, and a spring-actuated plunger adapted to cooperate with said holding notches to hold said valve in its extreme positions and also with said sloping sides to bring said valve to neutral position.

9. The combination with a lifting jack and an air-motor for operating the same, valve mechanism controlling flow of air to said motor to operate the same to raise or lower the jack, a handle for moving said valve mechanism in either direction from neutral, means operated by the jack toward the end of its raising or lowering movement to start said valve mechanism toward neutral condition, and a positioner for completing the return of said valve mechanism to neutral condition independently of further movement of the jack.

10. The combination with a lifting jack and an air-motor united to the frame of the jack and geared to the lifting element thereof, of a separate valve unit comprising a valve body, a duplex conduit connecting said valve body with said air-motor, an inlet conduit connected with another part of said body, a reciprocary inlet valve in the inlet passage of the body, an oscillatory reversing valve in said body between said inlet valve and the

passages of said duplex conduit, a mechanical interconnection between said valves adapted to cause said reciprocatory inlet valve to close when the reversing valve comes to neutral position and to open when the oscillatory valve is turned in either direction from neutral position, a handle for operating the reversing valve, and an automatic control linkage between said oscillatory valve and a movable part of the jack.

11. In an air-motor jack, the combination with the jack of a reversing valve having two positions in which it controls the flow of air to raise and lower the lifting member, respectively, and a neutral stop position, a handle for operating said reversing valve, linkage adapted to be operated by a movable part of the jack to start said reversing valve toward its neutral position under actuation by the jack, means then operative to bring said valve to the neutral position, and a device interconnecting said valves so that the inlet valve is opened when the reversing valve is moved to either of its extreme positions and closes when the reversing valve is moved to neutral position.

12. The combination with a lifting jack and an air-motor for operating the same, a connection conduit extending from the motor and containing two ducts for alternately conducting air to said motor and exhaust air therefrom, for operation of the motor in either direction to raise or lower the jack, a valve body applied to said conduit and containing two passages communicating with the ducts in said connection conduit, a supply passage and an exhaust outlet, an oscillatory reversing valve in said body adapted to connect said communicating passages alternately with the supply passage and with the exhaust outlet, a poppet valve in said supply passage, a cam portion connected with said oscillatory valve and cooperating with the stem of said poppet valve so that the poppet valve closes when the reversing valve comes to neutral position and is opened when the oscillatory valve is turned in either direction from neutral position, a handle for turning said oscillatory valve, and means controlled by the jack for automatically turning the oscillatory valve to neutral position.

13. The combination with a lifting jack having a shell, a lifting element guided in the top of said shell, and a lifting screw cooperating with said lifting element, of an air motor connected with the lower part of said shell and geared to said screw, a conduit rising from said motor and extending inward toward the shell, said conduit containing two ducts for alternately conducting air to the motor and exhaust air therefrom, a valve body applied to said conduit in close proximity to the shell, said valve body having two passages communicating with said ducts, a supply passage and an exhaust out-

let, an oscillatory reversing valve in said body adapted to connect said communicating passages alternately with the supply passage and the exhaust outlet, a handle for operating said valve manually, and means operated by said lifting element for operating said valve automatically.

14. The combination with a lifting jack having a shell, a lifting element guided in the top of said shell, and a lifting screw cooperating with said lifting element, of an air motor connected with the lower part of said shell and geared to said screw, a conduit rising from said motor and extending inward toward the shell, said conduit containing two ducts for alternately conducting air to the motor and exhaust air therefrom, a valve body applied to said conduit in close proximity to the shell, said valve body having two passages communicating with said ducts, a supply passage and an exhaust outlet, an oscillatory reversing valve in said body adapted to connect said communicating passages alternately with the supply passage and the exhaust outlet, a handle for operating said valve manually, a vertical rod having operative connection with said valve, and means on said lifting element to operate said rod.

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