

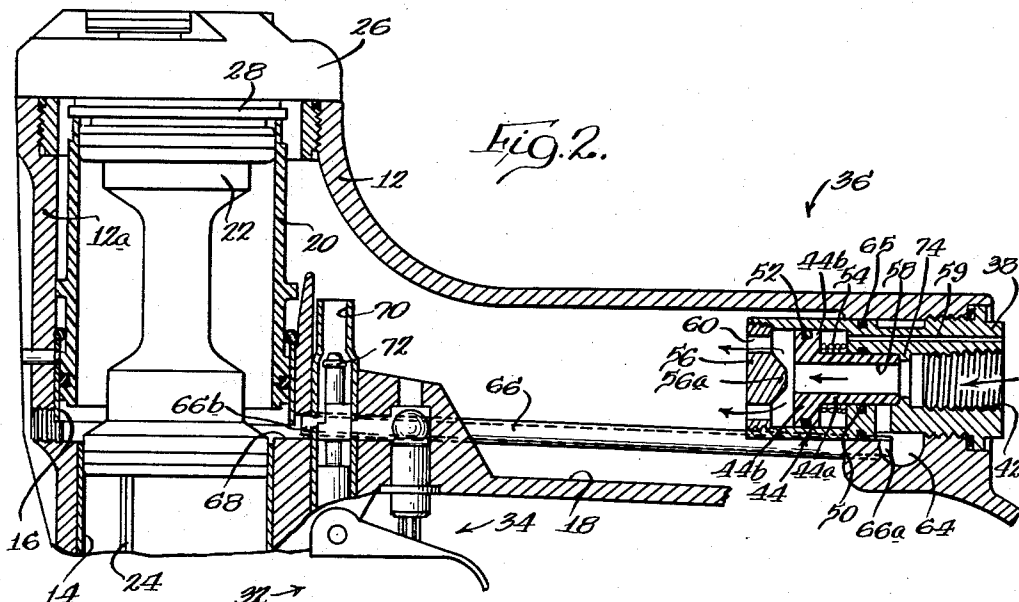
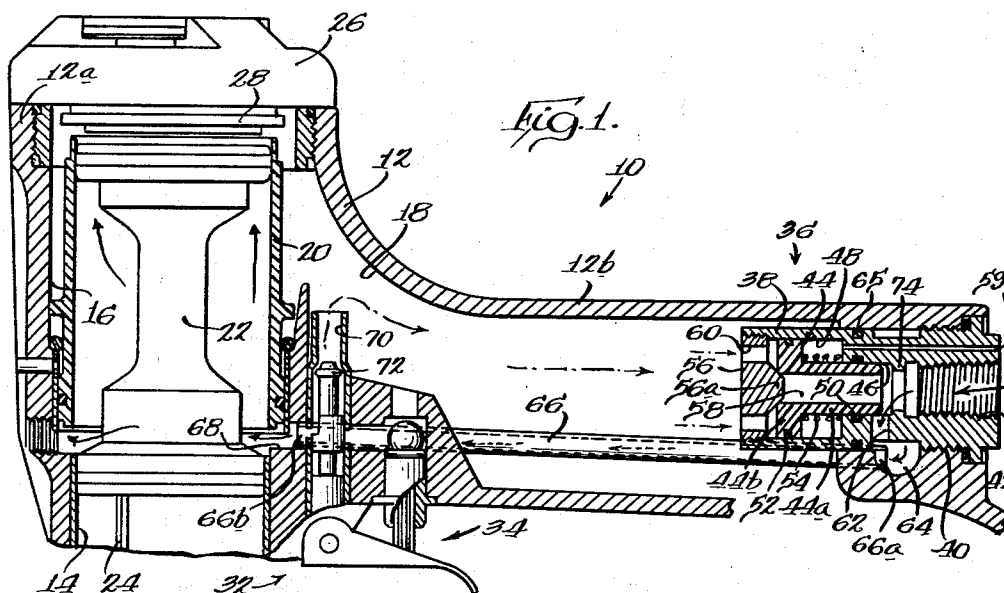
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FASTENER DRIVING APPARATUS

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FASTENER DRIVING APPARATUS

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This invention relates to a fastener driving apparatus and, a more particularly, to a fluid operated fastener driving apparatus including means for preventing operation of the apparatus when a source of pressurized fluid is connected thereto.

Fastener driving tools of the type in which the open end of a cylinder is placed in communication with an adjacent body of pressurized fluid or compressed air in a reservoir commonly include fluid operated means for producing separation of the cylinder and a main valve to control the admission of air to the cylinder for driving a piston connected to a fastener driving blade. In general, the fluid operated means for producing this separation is selectively supplied with fluid or compressed air from the reservoir under the control of one or more manually actuated valves. One problem encountered with this type of tool is a tendency for the tool to occasionally fire without actuation of the control valves when the reservoir is first connected to a source of pressurized fluid, such as a line connected to an air compressor. In larger tools of this type, the inadvertent firing of the tool can result in damage to the tool or injury to the operator. It appears that this inadvertent firing is due to the fact that the cylinder may be open when the air line is connected to the tool with the result that the piston is driven before the air build up in the reservoir is sufficient to operate the fluid operated means to close the cylinder. Some attempts have been made in the past to correct this problem by throttling the air flow from the line into the reservoir to delay the pressure buildup therein. However, this throttling tends to retard the flow of air to the reservoir during use of the tool and can reduce the speed at which the tool can be operated.

Accordingly, one object of the present invention is to provide a new and improved fastener driving apparatus.

Another object of the present invention is to provide a fastener driving apparatus including new and improved means for preventing inadvertent operation thereof when the apparatus is connected to a source of pressurized fluid.

Another object is to provide a fastener driving tool of the type having a cylinder directly placed in communication with an adjacent body of pressurized fluid by fluid operated means in which means are provided for supplying operating fluid to the fluid operated means prior to supplying fluid to the reservoir.

Another object is to provide a fastener driving tool of the type in which a cylinder is selectively placed in communication with an adjacent body of pressurized fluid by a fluid operated means in which communication between the source of pressurized fluid and the reservoir is controlled by a valve means responsive to the pressure of the fluid within the reservoir.

Another object is to provide a fastener driving tool in which a fluid operated means for separating a cylinder and a main valve to control the admission of pressure fluid to the cylinder is directly supplied with fluid when the tool is first connected to the fluid source and is thereafter supplied with fluid under the control of manually controlled valve means.

In accordance with these and many other objects and features of the present invention, an embodiment thereof comprises a pneumatically actuated fastener driving

tool adapted to be connected to a source of compressed air or pressurized fluid by an inlet line. The tool includes a housing having a cylinder with an open end exposed to the fluid in an adjacent reservoir, such as that provided by a hollow handle forming a part of the tool housing. A main valve means normally closes the open end of the cylinder to prevent communication between the cylinder and the fluid in the reservoir. A fluid operated means controlled by one or more manually actuated valves selectively places the cylinder in communication with the reservoir by separating the main valve and cylinder.

To prevent inadvertent operation of the tool when the tool is first connected to the air line, the fluid inlet to the reservoir in the housing is normally closed by a fluid operated valve, and additional means are provided for conveying the fluid supplied to the inlet directly to the fluid operated means. The fluid from the inlet operates the fluid operated means to close the open end of the cylinder and is then bled into the reservoir. When sufficient fluid has been accumulated in the reservoir, the pressure thereof operates the inlet valve means to close off the conveying means for supplying air directly from the inlet to the fluid operated means and to place the fluid inlet in direct communication with the reservoir. In this manner, any inadvertent operation of the fastener driving tool when the air line is connected thereto is avoided.

Many other objects and advantages of the present invention will become apparent from considering the following detailed description in conjunction with the drawings in which:

FIG. 1 is a fragmentary sectional view of a fastener driving tool which embodies the present invention and which is shown in a condition immediately following the connection of the tool to a source of fluid pressure; and

FIG. 2 is a fragmentary sectional view similar to FIG. 1, illustrating the tool in a normal condition prior to operation.

Referring now more specifically to the drawings, therein is shown a pneumatically operated fastener driving tool, indicated generally as 10, which embodies the present invention and which is of any suitable construction. The illustrated tool 10 is of the same general type as that shown and described in detail in Wandel and Doyle Patent No. 3,043,272. This tool drives or sets fasteners, such as staples or nails, using a compressed fluid as a power source and, in accordance with the present invention, includes means for preventing inadvertent operation of the tool 10 when it is first connected to the compressed fluid or air source.

The tool 10, as described in the above-identified patent, includes a housing 12 having a head portion 12a with an open upper end and defining both a lower cylindrical chamber 14 of lesser diameter and an upper, generally cylindrical chamber 16 of greater diameter. Compressed air or pressurized fluid is normally supplied to the upper chamber 16 from a reservoir 18 formed in a hollow handle portion 12b of the housing 12. A cylinder 20 that is slidably mounted in the upper chamber 16 slidably receives the upper portion of a piston 22, the lower portion of which is slidably mounted in the chamber 14. A fastener driving blade 24 secured to the lower end of the piston 22 is adapted to engage and drive fasteners, such as staples or nails, supplied by a suitable magazine assembly (not shown). The open upper end of the chamber 16 is closed by a removable closure cap 26 on which a resilient main valve or valve seat 28 is carried.

In the normal condition of the tool 10, after it has been supplied with compressed air, a safety valve assembly 32

and a manually controlled valve assembly 34 are both in a released condition so that compressed air is supplied to the lower end of the chamber 16 from the reservoir 18. This compressed air forces the cylinder 20 to its uppermost position in which its upper end engages the valve seat 28 to close off communication between the interior of the cylinder and the chamber 16. In this position, the upper end of the cylinder 20 also actuates an exhaust valve assembly (not shown) carried on the closure cap 26 to an open condition in which the atmosphere is placed in communication with the interior of the cylinder. The compressed air supplied to the lower end of the chamber 16 also acts on the piston 22 to hold it in an elevated or a normal position.

When the two valve assemblies 32 and 34 are actuated, compressed air is no longer supplied to the lower end of the chamber 16, and this portion of the chamber is connected to the atmosphere. This produces a downwardly acting force differential across the cylinder 20 so that the cylinder moves downwardly away from the closure cap 26 and the main valve means 28. In moving downwardly, the upper end of the cylinder permits the exhaust valve assembly to close to prevent the compressed air in the upper portion of the chamber 16 from escaping to the atmosphere. The cylinder 20 also moves out of engagement with the valve seat 28 so that compressed air from the chamber 16 and the reservoir 18 enters the cylinder 20 to force the piston 22 downwardly. During this power stroke, the lower end of the driver blade 24 engages and sets the fastener.

The piston 22 remains in its displaced or lower position until such time as both valve assemblies 32 and 34 are released. The release of these valve assemblies supplies compressed air to the lower portion of the chamber 16 from the reservoir 18 so that the cylinder 20 is again moved upwardly to engage the valve seat 28 and to close the exhaust valve assembly so that the interior of the cylinder 20 is placed in communication with the atmosphere. The venting of the upper portion of the interior of the cylinder 20 together with the provision of compressed air to the lower portion of the chamber 16 elevates the piston to its normal position. The tool 10 remains in this condition until both of the valve assemblies 32 and 34 are next actuated.

The tool 10 operates in the manner described above when the reservoir 18 in the hollow handle 12b has been filled with a pressurized fluid or compressed air at full line pressure. However, when the tool 10 is first connected to a source of compressed air, there is a possibility that the piston 22 will only be partially returned to the normal position shown in FIG. 2 and that the cylinder 20 will be spaced from the main valve 28 in the manner illustrated in FIG. 1. It compressed air is supplied directly to the reservoir 18 with the tool 10 in the position shown in FIG. 1, there is a possibility that the air admitted to the reservoir 18 will drive the piston 22 downwardly independent of any actuation of the safety valve 32 and the manual valve assembly 34. To prevent this inadvertent operation, the tool 10 includes an inlet control assembly which is indicated generally as 36 and which controls the sequential application of the fluid to the operating means for closing the cylinder 20 and then to the reservoir 18.

The inlet control means 36 includes a valve body 38 which is threadedly mounted within an opening 40 in the rear end of the hollow handle 12b and which includes an internally threaded portion 42 for receiving a quick detachable connector or other means for connecting a flexible air line to the tool 10. To provide means for controlling the flow of air from the inlet line to the interior of the reservoir 18, the inlet control assembly 36 includes a valve element 44 formed of plastic material having both a reduced diameter cylindrical portion 44a that is slidably mounted in a reduced diameter bore 46 in the valve body 38 and a greater diameter piston portion 44b that

is slidably mounted in a greater diameter cylindrical portion 48 of the valve body. Sliding contact between the reduced diameter portion 44a and the bore 46 is sealed by a resilient O-ring 50 carried on the valve body 38, and the piston portion 44b is sealed within the wall of the larger bore or cylinder 48 by an O-ring 52 carried on the valve element 44. A compression spring 54 interposed between a shoulder connecting the bores 46 and 48 and the piston portion 44b of the valve member 44 biases the valve element 44 toward a closure plug 56 that is threadedly secured in the outer end of the bore 48 on the valve body 38 so that a tapered central portion 56a on the plug 56 engages and is seated in an axially extending opening 58 in the valve member 44. A passageway 59 through the valve body 38 connects the portion of the cylinder 48 disposed to the right of the piston portion 44b to the atmosphere. The engagement of the tapered portion 56a with the valve element 44 at the end of the opening 58 normally prevents the flow of compressed air from the air line through the opening 58 to interior of the reservoir 18 through a plurality of peripherally spaced openings 60 in the closure plug 56. Thus, the valve element 44 in the inlet control assembly 36 normally prevents communication between the reservoir 18 and the source of pressurized fluid or compressed air.

In its normal condition, the inlet control means 36 also includes means for directly supplying compressed air from the source directly to the fluid operated means for closing the cylinder 20 so as to insure that this cylinder is closed and that the piston 22 is retracted to its normal condition before compressed air is supplied to the reservoir 18. More specifically, the compressed air supplied through the threaded portion 42 in the normal condition of the assembly 36 (FIG. 1) passes through a port or passageway 62 to a somewhat annular space or cavity 64 in the rear portion of the hollow handle 12b which is sealed from communication with the reservoir 18 by an O-ring 65 carried on the valve body 38. An inlet end of a fluid conveying means or pipe 66 is disposed within the chamber or cavity 64 and an outlet end 66b thereof is disposed in communication with the lower end of the chamber 16. Although the tube 66 can be inserted in the housing 12 following its fabrication, this tube is preferably cast in the housing 12 during the formation thereof.

The compressed air supplied to the chamber 64 through the passageway 62 passes through the tube 66 and is supplied to the lower end of the chamber 16 as soon as an air line is connected to the tool 10 to provide means for moving the cylinder 20 upwardly so that its upper open end seats on and is closed by the main valve 28 (FIG. 2). This compressed air also acts on the greater diameter, upper portion of the piston 22 to retract the piston to the normal position shown in FIG. 2. In this manner, compressed air is first supplied to the fluid operated means for closing the open upper end of the cylinder 20 when compressed air is supplied to the tool 10.

This compressed air also passes from the lower portion of the cylinder 16 into the reservoir 18 through one or the other of the valve assemblies 32 and 34. Assuming that the safety valve assembly 32 is in the normal or released position illustrated in the drawings, the compressed air supplied to the lower end of the chamber 16 by the tube 66 flows through a passageway 68 in the housing and upwardly through a passageway 70 in the safety valve assembly 32 around a resilient valve element 72 in the assembly 32 to be discharged into the reservoir 18. This compressed air acts on the left-hand end surface of the piston portion 44b of the valve member 44 so that when sufficient compressed air has been supplied to the chamber 18, thus indicating that sufficient air has been provided for closing the cylinder 20, the force of the compressed air in the reservoir 18 overcomes the resilient bias provided by the spring 54. This shifts the valve element 44, from the normal position shown in FIG. 1 to

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the operated position shown in FIG. 2 which is determined by the engagement of the right-hand end of the reduced diameter portion 44a with a flange 74 formed in the valve body 38.

In moving to this position, the body of the reduced diameter portion 44a of the valve member 44 seals the port or passageway 62 to terminate the flow of compressed air through the tube 65 to the fluid operating means for closing the cylinder 20. This movement of the valve element 44 also moves the end of the axial passageway 58 therein away from the tapered valve seat portion 56a on the closure 56 so that the passageway 58 is opened. Compressed air from the inlet air line now flows through the axial bore 58 and the plurality of peripherally spaced passageways 60 in the closure 56 into the reservoir 18 and provides a body of compressed air in the reservoir 18 at substantially full line pressure. This compressed air holds the valve member 44 in engagement with the flange 74 so that the passageway 62 remains sealed and the reservoir 18 remains in continuous communication with the source of pressurized fluid.

The inlet control assembly 36 remains in this condition (FIG. 2) until the source of pressurized fluid is disconnected from the tool 10. At this time, the compressed air in the reservoir 18 is discharged to the atmosphere through the opening 42, and the compression spring 54 shifts the valve member 44 to the left from the position illustrated in FIG. 2 to the position illustrated in FIG. 1. In doing so, the tapered valve seat 56a again closes the axial bore 58 to interrupt communication between the reservoir 18 and the inlet to the tool 10, and the passageway 62 is opened so that when compressed fluid is next supplied to the tool 10 it is conveyed through the tube 66 directly to the fluid operated means for closing the cylinder 20.

Although the present invention has been described with reference to a single illustrative embodiment thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A fastener driving tool for use with a pressurized fluid source comprising a housing having a hollow handle forming a fluid reservoir and a head portion with a cylinder having an end open to the fluid in the reservoir, main valve means normally closing the open end of the cylinder, piston means slidably mounted in the cylinder, fluid operated means for opening and closing the end of the cylinder by producing separation of the main valve and the end of the cylinder, and control means for delaying the admission of pressurized fluid to the reservoir until the fluid operated means closes the end of the cylinder.

2. A fastener driving tool for use with a pressurized fluid source comprising a housing having a hollow handle forming a fluid reservoir and a head portion with a cylinder having an end open to the fluid in the reservoir, main valve means normally closing the open end of the cylinder, piston means slidably mounted in the cylinder, means for selectively separating the main valve and the cylinder to admit fluid from the reservoir to the cylinder to drive the piston from a normal position adjacent the main valve to a displaced position, fluid means for returning the piston to its normal position, and control means for delaying the admission of fluid to the reservoir until the fluid means returns the piston to its normal position.

3. A fastener driving tool for use with a pressurized fluid source comprising a housing having a hollow handle forming a fluid reservoir and a head portion with a cylinder having an end open to the fluid in the reservoir, main valve means normally closing the open end of the cylinder, piston means slidably mounted in the cylinder, fluid operated means for opening and closing the end of

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the cylinder by producing separation of the main valve and the end of the cylinder, normally closed inlet means for supplying pressurized fluid from the source to the reservoir, and control means for opening the inlet means to supply fluid directly from the source to the reservoir after the fluid operated means closes the end of the cylinder.

4. A fastener driving tool for use with a source of pressurized fluid comprising a housing with a hollow handle forming a fluid reservoir and with a cylinder having an end exposed to the fluid in the reservoir, fastener driving means including a piston slidably mounted in the cylinder, main valve means for closing the open end of the cylinder, fluid operated means selectively supplied with fluid from the reservoir for producing separation between the main valve and the cylinder end to open and close the cylinder, means for supplying fluid from the source to the fluid operated means to close the cylinder, and means for admitting fluid from the source to the reservoir after fluid has been supplied to the fluid operated means.

5. A fastener driving tool for use with a source of pressurized fluid comprising a housing with a hollow handle forming a fluid reservoir and with a cylinder having an end exposed to the fluid in the reservoir, fastener driving means including a piston slidably mounted in the cylinder, fluid operated means for opening and closing the open end of the cylinder, first means for supplying fluid from the source to the fluid operated means, second means for supplying fluid from the reservoir to the fluid operated means, and means responsive to fluid in the reservoir for rendering the first means ineffective.

6. A fastener driving tool for use with a source of pressurized fluid comprising a housing with a hollow handle forming a fluid reservoir and with a cylinder having an end exposed to the fluid in the reservoir, fastener driving means including a piston slidably mounted in the cylinder, fluid operated means for opening and closing the end of the cylinder, first means for supplying fluid to the fluid operated means, second means for supplying fluid to the fluid operated means, and means responsive to fluid in the reservoir for rendering the first means ineffective and for rendering the second means effective.

7. The fastener driving tool set forth in claim 6 including at least one valve means in said second means.

8. A fastener driving tool for use with a source of pressurized fluid comprising a housing with a fluid reservoir and a cylinder having an open end, fastener driving means including a piston slidable in the cylinder, fluid controlled means for selectively opening and closing the open end of the cylinder to admit fluid from the reservoir, inlet valve means for supplying fluid from the source to the reservoir and normally biased to the closed condition, and means for supplying fluid from the source to the fluid controlled means to close the open end of the cylinder, fluid from said fluid controlled means passing to the reservoir to operate the inlet valve means to connect the reservoir to the source of fluid.

9. A fastener driving tool for use with a source of pressurized fluid comprising a housing with a fluid reservoir and a cylinder having an open end, fastener driving means including a piston slidable in the cylinder, fluid controlled means for selectively opening and closing the open end of the cylinder to admit fluid from the reservoir, conveying means placing said fluid operated means in communication with the reservoir, fluid operated valve means for controlling communication between the reservoir and the source of fluid, and means for supplying fluid to the fluid operated means to close the open end of the cylinder, said fluid passing over the conveying means to the reservoir to operate the fluid operated valve to place the reservoir in communication with the fluid source.

10. A fastener driving apparatus for use with a source of pressurized fluid comprising a housing having a fluid reservoir and a cylinder with an open end, fastener driving

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means including a piston slidably mounted in the cylinder, fluid operated means for opening and closing the end of the cylinder, a valve controlled fluid passage between the reservoir and fluid operated means for controlling the application of fluid from the reservoir to the fluid operated means to control the opening and closing of the cylinder, fluid operated valve means for controlling the admission of fluid from the source to the reservoir, and means for supplying fluid to the fluid operated means independent of the valve controlled passage so that fluid flows from the fluid operated means to the reservoir to operate the fluid operated valve.

11. A fastener driving apparatus for use with a source of pressurized fluid comprising a housing having a fluid reservoir and a cylinder with an open end, fastener driving means including a piston slidably mounted in the cylinder, fluid operated means for opening and closing the end of the cylinder, a valve controlled fluid passage between the reservoir and the fluid operated means for controlling the application of fluid from the reservoir to the fluid operated means to control the opening and closing of the cylinder, first fluid operated valve means responsive to the fluid in the reservoir for connecting the fluid source to the reservoir, and second fluid operated valve means responsive to fluid in the reservoir for connecting the fluid source to the fluid operated means.

12. A fastener driving apparatus for use with a source of pressurized fluid comprising a housing having a fluid

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reservoir and a cylinder with an open end, fastener driving means including a piston slidably mounted in the cylinder, fluid operated means for opening and closing the end of the cylinder, a valve controlled fluid passage between the reservoir and the fluid operated means for controlling the application of fluid from the reservoir to the fluid operated means to control the opening and closing of the cylinder, fluid inlet means to the housing connected to the fluid source, fluid conveying means between the fluid operated means and the fluid inlet means, valve means normally preventing communication between the fluid inlet means and the reservoir and providing communication between the fluid inlet means and the fluid conveying means, and means responsive to fluid in the reservoir for operating said valve means to prevent communication between the fluid inlet means and the fluid conveying means and to establish communication between the fluid inlet means and the reservoir.

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