AUTOMATIC ELECTRIC STAPLER


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ABSTRACT OF THE DISCLOSURE

An automatic stapler having a solenoid-operated cam actuator for the movable stapler head and a simplified control circuit which renders the device substantially fool-proof by eliminating the possibility of false starts or premature recycling of the mechanism.

This invention relates to an automatic stapling machine. The prime object of the invention is to provide a fully automatic low price stapler for home and office use which is characterized by simplicity of construction and operation, utilizing a minimum number of moving parts and requiring very little maintenance.

Another important object of the invention is to provide a simplified automatic electric stapler including a novel control circuit which renders the operation of the device virtually fool-proof by eliminating false or premature recycling of the mechanism.

Another object is to provide an automatic stapling machine which has built-in safeguards to prevent damaging of mechanical parts by overloading caused by excessive work thickness or damaging of the solenoid because of failure or improper functioning of other electrical components. In accordance with the invention, the powering solenoid can never at any time because of any component failure receive power for a long enough period of time to damage it.

The above and other objects and advantages of the invention will be readily apparent to those skilled in the art during the course of the following detailed description.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts throughout the same,

FIGURE 1 is a partly diagrammatic side elevation of an automatic stapler embodying the invention with the casing and base plate thereof shown in section;

FIGURE 2 is a fragmentary side elevational view of the stapler showing an adjustable sensing switch and associated parts;

FIGURE 3 is an end elevational view of the stapler with the casing and base plate shown in transverse cross section;

FIGURE 4 is a schematic view of the stapler powering and control circuit;

FIGURE 5 is a side elevational view similar to FIGURE 1 showing a modification of the stapler operating mechanism; and

FIGURE 6 is an end elevational view similar to FIGURE 3 of the structure in FIGURE 5.

In the drawings, wherein for the purpose of illustration are shown preferred embodiments of the invention, the numeral 10 designates a conventional office or home size paper stapler such as a type B9 Stapler manufactured by Bostitch, Inc., East Greenwich, R.I. The mechanical construction and operation of the stapler is well-known and need not be described in detail herein. Briefly, the stapler 10 embodies a head 11 which swings vertically relative to an anvil plate 12 upon a pivot 13. Spring means 14 is provided within the stapler to return the stapler head to the normal elevated position so that work may be introduced between the head and the anvil plate thereof.

The stapler 10 is suitably fixedly mounted upon a flat base plate 15 which extends somewhat on opposite sides of the stapler mechanism proper, as shown in FIGURE 3.

A housing 16 of sheet metal or the like is provided for supporting and enclosing the various electrical and mechanical components of the machine and the housing is suitably detachably rigidly secured to the base plate 15 so that it can be readily removed therefrom when necessary. At its forward end and bottom, the housing has a relatively large horizontal entrance slot 17 for paper and other work to be stapled.

Mounted centrally within the housing and immediately above the stapler is a pusher type solenoid 18 having a horizontal reciprocatory armature or core 19, held retracted by a return spring 20 whenever the solenoid is de-energized. The solenoid is pivotally suspended within the housing on a suitable pin 21 carried by a suspension bracket means 22. The solenoid carries and operates a cam or plunger actuator 23 at its forward end having an inclined cam face 24, as shown, engageable with an actuator roller 25, mounted upon the top and forward end of the stapler head 21. When the solenoid is energized, the cam 23 is thrust forward to the broken line position of FIGURE 1 and the stapler head is forced downwardly by the action of the cam face 24 and roller 25 to the stapling position. When the solenoid is de-energized, the cam 23 is retracted and the stapler head returns automatically to the normal elevated position.

Immediately above the forward lip 26 of cam 23 is a retainer or reaction roller 27 journaled upon a bracket 28, pivoted at 29 to a crosspin having its ends held in bearing brackets 30, FIGURE 3, secured to the side walls of the housing 16. A heavy compressible coil spring 31 bears upon the top of the bracket 28 to force the retainer roller 27 downwardly against the cam 23. The tension of the spring 31 may be adjusted by an adjusting screw 32 mounted upon the housing 16 as shown. By virtue of this arrangement, the work receiving gap of the stapler mechanism may be adjusted, and jamming and possible damage to parts of the mechanism caused by excessive thickness of work is avoided. That is to say, the spring 31 will always yield somewhat if too great a load is placed on the parts due to excessive thickness of the paper or work.

A main off and on switch 33 is suitably secured to the housing 16 near its rear end, and a sensing microswitch 34 or the like is carried by a bracket 35 which is adjustably secured to one housing side wall by means of a clamping screw 36 which operates within a horizontal adjusting slot 37 formed in the housing side wall. The sensing switch 34 has an arm or actuator 38 directly in the path of the work which is introduced into the stapling machine. By means of the arrangement shown, the position of the work sensing arm 38 may be adjusted to various positions along the work entry slot 17, see FIGURE 2.

Also mounted within the upper portion of the housing are a capacitor 39, relay 40 and a rectifier 41, all conventional elements.

With reference to the circuit shown in FIGURE 4, a source 42 of alternating current is connected by a wire 43 with the on and off switch 33, in turn connected in series by a wire 44 with the center terminal 45 of the sensing switch 34 having a normally closed contact 46 and the other contact 47. The contact 47 is connected with a wire 48 leading to one terminal of solenoid 18, the other terminal of which is connected with a wire 49 leading to a relay contact 50. The relay 40 has another stationary contact 51 and a movable contact 52 connected with a
wire 53, in turn connected with a wire 54 extending back to the source of current 42. Another wire 55 leads from the sensing switch contact 46 to the current rectifier 41, in turn connected with a wire 56, connected at 57 to the coil 40 which also connects to the wire 54. Capacitor 39 is connected across relay coil 40 by wires 58 and 59, connected respectively to wires 54 and 56, as shown. A potentiometer 60 may be included in the circuit as an optional feature to vary the resistance across the relay coil and hence lengthen or shorten the operating cycle. Increasing the resistance across the coil will lengthen the cycle, while a decrease in resistance will shorten the cycle. The user of the device equipped with a potentiometer may vary the speed from several milli-seconds to several seconds, as found desirable.

The mode of operation of the automatic stapler is as follows:

The main switch 33 is activated to send current through the normally closed contacts of sensing switch 34 and through current rectifier 41 to power relay 40 with direct current. Consequently, relay 40 is always energized even when no paper is introduced into the slot 17 and while the stapler is not operating. At this time, the relay common contact 52 leaves stationary contact 51 and engages contact 50 to close one leg of power to solenoid 18. However, solenoid 18 will not operate until sensing switch 34 is actuated due to contact of paper or other work with the sensing or actuating arm 38 of switch 34. The capacitor 39 connected across the relay coil is also receiving charging current at this time while the main switch 33 is closed and while the stapler mechanism is still idle.

The work to be stapled is now introduced into the receiving slot 17 and the work engages sensing or actuating arm 38 and the common contact 45 of switch 34 is now shifted into engagement with contact 47. When this occurs, power to the relay coil 40 is interrupted. However, the relay coil does not become de-energized immediately but is held powered by the charge on capacitor 39 for an appreciable period of approximately 100 milliseconds in practice. The common contact 45 of sensing switch 34 in moving to normally open contact 47 now energizes solenoid 18 through the closed contacts 45 and 47 of the sensing switch and the closed contacts 50 and 52 of the relay.

The charge on capacitor 39 now bleeds to a point below the operating voltage of relay 40 causing the relay to de-energize. When the relay 40 is de-energized, contacts 50 and 52 are opened and solenoid 18 drops out or is de-energized, completing the stapling cycle. The solenoid remains energized until the charge on the capacitor 39 bleeds to the point where the relay 40 is de-energized.

This mode of operation provides a number of safety factors in the stapler. The solenoid 18 cannot remain on when the stapler is overloaded by work thickness beyond the capacity of the machine. If sensing switch 34 fails in the actuated condition, solenoid 18 will operate and then de-energize and cannot remain on so as to cause improper recycling of the mechanism. If the relay 40 becomes faulty in the energized or de-energized conditions, the solenoid 18 will either operate one time or not at all. Also, if the capacitor 39 becomes faulty, relay 40 will not hold, and as a result, the relay will not operate the solenoid under these conditions. At no time through any component failure can the solenoid, which is of the intermittent duty type, ever receive power for a long enough period to damage it. Furthermore, the invention circuit eliminates the need for any mechanical means to make and break the circuit to the solenoid and insures against false recycling of the stapler. The circuit is completely automatic in operation. Selecting the proper value for the capacitor can either speed up or delay the cycle of operation, as desired.

In FIGURES 5 and 6 of the drawings, there is shown a modification of the stapler operating mechanism. The exact electrical circuit in FIGURE 4 is employed in this modification, without any change whatsoever, and the electrical mode of operation of the device is unchanged. It is simply the mechanical components in FIGURES 5 and 6 which have been modified to render the automatic stapler in this form somewhat more economical and more simplified.

In FIGURES 5 and 6, a housing 61 is employed including a base plate 62 for the stapler 63 which is preferably the same Bostitch Stapler type as employed in the prior form of the invention. In the present form, the stapler 63 does not have to be modified in any way and is installed on the base plate 62 in the form in which it is furnished by the manufacturer. The stapler 63 includes a head 64 with contoured operating pad or knob 65. The stapler head 64 swings upon a pivot 66 relative to the stationary anvil 67.

The housing 61 supports and contains the same electrical control elements utilized in the prior form of the invention, including the main on and off switch 33, sensing microswitch 34, capacitor 39, relay 40 and rectifier 41. Additionally, the elements 35, 36, 37 and 38, all previously described in connection with the sensing switch, remain unchanged. The switch 34 is adjusted and utilized in the same manner in the form of the invention shown in FIGURES 5 and 6.

A pull type solenoid 68 is supported within the housing 61 by a suitable bracket means 69 and includes a reciprocable armature 70 having an axially adjustable screw or stud 71 anchored to its forward end. A rigid stapler operating arm or lever 72 has its upper end hinged to the top wall of the housing as at 73 and has a specially curved lower extremity 74 which engages the pad 65 with a smooth cam-like action to assure steady and smooth operation of the stapler.

The lever 72 is linked to the stud 71 of the solenoid by means of a heavy pull spring 75, whose thickness is such that it will not deflect or straighten under normal loading conditions. However, the spring 75 will deflect slightly when the load is too great to avoid damaging any of the parts and this is an important feature of the construction. One end portion 76 of spring 75 is aprertured to receive the stud 71, and a shock-absorbing coil spring 77 surrounds the stud 71 and bears upon the end portion 76 to maintain the latter in contact with the stud head or lock nut 78, thereby eliminating chatter and lost motion. The other end of the spring 75 is aprertured to receive a screw 79 or the like anchored to the lever 72 near and above its lower end. Another shock-absorbing coil spring 80 on the screw 79 bears against the adjacent end of spring 75 to cushion the same. The shock-absorbing springs 77 and 80 allow free action of the leaf-type spring 75 during the full cycle of operation of the mechanism and no binding will occur. When the solenoid armature 70 is completely home or retracted to actuate the stapler, the spring 75 is in substantially a true horizontal plane and this particular geometry eliminates wear and chatter in the solenoid. The spring 75 tends to become straight under load and, as stated previously, will yield slightly when subjected to overload conditions.

The cycle of operation in connection with the circuit of FIGURE 4 is identical in the construction of FIGURES 5 and 6 and need not be repeated herein. All safety features and advantages present in the prior form of the invention are still present in the embodiment of FIGURES 5 and 6 and the mechanical construction is even more simple.

When the solenoid 68 is energized, the armature 70 is retracted, resulting in the lever 72 swinging downwardly and forcing the stapler head 64 down to the active position to staple the work. The parts return automatically to their inactive positions shown in FIGURE 5 upon completion of the cycle of operation. It is believed that the advantages of the modified construction will be readily apparent to those skilled in the art.
It is to be understood that the forms of the invention herewith shown and described are to be taken as preferred examples of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or scope of the subjoined claims.

Having thus described my invention, I claim:

1. A stapler comprising a base plate including a stapler anvil, a stapler head pivoted to the base plate and anvil and adapted to be depressed for delivering staples to work resting on the anvil, an actuating roller mounted upon the stapler head near the forward end thereof, a reciprocatory cam above the stapler head having an inclined cam face engaging the actuator roller shiftable in one direction to depress the stapler head and allowing elevation of the stapler head when retracted in the opposite direction, automatic power means connected with said reciprocatory cam to operate the same for cycling the stapler, and adjustable yielding means arranged opposite the actuator roller and engaging said cam and permitting limited overload movement of the cam laterally due to excessive thickness of work introduced into the stapler.

2. The invention as defined by claim 1, and a housing for said stapler, and means forming a pivotal connection between said cam and cam power means and said housing.

3. The invention as defined by claim 1, and wherein the adjustable yielding means comprises a spring, screw-threaded means to adjust the tension of the spring and a second roller urged by the spring into engagement with the side of the cam remote from said actuator roller.

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