United States Patent [19]

Schantz

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[54] **PUSH-TO-START SWITCH**

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[73] Assignee: **U.S. Controls Corp.**, New Berlin, Wis.

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[52] **U.S. Cl.** **335/186**, 335/170

[51] **Int. Cl.** **H01h 3/20**

[58] **Field of Search** ..... 335/186, 229, 170, 335/174, 254; 200/159 R

[56] **References Cited**

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Primary Examiner—Harold Broome
Attorney—Morsell & Morsell

[57] **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 slideably associated with a manually operable plunger for movement axially thereof, and there is inter-engagement so that pushing of the plunger causes movement of the armature toward the electromagnet. The handle of the plunger is square to coact non-rotatably with a square opening in the front plate and the portion of the handle that passes through the front plate has tapered wedges on all four sides. 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 de-energized. A permanent magnet is positioned to lock the armature in the released position after the coil is de-energized.

3 Claims, 9 Drawing Figures

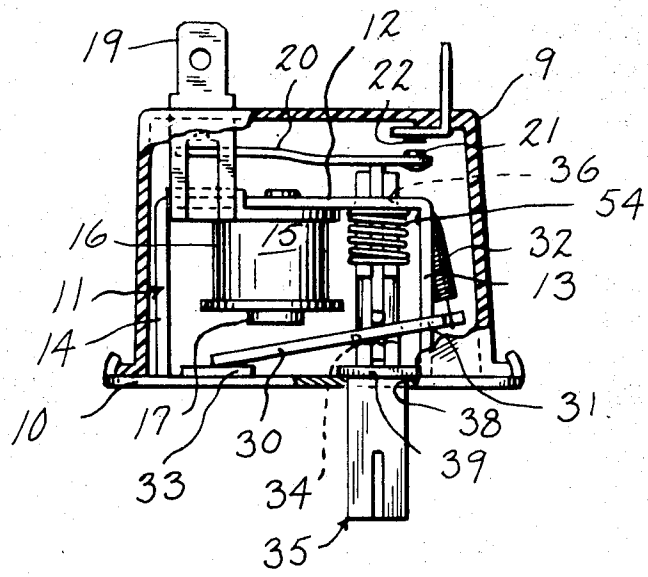


Fig. 1

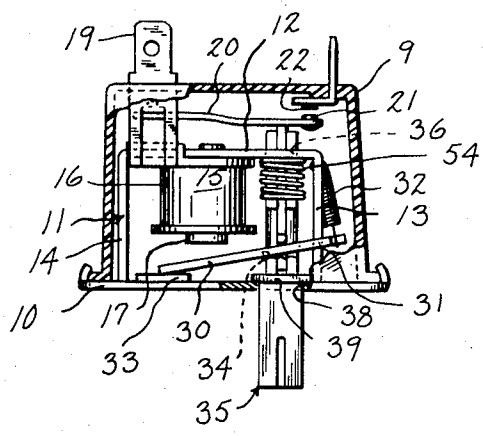


Fig. 2

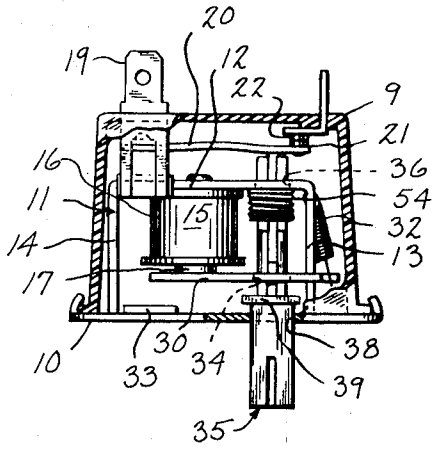


Fig. 3

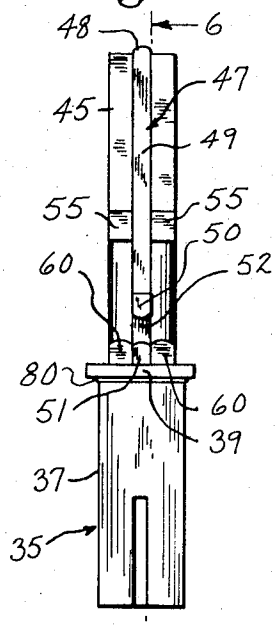


Fig. 4

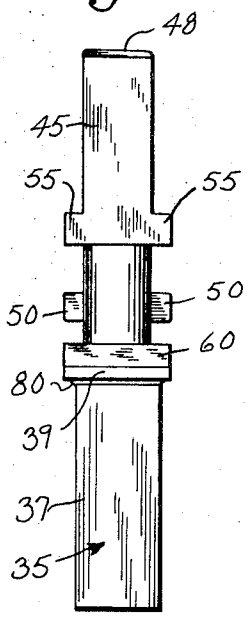


Fig. 5

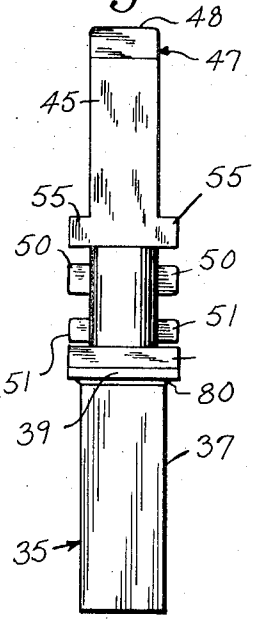


Fig. 6

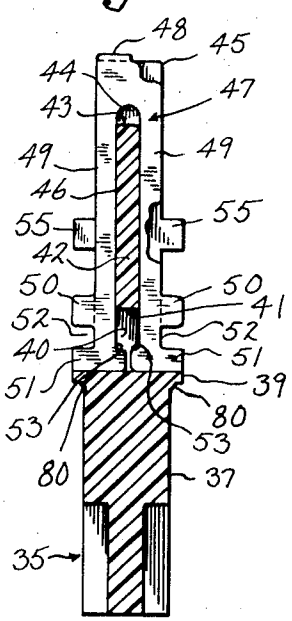


Fig. 7

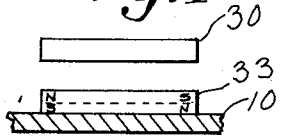


Fig. 8

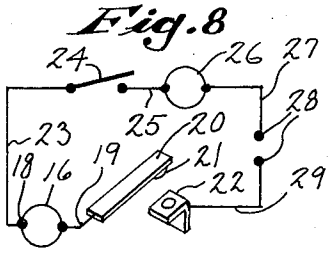
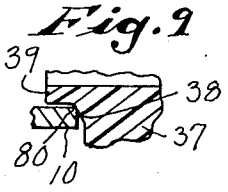


Fig. 9



PUSH-TO-START SWITCH

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 mounted adjacent to 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

The switch of this invention is an improvement in the switch disclosed in copending application, Ser. No. 75,618 which was filed on Sept. 25, 1970 for a "Push-to-Start Switch" now U.S. Pat. No. 3,622,925. Although the switch disclosed in said co-pending application performed its intended function well, the present invention improves upon it in several respects in that it eliminates undesired rotary movement of the plunger handle; provides for wedging of the plunger handle in retracted position to center the same; and provides magnetic locking means for locking the armature in its open position.

Accordingly, one object of this invention is to provide a push-to-start switch in which the plunger handle is secured against rotary movement.

Another object of this invention is to provide a switch of the above-noted character which includes means for automatically wedging the plunger handle in perfectlycentered position after it is returned to its rest position.

A further object of this invention is to provide a switch of the above-noted character which includes magnetic means for locking the armature in its open position and providing the functional characteristic that energizing of the electromagnetic without pressing of the plunger will not cause the contacts to close.

An additional object of this invention is to provide a switch wherein a permanent magnet is arranged in a novel manner to prevent unexpected bumps, shocks, or vibrations from freeing the armature to cause undesired switch action, and for causing a snap action effect when the plunger is pushed.

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 an electromagnet. An actuator which is slideably associated with a manually operable plunger is operably associated with the armature in a location between the fulcrum and electromagnet, there being movement of the armature toward the electromagnet when the plunger is pushed. The handle of the plunger is square to prevent rotary movement thereof and the portion of the handle that passes through the front plate has short tapers to automatically wedgingly center the handle each time it is released after being pushed. Before the armature end engages the electromagnet, 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 permanent magnet is positioned to coact with a portion of the armature to lock it in the released position after it has been released by the electromagnet.

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, and the armature being in the inactive position;

FIG. 2 is a view similar to FIG 1 showing the coil energized, the armature in contact with the core of the coil, and the contacts closed;

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

FIG. 4 is a view of the plunger and actuator assembly alone, looking at right angles to FIG. 3, with the actuator in withdrawn position;

FIG. 5 is a view similar to FIG. 4 showing the actuator in extended position;

FIG. 6 is a sectional view taken on the line 6—6 of FIG. 3;

FIG. 7 is an enlarged fragmentary view of the permanent magnet for locking the armature in its released position looking at the end of the armature;

FIG. 8 is a schematic circuit diagram showing one illustrative application of the embodiment shown in FIGS. 1–7; and

FIG. 9 is an enlarged fragmentary sectional view showing how the wedges on the plunger handle square up the plunger when it is in the retracted position.

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** (see FIG. **8**). 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. **8,** 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 arma-

ture normally urging the armature to the full line position of FIG. 1 with its opposite end seated against a permanent magnet 33 carried by the switch plate 10. The permanent magnet 33 can be any type but is preferably a double pole magnet such as illustrated in FIG. 7 and serves to releasably lock the armature 30 against the front plate 10 in the open condition of the switch. The armature has a hole 34 through which the shank of a plunger 35 slideably extends, the lower portion of the plunger projecting slideably through a rectangular hole 36 in the base 12 of the U bracket 11.

Referring now to FIGS. 3-8, inclusive, the external handle portion 37 of plunger 35 is preferably square in cross section and adapted to be slideable in a square hole 38 in the switch plate 10, the plunger having an enlarged square shoulder 39 on the inner side of the plate 10 which limits outward movement of the plunger. The handle portion 37 of the plunger is tapered on all four sides outwardly of the shoulder 39 to create short wedges 80 (see FIG. 9) to automatically center the plunger within the hole 38 of switch plate 10 every time the plunger is released. This squares up the plunger handle for appearance and quality appeal. Inwardly of the shoulder 39 the plunger is of reduced diameter and formed with a slot 40 (see FIG. 6) 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 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 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. 3 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 is assembled on the plunger as in FIGS. 3, 5 and 6, it is axially slideable 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. The limited amount of movement is permitted by the length of the slot 40 in the plunger (see FIG. 6), the actuator being moveable 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.

An extra set of lugs 60 is spaced inwardly of the shoulder 39. These lugs are spaced apart as shown in FIG. 3 so that the outer lugs of the actuator fit within the slot between the lugs 60 of the plunger, as shown in FIGS. 3 and 6, when the actuator is in a withdrawn position. Thus when the plunger 37 is pushed inwardly, its lugs 60 engage the armature 30 as shown in FIG. 2 to cause the movement of the armature toward the electromagnet. The shoulder 39 of the plunger first engages the outermost lugs 51 of the actuator and these lugs, in turn, act on the armature.

OPERATION

In operation, with the switch 24 in the circuit of FIG. 8 closed, the push button 36 is pressed inwardly (upwardly, referring to FIG. 1), the initial pressure of the finger causes freeing of the wedges 80 from the margin of the square hole 38 in the face plate 10. Immediately thereafter manual pressure breaks the attraction of the permanent magnet 33 and frees the armature. This freeing of the armature is in the nature of a snap action which gives a desirable feel in switch operation. Such snap action is usually achieved by a spring going over center. Thereafter the lugs 60 press on the armature 30 which in turn presses on the lugs 50, so that the left-hand end of the armature of FIG. 1 is moved toward the core 17 of the electromagnet. Further pressure of the plunger shoulder 60 on the armature 30 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. 8 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 engage, the circuit of FIG. 8 is complete so that 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 are in engagement a magnetic field is produced. In the illustrated embodiment it is produced because the coil 16 is energized, either by being in the same circuit as shown in FIG. 8 or by other suitable arrangement, to pull the end of the armature 30 the rest of the distance into contact with the core 17 and to hold it in this position. As this occurs there is contact overtravel resulting in contact wipe. Then, when the plunger 35 is released by the finger of the operator, the spring 54 engaging the plunger lugs 55 will cause the plunger to return to its outward position of FIG. 1. However, because the electromagnet is holding the armature 30 against the core 17, the armature being accommodated in the clip slots 52 and bearing against the lugs 50 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, holding the contacts 21–22 in circuit-completing condition. Thus the coil 16 becomes a holding coil to maintain the circuit complete.

When the work which the electrical device 26 is performing is over, the coil 16 is de-energized, releasing the armature 30 and breaking the contacts 21–22. 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 is thus released by the de-energized coil 16, the spring 32, which is attached to the projecting end of the armature, will urge the armature back to the inactive position of FIG. 1 where it will be releasably locked in released position by the permanent magnet 33. The armature, in so moving, will bear against the outer lugs 51 of the actuator clip, moving the clip simultaneously outwardly and allowing the spring contact finger 20 to move the contact 21 to the circuit-opening position of FIG. 1.

It is apparent from the above that the novel plunger and actuator clip arrangement of FIGS. 1 to 8 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 that the core 17 acts upon the armature 30 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.

The magnetic attraction force of the permanent magnet 33 varies inversely as the square of the distance of the air gap between the magnet 33 and the armature end 30. The pole spacings on the permanent magnet are so arranged as to give a short attraction length so as not to fight the action of the electromagnet. The permanent magnet 33 prevents the unintentional freeing of the armature 30 as a result of an unexpected bump, shock or vibration which might otherwise cause undesired switch action resulting in the starting of a clothes dryer or other machine. The permanent magnet also prohibits actuation of the switch should energization of the oil occur without pressing of the plunger. The novel wedge action at 80, FIG. 9, allows the wedges to find their position in the square hole 38 to center the plunger handle in the retracted position. Thus manufacturing tolerances of the parts do not have to be as close. The square plunger handle 37 in the square opening 38 provides for desirable rotational stability.

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, a contact member, a movably mounted second contact member, an electromagnet, an armature supported for movement from inactive position toward the electromagnet, a permanent magnet positioned to act on a portion of the armature to releasably maintain the armature in inactive position, biasing means normally urging the armature to a position where it engages said permanent magnet, manually operable contact moving means for causing movement of the second contact member into engagement with the first contact member and for causing manually initiated breaking of the magnetic attraction between the permanent magnet and armature and movement of the armature part way toward the electromagnet, and means including an electric circuit which includes said contact members whereby the electromagnet is energized when the contact members are thus engaged to magnetically move the armature the rest of the way toward the electromagnet and to maintain the contact members in closed condition as long as the electromagnet is thus energized, the permanent magnet being of such strength relative to the strength of the electromagnet, when the armature is in inactive position, that the armature is retained in such inactive position unless the manually operable contact moving means is manually operated.

2. A switch as claimed in claim 1 in which the armature is pivotally supported in unbalanced condition, in which there is a housing for the switch having a wall portion spaced from the electromagnet, in which the armature is so pivoted that an end is movable between said wall and the electromagnet, in which the biasing means normally urges said armature toward said wall, and in which the permanent magnet is mounted on said wall in such a position that it forms a seat for an end of the armature when the latter is in inactive position, said armature end extending transversely of the permanent magnet and the latter being arranged and positioned to provide a closed magnetic circuit without air gap.

3. A switch as claimed in claim 1 in which the manually operable contact moving means engages the armature between its pivotal support and said permanent magnet.

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