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Volkmann et al.

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[54] CONTROL VALVE MEANS FOR A PERCUSSION DEVICE ACTUATED BY COMPRESSED AIR

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **91/309,** 91/461, 137/624.14, 137/625.6

[51] **Int. Cl.** **F01l 25/02,** F15b 13/042

[58] **Field of Search** 91/308, 309, 304, 461; 137/624.14, 625.6; 227/130

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[57] **ABSTRACT**

In a control valve assembly for a pneumatically operated percussion device, a control valve piston is slidably mounted on a hollow release valve stem and encloses an auxiliary valve member to provide for automatic sequential operation. The admission of compressed air to the hollow release valve stem is blocked by a valve ring mounted on said valve stem, and the stem is provided with means for adjusting the rate of sequencing of the control valve piston and the auxiliary valve member.

2 Claims, 3 Drawing Figures

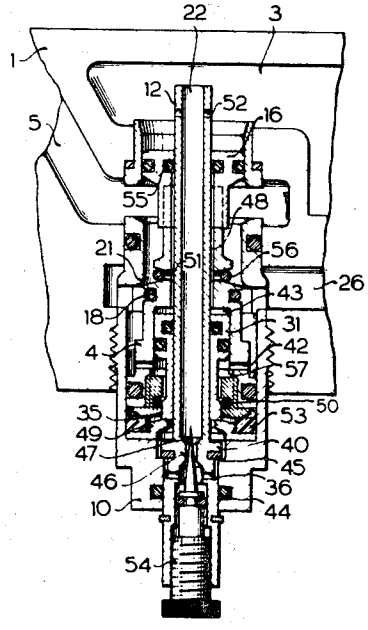
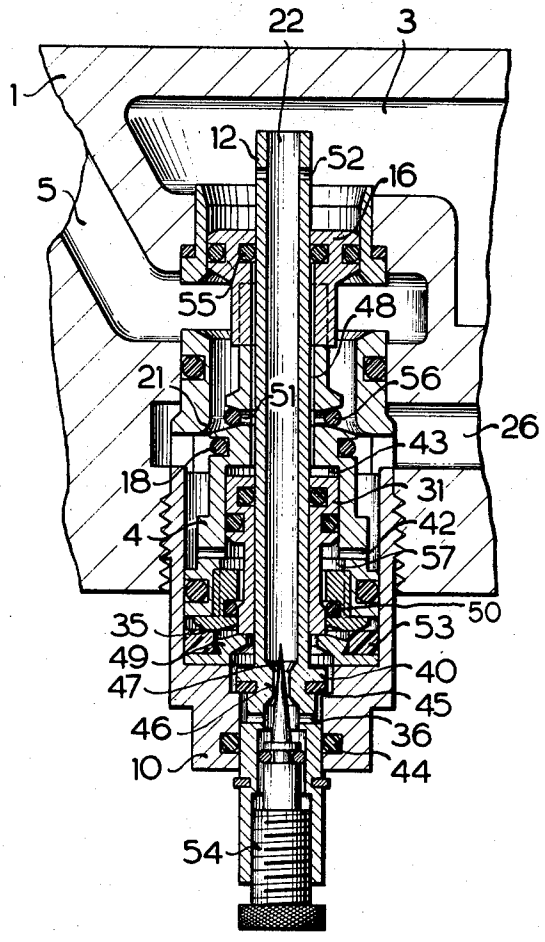


FIG.1



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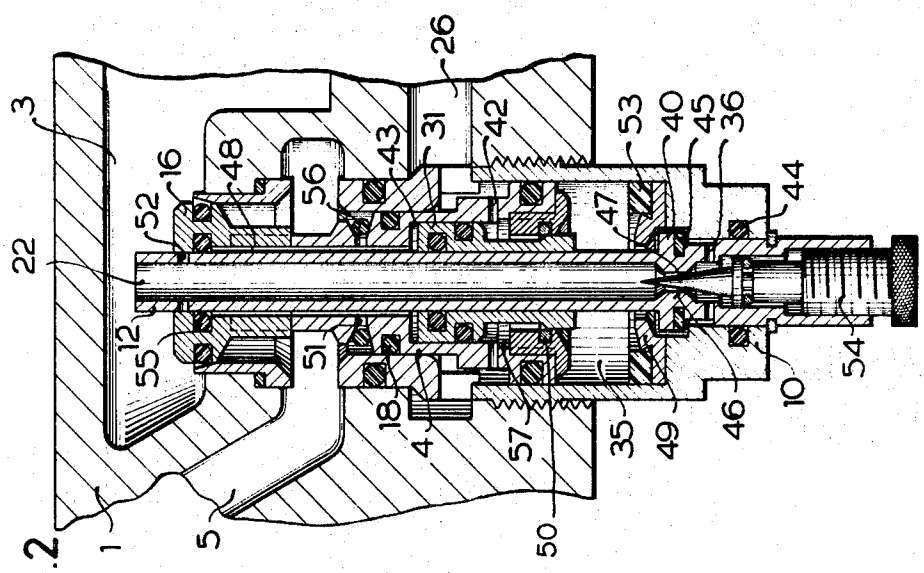

FIG.2

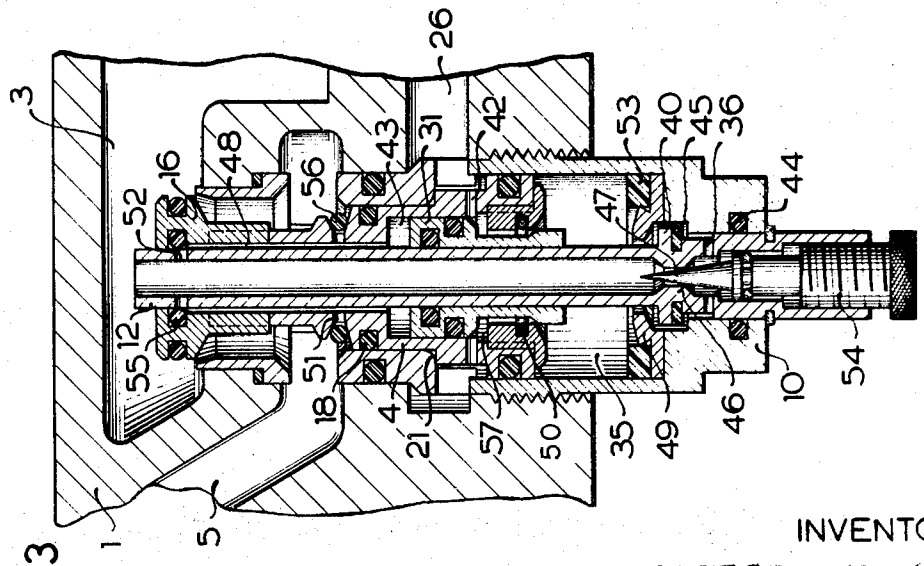

FIG.3

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CONTROL VALVE MEANS FOR A PERCUSSION DEVICE ACTUATED BY COMPRESSED AIR

The invention relates to a control valve assembly for a percussion device actuated by compressed air, especially for driving staples, nails, dowels and the like into a work piece.

The prior art control valve assembly is provided with a control valve of a differential piston type which connects the working cylinder of the device either with the vent passage when in a position of rest or with a compressed air supply line when in operation. For achieving axial movement of the control valve between the operating and rest positions there is provided a release valve which is operated manually by means of a trigger lever. The release valve opens and closes a passage which connects a compressed air supply line to a face of the differential piston of the control valve. Said passage consists of an axial bore in the release valve stem communicating between the piston face and the compressed air supply line so that the differential piston type control valve can be opened with little effort.

A hollow control valve is mounted for limited axial movement from the position of rest into the operating position and vice versa, on a release valve stem provided with an axial bore. The differential piston type control valve, having a lower face of greater effective surface than its upper face, is held in its upper position and counteracts the pressure of the compressed air of the air supply line with pressure in a valve housing chamber. In its upper position the control valve blocks the admission of compressed air from the air supply line to the air passage leading to the working cylinder.

The differential piston type control valve is movable on the release valve stem and is in its upper position at the end of the working stroke to blocks the air supply to the working cylinder. In the prior art devices of the type described, the release valve stem has to be lifted each time when a drive stroke is initiated in order to block the flow of compressed air from the axial bore. In the present invention, means are provided to sequence the device through a series of working strokes as long as the release valve stem is held and to vary the amount of time between strokes.

It is an important object of the present invention to provide a control valve arrangement of the type mentioned above wherein a very rapid sequence of working strokes occurs without the necessity of actuating the release trigger lever every time.

Another object of the invention is to provide control valve means which make it possible to vary the time interval between successive working strokes in a simple and easy manner.

A further object of the invention is to provide an automatic percussion device wherein the succession of working strokes is independent of the skill of the operator.

These and other objects of the invention will become apparent from the following description in connection with the accompanying drawings in which an embodiment of the invention is shown by way of an example. In the drawings

FIG. 1 is a sectional side elevation of a control valve assembly for a pneumatic portable stapler with the parts in their initial position,

FIG. 2 is the same sectional elevation of the control valve assembly in the position for the admission of compressed air to the working cylinder and

FIG. 3 is the same sectional elevation of the control valve assembly at the moment of reversal.

An essential feature of the present invention is characterized by the provision of means for an automatic sequence of operational steps, whereby the release valve stem seals off the compressed air. Said valve stem carries a or sealing ring for blocking the compressed air admission and is equipped with means for adjusting the rate of admission of compressed air to lift the control valve and the auxiliary piston-link valve member to provide a variable time interval between successive working strokes.

The release valve stem is equipped with means by which the interval between working strokes can be varied in a simple and easy manner. This can be achieved by a throttle unit. The throttle unit may be mounted in the flow of the compressed air in front of the control valve and comprises a nozzle and an adjustable conical needle cooperating with one another. The needle may be attached to an adjustment device, e.g. a manually adjustable setting screw. Since the connection with a venting aperture between the control valve and the auxiliary valve member respectively, is established only for a short time, it is advantageous to provide a valve seal between the control valve and the auxiliary valve member. This seal may preferably be constituted by a shoulder of the auxiliary valve member, which seats against a sealing ring of the control valve. For returning the control valve to its initial position, preferably an gap or port surrounds the release valve stem. This port communicates with a chamber formed between the control valve and the auxiliary valve member and with the supply line of compressed air. Transverse ports may be arranged on the upper end of the release valve stem to permit compressed air to enter said annular port. When the control valve is in its uppermost position, these ports communicate with said annular port. Venting of this annular port is advantageously obtained by means of a back pressure or check valve member connecting the annular port with a venting aperture of the stapler. A seal is provided between the lower part of the control valve and the auxiliary valve member, and comprises a bushing carrying a sealing ring, and the bushing is screwed into the control valve.

The control valve according to the invention operates the percussion device wherein it is mounted in a continuous manner without interruptions when the release valve stem is lifted but once. Operation ceases only when the valve stem is released, i.e. as soon as the admission of compressed air through the release valve stem into the chamber or space below the control valve is blocked.

Referring now to the drawings, the casing body 1 of a portable percussion device e.g. a pneumatic stapler, encloses a compressed air admission passage 3, which via a control valve 4 communicates with a port 5 leading to the working cylinder (not shown). The control valve 4 has a valve housing 10 comprising one or several parts. In the valve housing 10 a release valve stem 12 is guided. The control valve 4 encloses an auxiliary piston-like valve member 31. Both valves are differential pistons. The upper face of the control valve 4 is smaller than the lower one, whereas the auxiliary valve member 31 has its larger pressure face on the upper end thereof. Packings are provided between the individual sliding portions; the mode of operation of these packings will be described in greater detail hereinafter. An annular port or gap 48 extends in axial direction between the control valve 4 and the release valve stem 12. The gap opens into an annular chamber 43 between the auxiliary valve member 31 and the control valve 4. Said annular gap is closed off on its upper end by means of a sealing ring or packing 55. The release valve stem is provided with transverse ports or bores 52 on its upper end for the admission of air to this annular gap 48.

A throttle comprising a needle 47 and a nozzle 46 is provided at the lower end of the release valve stem 12. The throttle can be manually adjusted by means of a setting screw 54. Transverse bores 36 for admission of compressed air to a chamber 35 are located downstream of the throttle. The flow of compressed air from the axial bore 22 is interrupted by a valve or sealing ring 45 mounted on the shoulder 40 of the release valve stem 12. An additional chamber 57 between the central portion of the auxillary valve number 31 and the control valve 4 is, connected via transverse bores 42 of the control valve 4 with a venting passage 26. The auxiliary valve member 31 is provided with a collar stop 49. The control valve 4 has a bumper 53 to limit its downward movement. A check valve comprising transverse bores 51 and a sealing ring 56 serve to vent the annular gap 48 and chamber 43.

When the release stem 12 is lifted by means of a release trigger lever (not shown), the valve ring 45 is raised from its seat and allows the compressed air to enter from the axial bore

22 of the release valve stem 12 to the lower side of the auxiliary valve member 31. The latter is raised a small extent such that the air can continue to flow to the lower face of control valve 4. Thereafter, both parts, i.e. the control valve 4 and the auxiliary valve member 31 are moved upward, at a speed controlled by the adjustable throttle 46, 47, until the upper extremity 16 of control valve 4 opens port 5 for the admission of air from the air passage 3 to the working cylinder of the percussion device.

At this moment the connection of port 5 with the venting passage 26 is interrupted by means of the packing 18 which operates like a valve as it engages and moves past the shoulder 21 of the valve housing 10. The sealing ring 55, when in its upper terminal position, comes to rest above the transverse bores 52 permitting thereby air to be admitted to the annular gap 48. A rise in pressure in the annular gap 48 or in chamber 43 results in pressing the auxiliary valve member 31 downwardly. This is the moment, at which the control valve effects reversal, whereafter the sealing ring 50 is no longer adjacent the auxiliary piston 31 and, as represented in particular in FIG. 3, a communication is established between chamber 35 and the venting passage 26. As soon as the pressure in this chamber has decreased sufficiently, the control valve 4 and the auxiliary valve member 31 move downward until the latter comes to rest on the collar stop 49 and the sealing ring 50 of the control valve interrupts again the communication between the chamber 35 and the venting passage 26. The sealing ring 50 rests again hermetically tight on the auxiliary valve member 31. Shortly after reversal additional compressed air admission into the port 5 is interrupted by the upper end 16 of the control valve 4. During the continued downward movement of the control valve 4 a new communication is established between port 5 and the venting passage 26 such that the upper face of the working piston (not shown) can be relieved from air pressure. Simultaneously the sealing ring 56 is expanded by means of the excessive pressure existing in the annular gap 48 and in the chamber 43, allowing the compressed air to escape to the atmosphere. The transverse bores 51 of the control valve 4 operate in conjunction with sealing ring 56 like a check valve. As soon as the control valve 4 and the auxiliary valve member 31 have reached the lower end position and the communication between the chamber 35 and the venting passage 26 is interrupted, pressure begins again to rise and the entire cycle is repeated automatically. The time required to repeat the cycle is adjusted by varying the throttle 46, 47.

The present invention is of considerable advantage for pneumatic equipment of all kinds, and in particular for portable pneumatic percussion devices presupposing a rapid series of working strokes and, on account of the small actuating manual force required, allows of a considerable increase of the performance of such device. This is of particular importance where the percussion device is concerned for driving in staples, nails and other fasteners, so widely used in mass production. The invention is also of importance for pliers and packing devices for stapling the lids of cardboard boxes.

We claim:

1. A control valve assembly for automatically sequencing a pneumatically operated fastener driving tool to carry out successive working strokes with only one manual actuation of said control valve assembly, said tool including a body containing a compressed air supply chamber, a working cylinder with a driving piston therein, a main air supply passage connecting the working cylinder with the air supply chamber when said control valve assembly is in one position, and a vent passage venting the working cylinder when said control valve assembly is in another position;

said control valve assembly comprising:

a valve housing; first differential piston valve means;

second differential piston valve means; and

a valve stem shiftably disposed in said housing and being manually movable between an actuated position and a released position, said valve stem having an axial bore open at one end and in permanent communication with the air supply chamber for all positions of said valve stem, the other end of said axial bore supplying compressed air to said first and second differential piston valve means;

said first differential piston valve means being slidably mounted on said valve stem and movable by the flow of compressed air from said axial bore between one position connecting the air supply chamber to the main air supply passage and closing off the main air supply passage from the vent passage and another position closing off the main air supply passage from the air supply chamber and connecting the main air supply passage to the vent passage; and

said second differential piston valve means being slidably mounted on said valve stem and movable by flow of compressed air from said axial bore for automatically sequencing said first differential piston valve means between its two positions when said valve stem is held in its actuated position;

said valve stem having means to close off the flow of compressed air from said axial bore of said valve stem to stop the automatic sequencing of said first differential piston valve means when said valve stem is in its released position, and said valve stem having a nozzle portion and an adjustable needle at said other end of said bore, said needle being cooperable with said nozzle portion to regulate the flow of compressed air from said axial bore to said differential piston valve means to vary the time interval between successive working strokes of the driving piston.

2. A control valve assembly for automatically sequencing a pneumatically operated fastener driving tool to carry out successive working strokes with only one manual operation of said control valve assembly, said tool including a body containing a compressed air supply chamber, a working cylinder with a driving piston therein, a main air supply passage connecting the working cylinder with the air supply chamber when said control valve assembly is in one position, and a vent passage venting the working cylinder when said control valve assembly is in another position;

said control valve assembly comprising:

a valve housing; first differential piston valve means;

second differential piston valve means; and

a valve stem shiftably disposed in said housing and being manually movable between an actuated position and a released position, said valve stem having an axial bore open at one end and in permanent communication with the air supply chamber in all positions of said valve stem, the other end of said axial bore supplying compressed air to said first and second differential piston valve means;

said first differential piston valve means being slidably mounted on said valve stem and movable by the flow of compressed air from said axial bore between one position connecting the air supply chamber to the main air supply passage and closing off the main air supply passage from the vent passage and another position closing off the main air supply passage from the air supply chamber and connecting the main air supply passage to the vent passage; and

said second differential piston valve means being slidably mounted on said valve stem and movable by flow of compressed air from said axial bore for automatically sequencing said first differential piston valve means between its two positions when said valve stem is held in its actuated position;

said valve stem having means to close off the flow of compressed air from said axial bore of said valve stem to stop the automatic sequencing of said first differential piston valve means when said valve stem is in its released position, said valve stem and said first differential piston valve means defining an annular gap and a communicating annular chamber, said second differential piston valve means closing the end of said annular chamber; and

said valve stem having transverse ports adjacent said one end of said valve stem to connect said axial bore with said annular gap when said first differential piston valve means is in said one position; means to close off said annular gap from said axial bore when said first differential piston valve means is in other than said one position; and a nozzle portion and an adjustable needle at said other end of said valve stem, said needle being cooperable with said nozzle position to regulate the flow of compressed air from said axial bore to said differential piston valve means to vary the time interval between successive working strokes of the driving piston.

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