United States Patent [19]

Zakrewsky et al.

[11] **3,766,455**

[45] **Oct. 16, 1973**

[54] **ELECTROMAGNETICALLY OPERATED STAPLER**

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[22] Filed: **Aug. 9, 1972**

[21] Appl. No.: **278,973**

[30] **Foreign Application Priority Data**

Aug. 20, 1971 Germany ..... P 21 41 776.5
June 2, 1972 Germany ..... P 22 26 788.5

[52] **U.S. Cl.** **318/135,** 227/131, 310/14, 310/30, 310/50

[51] **Int. Cl.** **H02p 1/18,** B27f 7/22

[58] **Field of Search** 310/14, 30, 50, 195; 318/135; 227/131

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Assistant Examiner—H. Huberfeld
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[57] **ABSTRACT**

The operating winding of an electromagnetically operated stapler is in the period of time during the working stroke connected with a capacitor the discharge current of which energizes said winding with a strong current surge whereby a high impact power for driving staples into a work piece is achieved. During the charging period the capacitor is separated from said winding and joined to an alternating current source.

14 Claims, 3 Drawing Figures

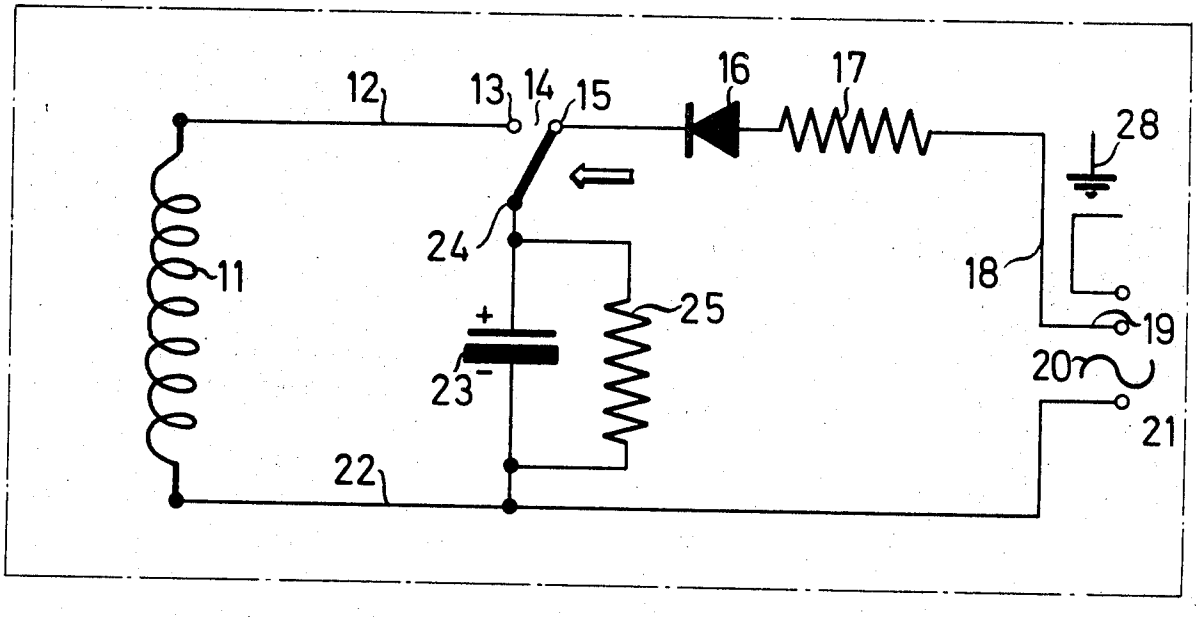
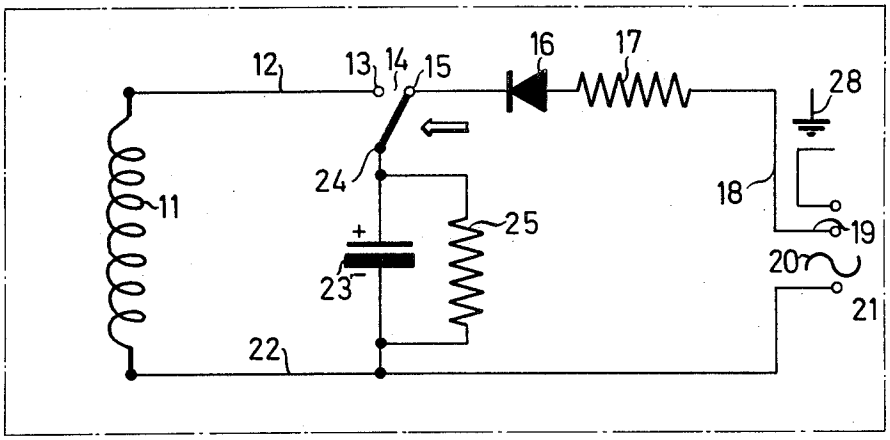


Fig. 1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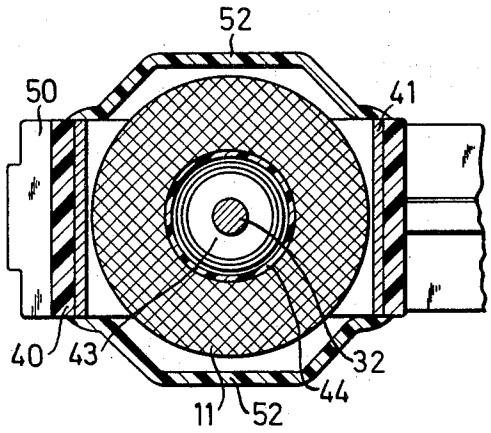
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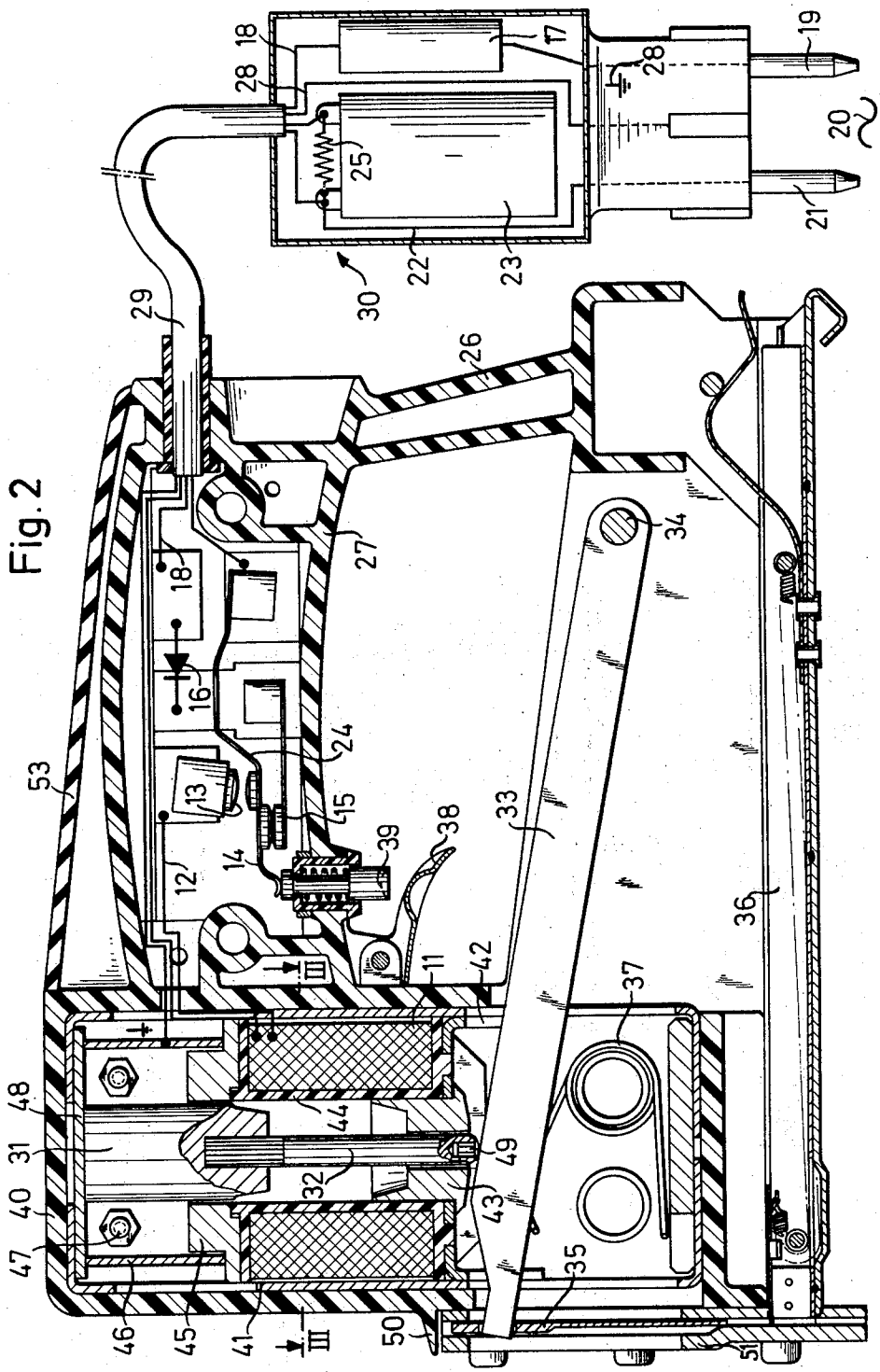
Fig. 3

Fig. 2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ELECTROMAGNETICALLY OPERATED STAPLER

DESCRIPTION OF THE INVENTION

The invention relates to an electromagnetically operated tool and, more particularly, to an electromagnetically operated stapler for driving fastener means such as staples, nails or similar means into a work piece. It is desirable to complete the operation performed by such tools in a single power stroke rather than to apply repeated blows to the staple, nail or other fastening means. This necessitates with electromagnetically operated tools a large induced magnetic field acting on an armature of the operating winding in order to deliver a sufficient amount of output power.

With a prior art electromagnetically operated tool the operating winding of the magnetic drive member is connected to a source of an alternating current potential for the duration of only half of a complete cycle of the alternating current potential. Hereby an electronic control circuit is mounted in the housing of the tool which circuit effects the connection of the operating winding to the alternating current potential. The winding which is energized by a half cycle of the alternating potential cannot generate a sufficient large electromagnetically induced field which acts on the magnetic member of the drive mechanism so that only a comparatively small output power is delivered. This prior art tool has the additional disadvantage that the operating winding heats up considerably such that with increased temperature the output power decreases. As during operation the operating winding is connected to the alternating current mains, radio interferences and an overload of the power system may occur. In addition, due to the fact that the electromagnet is not exploited to good advantage a portable tool becomes cumbersome because of its excessive weight and cannot be used as a convenient hand tool.

It is a primary object of the present invention to provide a new and improved electromagnetically operated tool.

Another object is to provide an electromagnetically operated tool that is capable of delivering a highly output power.

A further object is to provide a portable tool which is easy to manipulate and is protected from heavy mechanical stress.

In accordance with these and other objects one embodiment of the invention comprises an electromagnetically operated stapler or fastener the operating winding of which during the working stroke for driving a nail or similar fastening means into a work piece by a changeover switch starting the working stroke is connected to the discharge current circuit of a capacitor which is disconnected from the operating winding during charging and connected to an alternating current mains. This discharge current may assume a considerable value depending on the capacity of the capacitor; it occurs only during a very short span of time such that the operating winding receives, all of a sudden, a strong energizing current and develops a magnetic field of corresponding magnitude. This field then transmits on the armature of the operating winding a large mechanical power so as to provide a high impact effect. Due to the fact that the discharge current is only of extremely short duration the operating winding cannot substantially heat up even when kept continuously in operation so that its resistance remains practically unchanged

and, consequently, an impact effect is produced which remains always uniform. As no electrical connection exists between the alternating current mains and the operating winding, during operation when the capacitor is discharged and disconnected from the alternating current mains it is not possible for the mains to be affected and also radio interferences are not produced. Suitably the changeover switch is constructed as a manually actuated switch which in its position of rest has the charging circuit of the capacitor connected to the mains. When a working stroke is to be operated the changeover switch is actuated whereby the capacitor is connected to the operating winding and is discharged.

The capacitor may either be mounted within the housing of the device which is preferable especially for stationary devices. For portable devices the capacitor may be mounted within the supply line or directly within the mains plug resulting in a particularly light weight structure for the electromagnetic hand tool.

With a portable tool the weight must be as small as possible so as to permit easy handling. On this account the stapler housing is often made of thin sheets of light metal or of plastic material and is consequently heavily stressed during every working stroke by the impacting and recoil action taking place.

Additional savings in weight can be had for the portable stapler in accordance with the spirit of this invention by having the operating winding of the electromagnet formed of aluminium. Very suitable in this connection is the utilization of aluminium foil the several layers of which are isolated from one another by means of an oxide coat. An aluminium oxide coating of this type can be exposed without damage to temperatures up to about 1,500° C such that the operating winding remains operable even at large overloads. It may be desirable in some cases to make the operating winding of aluminium-enamelled wire, leading to an economy in weight amounting to about two-thirds of the coil weight of the operating winding.

Preferably the armature of the electromagnet is designed as a plunger type armature communicating via a prolonging pin in force transmitting relationship with a lever pivotally mounted at its rear end portion on an axis of the stapler housing, the anterior end of which lever being coupled to the driver. In order to prevent the pin from producing a force which would come to bear against the magnetic armature an additional feature of the invention provides that this pin is made of an antimagnetic material, e.g., of nickel-manganese steel. The end of said pin abutting the lever may preferably be provided with a hardened insert so as to prevent, to a large extent, exposure to wear and tear.

Other objects, features and many advantages of the present invention will be appreciated by reference to the following detailed description in connection with the accompanying drawings which represent by way of example an embodiment of the invention. In the drawings

FIG. 1 is a schematic circuit diagram of an embodiment of the invention;

FIG. 2 is an elevational sectional view of a portable stapler embodying the present invention; and

FIG. 3 is a cross sectional view taken on the line III—III of FIG. 2.

Referring to FIG. 1 of the drawings, the operating winding 11 of an electromagnetically operated stapler has one end connected via a conductor 12 to the fixed

contact 13 of a changeover switch 14, the opposite contact 15 of which is connected via a diode 16 and an Ohmic resistance 17 and a conductor 18 to one pole 19 of a monophase alternating current mains 20. The other end of the operating winding 11 is connected to the other pole 21 of the alternating current mains 20 via conductor 22 to which the negative pole of a capacitor 23 preferably of the electrolyte type commonly employed in photoflash lamps is also joined. The positive pole of the capacitor 23 is joined to the center contact 24 of the change-over switch 14. A quenching resistance 25 is connected parallel to the capacitor 23 which is discharged by said quenching resistance 25 when the capacitor 23 is disconnected from the mains 20.

The constructive development of this electromagnetically operated stapler according to the invention is illustrated in FIGS. 2 and 3.

The operating winding 11 is mounted in the housing 26 composed of plastic material. The hollow housing 26 is provided with a hollow handle 27 and encloses the changeover switch 14 together with its contacts 13, 15 and 24 as well as the diode 16, the conductors 12, 18, 22 and an earth connection 28. These conductors are united to form a cable 29 and are ending in a plug 30 to be connected to both poles 19 and 21 of the alternating current mains 20, and which plug contains the capacitor 23, the charging resistance 17 and the quenching resistance 25. The frontal portion 40 of the housing 26 encloses the electromagnetic drive. The cylindrical operating winding 11 of which comprises a plunger type armature 31 connected in power transmitting relationship via a pin 32 to a one-armed lever 33. This lever is pivotally mounted at its rear end onto an axis 34 of the housing 26. The front end portion of the lever 33 projects beyond the front face of the housing 26 and is flexibly coupled with a drive 35 which during the working stroke drives a staple (not shown) from a magazine 36 into a work piece. The lever 33 is maintained by means of a torsion spring 37 in its initial position illustrated in FIG. 2 of the drawings.

The change-over switch 14 is actuated by a finger-type lever 38 which pivots the center contact 24 of the changeover switch 14 via a resilient link member 39 from the position of rest shown in the drawings in upward direction until the contacts 24 and 13 are closed, whereby the capacitor 23 is discharged via the operating winding 11. The strong surge current occuring at this instant energizes the operating winding 11 and causes it to attract its armature 31 immediately, leading the lever 33 to move the driver 35 downwardly and drives a staple from the magazine 36 into the work piece with great force so that even large and long staples and nails are driven but with a single stroke.

The operating winding 11 is supported by a frame 41 made of strong iron sheets. The prismatic front portion 40 of the stapler housing 26 encloses the frame 41, the inner side of which has an insert 42 mounted thereon, e.g., welded thereto, to which a crosspiece 43 has been fixedly secured. The operating winding 11 rests over an interposed insulating sleeve 44 on said insert 42 as well as on the crosspiece 43 and is clamped by means of an upper crosspiece 45. The lower crosspiece 43 is formed as a guide for the pin 32 — being an extension of armature 31 — while the upper crosspiece 45 provides guidance for the armature 31. By way of an intermediate link 46 and two screws 47 a cover plate 48 is secured to the crosspiece 45. This cover plate 48 abuts the inner side wall of the frame 41 and serves as a strike plate for the return-stroke of the armature 31. Additionally, the cover plate 48 protects the housing portion 40 in this manner against the recoiling action of the armature 31.

The pin 32 transmitting the movement of armature 31 onto lever 33 is composed of non-magnetic material, e.g., of a nickel-manganese-steel alloy and carries on its lower end portion a hardened insert 49 resting on lever 33 and serving as protection against wear and tear.

The stapler constructed so as to be portable and have little weight has its operating winding 11 wound of oxidized aluminium foil which is resistant even to overheating on account of the insulating qualities of the oxide coating.

Since all mechanical forces of the magnetic system are absorbed by the strong iron sheet frame 41 which closes simultaneously also the magnetic circuit it is assured that the housing portion 40 is extensively protected from mechanical stress such that it can be of a light weight construction with thin walls.

To the front of the housing portion 40 a rip 50 is secured which rip covers the driver 35 and its guide portion 51. As can best be seen from FIG. 3, the housing portion 40 is closed off on its front and rear side by a cover plate 52 for each side. These cover plates are connected by means of screws and bolts to the housing portion 40 so as to permit easy access to the magnetic system. Likewise, the handle 27 may be provided with a protective covering 53.

An embodiment of the electromagnetically operated means as described may also be used with stationary staplers, e.g., with staplers, nailing or block stitching means or similar of the bench or table type.

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 this invention.

We claim:

1. In an electromagnetically operated tool adapted to be energized by an alternating current potential source and controlled to provide a single power stroke comprising a housing, winding means disposed in the housing, magnetically actuating means movably arranged adjacent the winding means, a manually actuated switch means carried by the housing and adapted to be joined to said winding means for initiation a working stroke of the tool, a capacitor means with one pole connected to said switch means and with the other pole connected to said alternating current potential source, and means controlled by actuation of said switch means for energizing said winding means by the discharge current of said capacitor means and separating said capacitor means from said alternating current potential source.

2. The tool as claimed in claim 1 wherein said capacitor means is arranged exterior to the housing of the tool.

3. The tool as claimed in claim 2 wherein said capacitor means together with a quenching and an Ohmic resistance are mounted on a main plug.

4. The tool as claimed in claim 3 wherein said capacitor means and resistance means are disposed within the housing of said main plug.

5. The tool as set forth in claim 1 wherein the capacitor means comprise an electrolytic condenser.

6. The tool as set forth in claim 1 wherein the magnetical actuating means and said winding means are mounted within a frame enclosed by a portion of the tool housing which frame is adapted to relieve the housing from the mechanical forces of the magnetical actuating means.

7. The tool according to claim 6 wherein the winding means is composed of aluminium.

8. The tool according to claim 7 wherein said winding means is wound of an oxidized aluminium foil.

9. The tool according to claim 6 wherein the winding means is mounted between two crosspieces inserted in said frame, which crosspieces form a guide for the armature and an extension pin of said armature, which extension pin is adjacent the magnetically actuating means.

10. The tool according to claim 9 wherein on the upper crosspiece a cover plate is secured absorbing the recoil action of the armature.

11. The tool according to claim 9 wherein said pin constituting an extension of the armature and abutting a lever of the magnetic actuating means is made of antimagnetic material.

12. The tool according to claim 11 wherein the pin is made of a nickel-manganese-steel alloy.

13. The tool according to claim 11 wherein the lower end portion of the pin abutting the lever is provided with a hardened insert.

14. The tool according to claim 1 wherein the frame is made of ferromagnetic material, particularly sheet iron.

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