

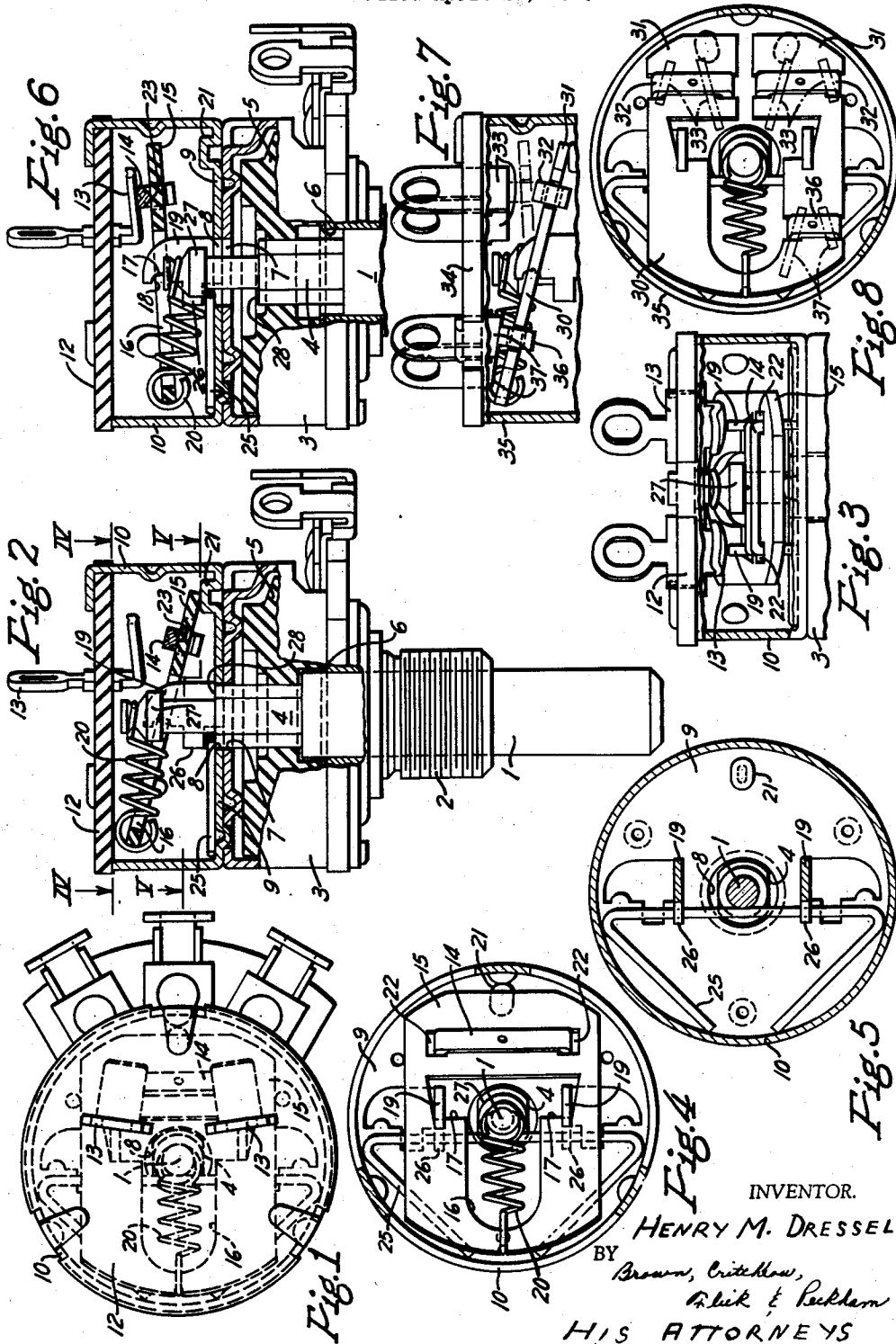
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PUSH-PULL ELECTRIC SWITCH

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PUSH-PULL ELECTRIC SWITCH

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This invention relates to push-pull electric switches, and more particularly to those used in conjunction with volume controls for radios and television sets.

One of the problems in a combined volume control and electric switch of the type in which the control shaft is rotated to regulate the volume of sound and is moved axially in opposite directions to turn the electric current on and off, is that if a strong spring is used for snapping a movable contact against a stationary contact so as to make good electrical contact with it, the lateral pressure exerted by the spring on the shaft may create so much side thrust that an undesirable amount of friction is produced. Another problem relates to grounding the control shaft. It has been found that the shaft bushing cannot be depended upon for making good electrical connection with the shaft to ground it. Thus, in sensitive circuits connected with the volume control, it is found that if the electrical resistance between the shaft and the bushing is not extremely low, the operator in touching the shaft will induce a disturbing voltage into the control circuit. When a line switch is combined with the control, that condition becomes a lot worse, because it also is possible for the switch circuit to induce voltages into the sensitive volume control circuit.

It is among the objects of this invention to provide a push-pull electric switch, in which a movable contact engages one or more stationary contacts with considerable pressure, in which side thrust on the control shaft is substantially eliminated, in which the shaft is effectively grounded, in which the last two objects are accomplished by a single additional element that also restricts outward movement of the shaft, in which the movable contact can be made self-aligning with a pair of fixed contacts, and in which the fixed contacts are shaped so that excessive solder or flux used in connecting wires to them cannot reach their contact faces.

In accordance with this invention a switch housing has front and back walls connected by a side wall. The front wall has a central opening through it, in front of which a bushing is rigidly mounted for rotatably and slidably supporting a control shaft that extends back into the housing. Preferably, the bushing is mounted on a volume control fastened to the front of the switch housing. Inside the switch housing there is a switch arm that is inclined to the shaft and that is provided with an opening which loosely receives the shaft extending through it. Provision is made for oscillatably mounting the arm on an axis extending across the shaft. A coil spring is tensioned between the rear end of the shaft and one end of the arm, with the point of connection of the shaft to the spring being movable by the shaft forward from a location in back of the arm axis to a location in front of that axis in order to cause the spring to snap one end of the arm forward and thereby swing its opposite end backward toward the back wall of the housing. An electric contact is carried by the free end of the arm for engagement with a fixed electric contact mounted in the housing in the path of the arm contact. A spring located in the

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housing in front of the coil spring is compressed between the housing side wall and the side of the shaft to substantially counteract the lateral tension exerted on the shaft by the coil spring. The shaft preferably is provided with a lateral projection that, when the shaft is pulled forward, will engage a portion of the compression spring extending across the shaft, thereby limiting forward movement of the shaft. Also, it is desirable that the fixed contact be L-shaped, with one leg of the L extending through the back wall of the housing and the other leg extending along the back wall inside the housing.

The invention is illustrated in the accompanying drawings, in which

Fig. 1 is a rear view of my switch;

Fig. 2 is a horizontal central section through the switch and part way through a volume control secured to the front of the switch;

Fig. 3 is a side view of the switch, with its side wall broken away to show the interior;

Figs. 4 and 5 are vertical sections taken on the lines IV—IV and V—V, respectively, of Fig. 2;

Fig. 6 is a fragmentary view similar to Fig. 2, but showing the switch closed;

Fig. 7 is a fragmentary view of a modified switch, with the upper part of its side wall broken away; and

Fig. 8 is a view looking into the back of the modified switch after the rear wall has been removed, the positions of the fixed contacts being indicated by broken lines.

Referring to the first six figures of the drawings, a control shaft 1 is rotatably and slidably mounted in a bushing 2 secured to the front of a suitable volume control unit 3. The bushing is threaded and adapted to extend through a hole in a panel and receive a nut for rigidly mounting the bushing in place. The shaft has a non-circular central portion 4 that is splined in a head 5 of insulating material rotatably mounted in the volume control housing. The head carries the usual contact (not shown) that slidably engages a resistance element 6 in the front of the control housing. The rear end of the shaft extends back through a central opening 7 in the back of the volume control and on through a similar opening 8 in the metal front wall 9 of a switch housing that has a cylindrical side wall 10 integral with its front wall. The front of the switch housing is welded or otherwise rigidly attached to the back of the volume control housing.

The control shaft extends back into the switch housing and, in its rear position is spaced a short distance from the insulated rear wall 12 of the housing. This wall supports a pair of fixed contacts 13 that are disposed quite close together between the center of the wall and one side of the housing. Each contact preferably is L-shaped, with one leg of the L rigidly mounted in the back wall of the housing and projecting from its opposite sides. The other leg of the L is inside the housing and extends along the back wall toward the adjacent side of the housing. This latter leg may be curved transversely slightly to provide a convex contact surface facing the front of the housing. The shape of these contacts prevents any solder or flux, which may creep along the contacts into the housing, from reaching their contact surfaces.

In order to engage the fixed contacts, one or more movable contacts are provided. A single bridging contact 14 for engaging both fixed contacts simultaneously is shown. This bridging contact is carried by one end of an arm 15 that is formed from a plate of insulating material. The arm is inclined to the shaft and is provided with an opening 16, through which the shaft extends. The opening is considerably larger than the shaft so that the arm will not engage it. As shown in Fig. 4, the opening preferably is formed from two slots

intersecting each other to form a T, with the cross bar of the T parallel to the bridging contact and close to it. The stem of the T extend from the opposite side of the cross bar toward the end of the arm remote from the contacts. Shoulders 17 are thus provided by the sides of the cross bar that connect with the stem of the opening. These shoulders are set in semicircular notches 18 (Fig. 6) in the edges of a pair of tongues 19 cut from the front wall of the switch housing and bent backwardly into parallel relation. The positions of the tongues in the ends of the cross bar of opening 16 prevent arm 15 from moving sideways. To hold arm shoulders 17 in the tongue notches, a coil spring 20 is disposed in the stem of opening 16 and has one end hooked around the adjacent end of the arm and the opposite end hooked onto the grooved rear end of the shaft behind the arm. In this position the spring also holds the adjoining end of the arm in its rear position and its free end in its forward position, which can be limited by a detent 21 pressed out of the front wall of the housing.

It will be seen that with this construction forward movement of the control shaft to the position shown in Fig. 6 will pull the inner end of the spring forward to a location in front of notches 18 and cause the opposite end of the spring to snap the adjoining end of the arm forward and thereby swing the bridging contact back against the fixed contacts. During this movement of the arm, it swings on an axis passing through its shoulders in the tongue notches, the tongues thereby serving as bearing members for oscillation of the arm. When the bridging contact strikes the fixed contacts it will align itself with them because it is formed from a bar that has forwardly bent ends extending loosely through oversized openings 22 in the arm and then bent toward each other, and the central part of the bar is provided with a rounded projection 23 (Fig. 2) that spaces the bar from the rear face of the arm. The bar can therefore rock in any direction on the projection to accommodate itself to the fixed contacts in order to bear against both of them with equal pressure. When the shaft is pushed in again, the coil spring will snap the arm in the opposite direction to swing the bridging contact away from the fixed contacts, as shown in Fig. 2.

It is a feature of this invention that the coil spring 20 can be made as strong as desired in order to hold the bridging contact tightly against the fixed contacts. This can be done without creating side thrust on the shaft that might cause it to bind, or at least turn and slide with considerable friction in the bushing, because the side thrust is balanced or nearly counteracted by means of a compression spring 25 that is located in front of the coil spring and compressed between the side wall of the switch housing and the side of the control shaft. By pushing laterally against the shaft in one direction, this spring prevents the coil spring from pulling the shaft off center in the opposite direction. The stronger the coil spring, the stronger the compression spring should be.

The compression spring preferably is triangular and formed from a wire that has a straight central portion extending entirely across the housing and the shaft, and converging end portions provided with free ends engaging the side of the housing. In fact, these ends may actually dig into the side wall. It will be seen that the compression spring is restrained by the control shaft and housing side wall from bodily movement in the plane of the spring. The spring is held against the front wall of the housing by lugs 26 projecting from the two tongues 19 and overlying the straight central portion of the spring. The compression spring also provides a very good electrical connection between the control shaft and the switch housing and thereby insures good grounding of the shaft.

Another advantage of compression spring 25 is that it can serve to limit forward movement of the control shaft

in the switch. This is done by providing the rear end portion of the shaft with an integral enlargement 27 that will strike the compression spring when the control shaft has been pulled forward a predetermined distance. The spring makes it easy to assemble the shaft with the switch housing because, after the spring has been put in place, the shaft can be pushed back through opening 8, with the rearwardly tapered enlargement 27 deflecting the spring laterally until the spring can snap back in front of the enlargement, thereby locking the shaft in the switch housing. If desired, the spring can also be used for limiting backward or inward movement of the control shaft, which can be provided with a shoulder 28 to engage the spring when the shaft has been pushed in the required distance.

In the embodiment of the invention shown in Figs. 7 and 8, other ways that the switch can be made are shown. The oscillatable switch arm 30 can be split between its central opening and its free end and each fork 31 thus formed can be provided with a floating bridging contact 32 like the one already described, but shorter. Each of these contacts can be swung back against a different pair of fixed contacts 33 mounted in the rear wall 34 of the switch housing 35. Due to the arm being forked, each bridging contact can engage its pair of fixed contacts without interference from the other set of contacts. That is, one fork of the arm can flex slightly relative to the other fork so that both bridging contacts will engage their fixed contacts with uniform pressure.

This embodiment of the invention also illustrates another feature, which is that the opposite end of arm 30 can be provided with one or more contacts 36 for engaging fixed contacts 37 at that side of the housing. It will be seen that contact 36 will engage contacts 37 when the contacts at the opposite end of the arm are open. There are electric circuits in which such a system is desirable.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A push-pull electric switch comprising a housing having front and back walls connected by a side wall, the front wall having a central opening through it, a bushing rigidly mounted in front of the front wall in line with said opening, a control shaft rotatably and slidably mounted in the bushing and extending back into the housing, a switch arm inside the housing inclined to the shaft and provided with an opening loosely receiving the shaft extending therethrough, means oscillatably mounting the arm on an axis extending across the shaft, a coil spring tensioned between the rear end of the shaft and one end of the arm, the point of connection of the shaft to the spring being movable by the shaft forward from a location in back of said axis to a location in front of said axis to cause the spring to snap said end of the arm forward and thereby swing its opposite free end backward toward said back wall, an electric contact carried by the free end of the arm, a fixed electric contact mounted in the housing in position to be engaged by the other contact when it is swung toward the fixed contact, and a spring in the housing in front of the coil spring and compressed between the housing side wall and the side of the shaft to substantially counteract the lateral tension exerted on the shaft by the coil spring.

2. A switch according to claim 1, including means projecting from the housing and overlying said compression spring to hold it against the front wall of the housing.

3. A switch according to claim 1, in which said compression spring has a portion extending across the shaft, and the shaft is provided with a lateral projection behind

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said spring portion for engaging it to limit forward movement of the shaft when the shaft is pulled.

4. A switch according to claim 1, in which said free end of the arm is forked and said arm contact is carried by one fork, a second contact is carried by the other fork, and an additional fixed contact is mounted in the housing in position to be engaged by said second contact when it is swung toward the additional fixed contact.

5. A switch according to claim 1, including a second contact carried by said one end of the arm, and a fixed contact mounted in the housing in position to be engaged by said second contact when the free end of the arm is swung forward.

6. A switch according to claim 1, in which there are two fixed contacts mounted in the housing and said arm contact is a bridging bar loosely connected to the arm so that it can adjust itself to said fixed contacts.

7. A switch according to claim 1, in which said fixed contact is of general L-shape with one leg of the L extending through the back wall of the housing and the other leg extending along the back wall inside the housing.

8. A push-pull electric switch comprising a housing having front and back walls connected by a side wall, the front wall having a central opening through it, a bushing rigidly mounted in front of the front wall in line with said opening, a control shaft rotatably and slidably mounted in the bushing and extending back into the housing, a switch arm inside the housing inclined to the shaft and provided with an opening loosely receiving the shaft extending therethrough, means oscillatably mounting the arm on an axis extending across the shaft, a coil spring tensioned between the rear end of the shaft and one end of the arm, the point of connection of the shaft to the spring being movable by the shaft forward from a location in back of said axis to a location in front of said axis to cause the spring to snap said end of the arm forward and thereby swing its opposite free end backward toward said back wall, an electric contact carried by the free end of the arm, a fixed electric contact mounted in the housing in position to be engaged by the other contact when it is swung toward the fixed contact, and a wire spring in the housing in front of the coil spring, the wire spring having a central body extending across the housing in engagement with the side of the shaft and having converging end portions terminating in ends pressing against the housing side wall hard enough to cause the wire spring to substantially balance the lateral pull of the coil spring on the shaft.

9. A switch according to claim 4, including lugs in the housing connected with the front wall of the housing at opposite sides of the shaft and overlying said spring body to hold it against the front wall of the housing.

10. A push-pull electric switch comprising a housing having front and back walls connected by a side wall, the front wall having a central opening through it, a bushing rigidly mounted in front of the front wall in line with said opening, a control shaft rotatably and slidably mounted in the bushing and extending back into the housing, a switch arm inside the housing inclined to the shaft and provided with an opening loosely receiving the shaft extending therethrough, bearing members projecting rearward from the front wall of the housing at opposite sides

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of the shaft, said arm being provided with transverse shoulders engaging one side of said members and adapted to rock thereon on an axis extending across the shaft, a coil spring tensioned between the rear end of the shaft and the end of the arm at said side of the bearing members to hold said shoulders against those members, the point of connection of the shaft to the spring being movable by the shaft forward from a location in back of said shoulders to a location in front of them to cause the spring to snap said end of the arm forward and thereby swing its opposite free end backward toward said back wall, an electric contact carried by the free end of the arm, a fixed electric contact mounted in the housing in position to be engaged by the other contact when it is swung toward the fixed contact, and a spring in the housing in front of the coil spring and compressed between the housing side wall and the side of the shaft to substantially counteract the lateral tension exerted on the shaft by the coil spring.

11. A switch according to claim 10, in which said arm opening is substantially T-shape, said coil spring being disposed in the stem of the T and said shoulders being located where the stem joins the cross bar of the T, said bearing members projecting through said arm opening at the opposite ends of its cross bar portion.

12. A push-pull electric switch comprising a housing having front and back walls connected by a side wall, the front wall being sheet metal and having a central opening through it, a bushing rigidly mounted in front of the front wall in line with said opening, a control shaft rotatably and slidably mounted in the bushing and extending back into the housing, a switch arm inside the housing inclined to the shaft and provided with an opening loosely receiving the shaft extending therethrough, the central portion of said arm being provided with laterally spaced transverse shoulders, substantially parallel tongues in the housing struck out of said front wall at opposite sides of the shaft and having notched edges receiving said shoulders, a coil spring tensioned between the rear end of the shaft and the end of the arm at the notched side of the tongues to hold said shoulders against the tongues, the point of connection of the shaft to the spring being movable by the shaft forward from a location in back of said shoulders to a location in front of them to cause the spring to snap said end of the arm forward and thereby swing its opposite free end backward toward said back wall, a fixed electric contact mounted in the housing in position to be engaged by the other contact when it is swung toward the fixed contact, and a spring in the housing in front of the coil spring and compressed between the housing side wall and the side of the shaft to substantially counteract the lateral tension exerted on the shaft by the coil spring.

13. A switch according to claim 12, in which said compression spring has a portion extending across said tongues, and lugs project from the tongues directly behind said spring portion to hold it against the front wall of the housing.

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