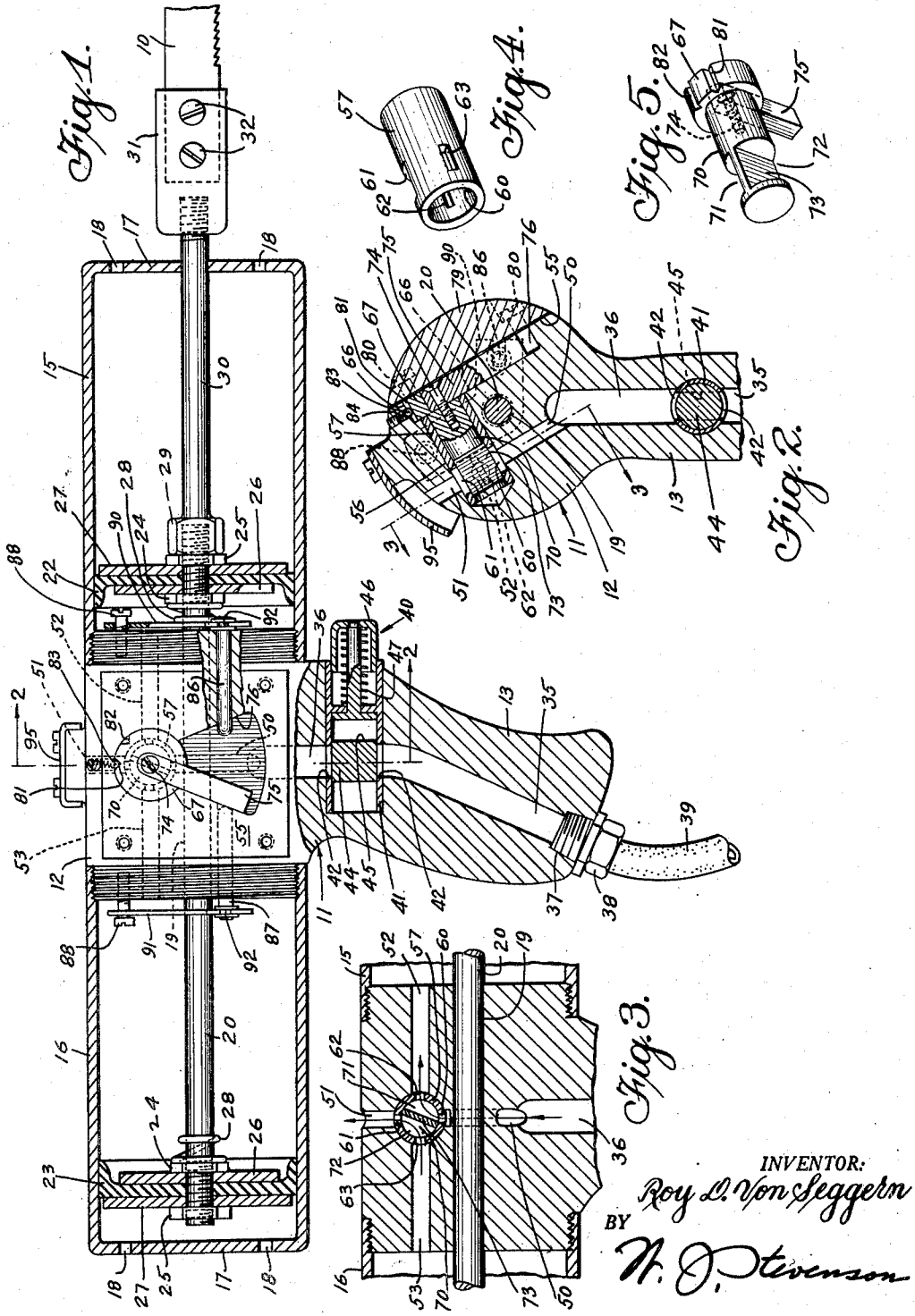
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PNEUMATIC SAW AND THE LIKE

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PNEUMATIC SAW AND THE LIKE

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This invention relates generally to pneumatically actuated tools and more particularly to an air-driven mechanism for reciprocating a hacksaw, file or other wood- or metal-working tool. Specifically, the invention is concerned with a tool having a new and improved valve means for controlling the flow of compressed air to the tool-actuating cylinders.

The pneumatic tool comprises, in general, a main body having a pistol-grip handle by which the tool can be held in a hand, cylinders connected to the forward and rearward ends of the body, and pistons reciprocable in said cylinders, one of the pistons having an axial extension or spindle to which a hack-saw or other tool may be connected, reciprocation of the interconnected pistons serving to reciprocate the tool. The body is provided with air flow passages leading from an air inlet port in the handle to the inner ends of the cylinders, and an air outlet or exhaust port. It is the usual practice in devices of this general character to employ slide valves which are slidable in the port in paths parallel to the common axis of the cylinders, these valves being arranged to be engaged by the inner ends of the pistons so that the compressed air is introduced alternately into the two cylinders. By this conventional arrangement, when air is introduced into one cylinder, the air within the other cylinder is exhausted by way of the outlet port, and vice versa.

While such conventional tools are quite practical and efficient in use, and have met wide acceptance, I have found that more efficient operation may be attained by modification of the air valve means. That is, it has been determined that the double slide valves of the prior tools have the tendency to wear and when this occurs leakage of the pressure air around the valves and directly into the cylinders, by-passing the air passage ducts provided for this purpose, frequently results in malfunctioning of the tool.

It is therefore an important object of the present invention to provide a reciprocable pneumatic tool in which is embodied an air valve means of a highly practical and efficient type, one which is positive in its action, and one which minimizes air leakage to the cylinders and exhaust port.

Another object of the invention is to provide a pneumatic tool, of the character referred to, in which is provided an air inlet duct in the handle of the tool, said duct leading to an air chamber in the body of the tool, a finger-operated valve being incorporated in the handle for controlling flow of the compressed air into the chamber. According to the invention, an oscillating valve is provided for controlling the flow of the air from the chamber alternately into opposite cylinders, said valve being oscillated in timed sequence with the reciprocation of the pistons to establish air flow into and from the cylinders.

Another object of the invention is to provide a pneumatic tool of the class specified in which the air valve consists of a sleeve fixedly arranged within the air chamber and having ports communicating with the air chamber, with the cylinders and with the air exhaust port, and a valve element adapted to oscillate within the stationary valve sleeve. According to the invention, said element has transverse grooves so arranged that as the element is pivoted in one direction pressure air is directed from the air chamber into one cylinder by way of one of the grooves of the element and one of said ports of the sleeve and air is simultaneously exhausted from the other cylinder by way of the other groove and port, pivotal movement of the valve element in the opposite direction effecting a reverse flow of the air to thus cause the tool to reciprocate.

Another object of the invention is to provide in a pneumatic tool of the type indicated an air valve means which is easily and quickly installed in and removed from the valve body without requiring disassembly of the cylinders, pistons, piston rods or other components of the tool actuator mechanism. Thus, by this provision the valve may be periodically removed for cleaning or other servicing and quickly re-installed or replaced by a new valve when such becomes necessary, the period of inactivation of the tool thus being minimized.

Another object of the invention is to provide means for retaining the valve element in its two positions during the major part of the stroke of the pistons, this means consisting of a spring-actuated detent ball on the valve sleeve engageable in detent notches in the periphery of the ocillating valve element.

A further object of the invention is to provide a positive means for actuating the valve element with a snap action, this means including a radial arm on the valve element, slidable plungers engageable against opposite sides of the arm and pivoted actuator levers operatively connected to said plungers and adapted to be engaged by springs carried by the pistons, said springs compressing upon engaging the levers and acting to pivot the latter when the spring energy is of sufficient magnitude to overcome the resistance offered by the spring detent means, at which time the lever acts to move the plunger and radial arm with a snap action so as to pivot the valve element. By this provision, the valve element is oscillated, first in one direction and then in the opposite direction, to cause introduction of compressed air alternately into the cylinders to effect reciprocation of the interconnected pistons and the hack saw or other tool carried thereby.

Further objects of the invention will appear from the following description and from the drawing which is intended for the purpose of illustration only, and in which:

Fig. 1 is longitudinal sectional through the tool-actuating mechanism;

Fig. 2 is a cross-sectional view, taken on line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view through the improved valve means, taken on line 3—3 of Fig. 2;

Fig. 4 is an enlarged perspective view of the stationary sleeve element of the valve; and

Fig. 5 is an enlarged perspective view of the oscillating valve element.

Referring to the drawing in detail, the invention is concerned with a pneumatically-operated mechanism for reciprocating a hack-saw blade 10, or other cutting or smoothing tool. The mechanism includes a body 11 having a substantially cylindrical head portion 12 provided with a depending handle portion or grip 13 by which the device is held in a hand. The front and rear ends of the head portion 12 have screw threads and screwed onto these ends are the inner threaded ends of cup-shaped cylinders 15 and 16, the outer end walls 17 of which have vent holes 18. The head portion 12 has an axial bore 19 providing a longitudinal bearing for a piston rod 20 which

is adapted to reciprocate therein, the ends of the rod extending into the cylinders 15 and 16.

Carried at the threaded ends of the piston rod 20, within the cylinders 15 and 16, are respective pistons 22 and 23. The pistons are connected to the rod ends by means of nuts 24 and 25 and backing discs 26 and 27. Carried by the piston rod 20 between the pistons 22 and 23 and the ends of the head portion 12 are small coil springs 28. Screwed onto the threaded extremity of the piston rod disposed in the cylinder 15 is the head 29 of a rod 30 which forms an axial extension of the piston rod, the rod 30 projecting axially through a hole in the end wall of the cylinder 15 and carrying a tool holder 31 having a socket in which the inner end of the tool 10 is secured by any suitable means, such as the screw 32.

The hand grip portion 13 is provided with an upwardly extending air inlet passage 35 which communicates with an air chamber 36 formed in the head portion 12. Screwed into a threaded counterbore 37 at the lower end of the passage 35 is the end fitting 38 of an air hose 39. Compressed air entering the device from the hose 39 is adapted to flow upwardly through the passage 35 and into the chamber 36. The introduction of air is, however, controlled by a finger-operated valve 40 having a sleeve 41 fixed within a transverse bore in the handle portion 13, said sleeve having valve openings 42 located in its upper and lower sides and in register with the passage 35 and chamber 36. Slidable in the sleeve 41 is a slide valve element 44 having a transverse valve opening 45 adapted to align with the openings 42 when the valve element is slid inwardly by means of a finger button or trigger 46. The valve element 44 is, however, normally maintained in its outward position to close the valve by means of a spring 47. Through means of the improved control valve means of the present invention, compressed air entering the air chamber 36, when the finger-operated valve 40 is opened, is caused to alternately enter the cylinders 15 and 16 to operate the pistons 22 and 23, the control valve means being constructed and arranged as next described.

The head portion 12 of the body 11 is provided with an air passage 50 forming an upper extension of the chamber 36. The body also has an air outlet or exhaust passage 51 communicating with the atmosphere. Also formed in the head 12 are longitudinal air passages 52 and 53 leading to the ends of the head and thus communicating with the interiors of the respective cylinders 15 and 16. The passages 50, 51, 52 and 53 together form a cross as clearly shown in Fig. 3. The head 12 is cut away at one side as indicated at 55 in Fig. 2 and is provided with a bore 56 extending inwardly from the surface 55 and in alignment with the intersection of the passages 50, 51, 52 and 53. Forced into this bore is a fixed valve sleeve 57 which has a first, lower port 60, a second, upper port 61 and third and fourth lateral ports 62 and 63. As illustrated in Fig. 3, the ports 60, 61, 62 and 63 register respectively with the air passages 50, 51, 52 and 53.

The bore 56 is counterbored at 66 to receive the head or flange 67 of a valve element 70, shown in detail in Fig. 5. The element 70 consists of a short shaft having the head 67 at one end, the other end being provided with a pair of relatively deep slots 71 and 72 at opposite sides of the element, the metal remaining between the slots providing a septum or partition 73. The valve element 70 is arranged to oscillate within the fixed sleeve 67, the head or flange 67 being rotatable in the counterbore 66. Secured in a slot in the outer face of the flange 67 by a screw 74 is an actuating arm 75 which projects radially and downwardly from the flange into a segmental recess 76 formed in the flat face 55 of the head 12. The valve assembly, including the parts 57, 70 and 75, is retained in the head 12 by means of a cap or cover 79 which is secured against the face 55 by screws 80 (Fig. 2).

It will be apparent from the above that when the arm 75 is pivoted back and forth in the recess 76, the valve element 70 is oscillated to a first position (Fig. 3) wherein its slot 71 establishes air flow between the pressure chamber 36 and the cylinder 15 by way of the ports 60 and 62, and its slot 72 establishes air exhaust flow from the other cylinder 16 to the atmosphere by way of ports 63 and 61 and exhaust passage 51. On the other hand, when the arm 75 is pivoted in the opposite direction to a second position, the valve element 70 is oscillated to align its slot 71 with the ports 62 and 61 and to align its slot 72 with the ports 60 and 63 so as to effect introduction of pressure air into the cylinder 16 and exhausting of air from the cylinder 15 to the atmosphere.

Means are provided for yieldingly retaining the valve element 70 in its two positions. This means includes a pair of circumferentially-spaced detent notches 81 and 82 formed in the periphery of its head 67. A plunger, preferably in the form of a detent ball 83, is slidable in a small hole in the head 12, extending radially of the axis of the valve element 70, and is urged successively into the notches 81 and 82 by a spring 84, as the valve element is oscillated.

According to the present invention, the valve element 70 is oscillated indirectly by the pistons 22 and 23, this being accomplished, in part, by actuating plungers 86 and 87 which are slidable in bores extending longitudinally within the head 12 between the recess 76 and the ends of the head. Pivotally and slidably mounted on screws 88 screwed into the opposite ends of the head 12 are shifter elements 90 and 91. As shown, these elements have holes through which the piston rod 20 passes. The lower ends of the shifter elements 90 and 91 are forked to engage in peripheral grooves 92 at the outer projecting ends of the actuating plungers 86 and 87. The shifter elements 90 and 91 are arranged to be engaged by the springs 28 carried by the piston rod 20 within the cylinders 15 and 16.

Assuming that the hack saw blade 10 is to be reciprocated to perform work, the operator holds the device in his hand by grasping the hand grip 13. To initiate operation of the device, it is only necessary to depress the trigger button 46 so as to open the valve 40 and thus allow flow of the pressure air into the chamber 36 and passage 50. With the valve element 70 in the position shown in Figs. 1 and 3, the air flows from the supply line through the ports 60, 62 and slot 71 and into the inner end of the cylinder 15, by way of passage 52. The pressure air, acting between the end of the head 12 and the piston 22, forces the latter outwardly in the cylinder 15. At the same time, air within the cylinder 16 exhausts to the atmosphere by way of the ports 63, 61, slot 72 and exhaust passsage 51.

As the pistons 22, 23, rod 20 and hack saw 10 approach the limit of their movement toward the right, as viewed in Fig. 1, the spring 28 carried by the rod 20 adjacent the piston 23 engages the shifter element 91 and tends to pivot the latter in counterclockwise direction. However, such pivotal movement is resisted by the valve element assembly 70, 75 due to the engagement of the detent ball 83 in the notch 81. Now, as the piston 23 continues its right-hand movement, its spring 28 is compressed against the shifter element 91 and when the force of the spring is sufficient to overcome the resistance of the detent means, the shifter element 91 is pivoted rapidly, with a snap action. Due to its connection with the actuating plunger 87, quick pivotal movement of the shifter element causes rapid sliding movment of the plunger into the recess 76. The result of this action is to cause the arm 75 to be thrown across the recess 76 to pivot the valve element 70 to a position where the detent ball 83 snaps into the notch 82, the arm 75 also shifting the plunger 86 toward the right.

As the valve element 70 is thus shifted in the sleeve 57, its slots 71 and 72 are so positioned that pressure air now enters the cylinder 16 by way of ports 60, 63, slot 72 and passage 53 the air so introduced acting between the head 12 and piston 23 to move the piston rod 20 and

tool 10 toward the left. Such pivoting of the valve element 70 also allows exhaust flow of air from the cylinder 15 to the atmosphere by way of the passage 72, ports 62, 61, slot 71 and passage 51. A deflector 95 may be provided for deflecting the exhaust air laterally away from the operator.

As the rod 20 approaches its limit of movement toward the left, the spring 28 of the piston 22 engages the shifter element 90 and becomes lightly compressed thereagainst. When the energy of the spring exceeds the resisting force of the detent ball 83 in the notch 82, the shifter element 90 is pivoted toward the left with a snap action so as to shift the plunger 86 in a left-hand direction and thus throw the arm 75 in clockwise direction into engagement with the left-hand side of the recess 76, as shown in Fig. 1.

The pivotal movement of the valve element 70 in opposite directions to effect introduction of pressure air alternately into the cylinders 15 and 16, and thus impart a reciprocatory movement to the tool 10, is continued so long as the valve 40 is maintained open. Due to the action of the oscillating valve 70 and the absence of direct hammering impact of solid metal parts, the device operates smoothly with a minimum of vibration and noise. Also, due to the quick, snap-action of the valve means, the tool is reciprocated quickly and practically without dwell at the ends of its reciprocatory movement so that the cutting action of the tool is greatly enhanced.

In accordance with the provisions of the patent statutes, I have herein described the principle of the invention, together with the construction of the device which I now consider to represent the best embodiment of the invention. I wish to have it understood, however, that various modifications might be made in the construction without departing from the spirit or scope of the invention, as defined in the appended claims.

I claim as my invention:

1. A pneumatically operated mechanism for reciprocating a tool, comprising: a body having an air chamber, an air inlet passage communicating with the chamber, an air exhaust passage communicating between said chamber and the atmosphere, said body also having a bore providing a bearing; coaxial cylinders carried by said body at the ends thereof; a piston rod slidable in said bore and projecting axially into said cylinders; pistons carried by said rod and slidable in said cylinders, said piston-and-rod assembly being adapted to support a tool, said body having air passages communicating between said chamber and said cylinders; an oscillating valve means for controlling flow of compressed air from said chamber alternately into the cylinders to reciprocate the pistons and the tool carried thereby, said valve means including a sleeve fixed within said body and having a first port communicating with said chamber, a second port communicating with said exhaust passage, a third port communicating with one of said cylinders, and a fourth port communicating with the second of said cylinders, and a two-way valve element oscillatable in said sleeve and having a pair of transverse slots, said element being rotatable to a first position wherein the first of its slots registers with said first and third ports and the second slot registers with said second and fourth ports, and rotatable to a second position wherein its said first slot registers with said second and third ports and its second slot registers with said first and fourth ports; actuating means, operative in response to sliding movement of said pistons in opposite directions, to oscillate said valve element to its said first and second positions; and detent means operative to yieldingly retain said valve element in its said first and second positions, said detent means including circumferentially-spaced notches in said valve element, and a spring-actuated detent plunger slidable on said body and engageable in said notches, said actuating means including a radial arm on said valve element; a pair of actuating plungers slidable in said body and having inner ends engageable against opposite sides of said radial arm; and plunger-actuating means movable with said pistons during inward sliding movement of the latter, said plunger-actuating means engaging the outer ends of said actuating plungers to oscillate the same.

2. A pneumatically operated mechanism for reciprocating a tool, comprising; a body having an air chamber, an air inlet passage communicating with the chamber, an air exhaust passage communicating between said chamber and the atmosphere, said body also having a bore providing a bearing; coaxial cylinders carried by said body at the ends thereof; a piston rod slidable in said bore and projecting axially into said cylinders; pistons carried by said rod and slidable in said cylinders, said piston-and-rod assembly being adapted to support a tool, said body having air passages communicating between said chamber and said cylinders; an oscillating valve means for controlling flow of compressed air from said chamber alternately into the cylinders to reciprocate the pistons and the tool carried thereby, said valve means including a sleeve fixed within said body and having a first port communicating with said chamber, a second port communicating with said exhaust passage, a third port communicating with one of said cylinders, and a fourth port communicating with the second of said cylinders, and a two-way valve element oscillatable in said sleeve and having a pair of transverse slots, said element being rotatable to a first position wherein the first of its slots registers with said first and third ports and the second slot registers with said second and fourth ports, and rotatable to a second position wherein its said first slot registers with said second and third ports and its second slot registers with said first and fourth ports; actuating means, operative in response to sliding movement of said pistons in opposite directions, to oscillate said valve element to its said first and second positions; and detent means operative to yieldingly retain said valve element in its said first and second positions, said detent means including circumferentially-spaced notches in said valve element, and a spring-actuated detent plunger slidable on said body and engageable in said notches, said actuating means including a radial arm on said valve element, a pair of actuating plungers slidable in said body and having inner ends engageable against opposite sides of said radial arm; resilient plunger-actuating means movable within each cylinder and engageable by and movable with said pistons during inward sliding movement of the latter, said plunger-actuating means engaging the outer ends of said actuating plungers to oscillate the same.

3. A pneumatically operated mechanism for reciprocating a tool, comprising: a body having an air chamber, an air inlet passage communicating with the chamber, an air exhaust passage communicating between said chamber and the atmosphere, said body also having a bore providing a bearing; coaxial cylinders carried by said body at the ends thereof; a piston rod slidable in said bore and projecting axially into said cylinders; pistons carried by said rod and slidable in said cylinders, said piston-and-rod assembly being adapted to support a tool, said body having air passages communicating between said chamber and said cylinders; an oscillating valve means for controlling flow of compressed air from said chamber alternately into the cylinders to reciprocate the pistons and the tool carried thereby, said valve means including a sleeve fixed within said body and having a first port communicating with said chamber, a second port communicating with said exhaust passage, a third port communicating with one of said cylinders, and a fourth port communicating with the second of said cylinders, and a two-way valve element oscillatable in said sleeve and having a pair of transverse slots, said element being rotatable to a first position wherein the first of its slots registers with said first and third ports and the second slot registers with said second and fourth ports, and rotatable to a second position wherein its said first slot registers with said second and third ports and its second slot registers with said first and fourth ports;

actuating means, operative in response to sliding movement of said pistons in opposite directions, to oscillate said valve element to its said first and second positions; and detent means operative to yieldingly retain said valve element in its said first and second positions, said detent means including circumferentially-spaced notches in said valve element, and a spring-actuated detent plunger slidable on said body and engageable in said notches, said actuating means including: a radial arm on said valve element; a pair of actuating plungers slidable in said body and having inner ends engageable against opposite sides of said radial arm; and actuating levers pivoted within the inner ends of said cylinders and having free ends engaging the outer ends of said actuating plungers, said levers being operatively engageable by said pistons.

4. A pneumatically operated mechanism for reciprocating a tool, comprising: a body having an air chamber, an air inlet passage communicating with the chamber, an air exhaust passage communicating between said chamber and the atmosphere, said body also having a bore providing a bearing; coaxial cylinders carried by said body at the ends thereof; a piston rod slidable in said bore and projecting axially into said cylinders; pistons carried by said rod and slidable in said cylinders, said piston-and-rod assembly being adapted to support a tool, said body having air passages communicating between said chamber and said cylinders; an oscillating valve means for controlling flow of compressed air from said chamber alternately into the cylinders to reciprocate the pistons and the tool carried thereby, said valve means including a sleeve fixed within said body and having a first port communicating with said chamber, a second port communicating with said exhaust passage, a third port communicating with one of said cylinders, and a fourth port communicating with the second of said cylinders, and a two-way valve element oscillatable in said sleeve and having a pair of transverse slots, said element being rotatable to a first position wherein the first of its slots registers with said first and third ports and the second slot registers with said second and fourth ports, and rotatable to a second position wherein its said first slot registers with said second and third ports and its second slot registers with said first and fourth ports; actuating means, operative in response to sliding movement of said pistons in opposite directions, to oscillate said valve element to its said first and second positions; and detent means operative to yieldingly retain said valve element in its said first and second positions, said detent means including circumferentially-spaced notches in said valve element, and a spring-actuated detent plunger slidable on said body and engageable in said notches, said actuating means including; a radial arm on said valve element; a pair of actuating plungers slidable in said body and having inner ends engageable against opposite sides of said radial arm; actuating levers pivoted within the inner ends of said cylinders and having free ends engaging the outer ends of said actuating plungers; and resilient means on said piston rods arranged between said pistons and said levers and engageable with said levers to pivot the same.

5. A pneumatically operated mechanism for reciprocating a tool, comprising; a body having an air chamber, an air inlet passage communicating with the chamber, an air exhaust passage communicating between said chamber and the atmosphere, said body also having a bore providing a bearing; coaxial cylinders carried by said body at the ends thereof; a piston rod slidable in said bore and projecting axially into said cylinders; pistons carried by said rod and slidable in said cylinders, said piston-and-rod assembly being adapted to support a tool, said body having air passages communicating between said chamber and said cylinders; an oscillating valve means for controlling flow of compressed air from said chamber alternately into the cylinders to reciprocate the pistons and the tool carried thereby; said valve means including a sleeve fixed within said body and having a first port communicating with said chamber, a second port communicating with said exhaust passage, a third port communicating with one of said cylinders, and a fourth port communicating with the second of said cylinders, and a two-way valve element oscillatable in said sleeve and having a pair of transverse slots, said element being rotatable to a first position wherein the first of its slots registers with said first and third ports and the second slot registers with said second and fourth ports, and rotatable to a second position wherein its said first slot registers with said second and third ports and its second slot registers with said first and fourth ports; actuating means, operative in response to sliding movement of said pistons in opposite directions, to oscillate said valve element to its said first and second positions; and detent means operative to yieldingly retain said valve element in its said first and second positions, said detent means including circumferentially-spaced notches in said valve element, and a spring-actuated detent plunger slidable on said body and engageable in said notches, said actuating means including: a radial arm on said valve element; a pair of actuating plungers slidable in said body and having inner ends engageable against opposite sides of said radial arm; actuating levers pivoted within the inner ends of said cylinders and having free ends engaging the outer ends of said actuating plungers; and coil springs on said piston rods arranged between said pistons and said levers and engageable with said levers to pivot the same.

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