March 11, 1941. H. C. HALL ET AL 2,234,405

PUSH-BUTTON SWITCH

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Fig. 1

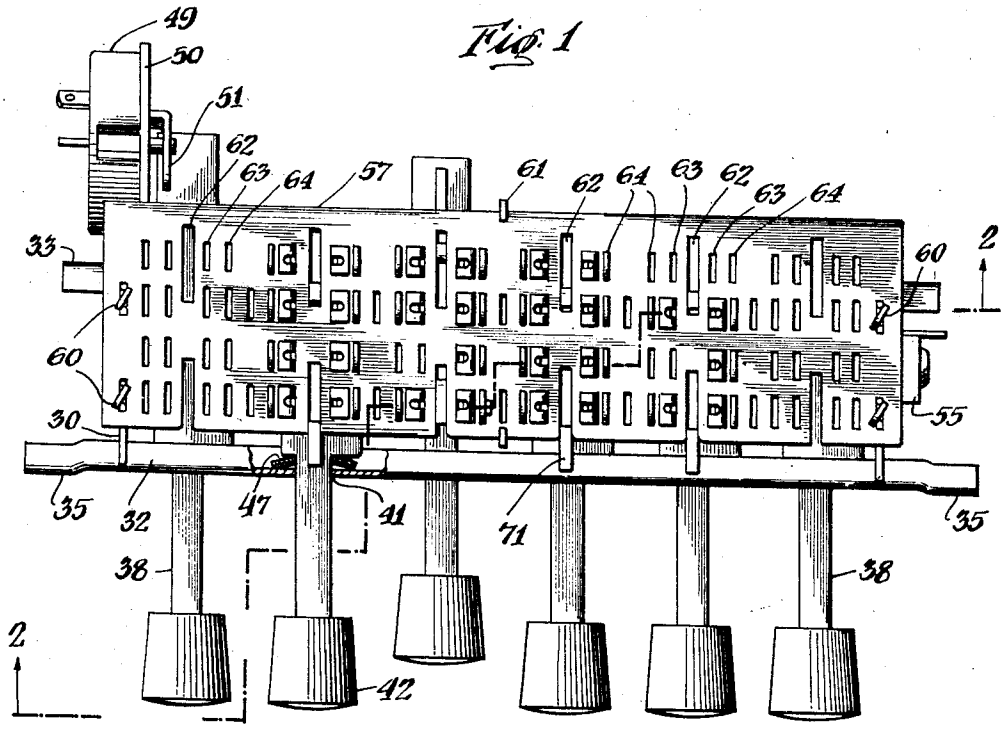


Fig. 2

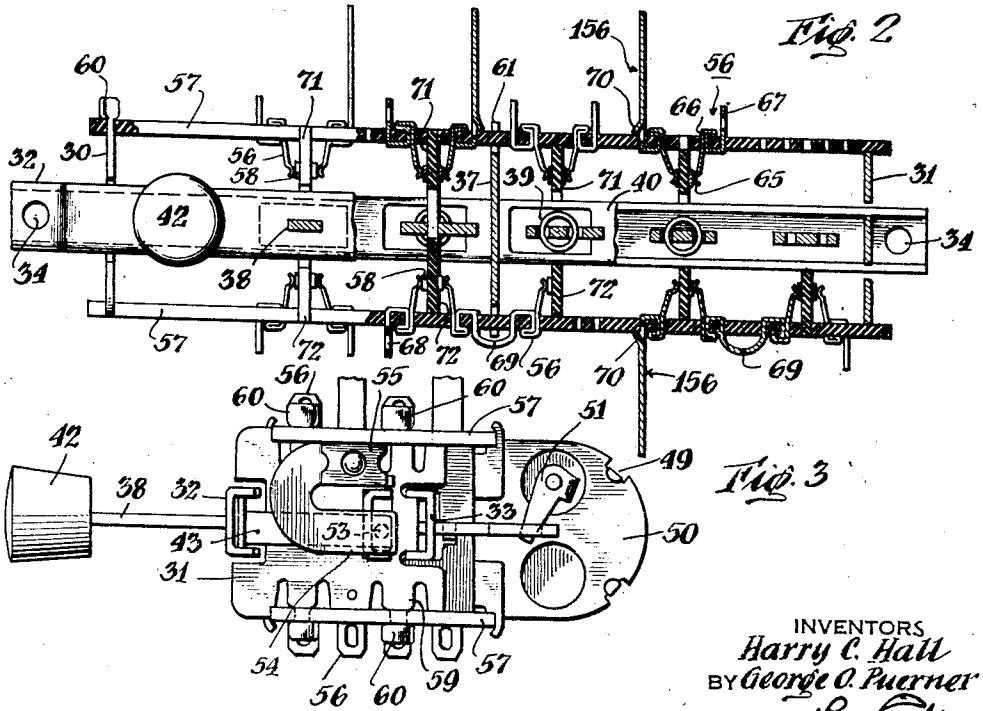


Fig. 3

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PUSH-BUTTON SWITCH

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Fig. 4

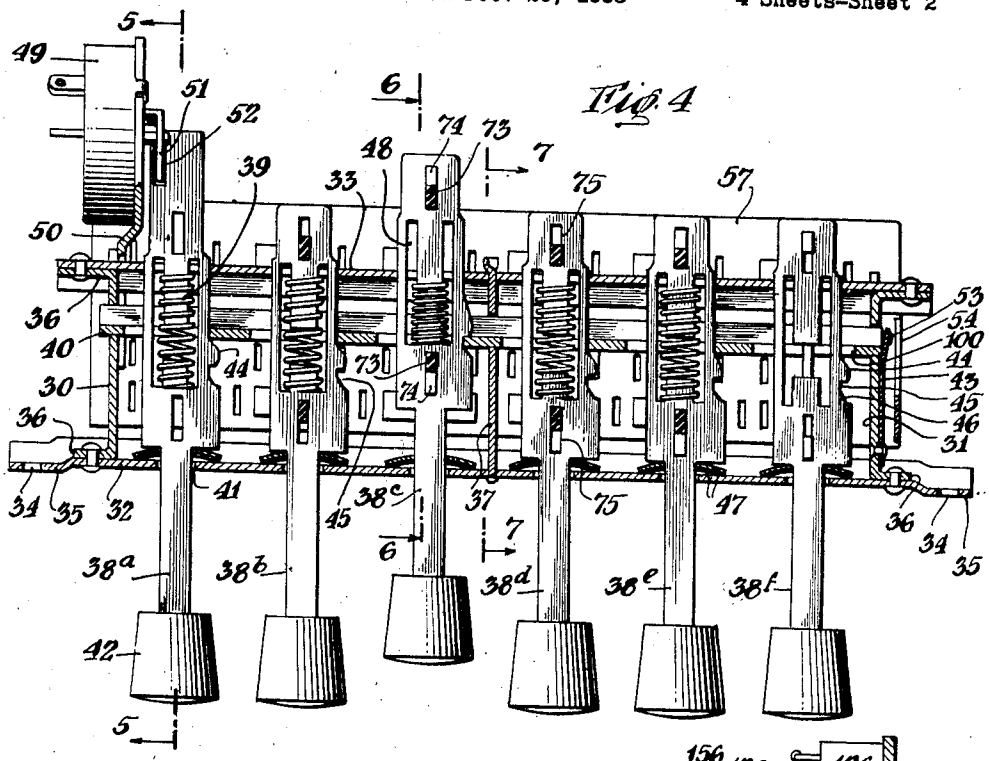


Fig. 5

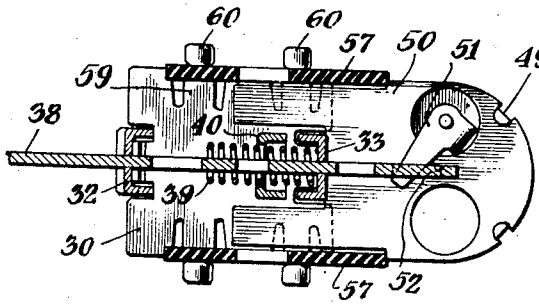


Fig. 6

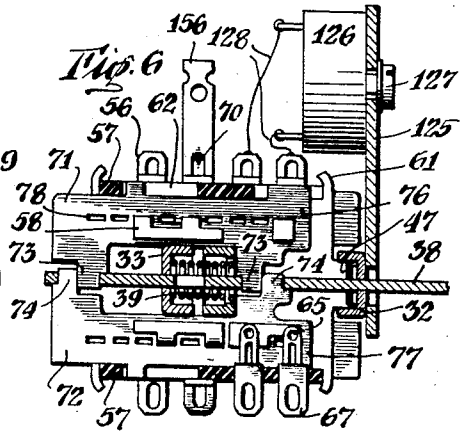


Fig. 7

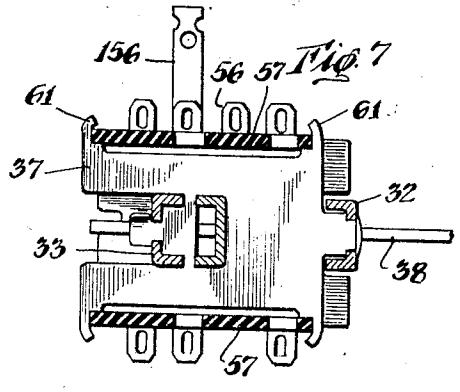
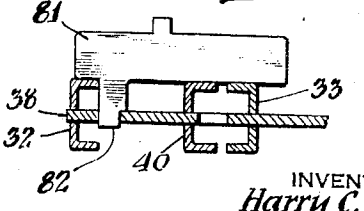


Fig. 10



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PUSH-BUTTON SWITCH

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Fig. 8

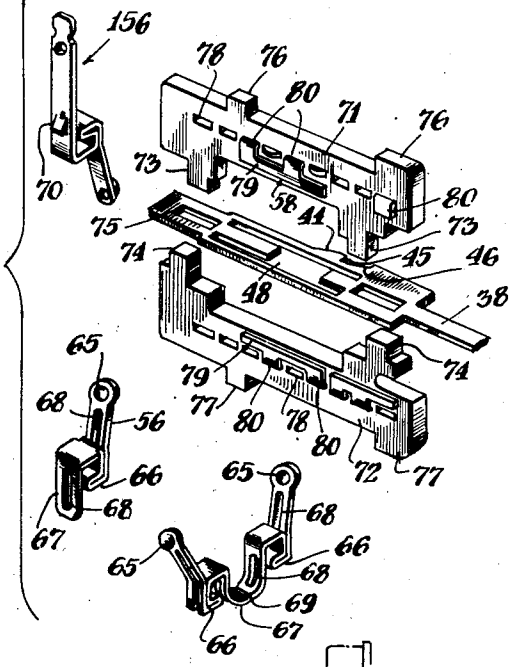


Fig. 9

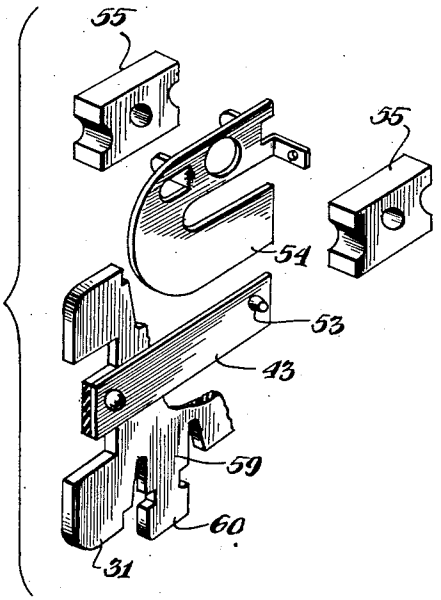


Fig. 11

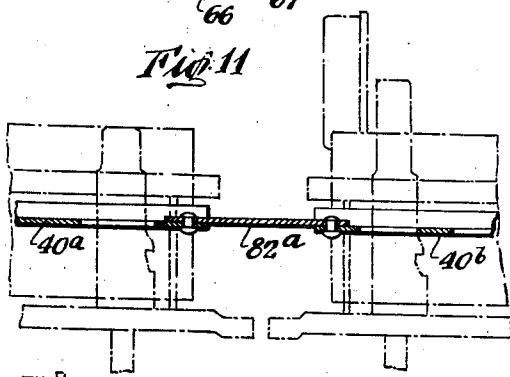


Fig. 12

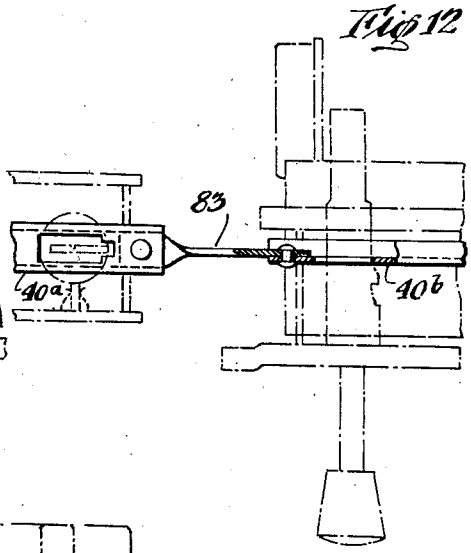
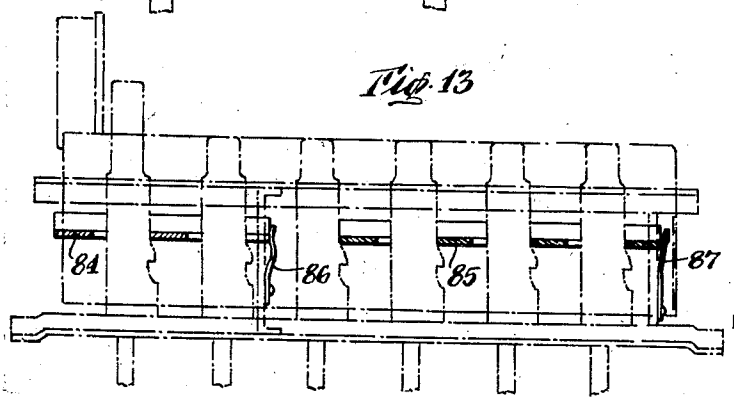


Fig. 13



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PUSH-BUTTON SWITCH

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Fig. 14

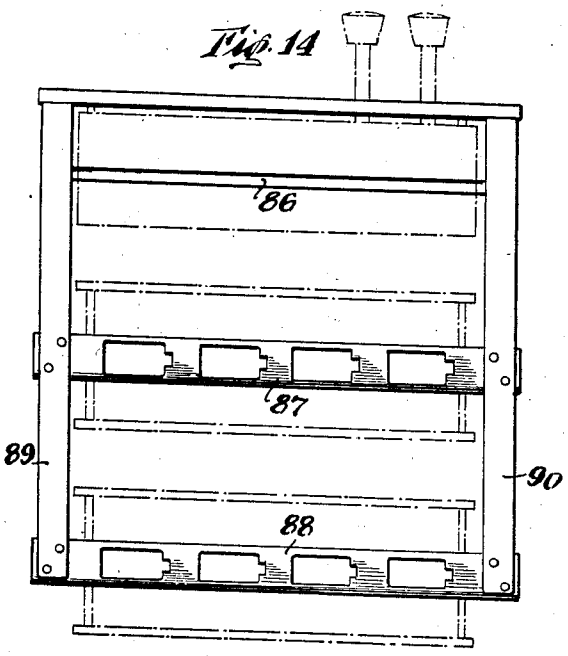


Fig. 15

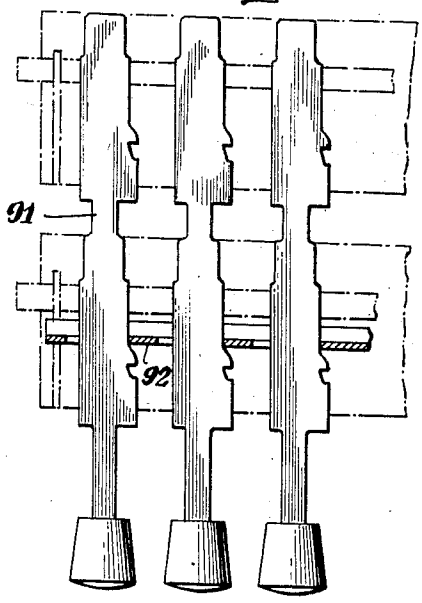


Fig. 16

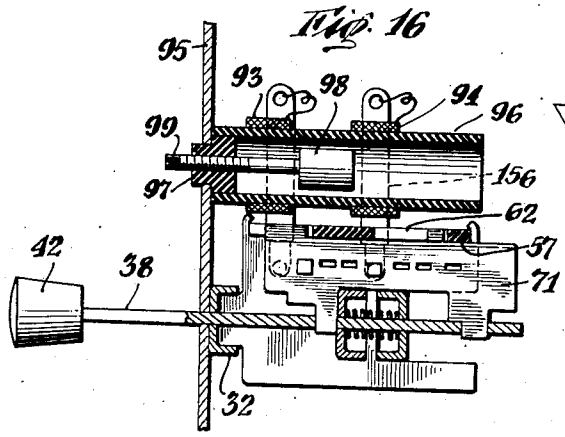


Fig. 19

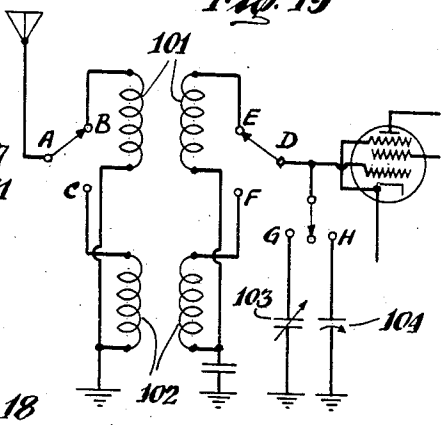


Fig. 17

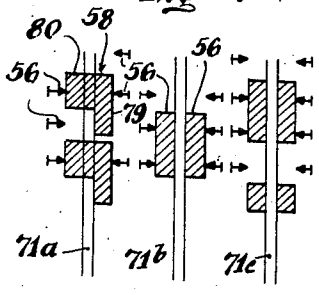
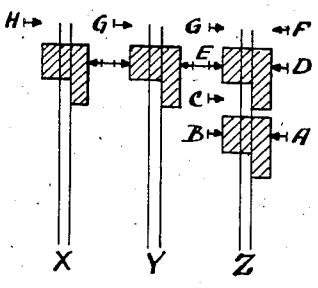


Fig. 18



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Patented Mar. 11, 1941

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UNITED STATES PATENT OFFICE

2,234,405

PUSH-BUTTON SWITCH

Harry C. Hall and George O. Puerner, Indianapolis, Ind., assignors to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

Application December 23, 1938, Serial No. 247,315

13 Claims. (Cl. 200—5)

This invention relates to electric switches and particularly to push-button switches.

An object of the invention is to improve the construction of push-button electric switches.

Another object is to improve the electrical arrangements and characteristics of such switches.

A further object is to improve the electric wiring connections and the circuits associated with push-button switches.

Other objects of the invention will be apparent from the following description and accompanying drawings taken in connection with the appended claims.

The invention comprises the features of construction, combination of elements, arrangement of parts, and methods of manufacture and operation referred to above or which will be brought out and exemplified in the disclosure hereinafter set forth, including the illustrations in the drawings.

In the drawings:

Figure 1 is a top view of a push-button switch embodying features of our invention;

Figure 2 is a section on the line 2—2 of Figure 1;

Figure 3 is an end view of the switch;

Figure 4 is a horizontal section through the switch;

Figures 5, 6 and 7 are sections on the lines indicated in Figure 4;

Figure 8 is an exploded view illustrating the movable and stationary contacts;

Figure 9 shows the parts of the latch bar actuated switch;

Figure 10 illustrates a modified movable insulating member;

Figures 11 and 12 illustrate interconnecting latch bar means for connecting two or more switches;

Figure 13 illustrates a single switch having two separate latch bars;

Figure 14 shows another means for interconnecting latch bars;

Figure 15 illustrates a means for interconnecting push rods;

Figure 16 shows a means for mounting an adjustable inductance on the switch; and

Figures 17, 18 and 19 illustrate diagrammatically certain circuit switching combinations according to the present invention.

The present invention is particularly applicable to push-button switches and switch combinations suitable for use in radio receivers for performing the various switching and tuning operations required therein, and also suitable for various other purposes such as in communication equipment, intercommunicating systems, electric testing instruments, business machines, and the like.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific means for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring to the drawings the switch in its preferred form comprises a metal frame made up of a pair of end plates 30 and 31 held in spaced parallel relation by channel bars 32 and 33 running longitudinally of the switch at front and rear, respectively. Front channel bar 32 extends beyond the ends of the switch and is punched with suitable mounting holes 34 near its ends whereby the switch may be screwed onto the back face of a panel through which the push button rods extend. The portions 35 of the rod surrounding the holes are raised to provide table portions adapted to space the other parts of the switch from the panel.

End plates 30 and 31 have angularly bent portions 36 which are riveted to channel bars 32 and 33. A center plate 37 is also provided which is staked to these bars as indicated.

The push-button rods or plungers 38 comprise strips of sheet metal suitably punched and shaped to receive retractile coil springs 39 and to provide cam edges to engage latch bar 40. The push rods are mounted side-by-side, extending from front to rear of the switch through horizontal slots 41 in the channel bars. They may project from the front of the switch for any distance desired and are provided, at their forward ends, with suitable buttons or knobs 42.

The mid-portion of each push rod is provided with an H-shaped aperture 48 in which is fitted a coil spring 39. When the push button is pressed so as to depress the rod the rear end of spring 39 engages rear channel rod 33 and hence the spring is compressed and tends to return the push rod to the forwardmost position. Spring 39 can be removed and replaced without disassembling the switch. It will be noted that the push rods are all mounted with their faces in a plane extending longitudinally through the switch. Thereby, in addition to their function as plungers they also serve as electrostatic shields between

the switch contacts 56 above and below the plungers.

Latch bar 40 is a channel shaped bar similar to the frame bars 32 and 33 and is mounted to slide in suitable apertures in end plates 30 and 31 and center plate 37. The latch bar is mounted between the frame bars and parallel to them. Leaf spring 43, riveted to the outer face of end plate 31 presses against the end of the latch bar and urges it toward the left (as seen in Figure 4). The latch bar has suitable slots to accommodate the push rods.

The right hand edge of each push rod (as seen in Figure 4) has a cam surface of the shape shown which engages the end of the associated slot of the latch bar. It will be seen that as any push rod is depressed the cam surface will slide along in engagement with the latch bar, the latch spring 43 tending to hold them in contact. Where a rod is depressed the latch bar will ride up the incline 44 of the cam surface and then drop into notch 45 to latch the push rod in depressed position as is shown for rod 38c in Figure 4. Should another rod now be depressed the latch bar will be lifted out of notch 45 in rod 38c and allow its coil spring 39 to restore it to normal position, the other push rod now being locked up in its stead. The push rods are each provided with a second incline 46 on their cam surfaces to enable release if all the rods should accidentally become latched up at once.

A pair of arched spring washers 47 surround the shank of each push rod just behind front bar 32 to absorb the inertia of the push rod when it is released. Felt or rubber silencing pads or washers can also be used.

The push-button switch has one of its push rods, namely rod 38*a*, extended to the rear for the purpose of actuating an auxiliary quick make and break A. C. switch 49 when that particular push rod is depressed. A. C. switch 49 is mounted on a bracket 50 attached to the end plate 30 and has its actuating arm 51 extending through slot 52 in the extended rear end of push rod 38*a*. The A. C. switch is arranged to open an A. C. circuit whenever push rod 38*a* is depressed and to close the circuit when rod 38*a* is released. Thus, if the push-button switch is used as a station selecting means for a radio receiving set the A. C. switch 49 may be connected in the power supply circuit for the set. When the push button on rod 38*a* is pressed the set is turned off. When any other button is pressed, to select a particular radio station, push rod 38*a* is released by the latch bar and hence turns the set on automatically. The A. C. switch can be arranged, if desired, to close a circuit when the button is depressed. Thus it may be suitable in combination instruments for the energization of phonograph turntable motors, as well as for other commercial applications.

The latch bar 40 is adapted to close a pair of contacts 53, 54 momentarily whenever a push button is pressed. Contact 53 is a contact disc or point welded to the end of latch spring 43. Contact 54 comprises a flat U-shaped spring held in normally spaced relation to contact 53 by insulating mounting blocks 55 which also serve to insulate contact 54 from the switch frame. Figure 9 shows the parts of the contact assembly in exploded view. It will be apparent that wherever the latch bar moves to the right (as seen in Figure 4) due to the depressing of a push button, the contact 53 will engage contact 54. These contacts may serve to short circuit the loud speaker of a radio receiver, when a push button is pressed to change the tuning, and thus prevent a disagreeable click from the speaker. For this purpose it is preferred that the spacing be so arranged that the muting switch close its contacts before the released plunger contacts open their circuits and that the muting contacts remain closed until the contacts on the depressed plunger close their circuits.

The principal contacts of the push-button switch comprise stationary contacts 56 mounted on insulating strips 57 along the top and bottom of the switch, and sliding contacts 58 mounted on sliding insulating plates 71 and 72 engaged by the push rods.

Insulating strips 57 are preferably formed of sheet Bakelite secured to end plates 30 and 31 by twisted ears 60. Center plate 37 also has pairs of narrows ears 61 which are bent over the edges of the strips 57 (Fig. 7). Ears 60 are on the ends of tongues 59 formed by providing notches in end plates 30 and 31 (see Figures 5 and 9). These tongues afford a certain amount of resiliency and allow for expansion and contraction without buckling or putting severe strain on the Bakelite. The mounting slots in the strips 57 are somewhat larger than the tongues so as to provide a slight amount of float in all directions to permit the strips 57 to adjust themselves.

Strips 57 are provided with aligned slots 62, opposite each push rod, which slots serve as guides for slide plates 71 and 72. At both sides of slots 62 are two additional rows of slots 63 and 64 in which the stationary contacts 56 are mounted.

Contacts 56 are formed of strips of sheet metal stamped to provide a contact spring finger with a rounded dome 65 at the contact end to provide a rounded contact face, and folded double in their mid-portions 66 to provide an anchoring portion. The terminal ends 67, opposite the contact ends, are adapted to have connecting wires or the like soldered thereto and are bent at right angles at an intermediate point. The contacts are mounted in slots 63 and 64 of sheet base 57 by inserting the folded portion 66 in slot 63 and the terminal end 67 in slot 64. The doubled portion 66 is then bent down against the face of sheet base 57 to anchor the contact in position and apply a spring tension to the spring finger portion of the contact terminating in rounded contact face 65, urging the contact face toward the sliding contacts. The contacts 56 are also preferably punched with slots 68 to increase their flexibility and render them less subject to breaking from bending or flexing (see Fig. 8). The contact design and form of mounting prevents solder from reaching the contact faces during soldering of wire to the terminal ends 67. Also it will be noted that the active contacting portions are within the switch where they are protected from injury.

Where the circuit requires that two adjacent contacts 56 be connected together this may be done simply by bending the two terminal ends 67 together and soldering or spot welding them, as shown at 69 in Figures 2 and 8.

In some cases, especially where a longer terminal end is required, as shown for contact 156 in Figures 2 and 8, additional anchoring may be secured by providing a small struck-up ear 70 near the base of the terminal end portion. When the contact is slipped into slots 63 and 64 in sheet base 57 the ear 70 is sprung in sufficiently to slide through the slot but as it slips completely through the slot it expands to lock the contact securely in place.

Sliding insulating plates 71 and 72 are formed

of sheet Bakelite. Slide 71 is provided, along one edge, with spaced projections 73 which fit into slots 75 in its push rod 38 and plate 72 has spaced projections 74 which also fit into these slots adjacent to projections 73 (see Figures 6 and 8). Projections 73 are closer together than projections 74 hence both occupy the inside position when mounted in the push rod (see Figures 4, 6 and 8). This makes it possible to vary the switch assembly when desired to provide a sliding contact plate 71 or 72 on only one side of the switch, leaving the other position vacant, and still obtain secure mounting of the slide plate.

The outside edges of plate 71 are provided with flange projections 76 and that of plate 72 with projections 77 which slide in guide slots 62 in the insulating bases 57. Hence whenever a push button is pressed, the push rod moves inward carrying its associated slide plates 71 and 72 which slide in slots 62.

Slides 71 and 72 are each punched with a row of small rectangular apertures 78 in which sliding contacts 56 are mounted. Contacts 56 are of a variety of forms. Generally they comprise a narrow strip of sheet contact metal 79 provided along its edge with spaced ears 80.

In the switch assembly the dome ends 65 of the spring fingers of stationary contacts 56 press against the surfaces of strip portion 79 and bent down ears 80 on the opposite sides of the slide 71 (or 72). When a push button is pressed the spring fingers slide over the surfaces of contact portions 79 and 80 and over the adjacent surface of the insulating slide 71 or 72. Various switching arrangements are thus made possible. The strip portion 79 may make continuous sliding contact with one stationary contact 56 and ears 80 may move from one contact to another when a button is pressed.

A variety of contact forms may be made from a standard contact blank by merely cutting the strip to the desired length and clipping off any undesired ears. In the preferred form of blank the ears 80 are spaced apart a distance which brings every other ear opposite a stationary contact. The intervening ear may then be left on or clipped off depending on whether a "shorting" or "non-shorting" switch is desired. In the "shorting" switch one pair of contacts is closed before the others are opened. In the "non-shorting" type there is a brief open-circuit interval at an intermediate point in the travel of the plunger.

The contacts can also be varied with respect to the co-operation between different plungers. In the so-called "leading" type of contacts the contact on a plunger being depressed will close a circuit before the contact on the plunger being released has opened. The "lagging" or "following" type of contacts do not close circuits on the actuating plunger until the released plunger has opened its contacts.

When desired, the portions of ears 80 which extend through slots 78 are left on to hold the contact on the insulating base, and merely the bent down portions of the ears are removed to prevent contact with the stationary contacts.

It is obvious that contacts 56 and 156 may be inserted where required in the slots in insulating plates 57 to make up the circuit combinations desired.

In some cases it may be desired to have one or more of the push buttons free of the control of the latch bar. This may readily be done, as shown for push rod 38*f* in Figure 4 by lengthening the slot 100 in the latch bar to clear the cam face of push rod 38*f*. If the spring 39 is allowed to remain in the push rod the button will only remain depressed while it is held and will return to normal as soon as it is let go. If the spring is removed, however, as shown in Figure 4, the push rod will remain in either position until moved. The associated contacts for push rod 38*f* may be connected, for instance, in the tone control circuit of the radio set to adjust the tonal output.

In some cases the slide plates may be modified as shown in Figure 10 to provide a more shallow switch which will fit into a smaller mounting space. In this form slide plate 81 has only a single projection 82 which completely fills a slot in push rod 38. The edge of plate 81 rests on and is guided by channel bar 33.

The push-button switches of the present invention are readily adapted to a wide variety of uses and can be readily interconnected in multiple units. Figure 11 shows how two switches can be mounted end to end and thin associated latch bars 40*a* and 40*b* interconnected by a link bar 82 riveted to both. In this arrangement the latch spring of 40*a* is left and both latch bars operate together under control of a single latch spring. This makes, in effect, a single switch of twice the length of each original.

Figure 12 shows how the two switches may be mounted end-to-end but with the buttons of the two switches at right angles to each other. In this case the latch bars are connected by twisted latch bar 83.

Figure 13 shows a single switch containing two separately acting latch bars 84 and 85 having individual latch springs 86 and 87, respectively. Bar 84 co-operates with two of the push rods and bar 85 with four.

Figure 14 illustrates how the latch bars 86, 87 and 88 of three switches, mounted in a bank one above the other, are interconnected by end brackets 89 and 90. The top switch of the bank has its push buttons at an angle with the others. This arrangement is suitable, for example, in a radio set where some push buttons are on the front of the cabinet and some on top or on a sloping panel.

Figure 15 shows how two switches may be mounted one behind the other either by interconnecting the push rods or by providing special long push rods 91 common to both switches. Only a single latch bar 92 is required for the assembly.

Figure 16 shows a switch adapted to switch inductance coils 93 and 94 into and out of a circuit. The coils are mounted on a plate 95 upon which the switch is also mounted. The push rods 38 extend through the plate. Coils 93 and 94 are wound on an insulating tube 96 having an end sleeve 97 fitted in a hole in plate 95. An iron core 98 is supported on the end of a threaded rod 99 which is screwed in a threaded hole in sleeve 97, the front end of the rod having a screw driver slot for adjustment purposes. The ends of coils 93 and 94 are connected to the soldering ends of contacts 156.

Figure 17 illustrates diagrammatically certain possible contact combinations with the switch. On the first slide 71*a* the contacts 56 each have one ear 80 extending through the slide to the other side. The elongated portion 79, of each contact makes contact with a stationary

contact 56 in both positions of the plunger and ear 80 in only one of the positions. On slides 71b and 71c the ears 80 are all sheared off of separate contact shoes 56 mounted on opposite faces of the slide.

Figure 18 shows a switch layout suitable for "skip-band" switching of the circuit shown in Figure 19. The circuit comprises two sets of inductances 101 and 102 for use respectively in receiving two different bands of wave lengths. Variable condenser 103 is used for tuning with either set of inductances. Normally fixed trimmer condenser 104 is permanently adjusted to receive a particular radio station when associated with coils 101.

The switching connections A to H are correspondingly lettered in Figures 18 and 19. With the contacts as shown in Figure 18 the connections are as shown in Figure 19. If plunger X is pushed contact H is closed to connect trimmer condenser 104 into the circuit. If plunger Y is pushed (incidentally releasing plunger X) the variable tuning condenser 103 is associated with the circuit. If plunger Z is pushed switches A and D are transferred to contacts C and F associated with coils 102 and condenser 103 is associated therewith through contact G. It is obvious that additional plungers like X may be provided for selecting additional stations.

The switch of the present invention is applicable to a wide variety of uses. An important use is in push button automatic tuned radio receivers of both the motor driven tuning element type and the present "trimmer" condenser or "trimmer" coil type. One of the push buttons of the switch may also be used as a transfer switch for connecting the radio set at will from manual to automatic operation and vice versa. It may also be used for changing a set from operation on one wave band to another.

As illustrated and described the push button switch may also be adapted to control the A. C. line switch of the radio set. A two point tone control switch may also be provided by using one of the buttons of a push button bank for this purpose.

The switch is also applicable to meter switching, various types of electric servicing instruments, signal generators and oscillators, communication equipment, intercommunicating systems, sound systems, business machines, telephone systems, annunciator systems and the like.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A push-button electric switch comprising a frame, a push rod mounted for reciprocation therein, a contact panel of sheet insulating material mounted on said frame parallel to said push rod, a slide of sheet insulating material mounted edgewise on said push rod with its free edge adjacent said panel, said edge moving in a path parallel to said panel, and co-operating contacts on said panel and slide.

2. A push-button electric switch comprising a frame, a push rod mounted for reciprocation therein, a contact panel of sheet insulating material mounted on said frame parallel to said push rod, a slide of sheet insulating material mounted edgewise on said push rod with its free edge adjacent said panel, said edge moving in a path parallel to said panel, and co-operating contacts on said panel and slide, said panel contacts comprising spring fingers supported on said panel and extending to points of sliding engagement with the sides of said slide.

3. A push-button electric switch comprising a frame, a push rod mounted for reciprocation therein, a contact panel of sheet insulating material mounted on said frame parallel to said push rod, a slide of sheet insulating material mounted edgewise on said push rod with its free edge adjacent said panel, said edge moving in a path parallel to said panel, and co-operating contacts on said panel and slide, said panel contacts comprising spring fingers supported on said panel and extending to points of sliding engagement with the sides of said slide and said slide contacts comprising strips of sheet metal mounted flatwise against said slide.

4. A push-button electric switch comprising a frame, a push rod mounted for reciprocation therein, a contact panel of sheet insulating material mounted on said frame parallel to said push rod and having aligned slots therein parallel to said rod, a slide of sheet insulating material mounted edgewise on said push rod with its free edge adjacent said panel and having guide projections thereon sliding in said slots, and co-operating contacts on said panel and said slide.

5. A push-button electric switch comprising a frame, a push rod mounted for reciprocation therein, a contact panel of sheet insulating material mounted on said frame parallel to said push rod and having aligned slots therein parallel to said rod, a slide of sheet insulating material mounted edgewise on said push rod with its free edge adjacent said panel and having guide projections thereon sliding in said slots, and co-operating contacts on said panel and said slide, one each of said co-operating contacts comprising a spring finger and the other comprising a flat metal layer disposed against the surface of its insulating support.

6. A push-button electric switch comprising a frame, a flat push rod mounted for reciprocation therein, a pair of contact panels of sheet insulating material mounted on said frame on opposite sides of said push rod and parallel to the plane of said push rod, said push rod having longitudinally spaced recesses therein, a pair of slides of sheet insulating material mounted edgewise against the two faces of said push rod with projections fitting into said spaced recesses, the free edges of said slides being adjacent said panels, said slides and panels having co-operating bearing portions retaining said slides in operating position and co-operating contacts on said slides and said panels.

7. A push-button electric switch comprising a frame, a flat push rod mounted for reciprocation therein, a pair of contact panels of sheet insulating material mounted on said frame on opposite sides of said push rod and parallel to the plane of said push rod, said push rod having longitudinally spaced slots therein, a pair of slides of sheet insulating material mounted edgewise against the two faces of said push rod with projections fitting into said spaced slots, the free edges of said slides being adjacent said panels, said slides and panels having co-operating bearing portions retaining said slides in operating position and co-operating contacts on said slides and said panels, the projections on one of said slides being spaced fur-

ther apart than those on the other slide whereby they will be outside the same when mounted in said push rod.

8. A push-button electric switch comprising a frame, a push rod adapted to reciprocate therein, a contact panel of sheet insulating material mounted in a plane parallel thereto, contacts mounted on said panel, a slide plate of sheet insulating material mounted in a plane perpendicular to the plane of said contact panel and parallel to the axis of said push rod, a connection between said push rod and slide plate whereby said plate is controlled by said push rod, said plate sliding in a path parallel to said panel, and contacts on said slide plate engaging said panel contacts in at least one position of said slide plate.

9. A push-button type electric switch comprising a frame, a push rod mounted for longitudinal reciprocation therein, a panel of sheet insulating material mounted on said frame in a plane parallel to the longest axis of said push rod, and a slide plate in a plane perpendicular to said panel and parallel to the longest axis of said push rod disposed between said push rod and said panel, said push rod having receptive socket means and said plate having projecting means held therein for supporting said plate from said rod, said panel having a guideway thereon and said plate having a sliding portion sliding in said guideway, and co-operating contacts mounted respectively from said panel and from said slide plate.

10. A push-button type electric switch comprising a frame, a plurality of parallel push rods mounted for longitudinal reciprocation therein, a panel of sheet insulating material mounted on said frame in a plane parallel to the axes of said push rods, and a slide plate mounted on each of said push rods in a plane parallel to the axis of its respective push rod and perpendicular to said panel with a free edge thereof adjacent said panel, said panel having guideways adjacent said slide plates and each of said plates having a sliding portion sliding in said guideway during reciprocation thereof by their respective push rods, and co-operating contacts mounted respectively on said panel and each of said slide plates.

11. An electric switch comprising a contact mounting panel of sheet insulating material, a slide plate and means supporting said slide plate in a plane perpendicular to said mounting panel with one of its edges adjacent said panel for reciprocation in a path parallel to said panel, said panel having a guideway confining movement of said slide plate to said path, co-operating contacts mounted on said panel and said slide plate respectively, said contacts co-operating to complete an electric circuit in at least one position of said slide plate, and a push button for moving said slide plate.

12. An electric switch comprising a contact mounting panel of sheet insulating material, a plurality of parallel slide plates and means supporting said slide plate in parallel planes perpendicular to said mounting panel each with one of its edges adjacent said panel for reciprocation in a path parallel to said panel, said panel having guideways confining movement of said slide plates to their respective paths, co-operating contacts mounted on said panel and said slide plates respectively, said contacts co-operating to complete electric connections in predetermined positions of said slide plates, and a row of push buttons connected respectively to said slide plates for actuation thereof.

13. A push-button electric switch comprising a frame having a front plate provided with a row of apertures therein, an insulating panel mounted on said frame in a plane perpendicular to said front plate and parallel to said row of apertures, a row of parallel push rods mounted for longitudinal reciprocation in said apertures parallel to said panel, slide plates mounted respectively on said push rods in parallel planes perpendicular to said panel and to said front plate for reciprocation in paths parallel to said panel, an edge of each of said plates being adjacent said panel, guide means on said panel confining the motion of said plates to reciprocation in said paths parallel to said panel, and co-operating contacts on said panel and said slide plates for effecting circuit connections in predetermined positions of said slide plates.

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