Oct. 11, 1966 C. SIEGMANN 3,278,102

DEVICE FOR DRIVING FASTENERS

Filed May 20, 1964 2 Sheets-Sheet 1

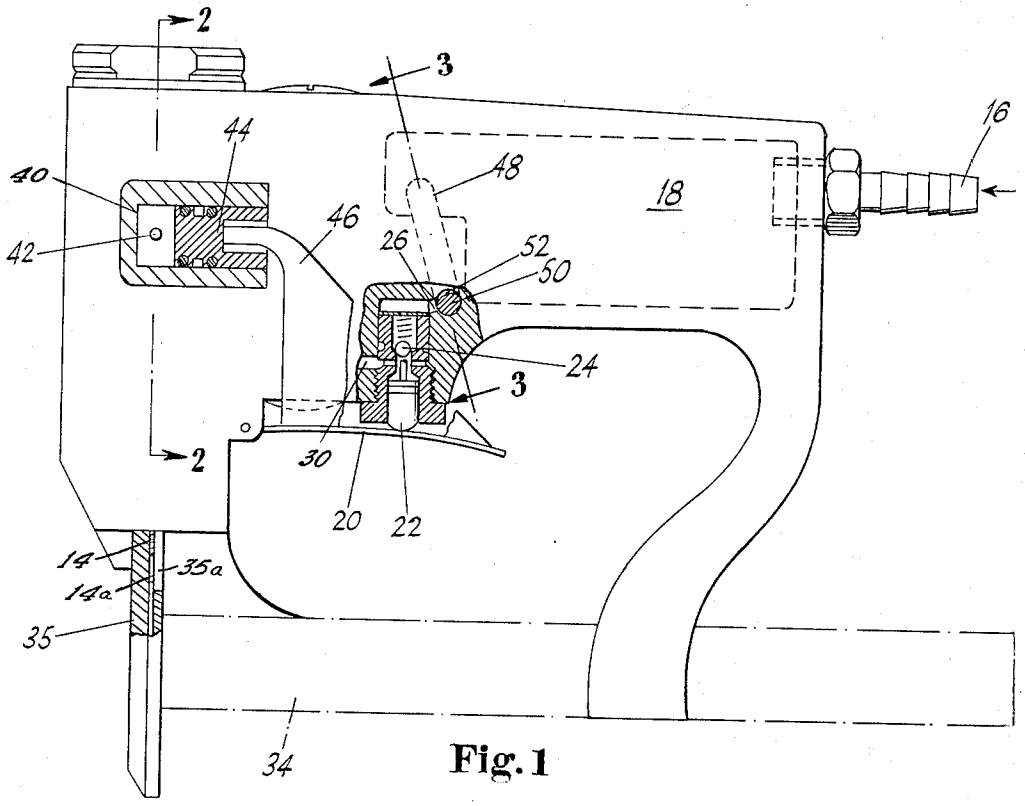


Fig. 1

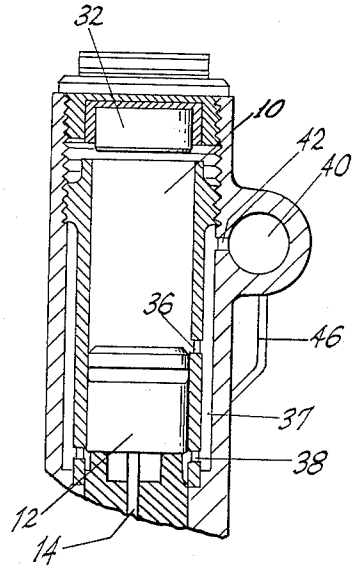


Fig. 2

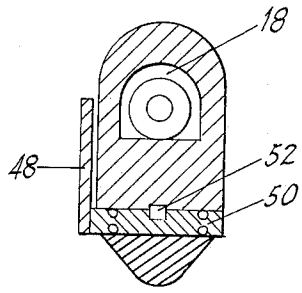


Fig. 3

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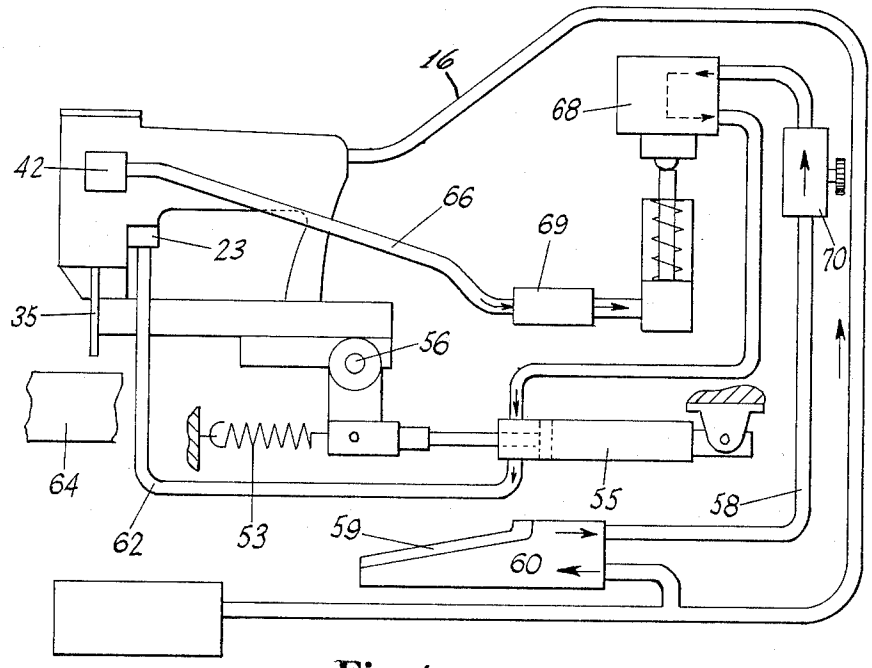


Fig.4

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DEVICE FOR DRIVING FASTENERS

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11 Claims. (Cl. 227—130)

The invention pertains to pneumatic fastener applying devices, particularly stapling and nailing devices, with a working piston performing single percussive working strokes upon actuation of control means. A well known exemplary embodiment of a pneumatic fastener applying device to which this invention may be applied is described in United States Patent No. 2,982,922 in the name of A. G. Juilfs.

In a pneumatic fastener applying device with a piston performing a working stroke upon each actuation of the firing valve, in response to said control means even a skilled operator is unable to operate the device with the maximum stroke sequence at which the device is actually able to operate. The reason for this is that the operator is not in a position to actuate with his fingers or with his foot the control means, which directly or indirectly controls the air supply to the cylinder, with such a speed that the device can operate at its maximum stroke capacity. For modern stapling devices, maximum stroke capacity can vary from 200 to 1000 strokes per minute.

Attempts have already been made to increase the stroke sequence of pneumatic fastener applying devices by inserting in the compressed air conduit leading to the working cylinder, means for periodically interrupting the air supply; one such instance involves inserting in the line a rotary valve means which periodically opens and closes this conduit and which is actuated by a small regulatable electric motor. This arrangement, which considerably complicates the design of the apparatus, has not proven satisfactory.

In contradistinction to this prior art, an object of this invention is to provide a design permitting pneumatic fastener applying devices of the above mentioned type to operate with a very rapid stroke sequence, this design depending primarily on pneumatic means. No additional power supply is required for this design.

According to this invention, the problem is solved by feeding some of the compressed air actuating said piston to a pneumatic auxiliary means, during a short time interval towards the end of a working stroke, said auxiliary means closing briefly the firing valve for the compressed air actuating the working piston. This cycle will continue as long as the control means is held in actuated position.

The novel apparatus for carrying out the object is to be of extremely simple design and of such construction that it can be installed in a simple manner in devices already used in industry.

In one modification of the novel apparatus there is provided a pneumatic auxiliary means with an actuating member, the driven side of said actuating member being in communication with an aperture disposed in the wall of the working cylinder in such a manner that compressed air actuating the working piston can pass through said aperture at the end of the working stroke of said working piston, and the driving side of said actuating member being operatively connected with said control means.

In another modification of the novel apparatus, the actuating member of an auxiliary means which communicates on its driven side with a working cylinder wall passage through which compressed air impinging on the working piston flows, constitutes either itself a control valve disposed in a line for compressed air effecting pneumatic actuation of the firing valve, or is operatively connected to such a control valve.

In pneumatic fastener applying devices including a by-pass space, into which air for effecting the return of the piston enters from the working cylinder, the auxiliary means can be in communication with said by-pass space.

Preferably a piston or a diaphragm is used as the actuating member of the auxiliary means.

If the control means of the fastener applying device includes a manually actuated trigger, a linkage consisting of one or of several parts can serve for transmitting the working movement of the actuating member of the auxiliary means to the trigger.

An advantageous further modification of the invention resides in providing a pneumatic fastener applying device equipped with a novel auxiliary means for permitting a desired number of repetitive actuations of the device, with a further means for effecting changes in the frequency of the blows. Such further means permit adaptation of the blow frequency to the individual working operation performed by the device at a given time. If, for instance, a pneumatic stapling device is used for staples arranged in a straight row so that the device will only have to be moved along this straight line a short distance from one stapling position to the next, it is desirable to operate the stapling device with a more rapid blow frequency than in work where the driving positions are spaced farther apart or in work in which the positions where staples are to be driven are disposed at an angle so that the operator will have to turn the device during operation. The provision of such a blow frequency control means enables the operator to select a suitable blow frequency for a given type of work.

For instance, in a fastener applying device provided with a pneumatically actuated firing valve, to which the actuating air is fed via a trigger responsive control means in communication with the air feed line, such a blow frequency control means can comprise a manually actuated throttling means provided in the conduit connecting said air feed line to said control means. If such a throttling means is so operated that the amount of air supplied to the pneumatically actuated firing valve is reduced, more time will be required for opening the firing valve, so that the blow frequency will be decreased.

The novel auxiliary means can also be used in arrangements in which the fastener applying device is fixedly arranged above a table for supporting the work into which staples etc. are to be driven and in which the work is moved, either automatically or by the operator in such a way that the position for driving the next staple is disposed below the driver of the fastener applying device. Such fixedly disposed fastener applying devices work as a rule in such a manner that the device is rotated after each working stroke for lifting the driver off the workpiece. Rotation of the device away from the workpiece is customarily effected by spring means; and the subsequent rotation of the device into engagement with the workpiece is achieved by means of a pneumatically actuated additional means. On operation of this additional means, the air inlet or firing valve for the working piston is approximately simultaneously actuated. The control means which is usually actuated by the operator with his foot, is located in the air line leading to the additional means, which air line is in communication with the air feed line to the firing valve of the fastener applying device. In fastener applying devices arranged in the above described manner the auxiliary means is disposed in the air line leading to the additional means, and the actuating member of the additional means can either be the control valve for this line or can be a member actuating such control valve.

Modifications of the invention are described in the following part of the description with reference made to the accompanying schematic drawings.

In the drawings:

FIG. 1 shows in side elevation a stapling device of customary design which is provided with a novel auxiliary means partly shown in section;

FIG. 2 is a sectional view along the line 2—2 of FIG. 1;

FIG. 3 is a sectional view along the line 3—3 of FIG. 1; and

FIG. 4 is a schematic view of an auxiliary means for a rotatably arranged stapling device.

On the front end, i.e. the left hand end, of the pneumatic stapling device shown in FIG. 1 the working cylinder **10** is provided in the usual manner (see FIG. 2) with the working piston **12** having the driver **14** attached thereto. In the right hand end of the device there is provided a compressed air reservoir **18** connected by a conduit **16** to a compressed air source (not shown).

For operating the device the operator actuates the trigger **20** thereby lifting piston **22** which opens the control means valve **24** connected by a passage **26** with the air reservoir **18**. When the valve **24** opens, compressed air flows through a passage **30** and opens the firing valve (not shown) of the device. The compressed air then flows from reservoir **18** through the opened firing valve to the upper end of cylinder **10** and drives the working piston **12** downwardly with great force, after overcoming the holding force of a magnet **32** holding this piston in its inoperative position. In this manner a staple which is pushed out of the staple magazine **34** into the guide means **35** of the driver is driven into the workpiece.

If the piston has reached its lowermost driving position (shown in FIG. 2), working air can pass into by-pass space **37** through aperture **36**. The air entering the by-pass space **37** passes through aperture **38** to the lower side of the working piston. If the trigger **20** is then released by the operator and goes back to its initial position, the control means valve **24** closes and the compressed air holding the piston of the firing valve (not shown) in its upper or opened position is vented. The firing valve is then closed by its biassing spring and the space of the cylinder **10** above the working piston **12** is vented in the usual manner. The air in by-pass space **37** then returns the working piston to its upper position in which it is held by magnet **32**. During this return stroke, the driver **14** which is provided with a cut-out portion **14***a* effects a connection between the lower part of the cylinder and a venting opening **35***a* provided in the guide means **35** of the driver. As the speed imparted to the piston by the by-passed air (before the lower part of the cylinder is connected to atmosphere by the venting opening), is very considerable, the piston can engage the magnet in spite of the existence of the venting connection. A new cycle of operation is then initiated by actuating trigger **20**.

In prior known fastener applying devices the operator had to release the trigger at the end of each working stroke and had to push the trigger upwardly to initiate the next cycle. The maximum possible speed of the device was therefore dependent on the manual dexterity of the operator. However, even the most skilled operator was not able to reach the highest possible operating sequence of the device, which resulted in the above referred to disadvantages which are avoided by the novel method according to the invention.

The modification of the auxiliary means shown in FIGS. 1–3 for carrying out the novel method comprises the following principal parts: a small auxiliary cylinder **40** arranged at the front portion of the device; a passage **42** connecting this auxiliary cylinder **40** with the by-pass space **37**; an auxiliary piston **44** within said cylinder; and a linkage comprising an interconnecting lever **46** made of metal or plastic operatively connecting this piston **44** with trigger **20**. In the shown modification this lever which is provided at its one end with a lug penetrating into the interior of the auxiliary piston **44** is engaging the trigger **20** with its other end, and may be fixedly connected thereto.

The operation of the auxiliary means is as follows. If the working piston **12** has reached its lowermost position shown in FIG. 2 and the by-pass space **37** has been filled with working air, this working air flows through passage **42** into the auxiliary cylinder **40** and forces the auxiliary piston **44** outwardly. The piston moves the interconnecting lever **46** in such a way that it exerts on the trigger a pressure which is larger than the pressure exerted thereon by the operator's hand. The trigger is thus forced downwardly to its normal position. In this normal position the piston **22** permits the control means valve **24** to assume its closed position and at the same time the space below the piston of the firing valve (not shown) is vented, closing this valve. The working piston is then returned by the pressure of the by-passed air in space **37** to its initial position; the pressure in the by-pass space **37** and also the pressure in the auxiliary cylinder is decreased to the pressure of the ambient atmosphere via the cut-out portion **14***a* of the driver and the vent opening **35***a* in the guide means. The trigger is then lifted again by the pressure continuously exerted by the operator and a new working cycle is initiated.

The auxiliary cylinder **40** is so dimensioned that the air pressure exerted in it on the piston can easily overcome the pressure exerted by the operator on the trigger. The stroke of the auxiliary piston is only small. It is of course possible to provide a spring holding the auxiliary piston in engagement with the interconnecting lever **46**. In practice the periodically exerted counter pressure is hardly felt by the operator who continuously presses the trigger **20** upwardly with his hand.

After the new auxiliary means has been installed, the fastener applying device can work with its maximum speed. However, as already mentioned this maximum speed can be too high for certain operations. In order to enable the operator to adjust the device in such a way that it operates with a desired operating sequence, there is provided in the air line **26** to the control means valve **24** a throttling means comprising a cylindrical throttle valve **50** provided with a handle **48**. The throttling orifice **52** of the throttle valve is preferably of half-moon shape which has proven particularly favorable for a fine adjustment of this valve. By throttling the air passing through the control means valve **24** the time required for opening the pneumatically actuated firing valve is increased, thereby decreasing the stroke sequence.

Inasmuch as for some operations the periodically repeated drive effected by the auxiliary means may not be desirable, the operator can shut down the auxiliary means. The means for effecting such shutdown can for instance be the auxiliary piston **44** itself which by finger pressure or by mechanical means or the like is shifted to a position in which it closes bore **42**.

In the embodiment of the invention shown schematically in FIG. 4 on a smaller scale, the fastener applying device is rotatably arranged and can during the operation be rotated against the biasing force of a spring **53** about axis pivot **56** by means of a piston cylinder mechanism **55** which is connected by an air line **58** with the air feed line **16**. Air flowing through line **58** is controlled by a valve **60** actuated by the operator's foot by means of a lever **59**. Line **58** is in communication with the piston cylinder mechanism **55** and with a line **62** which is connected to the control means valve **23**. When actuating the foot control valve **60**, the fastener applying device is so rotated by the piston cylinder mechanism **55** that the guide means **35** for the driver engages the workpiece **64**. During this action lines **58** and **62** are supplied with compressed air, so that the firing valve of the fastener applying device opens and a staple is driven into the workpiece. When releasing lever **59** lines **58** and **62** are vented

through valve 60. Spring 53 then rotates the device upwardly and the firing valve closes.

The novel method of this invention can easily be adapted to control a fastener applying device as just described. The actuating element of the auxiliary means can be designed as a spring biased piston valve 68, the driven side of which communicates with the by-pass space 37 by means of a line 66 connected to passage 42. When the pressure of the by-passed air actuates valve 68, this results in venting of line 62 and of that part of line 58 which leads to the piston cylinder mechanism 55. This occurs although the operator maintains valve 60 in its opened position. When the pressure in line 66 drops, valve 68 opens filling lines 58 and 62, so that the cycle is repeated, provided that valve 60 is still open.

Into line 58 a throttling device 70 is inserted which has the same function as the throttle valve 50 of the first modificaton.

Furthermore there is provided in line 66 a cut-out valve 69 by which the auxiliary device can be made inoperable.

It will of course be understood that various modifications can be made in this invention without departing from its scope or spirit. For example, the piston in the auxiliary cylinder might readily be replaced by a conventional diaphragm member. Accordingly, no limitations are intended except insofar as set forth in the claims which follow.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a pneumatic fastener applying device including a piston movable in a cycle consisting of a working stroke and a return stroke, manually actuated control means for initiating said working and return strokes, a driver connected to said piston, a drive track, and means for successively feeding a fastener into said drive track in a position to be driven by said driver after each return stroke of said piston, the improved control structure comprising pneumatic means for initiating and sustaining repetitive cycling of said piston so long as said control means is actuated.

2. A pneumatic fastener applying device comprising:

(a) a piston movable in a cycle consisting of a working stroke and a return stroke;

(b) a driver connected to said piston;

(c) a drive track;

(d) manually actuated control means for initiating said working and return strokes;

(e) means for successively feeding a fastener into said drive track in a position to be driven by said driver after each return stroke of said piston; and

(f) pneumatic means for initiating and sustaining repetitive cycling of said piston so long as said control means is actuated.

3. In a pneumatic fastener applying device including a working cylinder consisting of a piston movable in a cycle having working stroke and a return stroke, manually actuated control means for initiating said working and return strokes, a driver connected to said piston, a drive track, and means for successively feeding a fastener into said drive track in a position to be driven by said driver after each return stroke of said piston, the improved control structure comprising:

(a) a valve communicating with said working cylinder during at least a portion of said working stroke effective to by-pass a portion of the compressed fluid actuating said piston; and

(b) means responsive to said by-passed compressed fluid for initiating and sustaining repetitive cycling of said piston so long as said control means is actuated.

4. A fastener applying device including a piston movable in a cycle consisting of a working stroke and a return stroke control means for initiating said strokes, and means

for successively feeding a fastener into a position to be driven by said piston after each return stroke, characterized by a pneumatic auxiliary means having an aperture communicating with said working cylinder and including an actuating member, the driven side of said actuating member being in communication with the compressed air actuating said piston during at least a portion of its cycle through said aperture, whereby said compressed air actuating said working piston can pass through said aperture to move said actuating member, and the driving side of said actuating member being operatively connected with said control means

5. A device according to claim 4 including a by-pass space receiving air at the end of said working stroke from said working cylinder for effecting the return of said piston, said auxiliary means communicating with said by-pass space.

6. A device according to claim 4 wherein the operative connection between said actuating member and said control means comprises a linkage serving to transmit the working movement of the actuating member of the auxiliary device to control means.

7. In a pneumatic fastener applying device including a working cylinder having a piston movable in a cycle consisting of a working stroke and a return stroke, means controlling admission of fluid power into said cylinder, a driver connected to said piston, a drive track, and means for successively feeding a plurality of fasteners into said drive track in a position to be driven by said driver after each return stroke of said piston, the improved control structure comprising;

(a) manually actuated control means movable from an inoperative position to an operative position;

(b) auxiliary means movable from a first position to a second position, whereby when said auxiliary means is at said first position, movement of said manually actuated control means from said inoperative position to said operative position is effective to cause said device to perform the working stroke of its cycle, and the return of said manually actuated control means from said operative position to said inoperative position is effective to cause said device to effect the return stroke of its cycle; and

(c) pneumatic means effective only when said auxiliary means is at said second position for initiating and sustaining repetitive cycling of said piston so long as said manually actuated control means is in said operative position.

8. A device according to claim 1 including manually adjustable throttling means associated with said control means.

9. A device according to claim 2 including manually adjustable throttling means associated with said control means.

10. In a pneumatic fastener applying device for use with a supply of fluid under pressure including a working cylinder having a piston movable in a cycle consisting of a working stroke and a return stroke, manually actuated control means for initiating said working and return strokes, a driver connected to said piston, a drive track, and means for successively feeding a fastener into said drive track in a position to be driven by said driver after each return stroke of said piston, the improved control structure comprising:

(a) a valve communicating with said supply of fluid under pressure during at least a portion of said cycle and effective to by-pass a portion of said fluid under pressure; and

(b) means responsive to said by-passed fluid under pressure for initiating and sustaining repetitive cycling of said piston so long as said control means is actuated.

11. An apparatus for controlling pneumatic fastener applying devices including a working piston performing a cycle consisting of a working stroke and a return stroke

upon actuation of a control means, and means for feeding a fastener into position to be driven after each return stroke of said piston, characterized by means for admitting compressed air to actuate said working piston in a working stroke, pneumatic auxiliary means to actuate said piston in a return stroke, and means for feeding some of the air actuating said working piston to said pneumatic auxiliary means during a short time interval toward the end of said working stroke, said pneumatic auxiliary means closing only briefly said means for admitting compressed air, whereby said cycle is repeated so long as said control means is held in its actuated position.

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