United States Patent

[11] 3,622,925

[72] Inventor **Robert H. Rose**
Milwaukee, Wis.

[21] Appl. No. **75,618**
[22] Filed **Sept. 25, 1970**
[45] Patented **Nov. 23, 1971**
[73] Assignee **U.S. Controls Corp.**
Milwaukee, Wis.
Continuation-in-part of application Ser. No. 853,878, Aug. 28, 1969, now abandoned. This application Sept. 25, 1970, Ser. No. 75,618

[54] **PUSH-TO-START SWITCH**
12 Claims, 16 Drawing Figs.

[52] **U.S. Cl.** **335/186**
[51] **Int. Cl.** **H01h 3/20**
[50] **Field of Search** 335/186, 163, 167, 266, 155, 157, 203; 317/154, 123

[56] **References Cited**

UNITED STATES PATENTS

3,161,743	12/1964	Roeser	335/163
3,526,863	9/1970	Vogelsang	335/186
3,568,114	3/1971	Cherry et al.	335/186

Primary Examiner—Harold Broome
Attorney—Morsell & Morsell

ABSTRACT: An armature is fulcrumed near one end and its other end is normally spring urged in a direction away from the pull of an electromagnet. An actuator is slidably associated with a manually operable plunger for movement axially thereof, and there is interengagement so that pushing of the plunger causes movement of the armature toward the electromagnet. Before the armature engages the core the actuator causes closing of contacts in an electric circuit to energize the coil so that the armature thereafter holds the actuator in contact-closing position, there being spring means for returning the plunger to starting position while the actuator is thus held, and there being means between the armature and actuator for returning the actuator to starting position when the coil is deenergized.

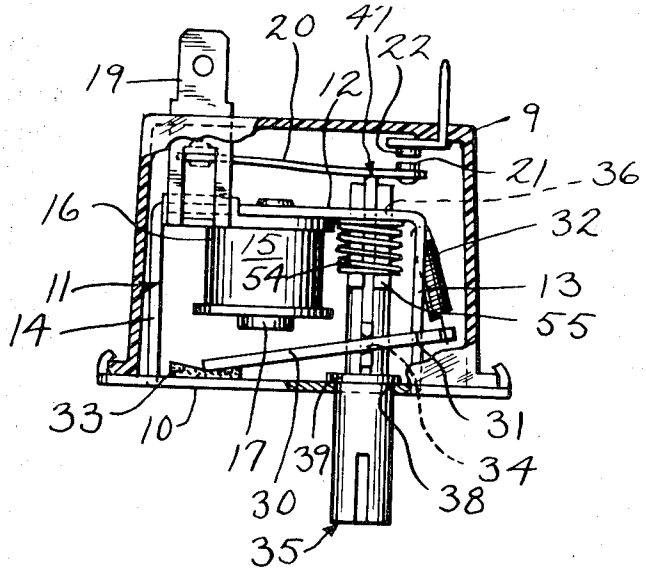


Fig. 1

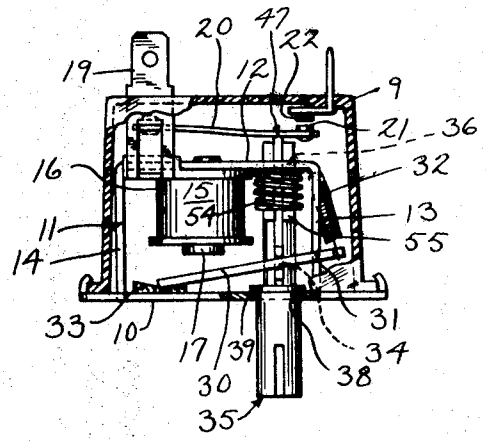


Fig. 2

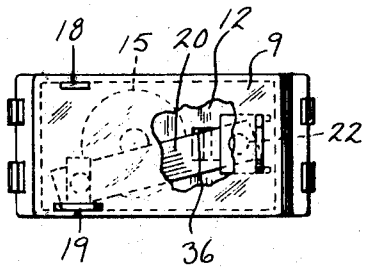


Fig. 3

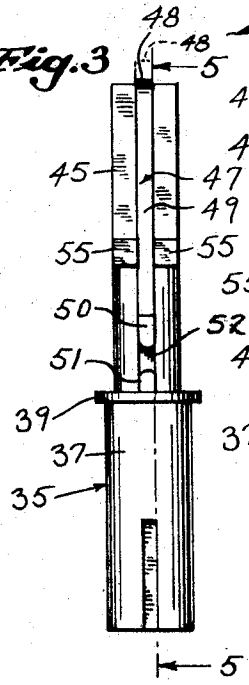


Fig. 7

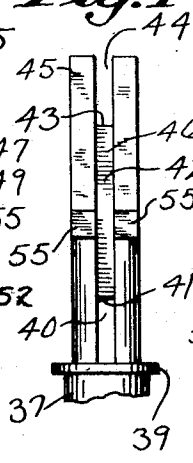


Fig. 4

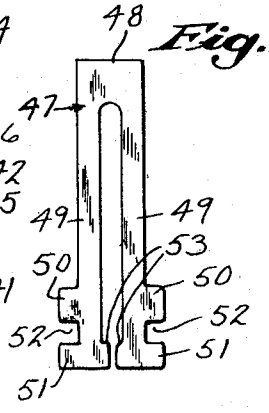


Fig. 5

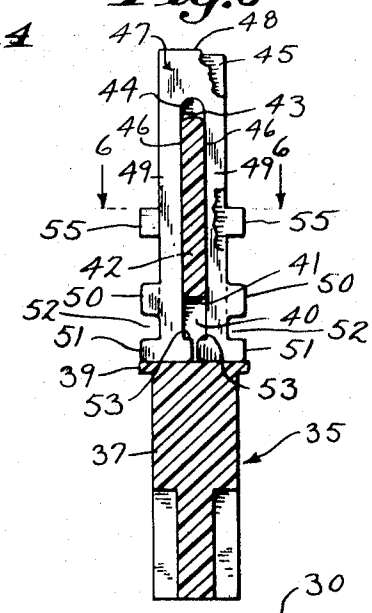


Fig. 6

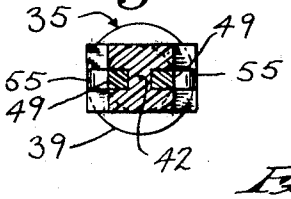


Fig. 8

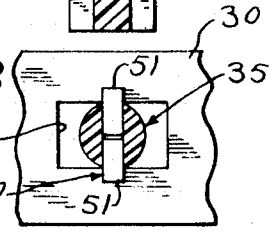
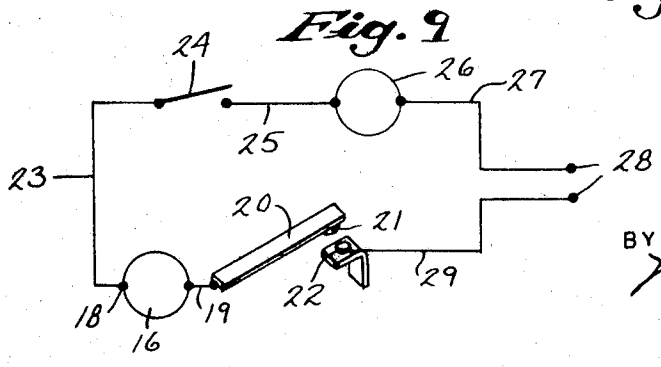


Fig. 9



INVENTOR
ROBERT H. ROSE

BY

ATTORNEYS

Fig. 10

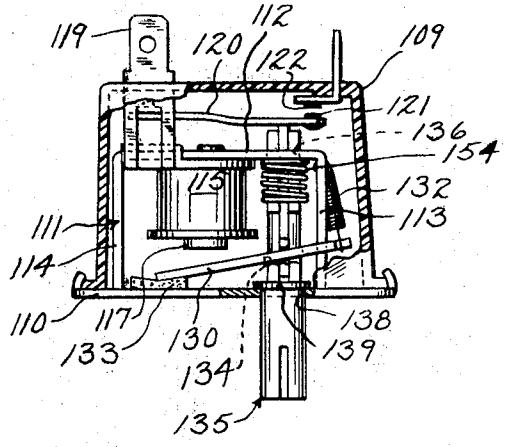


Fig. 11

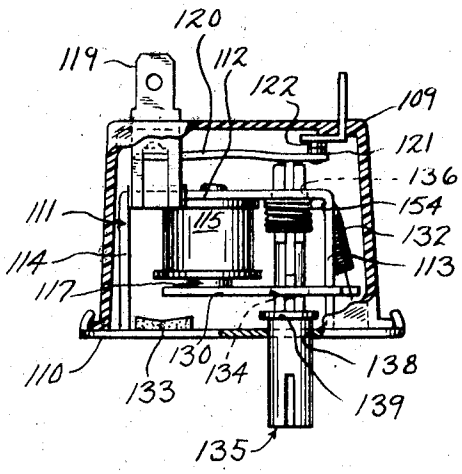


Fig. 12

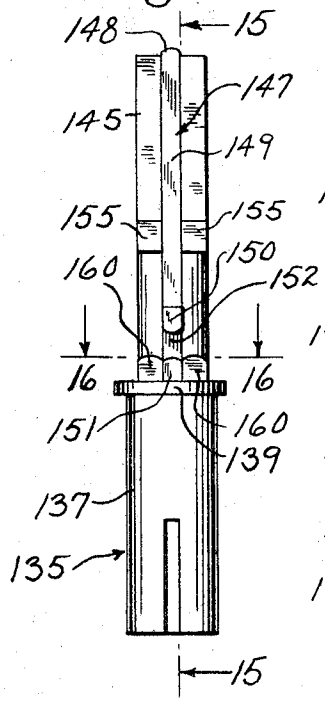


Fig. 13

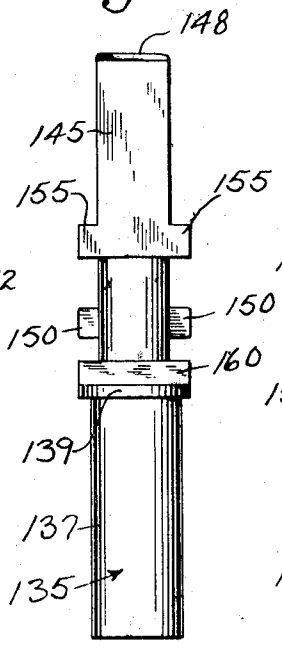


Fig. 14

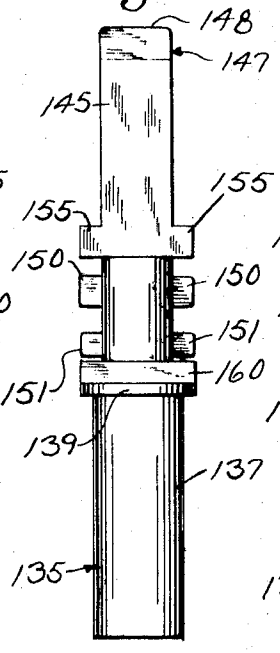


Fig. 15

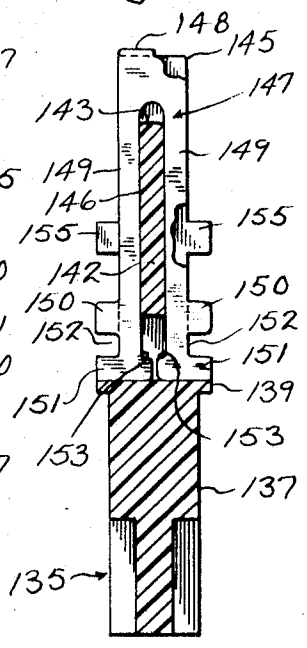
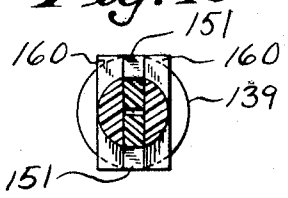


Fig. 16



INVENTOR
ROBERT H. ROSE

BY Mosell & Mosell

ATTORNEYS

PUSH-TO-START SWITCH

This is a continuation-in-part of application Ser. No. 853,878 filed Aug. 28, 1969.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to push-to-start switches which are useful in a variety of environments, the switch being particularly useful in the electric circuit to an electric clothes dryer where the main switch of the clothes dryer is embodied in the door of the dryer and is closed when the dryer door is closed. When thus used, the switch of the present invention must be pressed by the operator after the door has been closed and before the dryer will start and is in the nature of a safety device.

2. Description of the Prior Art

Switches for performing this general function have heretofore been proposed. However, such switches are complicated and expensive to manufacture and assemble. Furthermore, in prior art push-to-start switches the coil customarily acts on the armature to maintain the switch in closed position with a one-to-one mechanical advantage, whereas a much greater mechanical advantage would be highly desirable in a switch of this type. Push-to-start switches are shown in Williams U.S. Pat. No. 1,839,629, Buckthal U.S. Pat. No. 2,487,751, and Bury U.S. Pat. No. 3,153,124. Roeser U.S. Pat. No. 3,161,743 discloses a pushbutton assembly where the armature is manually pushed toward the electromagnet before the electromagnet takes over. In Roeser, however, the actuator is not supported on the manually operable plunger and the construction is much more complicated and expensive. Also in Roeser, when the armature is released there is no connection between the armature and the actuator which causes positive return movement of the actuator, instead the return movement in Roeser is caused by a separate spring. Also in Roeser, there is nothing to urge the manual plunger back to starting position. The Roeser switch is not an AC device, and if it were attempted to use it as an AC device, it would be noisy. In addition, the magnetic path in Roeser is through the hinge pin, which is undesirable, as it provides a poor magnetic couple. With the present invention there is a greater flux transfer area. The construction of the present invention renders manufacturing control much simpler, gives a firmer movement, and is a simple construction in general to manufacture.

SUMMARY OF THE INVENTION

The present invention provides, in a switch, an armature which is fulcrumed near one end and which is spring-urged in a direction away from a magnet. An actuator which is slidably associated with a manually operable plunger is operably associated with the armature in a location between the fulcrum and magnet, there being movement of the armature toward the magnet when the plunger is pushed. Before the armature end engages the magnet, the actuator closes the contacts in an electric circuit. This action or other suitable means causes formation of a magnetic field so that the armature thereafter is acted upon by said magnetic field, the latter holding the actuator in contact-closing position, there being spring means for returning the plunger to starting position while the actuator is thus held, and there being means for returning the actuator to starting position when it is released by the magnetic field.

A general object of the invention is to provide a push-to-start switch which is compact, simple and inexpensive in construction, and which embodies relatively few parts.

A further object of the invention is to provide a switch of the class described in which the arrangement is such that the coil of the electromagnet acts on the armature with a relatively large mechanical advantage to maintain the switch in circuit closing condition with a small coil drawing a minimum amount of current.

A further object of the invention is to provide a switch of the class described having a manually operable pushbutton wherein the manual operation moves the armature a substantial distance toward core-contacting position before the magnetic field takes over to move the armature the remainder of the distance and to hold the armature and parts in circuit-making condition until the coil is deenergized.

A more specific object of the invention is to provide an improved switch of the class described in which there is a novel plunger and actuator construction, the actuator being slidably mounted on the plunger for limited axial movement relative thereto, and there being a novel interengagement between the actuator and plunger and between the actuator and armature.

With the above and other objects in view, the invention consists of the improved push-to-start switch and all of its parts and combinations, as set forth in the claims, and all equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing, illustrating one complete embodiment of the preferred form of the invention, in which the same reference numerals designate the same parts in all of the views:

FIG. 1 is a top view of the switch, the top of the casing being broken away to show the interior mechanism;

FIG. 2 is an end view of the switch of FIG. 1, part of the casing being broken away;

FIG. 3 is a plan view of the plunger and actuator assembly alone;

FIG. 4 is a plan view of the actuator separated from the plunger;

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 3;

FIG. 6 is a sectional view taken on the line 6—6 of FIG. 5;

FIG. 7 is a view of the plunger in the same position as FIG. 3 with the actuator clip removed;

FIG. 8 is a fragmentary detail view showing the engagement of the actuator lugs with the armature;

FIG. 9 is a wiring diagram;

FIG. 10 is a view like FIG. 1 showing a slightly modified construction with the armature in the inactive position;

FIG. 11 is a view similar to FIG. 10 of the modification showing the coil energized, the armature in contact with the core of the coil, and the contacts closed;

FIG. 12 is a plan view of the plunger and actuator assembly alone, as used in the modification of FIG. 10;

FIG. 13 is a view of the plunger and actuator assembly alone, looking at right angles to FIG. 12, with the actuator in withdrawn position;

FIG. 14 is a view similar to FIG. 13 showing the actuator in extended position;

FIG. 15 is a sectional view taken on the line 15—15 of FIG. 12; and

FIG. 16 is a sectional view taken on the line 16—16 of FIG. 12.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawing, the switch includes a front supporting plate 10 to which the ends of a U-shaped bracket 11 are suitably connected, the bracket having a base portion 12 and legs 13 and 14. The base of the bracket supports means for producing a magnetic field such as an electromagnet 15 having a coil 16 and a core 17. While there may be various ways of controlling the magnetic field, in the preferred embodiment one end of the coil is electrically connected to a terminal 18 and the other end to a terminal 19. The latter is electrically connected to one end of a spring finger 20, the other end of said finger carrying a movable contact 21 which is adapted to be moved into and out of engagement with a stationary contact 22. A casing 9 encloses the assembly.

The terminal 18 is connected to a wire 23 in an electric circuit of the type shown in FIG. 9, the wire leading to a switch 24. A wire 25 on the other side of the switch 24 may lead to a suitable device 26 to be controlled, such as an electric motor. On the other side of the device 26 an electric wire 27 may lead to one side of a suitable source of electricity such as at 28, a

wire 29 connecting the other side of the source with the contact 22.

An armature 30 is suitably fulcrumed on the leg 13 of the bracket as at 31, there being a coil spring 32 connected between the bracket and the end of the armature normally urging the armature to the full line position of FIG. 1 with its opposite end seated against a cushioning abutment member 33 carried by the switch plate 10. The armature has a hole 34 (see FIG. 8) through which the shank of a plunger 35 slidably extends, the lower portion of the plunger projecting slidably through a rectangular hole 36 in the base 12 of the U-bracket 11.

Referring now to FIGS. 3–8, inclusive, the external portion 37 of the plunger 35 is preferably round and adapted to be slidable in a hole 38 in the switch plate 10, the plunger having an enlarged shoulder 39 on the inner side of the plate 10 which limits outward movement of the plunger. Inwardly of the shoulder 39 the plunger is of reduced diameter and formed with a slot 40 (see FIGS. 5 and 7) which extends completely through the plunger but which is of short extent terminating at the end 41 of webbing 42. The webbing 42 in turn terminates short of the lower end of the plunger as at 43, and below said end 43 of the webbing is another slot portion 44 which extends entirely through the plunger. The intermediate portion of the plunger merges into a lower portion 45 which is rectangular in cross section as shown in FIG. 6 to coact with the rectangular hole 36 and maintain the plunger and actuator 47 in properly assembled relationship with the armature 30. The sides of the intermediate and lower portions of the plunger are grooved as at 46.

The actuator clip 47, shown removed in FIG. 4, is preferably formed of plastic and comprises a closed end 48 and legs 49 which are spreadable enough to permit slipping of the actuator over the lower end of the plunger, with the legs 49 of the actuator engaging the grooves 46 of the plunger in the manner shown in FIGS. 5 and 6. The actuator legs have inner laterally projecting lugs 50 and outer laterally projecting lugs 51, there being slots 52 between the lugs. When the actuator clip of FIG. 4 is assembled on the plunger as in FIGS. 3, 5 and 6, it is axially slidable from the position shown in full lines in FIG. 3, where the inner end 48 of the actuator is close to flush with the inner end of the plunger to a position where the inner end of the actuator projects a short distance beyond the inner end of the plunger as shown by dotted lines in FIG. 3. The limited amount of movement is permitted by the length of the slot 40 in the plunger (see FIGS. 5 and 7), the actuator being movable inwardly until the inwardly projecting shoulder portions 53 engage the end 41 of the webbing 42. The shoulder portions are also important to maintain suitable spacing between the legs 49 of the clip 47.

The modification of FIGS. 10–16, inclusive, is very similar to the form of the invention shown in FIGS. 1–8, inclusive. Therefore all corresponding parts in the modification are designated by the same numerals used in FIGS. 1–8 preceded by the digit "1". The only difference in the constructions is that in the modification there is an extra set of lugs 160 inwardly of the shoulder 139. These lugs are spaced apart as shown in FIG. 12 so that the outer lugs 151 of the actuator, which correspond in all respects to the lugs 51 of FIG. 4, fit within the slot between the lugs 160 of the plunger, as shown in FIGS. 12 and 15, when the actuator is in a withdrawn position. Thus when the plunger 137 is pushed inwardly, its lugs 160 engage the armature 130 as shown in FIG. 11 to cause the movement of the armature toward the electromagnet. In the form of the invention of FIGS. 1–8 the shoulder 39 of the plunger first engages the outermost lugs 51 of the actuator and these lugs, in turn, act on the armature. Other than the above, the construction is the same as heretofore described in connection with FIGS. 1–9, inclusive.

OPERATION

In operation, with the switch 24 in the circuit of FIGS. 9 closed, the pushbutton 35 is pressed inwardly (upwardly, referring to FIG. 1). During this action the shoulder 39 of the plunger engages the top lugs 51 of the actuator clip 47 so that there is a push on the clip. The lugs 51 of the actuator clip in turn press against the armature 30 (see FIGS. 1 and 8) so that the left-hand end of the armature of FIG. 1 is moved toward the core 17 of the electromagnet. In the modification of FIGS. 10–16 the lugs 160 of the plunger press directly against the armature and the engagement of the armature with the actuator lugs 150 moves the actuator. Further pressure of the plunger shoulder 39 on the lugs 51 (in the form of the invention of FIG. 1) causes the actuator clip to be moved further inwardly to push the contact finger 20 until its contact 21 engages the contact 22 to complete the electric circuit of FIG. 9 and also to move the armature close enough to the pole piece 17 so that the armature will be attracted by said pole piece. At this point the armature has still not advanced into contact with the core 17 but is closer thereto. The instant the contacts 21–22 or 121–122 engage, the circuit of FIG. 9 is complete so the electric instrument 26 will start to operate. In the case of a clothes dryer, this will start the dryer operating, the closed dryer door having previously caused closing of the switch 24. Also, the instant that the contacts 21–22 or 121–122 are in engagement a magnetic field is produced. In the illustrated embodiment it is produced because the coil 16 or 116 is energized, either by being in the same circuit as shown in FIG. 9 or by other suitable arrangement, to pull the end of the armature 30 or 130 the rest of the distance into contact with the core 17 or 117 and to hold it in this position. As this occurs there is contact overtravel resulting in contact wipe. Then, when the plunger 35 or 135 is released by the finger of the operator, the spring 54 or 154 engaging the plunger lugs 55 or 155 will cause the plunger to return to its outward position of FIG. 1 or FIG. 10. However, because the electromagnet is holding the armature 30 against the core 17 or 117, the armature being accommodated in the clip slots 52 or 152 and bearing against the lugs 50 or 150 of the actuator clip will keep the clip in an inward condition with its tip projecting the maximum distance beyond the end of the plunger, as shown by broken lines in FIG. 3, holding the contacts 21–22 or 121–122 in circuit-completing condition. Thus the coil 16 or 116 becomes a holding coil to maintain the circuit complete.

When the work which the electrical device 26 is performing is over, the coil 16 or 116 is deenergized, releasing the armature 30 or 130 and breaking the contacts 21–22 or 121–122. In the case of an electric dryer, this occurs when the timer completes its cycle, or when the door- opening switch is operated. When the armature 30 or 130 is thus released by the deenergized coil 16 or 116, the spring 32 or 132, which is attached to the projecting end of the armature, will urge the armature back to the inactive position of FIG. 1 or FIG. 10. The armature, in so moving will bear against the outer lugs 51 or 151 of the actuator clip, moving the clip simultaneously outwardly and allowing the spring contact finger 20 or 120 to move the contact 21 or 121 to the circuit-opening position of FIG. 1 or FIG. 10.

It is apparent from the above that the novel plunger and actuator clip arrangement of FIGS. 3 to 8 and 12 to 16 allows manual operation to move the armature close enough to a magnetic field that the armature can thereafter be attracted by said field. In addition, the arrangement greatly simplifies the construction of a switch of this type, and brings about foolproof operation. It is noted from FIG. 1 or FIG. 10 that the core 17 or 117 acts upon the armature 30 or 130 with an approximately three-to-one mechanical advantage. Thus a relatively light coil is all that is required and the construction is rendered less expensive and more compact.

It is to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

What I claim is:

1. In a switch for controlling an electric circuit, a contact member in said circuit, a movably mounted second contact member in said circuit, an electromagnet, an armature supported for movement toward and away from said electromagnet, a spring directly connected with the armature normally biasing said armature toward a released position with respect to the electromagnet, a manually operable plunger supported for movement adjacent said armature, an actuator supported on said plunger for limited movement relative thereto, means between said plunger, armature and actuator for causing conjoint movement in response to initial pressure on the plunger, the actuator being positioned to also cause movement of the movable contact member into engagement with the fixed contact member to complete the electric circuit and also energize the electromagnet in response to a predetermined amount of movement of the actuator whereby the armature is magnetically moved the rest of the way toward the electromagnet independently of plunger pressure, and means between the armature and actuator for maintaining the contact members in closed condition as long as the electromagnet is energized.

2. A switch as claimed in claim 1 in which there is means between the actuator and armature for causing return movement of the actuator when the armature is released.

3. A switch as claimed in claim 1 in which there is means for returning the plunger to starting position while the armature is held by the energized electromagnet.

4. A switch as claimed in claim 3 in which there is means for returning the actuator and armature to starting position when the coil is deenergized.

5. A switch as claimed in claim 1 in which the actuator is supported by the plunger for axial movement relative thereto.

6. A switch as claimed in claim 5 in which the armature has an opening, and in which the plunger and actuator extend through said opening of the armature.

7. A switch as claimed in claim 1 in which the movement of the actuator which is in response to the magnetic movement of the armature is independent of movement of the plunger.

8. A switch as claimed in claim 1 in which the armature has a fulcrum, and in which the plunger and actuator are mounted between the fulcrum and the electromagnet.

9. A switch as claimed in claim 1 in which the actuator is mounted for axial movement on the plunger and has an inner end beyond the inner end of the plunger for engagement with the movable contact member, in which the plunger has a lug which engages the armature when the plunger is pushed inwardly, in which there is a lug on the actuator engaged by the armature when the latter is released to cause return movement of the actuator, and in which there is a second lug on the actuator which is engaged by the armature to hold the actuator in contact-making position independently of the plunger when the armature is being held by the electromagnet.

10. A switch as claimed in claim 9 in which there is a plunger return spring positioned to be compressed upon inward movement of the plunger.

11. A switch as claimed in claim 9 in which the armature has an opening through which the plunger and actuator extend, with one of the actuator lugs engageable with one side of the armature and with the other actuator lug engageable with the other side of the armature.

12. In a switch for controlling an electric circuit, a contact member in said circuit, a movably mounted second contact member in said circuit, means for creating a magnetic field, an armature supported for movement toward and away from said magnetic field, a manually operable plunger supported for movement adjacent said armature, an actuator supported on said plunger for movement relative thereto, means between said plunger, armature and actuator for causing conjoint movement in response to initial pressure on the plunger, means between the actuator and armature for causing return movement of the armature when the armature is released, the actuator being positioned to also cause movement of the movable contact member into engagement with the fixed contact member to complete the electric circuit and, at the same time, move the armature closer to the magnetic field to cause it to be attracted thereby whereby the armature is magnetically moved an additional distance independently of plunger pressure, means between the actuator and armature for maintaining the contact members in closed condition as long as the armature is maintained in its last-mentioned position by the magnetic field, and means for controlling said magnetic field.

* * * * *