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Pålsson et al.

[11] **3,786,286**

[45] **Jan. 15, 1974**

[54] **SELF-INTERRUPTING RECIPROCATING MOTOR**

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[52] **U.S. Cl.** **310/34,** 310/50, 227/131

[51] **Int. Cl.** **H02k 33/10**

[58] **Field of Search** 310/34, 35, 50; 227/131; 318/125

[56] **References Cited**

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3,347,438 10/1967 Doherty ..... 310/34 X

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1,290,830 3/1962 France 227/131

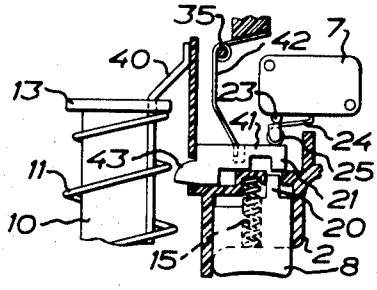
Primary Examiner—D. F. Duggan

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[57] **ABSTRACT**

Electrically operated stapler, nailer or the like comprising a solenoid the armature of which is part of a piston means and which provides a driving force for a staple, nail or the like, circuit means for supplying at least part of the half periods of an alternating current to said solenoid as long as a switch is actuated and means for inhibiting actuation of said switch by manually actuable means in a stroke of said piston means and until release of the last named means for renewed actuation thereof.

4 Claims, 2 Drawing Figures



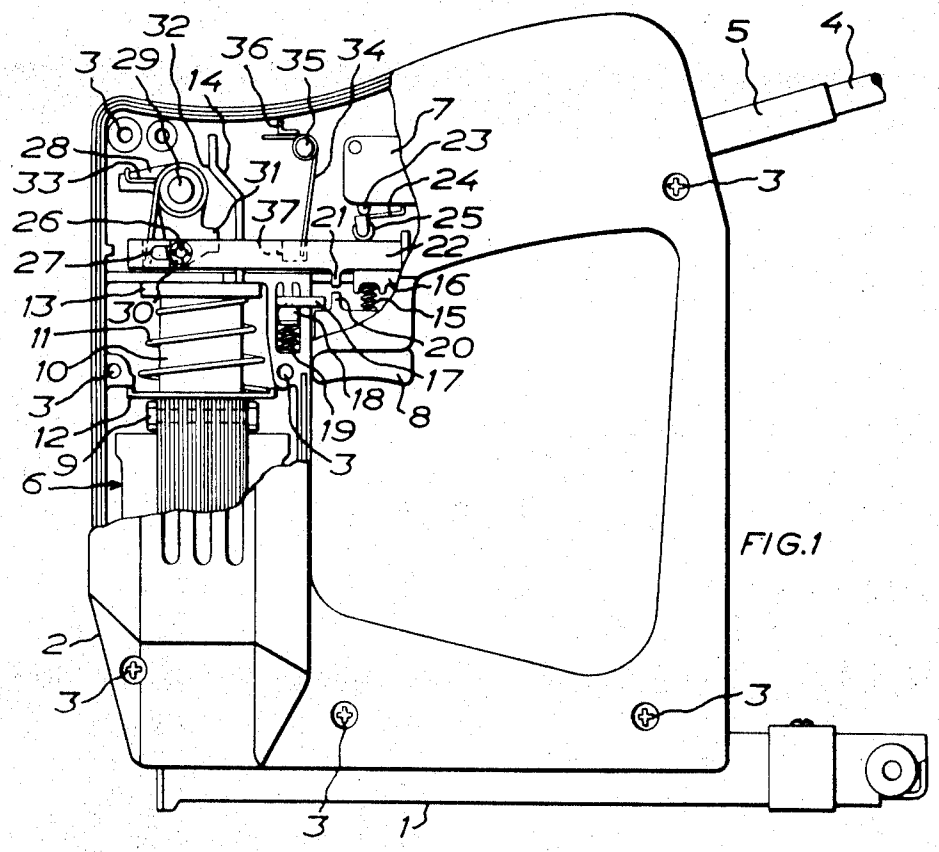

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FIG.1

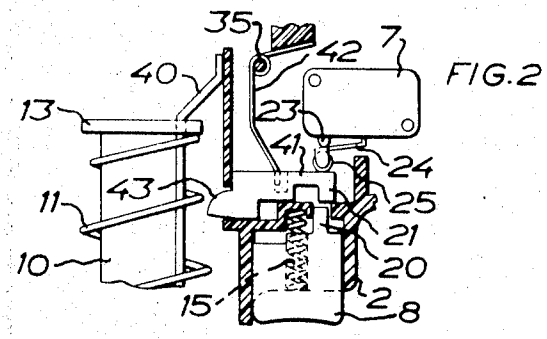

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FIG.2

SELF-INTERRUPTING RECIPROCATING MOTOR

This invention relates to a device for providing a stroke of a piston means which at least partially is in the form of an armature for a solenoid and specifically but not exclusively an electrically operated portable stapler or nailer.

Electrically operated portable prior art staplers often are of a complicated construction and as a consequence very costly. Moreover, prior art staplers are less reliable as their energization mostly is controlled solely electronically so that a fault in a component can produce serious risks. An example of such a stapler is described in U.S. Pat. No. 3,179,866.

One object of the present invention is to provide an improved device for providing a stroke of a piston means so that the stapler, nailer or the like will be less complicated and more reliable.

The device according to the present invention comprises an alternating current source for supplying said solenoid, switch means for connecting said alternating current source to said solenoid, manually actuable means for operation of said switch means, means for supplying at least part of the half periods of said alternating current to said solenoid as long as said switch means is actuated by said manually actuable means, and means for inhibiting said operation of said switch means by said manually actuable means in said stroke of said piston means and until release of said manually actuable means for renewed actuation thereof.

Two embodiments of the present invention will be described more in detail hereinbelow with reference to the accompanying drawings in which:

FIG. 1 is a view of a stapler equipped with a device according to the present invention, certain parts having been broken away to visualize the detailed inner construction thereof;

FIG. 2 is a partial section of another embodiment of the device according to the invention.

The stapler illustrated is for electric ejection of a staple from a magazine of staples **1.** This staple magazine may be of any conventional construction whatever and will not be described in detail as it is no part of the present invention. The stapler has a molded casing **2** of plastic which can be taken apart and is divisible into two halves which are kept together by screws **3** extending through the two halves of the casing. The stapler is connectible to an electric A.C. source by means of an electric cable **4** which in the proximity of the casing **2** has a relieving socket **5** to avoid damage to the cable **4** at the point where it is secured in the casing **2.**

The cable **4** serves to supply alternating current to an electric circuitry for feeding electric pulses to a solenoid **6** as long as an electric switch **7** is kept actuated by means of a trigger **8.** This circuitry may be the one described in our copending U.S. Pat. application Ser. No. 216,755 filed Jan. 10, 1972, in which the inventors are Sven Gunnar Pålsson and Jan Bertil Janocha.

The circuitry described in the above mentioned patent application operates as follows. As long as the switch **7** is kept actuated and thus closed, the coil winding of the solenoid **6** will be supplied with the positive half periods of the alternating current fed to the stapler through the cable **4.**

The solenoid **6** in the first embodiment comprises a coil body which carries a coil winding connected to the electric circuitry. The coil body carrying the coil winding furthermore has a U-shaped iron core which consists of a plurality of sheet metal strips which are held together by bolts **9.** It should be observed, however, that the iron core is closed so as to form a closed magnetic circuit for amplifying the magnetic field generated by the coil winding. This magnetic field serves to retract an armature **10** into the coil winding and thus to produce a stroke by which a staple is ejected from the magazine **1.** The armature of piston **10** is spring loaded towards the position illustrated in the drawing by means of a spring **11** which is interposed between a spring supporting washer **12** and an end plate **13** on the piston **10.** Further, the piston **10** carries a guiding curve **14** which is carried along by the piston in the operating stroke thereof.

As already pointed out the trigger **8** serves to actuate the switch **7.** The trigger **8** is movable between the two halves forming the casing and is spring loaded towards the position illustrated in the drawing by means of a spring **15.** The spring **15** is disposed between a stationary part **16** of the casing **12** and extends into a recess (not shown) formed in the trigger **8.** To prevent unintentional actuation of the trigger **8** there is provided a safety means **17** which consists of a plate which is movable upward out of and downward into the plane of the drawing. The plate is movable between two positions, and in one position the plate has a notch aligned with the trigger **8.** Upon alignment of the notch and the trigger **8** the latter can be moved past the safety plate. For retention of the safety plate **17** in the two different positions the plate has two cup-shaped recesses into which fits a ball **18.** A spring **19** urges the ball **18** against the safety plate. The trigger **8** furthermore has a projection **20** which when the parts occupy the normal or rest position illustrated in the drawing is positioned opposite a projection **21** arranged on an operating arm **22.** Upon actuation of the trigger **8** the projection **20** will thus engage the projection **21** on the operating arm **22,** pressing said arm against the switch **7** which has a plunger **23** intended for closure of the switch and operable by means of an arm **24** which is pivotally mounted in the switch **7** and carries a roller **25** at its free end. When the operating arm **22** is pressed against the switch **7** the arm **24** will thus be swung against the plunger **23,** urging it into the switch **7** and providing closure thereof. The arm **24** and/or the plunger **23** is spring-loaded towards the position illustrated in the drawing.

At the closure of the switch **7** the positive half periods of the alternating current supplied to the stapler are fed via the above described circuitry to the solenoid **6** as long as the switch **7** is kept closed.

The operating arm **22** is disposed on a pin **26** which extends through an elongate hole **27** in the operating arm **22** and is secured to a rocking member **28** having two arms and being pivoted to a shaft **29.** A spring washer **30** is disposed on the end of the pin **26** to retain the operating arm on said pin, whereby the operating arm **22** is movably retained to the pin **26** between the arm on the rocking member **28** carrying the pin and the spring washer **30.** The arm of the rocking member **28** carrying the pin **26** moreover has a cam follower surface **31** which is intended to cooperate with a guiding surface **32** on the guiding curve **14.** The other arm of the rocking member **28** serves to retain one end of a spring **33** which is wound one or more turns about the rocking member **28** and the other end of which extends

into a recess formed in the operating arm 22, whereby said arm 22 is urged towards the position illustrated in the drawing and a possible pivotment of the rocking member clockwise results in the operating arm 22 being moved to the left from the position illustrated in the drawing. Such a clockwise pivotment of the rocking member 28 is realized by means of the guiding curve 14 upon engagement between the cam surface 32 and the cam follower surface 31. This engagement is realized at a stroke of the piston 10.

At each stroke of the piston 10 the rocking member 28 will thus be pivoted clockwise and move the operating arm 22 to the left, whereby the projection 21 is moved out of alignment with the projection 20. As soon as the projection 21 has been moved away from the projection 20 actuation of the trigger 8 will not result in any actuation of the switch 7 since the operating arm 22 is urged towards the position shown in the drawing by means of the arm 24 which is spring-loaded in a direction away from the switch 7. As soon as the piston 10 has returned to the position illustrated in the drawing the operating arm 22 is returned to the position illustrated in the drawing on the one hand by means of the spring 33 and on the other hand by means of a further spring 34 which is arranged on a pin 35 and one end of which is supported on a stationary part 36 of the casing, while the other end thereof extends into a recess 37 formed in the operating arm 32.

Although the above mentioned circuitry supplies positive half periods to the solenoid 6 as long as the switch 7 is closed, the solenoid will be supplied with half periods for the time that elapses until the piston has moved so far a distance that the guiding curve 14 has actuated the rocking member 28 so much that the operating arm has moved so far to the left that the projection 21 has released the projection 20 each time the switch 7 is closed by means of the trigger 8, since actuation of the switch 7 by means of the trigger 8 is interrupted by the displacement of the operating arm 22 with the aid of the cam 32 and the rocking member 28 before the piston 10 has reached the end of its stroke. If the trigger 8 is retained in actuated condition the projection 21 of the operating arm 22 after one stroke will rest on the projection 20 of the trigger 8, whereby a renewed actuation of the switch 7 must be preceded by a release of the trigger 8 in order that the projections 20 and 21 shall again occupy the position illustrated in the drawing.

The embodiment illustrated in FIG. 2 gives exactly the same function of the stapler or nailer as that shown in FIG. 1. Like parts in the two figures carry the same reference numerals. All hatched parts in FIG. 2 are comprised in the plastic casing 2. The main difference resides in the configuration of the guiding curve 40 which is secured to the piston 10, and the operating arm 41 which carries the projection 21 cooperating with the projection 20 arranged on the trigger 8. The spring 42 urging the operating arm 41 towards the position shown in FIG. 2 has a slightly different configuration from that in FIG. 1. One end of the spring 42 is supported on a part of the casing while the other end of the spring rests in a recess formed in the operating arm 41. The operating arm 41 has a cam surface 43 which projects into the path of the guiding curve 40, and at a stroke of the piston 10 the curve will engage the cam surface 43, urging the operating arm 41 against the force of the spring 42, whereby the projection 21 is moved away from the projection 20 and the trigger 8 remains inoperative like in the embodiment according to FIG. 1.

With the use of the above described circuitry the stapler according to the present invention can be equipped with an extremely simple and inexpensive and reliable circuitry for supplying the solenoid 6 with electric current, and by the mechanical guiding of the actuation of the switch 7 there is obtained a very reliable and safe function since interruption of the pulses fed to the solenoid 6 takes place by positive mechanical means and not electronically as in the prior art constructions.

While two embodiments of the present invention have been described and shown it is obvious to those skilled in the art that many modifications may be resorted to within the scope of the invention defined in the appended claims. The present invention must not either be considered restricted to the use of the stapler but is applicable in any apparatuses whatever in which it is desired to provide some kind of solenoid armature.

What we claim and desire to secure by Letters Patent is:

1. In an electrically powered device having a solenoid with a moveable armature, and a switch connected to said solenoid to deliver thereto electrical power for moving said armature, the improvement which comprises in combination a trigger moveable between an operate position and a non-operate position, a switch actuator supported independently of said trigger and moveable between a first position and a second position, said switch actuator when in said first position being responsive to the movement of the trigger to said operate position to set the switch in a closed state, said switch actuator when in said second position being non-responsive to the movement of the trigger and disposed to set the switch in an open state, and means coupled to said switch actuator and responsive to the movement of said armature to move said switch actuator to said second position when the armature moves to a working position, and to move said switch actuator to said first position, when the armature returns to a rest position.

2. The improvement according to claim 1 wherein said switch actuator and trigger have respective contact surfaces disposed for engagement when said switch actuator is in said first position, and disposed out of engagement when said switch actuator is in said second position.

3. The improvement according to claim 1 wherein said means coupled with the switch actuator and respective to the movement of said armature includes means defining a cam surface moveable with said armature and a pivotally moveable follower member coupled to said switch actuator and disposed for movement upon engagement by said cam surface.

4. The improvement according to claim 1 including resilient means biassing said trigger into said non-operate position and biassing said switch actuator toward said first position.

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