July 2, 1968 P. R. VIRNOCHE, JR 3,391,258

SWITCH CONSTRUCTION HAVING THREE SPRING BLADE CONTACT ARMS AND SPACER MEANS THEREBETWEEN

Filed Oct. 24, 1966

FIG. 1

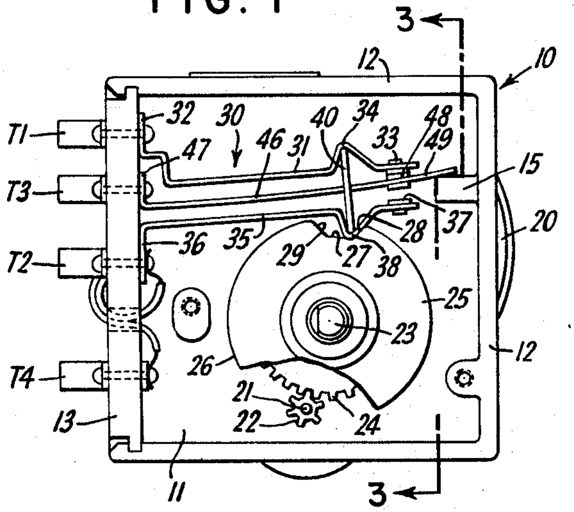


FIG. 3

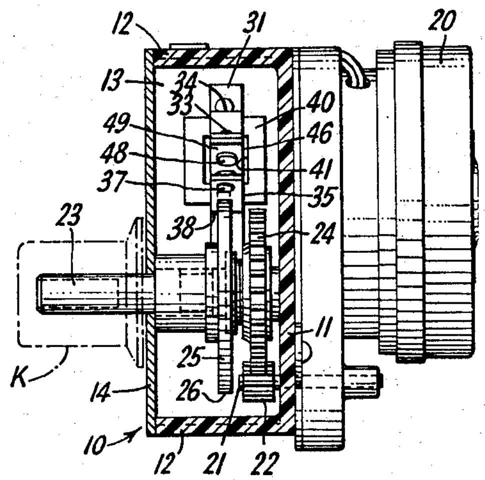


FIG. 2

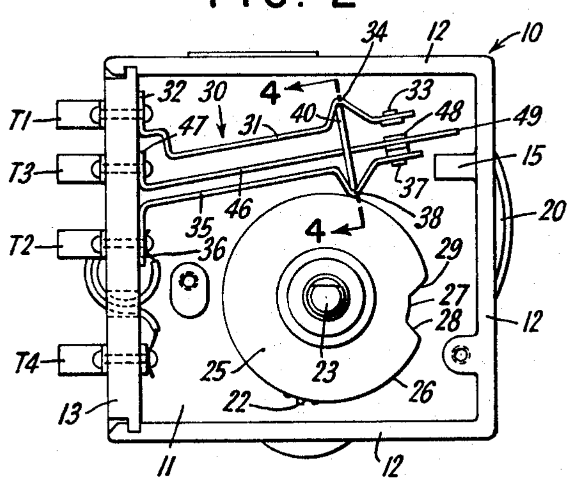


FIG. 4

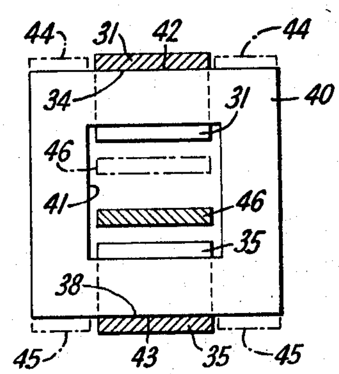
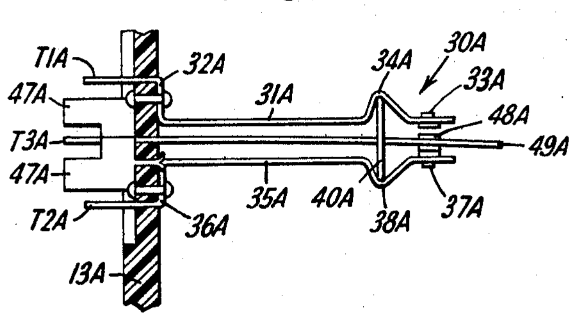


FIG. 5



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SWITCH CONSTRUCTION HAVING THREE SPRING BLADE CONTACT ARMS AND SPACER MEANS THEREBETWEEN

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ABSTRACT OF THE DISCLOSURE

A cam actuated switch having a pair of spring blade contact arms each with a deformation, a hollow spacer for said pair of arms being seated and retained in said deformations, and a third contact arm being disposed between said pair of arms and extending through said spacer.

This invention relates generally to electric circuit controls and more specifically to switches therefor.

The invention is particularly adapted for a time control which makes and breaks switches to derive timed operation. Control means of this general type are shown, described and claimed in U.S. Patents 2,975,612 and 3,001,036 which were granted to J. J. Everard and are assigned to the same assignee as is the present application. Although the controls of the foregoing patents are of repetitive operating cycle type, there is no intent to limit the novel switch of the present application to such a single environment. Accordingly, the present invention is shown and described in a control having a rotary cam which is manually reset at the beginning of each operating cycle. Such a device is shown and described in U.S. Patent 2,562,481 granted to E. W. Swayze.

An object of the present invention is to provide a single pole, double throw switch of improved construction.

Another object of the present invention is to provide the foregoing switch having spring blade contact arms with improved current transmission characteristics.

And another object of the present invention is to provide the foregoing switch with blade spacer means disposed adjacent the contacts.

The present invention contemplates an electric switch comprising a cam actuator and a limit stop; a pair of spaced elongated spring arms each having a movable end with a contact thereat, and a deformation extending away from the other of said pair of arms to provide a pair of spaced apart alined seats; a spacer having an opening therethrough, being disposed between said pair of arms and being engaged and retained by said seats; a main elongated spring arm spaced between said pair of arms and extending through the opening in said spacer; said main arm having a movable end with a main contact thereat alined with the contacts of said pair of arms, and being self-biasing to urge its movable end into engagement with said limit stop; said pair of arms being self-biasing to urge the contact of one of said pair of arms into engagement with the main contact, and to urge the other of said pair of arms into engagement with the cam actuator and the contact thereof away from the main contact; and said cam actuator being operable against the self-bias of said pair of arms to move the contact of the one out of engagement with the main contact and the contact of the other into engagement with the main contact.

The foregoing and other objects and advantages will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawings wherein several embodiments of the invention are illustrated by way of example. It is to be expressly understood, however, that the drawings are for illustration purposes only and are not to be construed as defining the limits of the invention.

FIGURES 1 and 2 are elevational views of a time control, with the cover removed, having a switch made in accordance with the present invention; each illustrating the switch in one of its two operated positions opposite from the position shown in the other;

FIGURE 3 is an end elevational view of the time control with the switch housing thereof shown in section taken on line 3—3 of FIGURE 1;

FIGURE 4 is an enlarged sectional view of the novel switch taken on line 4—4 of FIGURE 2; and

FIGURE 5 is an enlarged elevational view of a modified switch and the part of the casing, partially broken away, to which it is attached.

Referring now to the drawings, a hollow switch casing **10** has a rectangular wall **11** with a peripheral flange **12** extending therefrom along three of its edges. A removable flange piece **13** slidably connected at its ends to flange **12** is provided along the fourth edge of wall **11**, and a cover **14** is provided which engages flange **12** and flange piece **13** to complete the hollow casing **10** structure. An internal abutment **15** is provided in casing **10** adjacent one side of flange **12** which is opposite from flange piece **13**.

A synchronous or timer motor **20** with a gear train normally provided in its casing, is connected in any suitable manner, well known in the art, to wall **11**. One such motor is shown in U.S. Patent 3,164,734 which was granted to R. A. Heinzen, Jan. 20, 1965, and assigned to the same assignee as is the present application. Motor **20** has an output gear **22** disposed in switch casing **10** and fixedly mounted on a motor output shaft **21** which extends through wall **11**.

A pinion **24**, in mesh with and driven by gear **22**, is fixedly mounted on a cam shaft **23** which is journalled at one end in wall **11** and extends at its other end through cover or wall **14**. A knob K, as indicated, is fixedly connected to the exposed end of shaft **23** for manually rotating a switch operating cam **25** in casing **10**. Cam **25**, mounted on and and rotated by rotation of shaft **23**, has an annular edge providing a first cam surface **26**, and a formed indent in the annular edge providing a second cam surface **27** connected to the first cam surface by ramps **28** and **29** for actuating a switch **30**.

Switch **30**, as shown, has a pair of spaced and substantially parallel elongated spring arms **31** and **35**. Arm **30** has a flange **32** at one end connected to flange member **13** and electrically connected to a terminal T1 external of casing **10**, and a contact **33** at its other end. Between its ends and preferably adjacent contact **33**, arm **31** has a generally V-shaped deformation **34** forming a recess extending away from arm **35**, the base of which is formed by the apex of the V-shape providing a spacer seat. Arm **35**, similarly, has a flanged end **36** connected to flange member **13** and electrically connected to a terminal T2, a contact **37** at its other end which is disposed in spaced face to face alinement with contact **33** of arm **31**, and a generally V-shaped deformation **38** which is alined with and extends oppositely from deformation **34**.

A spacer **40**, disposed between arms **31** and **35**, has a pair of substantially parallel opposed edges **42** and **43** which are engaged and retained by formed seats **34** and **38**, respectively. Seats **34** and **38**, which are disposed substantially transverse the lengths of arms **31** and **35**, prevent spacer **40** from moving axially relative to arms **31** and **35**. To prevent lateral movement, if necessary, edges **42** and **43** may be notched by providing extended edge end portions **44** and **45**, respectively, as shown in FIGURE 4. Spacer **40** also has a central openings **41**.

A common or main elongated spring arm **46** is spaced between and is substantially parallel to arms **31** and **35**.

Arm 46, which has a flanged end 47 connected to flange member 13 and electrically connected to a terminal T3, extends through the opening 41 in spacer 40 and has a contact 48 alined with and providing faces to engage contacts 33 and 37, alternatively. The contact end 49 of arm 46 extends beyond the contact ends of arms 31 and 35, and is adapted to engage abutment 15 in casing 10, as shown in FIGURE 1.

A modified switch 30A is shown in FIGURE 5 in which switch blades 31A, 35A and 36A correspond to blades 31, 35 and 36, respectively, of switch 30, and have corresponding portions thereto identified by the same number, as previously used, with an A suffix. The primary difference is that a modified flange member 13A is provided with openings therethrough for terminals T1A, T3A and T2A which are now portions of blades 31A, 35A and 46A, respectively, and not separate terminals requiring electrical connection. The flange 47 of arm 46 is eliminated from arm 46A, and is replaced by a pair terminal flanges 47A which are staked to flange member 13A, as shown.

The operating time cycle of switch 30 in a time control having a repetitive operating cycle would be the time period in which cam 25 makes one complete revolution. However, in the reset type control as shown in the drawings, the operating time cycle is the elapsed time it takes cam 25 to rotate to its position, as shown in FIGURE 1, from its reset position in which deformed portion 38 engages cam surface 26 adjacent the ramp surface 29. The speed of rotation of cam 25 or the operating time cycle is derived by the speed and input/output ratio of the gear train of motor 20, and the ratio of gears 22 and 24.

Arms 31, 35 and 46 are always flexed from their normal positions which would be substantially at right angles to flange member 13, as shown in FIGURE 5 with respect to modified switch 30A, and are, therefore, self-biasing. Switch 30, as shown in FIGURE 1, is at the end of an operating cycle, prior to reset, wherein the contact end 49 of the leaf spring arm 46 engages abutment 15 to limit the maximum return travel of contact 48 in the direction of arm 35. The deformed portion 38 of spring arm 35, in addition to providing a seat for one end of spacer 40, acts as a cam follower and positively engages cam surface 27, forming the bottom of the indent in cam 25, under the influence of the self-biasing of arm 35. Because of its self-biasing, arm 31 follows arm 35 and maintains spacer 40 positively seated in the opposed deformations 34 and 38. It should be noted that spacer 40 is always substantially normal to the planes of arms 31, 35 and 46.

With cam 25 positioned as shown in FIGURE 1, switch 30 is in the condition described immediately above and provides an electrical connection between terminals T1 and T3 through closed contacts 33 and 48. Contacts 37 and 48, at this time are open and no electrical connection is, therefore, provided between terminals T2 and T3. To start a new operating cycle, knob K is manually rotated to rotate shaft 23 and cam 25, clockwise, as indicated in the drawings.

As cam 25 moves, the apex of the deformed portion 38 of arm 35 will traverse the ramp surface 29 and move into contact with cam surface 26 which progressively urges the contact end to move, against its self-bias toward arm 46. This movement of arm 35, through spacer 40, moves the contact end of arm 31, against the self-bias of that arm, causing a succession of occurrences. First, contacts 33 and 48 break or open and terminate the electrical connection between terminals T1 and T3. Contacts 37 and 48 then make or close and electrically connect terminals T2 and T3. Terminal movement of arm 35, as the deformed portions 38 approaches the end of ramp surface 29 and starts to engage cam surface 26, urge the free end 49 of the common spring switch arm 46 to move, against the self-bias of arm 46, away from the limit stop or abutment 15 through closed contacts 37 and 48.

It now should be readily understood that the self-bias of

the spring arm 31 provides the desired contact pressure when contacts 33 and 48 are closed, and the self-bias of spring arm 46 provides such pressure when contacts 37 and 48 are closed. Switch 30 will remain in its condition with contacts 37 and 48 closed for the time period that deformed portion 38 engages cam surface 26 of cam 25 which is now rotatably driven by motor 20.

In the arrangement shown, motor 20 is to rotatably drive cam 25 when deformed portion 38 engages cam surface 26 and contacts 37 and 48 are closed. One way to control motor 20 is to connect its leads to terminal T2 and a terminal T4, as shown, and thereby permit the opening and closing of contacts 37 and 48 to control motor energization. As the deformed portion 38 leaves cam surface 26 and traverses ramp surface 28, switch 30 returns to its initial condition, as shown in FIGURE 1, and terminates the operating time cycle.

At this time, the self-bias of the deflected arms 31, 35 and 46 cause their contact end to move toward cam 25 until the end 49 of arm 46 engages stop 15. The contact ends of arms 31 and 35 with spacer 40 therebetween will continue to move relative to arm 46 until the deformed portion 38 again contacts the cam surface 27. As a result, contacts 37 and 48 will open terminating the electrical connection between terminals T2 and T3, and the deenergizing motor 20. Contact 33 will then engage contact 48, again, electrically connecting terminals T1 and T3.

Provision of spacer 40 retained in the seats formed by deformations 34 and 38 permits simultaneous follower type movement of arms 31 and 35 relative to arm 46 while providing an improved construction. By eliminating the slots of the prior art from the spring arms 31, 35 and 36, the cross-sectional area of each arm between its terminal connection and its contact is constant. This eliminates a resistance area and improves the current carrying capacity of each arm. Additionally, a structural weakness in each of the arms is eliminated and prevents maximum deflection from localized areas as in the prior art. The self-destructive interaction of the sharp edges of the spring arm slots and the spacer of the prior art is also eliminated.

Although several embodiments of the invention have been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes may be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

I claim:

1. An electric switch comprising:

a cam actuator and a limit stop;

a pair of spaced elongated spring arms each having a movable end with a contact thereat, and a deformation extending away from the other of said pair of arms to provide a pair of spaced apart alined seats;

a spacer having an opening therethrough, being disposed between said pair of arms and being engaged and retained by said seats;

a main elongated spring arm spaced between said pair of arms and extending through the opening in said spacer;

said main arm having a movable end with a main contact thereat aligned with the contacts of said pair of arms, and being self-biasing to urge its movable end into engagement with said limit stop;

said pair of arms being self-biasing to urge the contact of one of said pair of arms into engagement with the main contact, and to urge the other of said pair of arms into engagement with the cam actuator and the contact thereof away from the main contact; and

said cam actuator being operable against the self-bias of said pair of arms to move the contact of the one out of engagement with the main contact and the contact of the other into engagement with the main contact.

2. The electric switch in accordance with claim 1, wherein:

the deformation of the other of said pair of arms engages the cam actuator and provides a cam follower portion.

3. The electric switch in accordance with claim 1, wherein:

the deformation of each of said pair of arms is adjacent the contact and is substantially of a V-shape extending away from said main spring arm;

the apex of each V-shaped deformation being disposed transverse to the length of the arm and providing one of said pairs of seats; and

said spacer being retained by said seats substantially normal to said arm.

4. The electric switch in accordance with claim 3, wherein:

said spacer has a pair of substantially parallel edges engaged by said pair of seats.

5. The electric switch in accordance with claim 4, wherein:

each of said substantially parallel spacer edges is recessed to provide a pair of extended end portions to engage the edges of the seat and prevent lateral movement of said spacer relative to all of said arms.

6. The electric switch in accordance with claim 3, and further comprising:

a casing having a flange member;

each of said arms having a flange at its end opposite from its movable end connected to said flange member; and

a plurality of terminals extending outwardly of said casing from said flange member each electrically connected to one of said spring arms.

7. The electric switch in accordance with claim 6, wherein:

each flange is unitary with the end of the arm to which it is electrically connected.

8. The electric switch in accordance with claim 6, wherein;

said cam actuator is a rotary cam; and

said limit stop is an abutment in said casing.

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H. BURKS, *Assistant Examiner.*