June 28, 1966 R. J. CARTIER ETAL 3,258,548

THREE POSITION SLIDE BAR TYPE SWITCH

Filed Jan. 13, 1964 3 Sheets-Sheet 1

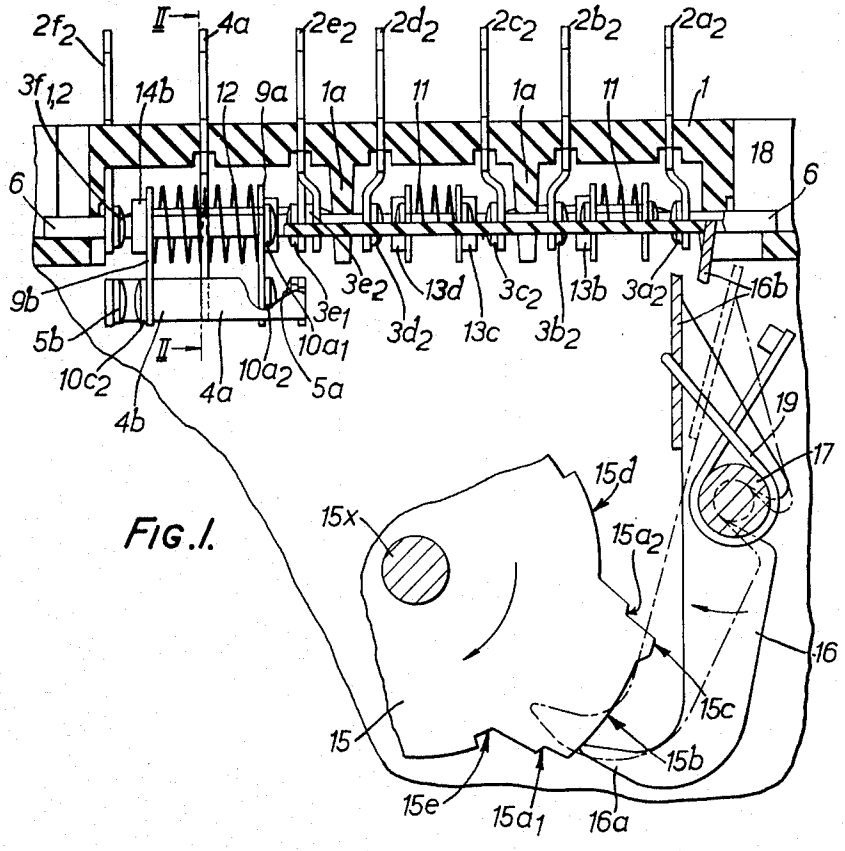

FIG. 1.

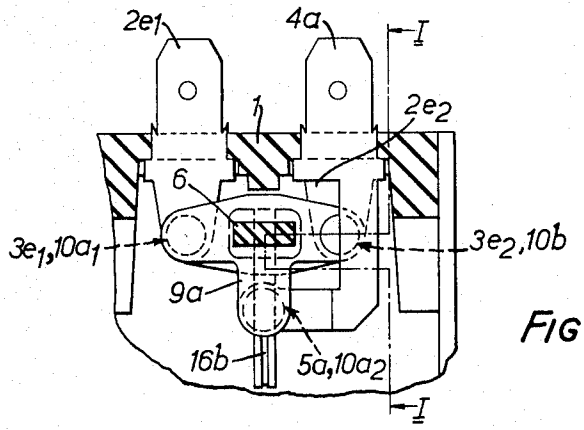

FIG. 2.

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THREE POSITION SLIDE BAR TYPE SWITCH

Filed Jan. 13, 1964 3 Sheets-Sheet 2

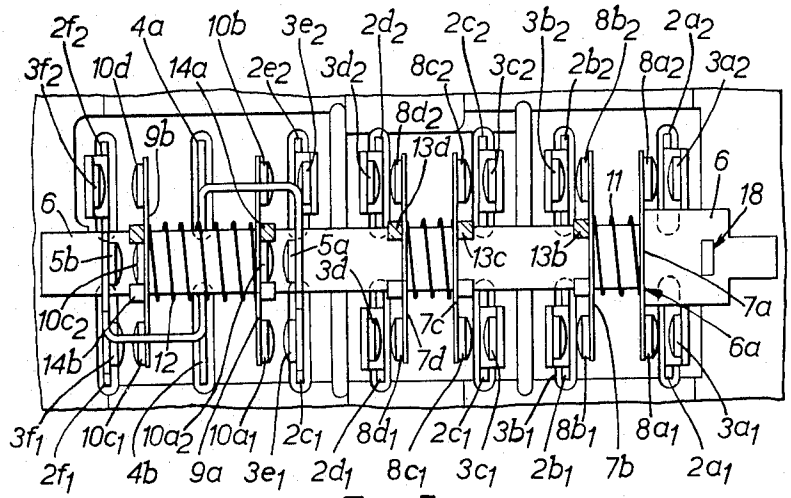

FIG. 3.

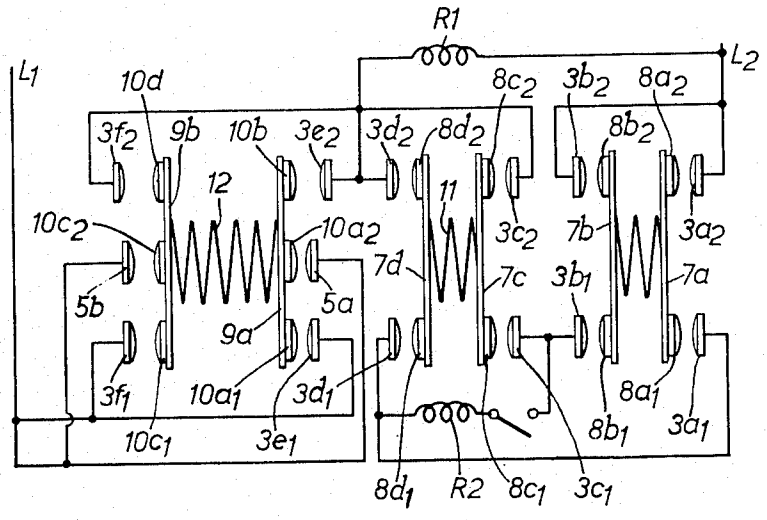

FIG. 4.

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THREE POSITION SLIDE BAR TYPE SWITCH

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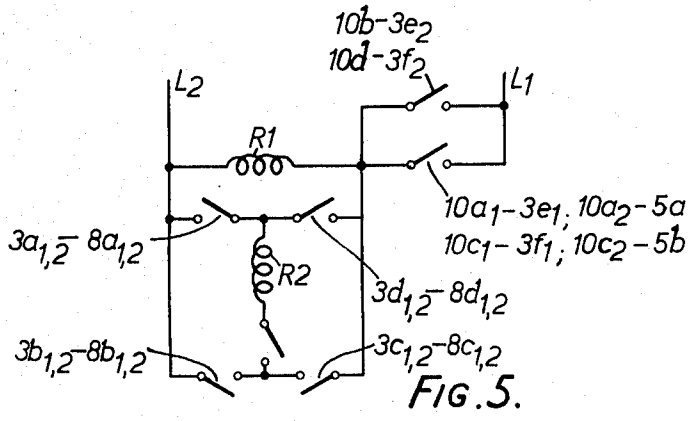

FIG. 5.

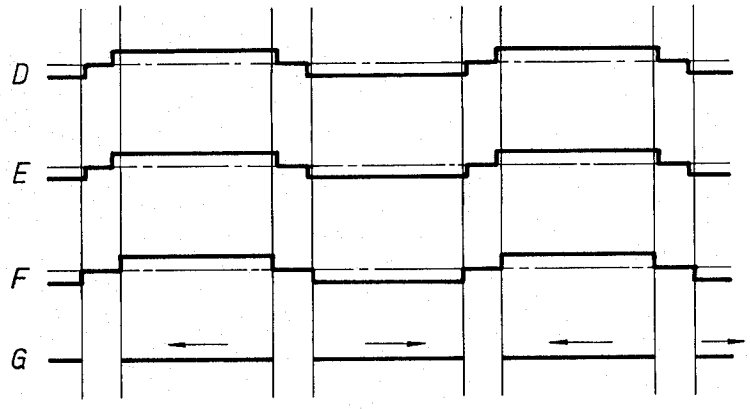

FIG. 6.

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3,258,548

THREE POSITION SLIDE BAR TYPE SWITCH

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1 Claim. (Cl. 200—16)

This invention relates to electric switch devices, and particularly to a reversing switch device. More particularly, the invention relates to a switch device for use in controlling the functions of a clothes or dish washing machine, for example, a washing machine in which the clothes drum is first in one direction and then in the opposite direction during a washing cycle. In such a washing machine, it is important to avoid sudden reversal of the power supply to the motor, particularly when the drum is rotating at speed in one direction.

One object of the present invention is to provide an electric reversing switch device having generally improved performance.

Another object of the invention is to provide an improved electric switch device having increased switching capacity within a confined space.

Another object of the invention is to provide an improved electric switch device developing adequate contact pressure when the switch is made.

Another object of the invention is to provide an improved electric switch device which facilitates breaking of the switch contacts in the event of the contacts becoming welded together.

These and other objects of the invention and the manner in which they are achieved will become apparent from the description of one embodiment of the invention which is given by way of example only with reference to the accompanying drawings, in which:

FIGURE 1 is a side elevation; part in section on the line I—I of FIGURE 2, of a cam-actuated reversing switch;

FIGURE 2 is an end view, part in section along the line II—II of FIGURE 1 of the same switch as is shown in FIGURE 1;

FIGURE 3 is an underneath view of the switch of FIGURE 1;

FIGURE 4 is a plan of the electrical connections of the reversing switch contacts, and the windings of a reversible motor controlled by the switch;

FIGURE 5 shows the electric layout of the connections of the reversible motor with the reversing switch; and

FIGURE 6 is a working diagram of the reversing switch and the reversible motor.

In the embodiment shown in the drawings, the switch device comprises an insulating support or base **1** in which fixed blades $2a_1$ to $2f_1$ and $2a_2$ to $2f_2$ are distributed in two longitudinal parallel rows and perpendicular to the longitudinal axis of the device and each supporting separate contacts $3a_1$ to $3f_1$ and $3a_2$ to $3f_2$.

Two other fixed blades **4***a* and **4***b* carry respectively fixed contacts **5***a* and **5***b*, the first of which is arranged in the plane of the contact $3e_1$, and second being arranged in the plane of the contact $3f_1$.

Midway between the two rows of contacts $3a_1$ to $3f_1$ and $3a_2$ to $3f_2$ is a movable switch member in the form

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of an insulating strip **6** of substantially rectangular section. The ends of strip **6** are guided into corresponding openings in a support **1**, and the intermediate part of said strip is slidable in guides formed by feet **1***a* of the support **1**.

The strip **6** forms the supporting element for the movable parts of the reversing switch and carries the movable contact elements formed by conductor bridges **7***a*, **7***b*, **7***c*, **7***d*, and **9***a*, **9***b*. Each of the four bridges **7***a* to **7***d* carries two contacts $8a_1$, $8a_2$ to $8d_1$, $8d_2$, respectively, and each of bridges **9***a* and **9***b* carries three contacts $10a_1$, $10a_2$, **10***b* and **10***c*, $10c_2$, **10***d*, respectively.

Each of the contact-carrying conductor bridges **7***a* to **7***d*, **9***a* and **9***b* has a rectangular section hole through which passes the strip **6**, in a sliding fit. The section of each hole is such that not only can the strip **6** slide within the hole but the bridge can take up an oblique position relative to the strip when it suffers a constraint due to the fact that one of the contacts which it supports engages its corresponding fixed contact before the other of the contacts which it supports contacts its corresponding fixed contact.

Furthermore, each of the bridges is resiliently biased in the direction of the group of fixed contacts with which it co-operates, this being effected by means of springs **11**, **12**, each of said springs being common to two bridges which it thus tends to move away from one another.

When the strip **6** is in a neutral position, the rest position of the movable contacts is determined by stops **13***b* to **13***d* and for the end bridge **7***a* by a shoulder **6***a* on the strip **6**.

When changing the location of the stops on the strip **6**, one adjusts the separation in the neutral position of the movable contacts with respect to the corresponding fixed contacts.

As is seen from FIGURES 1 and 2, and more particularly from FIGURE 4, when strip **6** is moved in one direction or the other, not all contacts will be closed or opened simultaneously. Contacts $3a_1$–$8a_1$, $3a_2$–$8a_2$, $3b_1$–$8b_1$, $3b_2$–$8b_2$, $3c_1$–$8c_1$, $3c_2$–$8c_2$, $3d_1$–$8d_1$, and $3d_2$–$8d_2$ will close before closing of contacts $3e_1$–$10a_1$, **5***a*–$10a_2$, and $3f_1$–$10c_1$, $10c_2$–**5***b*, continuation of movement of strip **6** producing closing of these last contacts. The latter contacts will open in the reverse order to that in which they close.

In this specific embodiment of the reversing switch, actuation is effected by a cam **15** fixed on a shaft **15***x* and whose profile is formed by steps **15***e*, $15a_1$, **15***b*, **15***c*, $15a_2$ and **15***d* arranged at different radial distances and connected to one another by steeply inclined cam portions.

The cam **15** acts on a cam follower **16***a* at the end of one of the arms of a lever **16** pivoted at **17** and whose other arm has, set at right-angles thereto, a small tongue **16***b* whose end is engaged in a hole **18** in the strip **6**. A spring **19** acts on the lever **16** to keep the cam follower **16***a* constantly in contact with the cam **15**.

Depending on the step of the cam with which the cam follower **16***a* is in contact, the following operations are effected:

(A) With cam follower **16***a* in contact with step $15a_1$ or $15a_2$ of cam **15**; strip **6** is in the neutral position; all circuits controlled by the contacts are open (position shown in FIGURES 1, 3 and 4 in the drawing).

(B) With cam follower **16***a* in contact with the step **15***b*; strip **6** is to the left in the figures mentioned above; it is then that the circuits controlled by contacts ($3b_1$, $8b_1$, $3b_2$, $8b_2$), ($3d_1$, $8d_1$,$3d_2$, $8d_2$), ($3f_1$, $10c_1$), ($5b_1$ $10c_2$) are closed.

(C) With cam follower **16***a* in contact with step **15***c* of the cam; in FIGURES 1, 3 and 4, strip **6** is further to the left; then in addition the circuit controlled by contacts ($3f_2$, **10***d*) is closed.

(D) With cam follower **16***a* in contact with step **15***d* of the cam; strip **6** is to the right in FIGURES 1, 3 and 4; then the circuits controlled by the contacts ($3a_1$, $8a_1$, $3a_2$, $8a_2$), ($3c_1$, $8c_1$, $3c_2$, $8c_2$), (**10***a*$_2$, **5***a*), (**10***a*$_1$, $3e_1$) are closed.

(E) With cam follower **16***a* in contact with step **15***e* of the cam; strip **6** is further to the right in FIGURES 1, 3 and 4; then in addition the circuit controlled by contacts ($3e_2$, **10***b*) is closed.

The essential working characteristic of the switch is dependent on the sequential closing and/or opening of certain contacts. When the cam follower **16***a* passes from the step **12***a*$_2$ of the cam to step **15***d* of the cam displacing the strip **6** to the right, at first fixed contacts $3a_1$, $3a_2$, $3c_1$, $3c_2$ engage the movable contacts $8a_1$, $8a_2$, $8c_1$, $8c_2$ respectively, and only after that does engagement occur respectively between fixed contacts **5***a* and $3e_1$ and movable contacts **10***a*$_2$ and **10***a*$_1$ of bridge **9***a*.

When the cam follower **16***a* passes from step **15***d* of the cam to step **15***e* of the cam, the strip is moved to the extreme right position and the pivoting of bridge **9***a* effects engagement between fixed contacts $3e_2$ and movable contact **10***b*.

From the above description of the sequence of contact-closing operations, the corresponding sequence of contact-opening operations will be readily apparent.

The speed of opening and/or closing of contacts is automatically determined by the profile of the cam **15** and its speed of rotation.

The switch described above has numerous applications in effecting delayed operation of the controls of certain circuits or devices. It is, however, particularly applicable in controlling the direction of rotation of a reversible motor which it is desired to stop, after rotation in a certain direction, before the supply is re-connected for rotation in the opposite direction.

The branch circuit layout of FIGURE 5 is obtained when the fixed blades of the reversing switch are connected, in the manner shown in FIGURE 4, to the auxiliary windings of a single-phase motor.

Then the working cycle of the motor is evident from FIGURE 6, wherein:

T is the time abscissa;
D, the working cycle of contacts ($3a_1$, $8a_1$, $3a_2$, $8a_2$) and ($3b_1$, $8b_1$, $3b_2$, $8b_2$);
E is the working cycle of contacts ($3c_1$, $8c_1$, $3c_2$, $8c_2$) and ($3d_1$, $8d_1$, $3d_2$, $8d_2$);
F is the working cycle of contacts (**5***a*, **10***a*$_2$), ($3e_1$, **10***a*$_1$) and (**5***b*, **10***c*$_2$), ($3f_1$, **10***c*$_1$);
G is the time for the rotation, in the two directions, of the motor.

It is evident that the description given above of the switch, the cricuits controlled thereby and the operation of the switch as a reverser has only been given by way of example and is not limiting and that the switch and its operation can be modified without thereby departing from the scope of the invention.

It is also evident that, although the switch device described above is particularly suitable for use as a reverser to control the direction of rotation of a reversible electric motor, such as the motor driving the clothes drum of a washing machine, the device can equally well be arranged to act as contact maker, circuit breaker, controller, change-over switch, or the like, with a stepped or sequential action.

It will be appreciated that by means of the switch construction described above, having regard in particular to the provision of double contacts at each end of each bridge system **7***a*, **7***b*; **7***c*, **7***d* and **9***a*, **9***b*, the spacing between the moving and fixed contacts is reduced below that of two-way conventional switches whilst still conforming with electrical safety requirements. Consequently, a very large switching capacity is obtainable within a restricted space.

A problem with a sliding type switch actuator is to develop adequate contact pressure when the switch contacts close. By causing slight overtravel of the sliding strip **6** in the above-described switch device, the respective springs **11** will act to develop the desired contact pressure.

Another feature of the above-described switch device which provides good switch performance is the ability of the contact pairs to break apart if they should have become welded together during closing of the contacts. This is brought about by the fact that the bridges can pivot to develop leverage and a sliding action between the contacts which is highly effective in breaking the contacts apart.

Another advantageous feature of the above-described switch device is the good switching action which is obtainable when the strip **6** is moved in either direciton from its neutral position, by reason of the springs **11**.

Furthermore, by controlling the opening and closing of the contact pairs from a single rotatable cam, correct switch sequencing is assured.

Numerous other advantages will be apparent from the embodiment of the invention described above, including the fact that the switches open and close in sequence, that contact pressure remains adequate as the sliding strip or bar **6**, keeps moving, the sliding strip forces the contacts open, low contact bouncing is obtained through the two contact system and the spring load, the neutral position of the contacts can be adjusted by bending the drive lever, and the contact opening and closing speed can be controlled along with the sequencing thus giving good switching conditions by eliminating or reducing capacitor discharge problems.

In the washing machine industry, the word "reversing" is frequently given the specialized meaning of a reversal of a clothes drum accompanied by a change in the function of the machine, whilst the word "inversing" is applied to a reversal not accompanied by a function change. In this specification, however, no such distinction or specialized meaning should be implied.

Although but a single embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claim.

We claim:

A switching mechanism including,
a support,
a slide bar slidably carried on the support,
spaced stops on the bar,
a pair of contact bars slidably carried on the slide bar between the stops,
a spring carried on the slide bar between the contact bars and urging the contact bars against the stops,
a contact on each end of each contact bar,
a third contact in a medial position on each contact bar,
fixed contacts carried on the support in alignment with the contacts on the contact bars, said contact bars lying between the fixed contacts whereby in one position of the slide bar one contact bar contacts one set of fixed contacts and in a second position of the slide bar the second contact bar contacts the second set of fixed contacts and in an intermediate position no contacts are made,
the three fixed contacts opposing each contact bar being arranged in a non-planar manner whereby the contact bar makes contact with a middle and one end contact first and then pivots on the middle contact to close on the other end contact as the slide bar moves in the closing direction,
and means for reciprocating the slide bar to said positions.

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