

March 6, 1951

G. J. KENNEDY
SWITCHING APPARATUS

2,544,535

Filed June 11, 1947

4 Sheets-Sheet 1

FIG. 1.

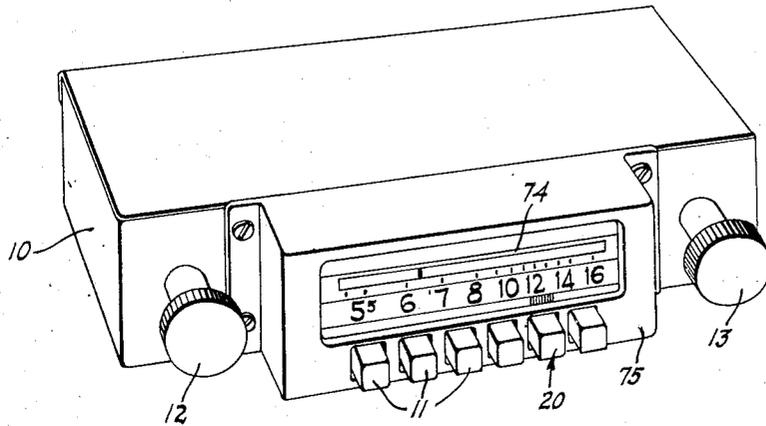
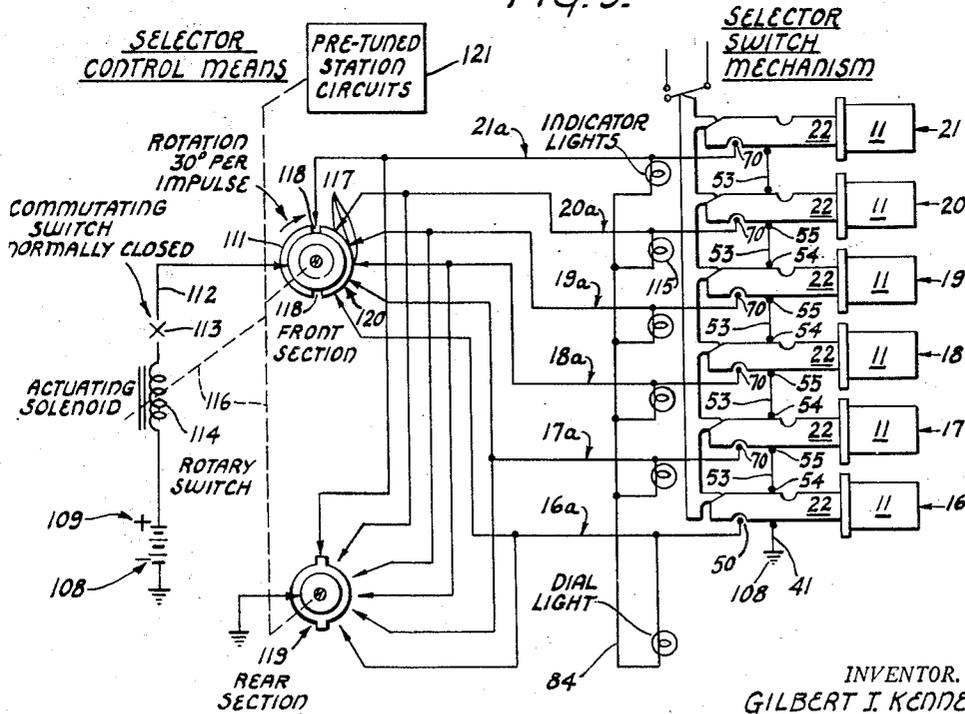


FIG. 9.



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FIG. 2.

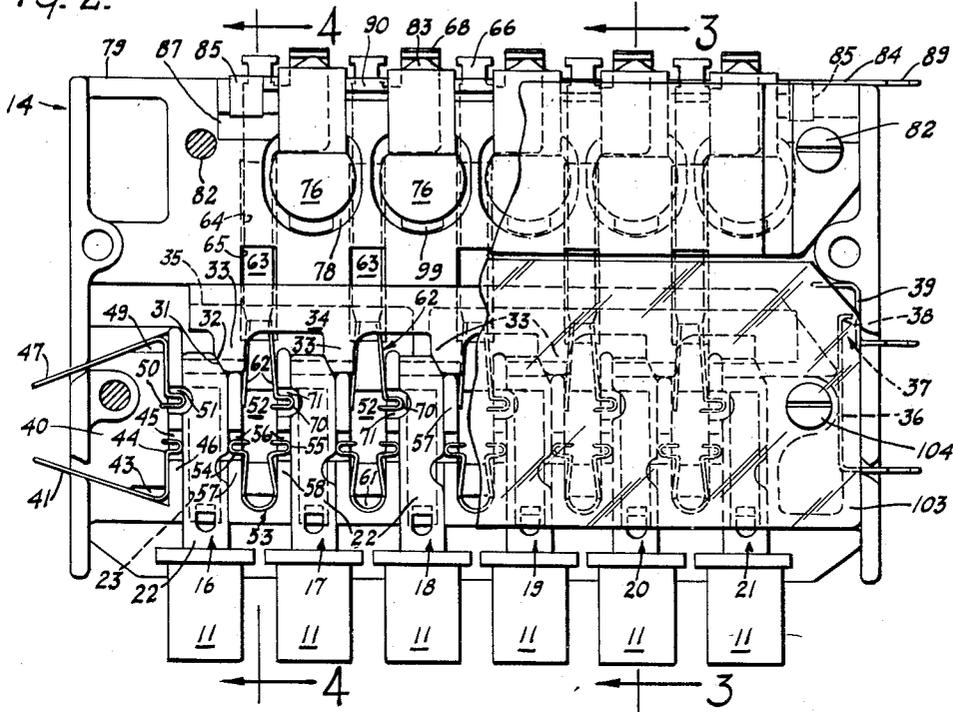


FIG. 3.

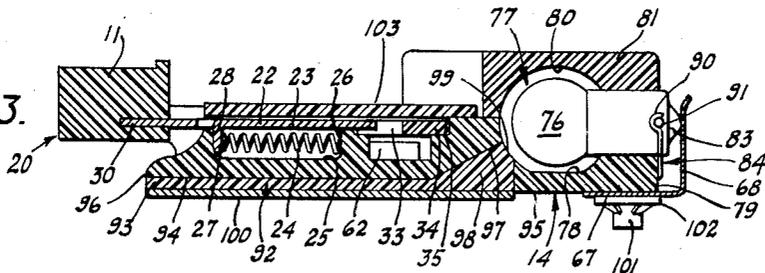
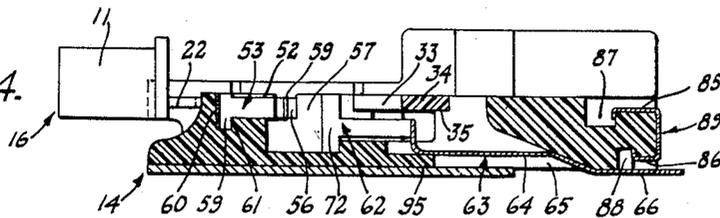


FIG. 4.



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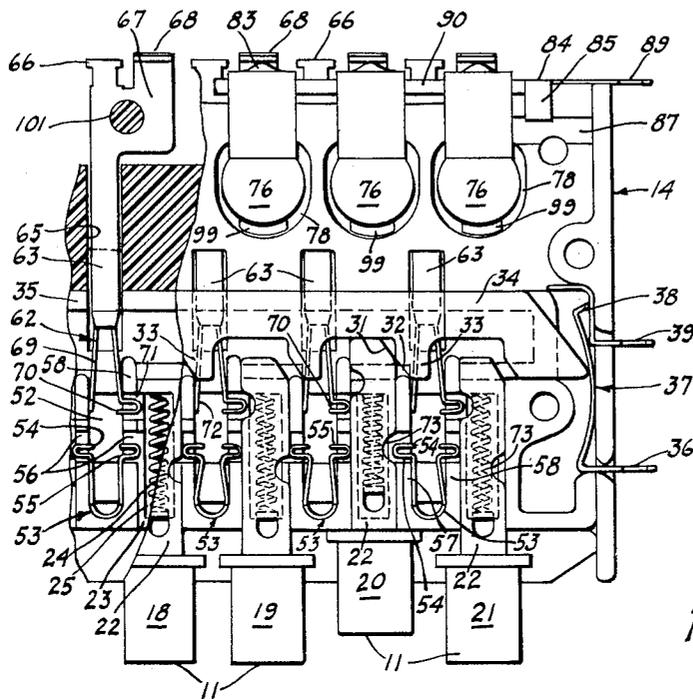


FIG. 5.

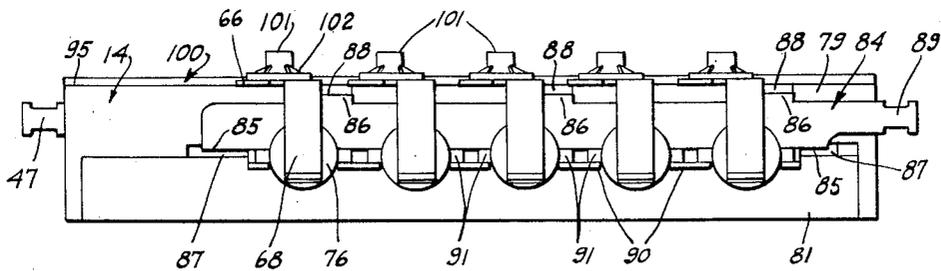


FIG. 6.

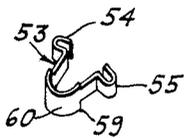


FIG. 8.

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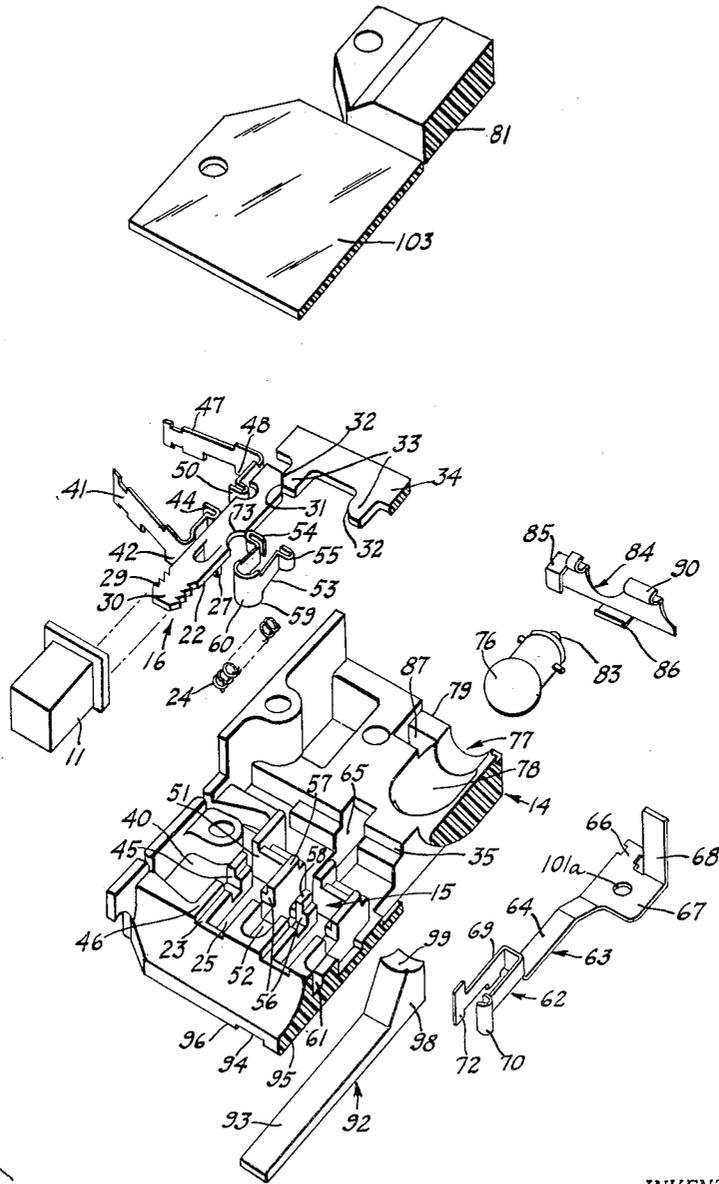
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FIG. 7



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UNITED STATES PATENT OFFICE

2,544,535

SWITCHING APPARATUS

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Application June 11, 1947, Serial No. 754,013

7 Claims. (Cl. 200—16)

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This invention relates to circuit selector switches and more particularly to push-button station selector switches for use in radios of the multiple circuit type.

The principal object of the invention is to provide improved means for selecting one of a plurality of circuits, and more particularly one of a plurality of pretuned circuits of a radio or similar device.

Another object of the invention is to provide a switch mechanism which is operable to select one only of a plurality of circuits, regardless of whether more than one selector key or push-button is operated simultaneously.

Still another important object of the invention resides in the particular construction and arrangement of the various physical components of the mechanism, by virtue of which assembly and repair of the apparatus is facilitated and a considerable cost reduction is effected.

The manner in which the aforesaid and other objects are attained, will become apparent from the following specification and the accompanying drawings illustrating a preferred embodiment of the invention, and in which:

Figure 1 is a general view, in perspective, of apparatus incorporating the present invention;

Figure 2 is a bottom plan view of a preferred embodiment of the switch mechanism of the invention, illustrated as removed from its housing and with certain parts broken away more clearly to illustrate the various physical components thereof;

Figure 3 is a sectional view taken substantially along line 3—3 of Figure 2;

Figure 4 is a sectional view taken substantially along line 4—4 of Fig. 2;

Figure 5 is a fragmentary bottom plan view, with parts broken away and with one of the selector switches shown in its operative position;

Figure 6 is a rear elevational view of the mechanism;

Figure 7 is an exploded view, in perspective, of a portion of the switch mechanism, showing more clearly the details and interrelation of various elements thereof;

Figure 8 is a perspective view of an element of the invention; and

Figure 9 is a diagrammatic view of the switching means of the invention, shown in association with an exemplary control circuit.

Referring now in detail to the drawings, and more particularly to Figure 1 thereof, there is shown a casing or housing 10 in which is housed selector switch mechanism embodying the pres-

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ent invention. Disposed on the front wall of the housing are various control elements, which, in the particular embodiment shown, comprise a plurality of push-buttons 11, a conventional "On-Off" volume control element 12, and a manual tuning knob 13. Neither the element 12 nor the manual tuning mechanism controlled by knob 13 forms a part of the present invention and, therefore, detailed illustration and description of these elements are not necessary herein.

Referring now to Figures 2 through 6, in which the switch mechanism is shown removed from housing 10, the numeral 14 designates a base member which, as seen more clearly in Figure 7, is provided with a plurality of suitable recesses, indicated generally by the numeral 15, adapted to receive various components of the device. The mechanism, as seen in Figure 2, comprises a plurality of switches 16, 17, 18, 19, 20 and 21 which, as shown in Figure 9, are adapted to close associated circuits including branches 16a, 17a, 18a, 19a, 20a and 21a, respectively, and each of which circuits, as shown in this, the preferred form, operates the selector mechanism (so labeled on Figure 9) to effect selection of one of a plurality of conventional pretuned station circuits indicated diagrammatically by the block so labeled.

It should be understood, that, although the invention has been illustrated with one type of circuit means, seen in Figure 9, in its primary aspect the invention is concerned with physical features of the switch mechanism (as illustrated in Figures 1 through 8) and not with the particular circuit arrangement shown, which may take other forms.

To facilitate further understanding of the invention, the description immediately following will have reference to switch 16 only. Referring to Figure 3, it is seen that this switch includes a switch key 22 mounted for reciprocatory movement in a recess or guide-way 23, formed in base member 14, the key 22 being normally urged to a projected position relative to base 14 (as illustrated in Figure 3) by a coil spring 24 positioned beneath the switch key in a recess 25. The right-hand end of the spring is adapted to react against the inner end wall 26 of the recess while the other end is biased against a downwardly projecting key portion 27 and normally urges the key to its fully projected position in which the depending portion 27 is against front wall 28 of the recess. Manual actuation of the switch key is facilitated by providing on its outer end, one of the push-buttons 11, which may be at-

tached thereto in any convenient manner, but, as illustrated in Figure 7, is preferably forced over serrations 29 formed on the outer end 30 of the key.

Referring now to Figures 2 and 7, it is seen that the right-hand inner corner of key 22 is bevelled, as indicated at 31, and is so positioned as to bear against a similarly but oppositely bevelled edge 32 on one of a plurality of fingers 33 projecting forwardly from a slide bar 34. The slide bar is positioned for reciprocatory movement in a transverse guide-way 35, formed in base 14, and extends across the base to a point slightly past the inner end of switch 21 and into abutting relation with a resilient movable contact element 36 of a switch 37. Transverse movement of the slide bar to the right, as illustrated in Figures 2 and 5, will move the end 38 of movable element 36 into contact with the stationary contact element 39 of the switch to thus close an associate circuit, which, in the present case, controls circuits (not shown) to open the loud speaker circuit and thus mute the radio during actuation of the switching mechanism.

A recess 40 is located to the left of switch 16, as seen in Figures 2 and 7, and receives a resilient conductor strip 41 which is locked within said recess by a portion 42 (see Figure 7) extending downwardly into a deeper recess 43 (Figure 2) which is of substantially the same width as portion 42, and thus prevents lateral displacement of the conductor relative to the base structure. The inner end of this conductor is provided with a contact loop 44 which extends through an aperture or slot 45 in the side wall 46 of switch key guide-way 23 and into contact with the left side edge of the key. A second resilient conductor strip 47 is positioned at the opposite side of the recess 40 and is locked therein by a downwardly extending portion 48 depending into a recess 49 of substantially the same width as portion 48. The inner end of this latter conductor is also provided with a contact loop 50 which extends through an aperture or slot 51 in the side of wall 46 of guide-way 23 in a manner similar to that already described with reference to contact loop 44 of conductor 41.

Switch key 22 has its edge portion cut away in the region of aperture 51 thereby preventing contact of the key with loop 50, when the key is in its projected position, and thus maintaining circuit branch 16a out of the circuit controlled by switch 16. To close switch 16, pressure is exerted against its push-button 11, thus moving key 22 inwardly along guide-way 23 against the tension of spring 24, until the left side edge of the key (as viewed in Figure 2) contacts loop 50 of conductor 47 and thus closes a circuit including branch 16a, in the manner described hereinafter. It will be noted that immediately upon inward movement of the switch key, toward depressed or operative position, bevelled edge 31 thereof will move against the bevelled edge 32 of finger 33 to urge slide bar 34 transversely to the right, and thus close muting switch 37 before closing the circuit including branch 16a, as described above. When the pressure is removed from push-button 11, coil spring 24 immediately returns the key to its normal projected position and, concurrently therewith, slide bar 34 is returned to its normal position by the inherent resilience of contact element 36 of the muting switch.

Having described the construction and operation of switch 16, which conditions the mecha-

nism for manual operation by knob 13, the various switches for selecting a particular station circuit will now be described.

From the drawings, it is seen that each of the remaining switches (17 through 21) is provided with a switch key 22 similar in every respect to that just described in connection with switch 16, and that each of the keys is mounted in a similar guide-way 23. Each key has its bevelled inner end 31 abutting the bevelled end 32 of a corresponding finger 33 on slide bar 34 so that actuation of any one of the keys will move the slide bar to the right, to close muting switch 37 in the manner described heretofore. In addition to the above-described similarities, each key is similarly held in its projected position by a spring 24 positioned in a recess 25 therebeneath, in the same manner as described above with respect to switch 16.

Provided between each pair of switch keys 22 is a recess 52 (Figure 7), each having positioned therein a resilient U-shaped conductor strip 53 (Figure 8) having its end portions terminating in contact loops 54 and 55 which extend through apertures 56 provided in the walls 57 and 58 of adjacent guide recesses 23 and into contact with adjacent switch keys. With reference to Figure 4, it is seen that each of these strips is provided with a portion 59 which depends from its forward end loop 60 into a recess 61 of greater depth than that portion of recess 52 immediately beneath the side portions of the strip.

Also positioned in each of recesses 52 is the inner end 62 of a resilient conductor strip 63 which, as shown in Figure 4, has its intermediate portion 64 extending rearwardly and downwardly through an aperture 65 in base 14, and its outer end 66 terminating just beyond the rear edge of the base member to provide means for connecting a circuit wire thereto. The other end portion of this conductor, as illustrated in Figures 4, 5 and 7, is also provided with a laterally extending portion 67 terminating in an upwardly extending lamp contact strip 68, the purpose of which will be described hereinafter.

The inner end 62 of this strip comprises a U-shaped member 69, one end of which comprises a contact loop 70 which extends through an aperture 71 in the right-hand wall 58 (as viewed in Figure 2) of each recess 52, while its other side 72 bears against the left-hand wall 57 of the recesses to bias the contact loop 70 in a counter-clockwise direction and into contact with switch keys 22 when the key is in its operative or depressed position. It will be noted that in switches 17 through 21 the contact loop 70 of each of conductor strips 63 is in a position corresponding to that of contact loop 50 of conductor member 47 relative to the switch key 22 of switch 16, and that each of the keys has its left-side edge cut away, or notched, in the region of contact loop 70 so that, when the keys are in their normal projected or rest position, no contact is made between the loop and the key. Therefore, it can be seen that, with the particular arrangement of switch keys and hair pin conductor elements, as shown in Figure 2, all of the switch keys are in series circuit with conductor strip 41, but, by reason of the notches, all of the associated circuits are open.

When it is desired to close one of the switches, the proper push-button is depressed, for example, switch 20, as shown in Figure 5, to cause the associated switch key 22 to bear against contact loop 70 of conductor 63 and thus to complete

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a circuit including branch 20a. Each of switch keys 22 is provided with a recess or notch 73 in its right-hand side edge. When the key is in its projected or rest position, these notches lie just forward of the plane of the contact loops 55. The purpose of this is explained below.

A particular feature of the invention resides in the arrangement of the various switch elements just described. It is evident that, when one switch key is depressed to select a particular circuit, notch 73 moves into alignment with contact loop 54 of hair pin conductor 53 so that all the other switches to the right thereof, as seen in Figures 2 and 5, are out of circuit with those to the left. This is illustrated most clearly in Figure 5, in which it can be seen that the first three of the conductors 53 (counting from the left) are in circuit contact with switch keys 22 of switches 18, 19 and 20, but, because notch 73 in the right-hand edge of the switch key of switch 20 has been moved into alignment with contact loop 54 of the next succeeding or fourth hair pin conductor 53, switch key 22 of switch 21 is out of circuit with the switch to the right thereof and, therefore, even if switch 21 be pushed in it would not close its associated circuit.

It is apparent, of course, that a similar condition exists with each of the other switches upon actuation thereof and that, regardless of which one is actuated, or whether more than one switch is actuated at one time, only one switch can possibly be operative to close the circuit controlled thereby; the controlling switch of those actuated being the one closest to conductor strip 41. Thus, for example, and with reference to Figure 2, it can be seen that, if switch 17 should be actuated, all of the switches to the right thereof are out of circuit contact therewith and operation of any one, or more, would be ineffective to close another circuit.

Mechanism is provided for indicating, by illumination on the face of the dial 74 of bezel 75 (see Figure 1), the particular circuit or station in operation. With reference to Figures 2, 3, 5 and 7, it can be seen that this mechanism comprises a part of the switch mechanism and includes a plurality of lamps 76, one for each of switches 17 through 21, mounted in recesses 77, of which the lower half 78 is formed in base 14 adjacent the rear edge 79 thereof, while the upper half 80 is formed in a cover member 81 secured to the base in any suitable manner, as, for example, by screws 82. One of the contacts for energizing the lamps is provided by the up-standing end portion 68 of conducting strip 63 which, as shown, abuts the rear contact element 83 of the lamp. The other contact is provided by a strip 84 secured to the rear edge 79 of base 14 (see Figure 6). With reference to Figure 4, it is seen that this strip is provided at intervals, along its top and bottom edges, with clamping elements 85 and 86, respectively, which are adapted to fit into top and bottom recessed portions 87 and 88, respectively, of base 14, to hold the strip firmly to the rear edge thereof. The strip is also provided at its right-hand with a tab 89 for connecting it with one side of the lamp circuit and, at intervals corresponding to the space between the bases of the lamps, with loops 90 in which the side wall contact studs 91 of the lamps are engaged. Energization of the lamps is by any suitable means in circuit with each of the corresponding push-buttons, so that actuation of any one of the push-buttons will

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also energize the associated lamp, for example, see the lamp circuits illustrated in Figure 9. In this figure the lamp shown associated with circuit 16a is adapted to illuminate dial 74 during manual tuning by knob 13.

In accordance with a further feature of the invention, means is provided to conduct the light forwardly to indicate on the dial the station selected. This is accomplished by providing a light conducting element 92 which may comprise any suitable substance, such as one of the clear plastics of the methyl-methacrylate family, of which the light conducting characteristics are well known. Each of these light conducting elements comprises a flat elongate strip portion 93 positioned in a groove or recess 94 in the under, plane surface 95 of base 14, as illustrated in Figure 3, but which is, in actuality, the top surface of the present embodiment, when assembled in the housing 10. This position is, of course, a matter of choice, it being understood that the mechanism may assume any convenient position permitting manual actuation of the push-buttons.

As seen in Figure 3, the groove 94 extends from the lower front edge 96 of the base to a position beneath the lamp-receiving aperture and terminates in an enlarged portion 97 extending upwardly into lamp recess 77. An inner end portion 98 of light conducting element 92 extends upwardly into and substantially fills aperture 97, and the innermost end 99 is so positioned as to receive light from the lamp, which light is conducted forwardly through the strip portion 93 and directed upon the dial 74 immediately above the particular push-button actuated (see shaded area above switch 20 in Figure 1). A cover plate 100 is secured over the surface 95 to prevent displacement of the light directing elements from grooves 94.

With reference to Figure 7, another of the primary advantages of the invention becomes apparent. This view illustrates the simplicity of assembly of this switch, it being necessary merely to drop most of the parts in the particular recess or aperture adapted to receive them.

It should be understood that the normal condition of each of the resilient conductor elements is preferably somewhat extended in comparison to its condition when disposed within base 14. See, for example, Figure 8, which shows one of the hair pin conductors 53 in its normal condition when removed from the base member 14. As seen in this figure, the side walls are spread outwardly at an angle greater than the angle therebetween when the element is in its recess. Therefore, when it is stated in the following description that the various resilient connectors are dropped into their recesses, it is to be understood that they are first flexed to the condition in which they are shown in Figure 2.

In the process of assembling the various elements of the switch in proper position in base 14, spring 24 is dropped into recess 25 after which switch key 22 is dropped into its guide recess 23 with its downwardly extending portion 27 between the front wall 28 of the recess and the outer end of the spring; the connectors 41 and 47 are dropped into the recess 40, and slide bar 34 into its guide recess 35. Conductor strip 63 is assembled with the base by passing its inner end 62 upwardly through aperture 65 into recess 52, as shown, and then lifting its outer end 66 upwardly over a stud 101, depending from and preferably integral with base 14, a hole 101a being provided for that purpose. After this a speed nut 102 is

secured over the stud to hold the strip securely in place. When these various physical components of the mechanism have been assembled as described, a cover plate 103 is secured over these elements, as by screws 104, to prevent displacement of the various elements.

As above-indicated, the circuit selecting apparatus of the invention has been illustrated, in Figure 9, in association with an exemplary circuit adapted to be controlled by such apparatus, while—insofar as the concepts of the present invention are concerned—other circuits may be employed, reference to the showings of Figure 9 provides a proper basis for an exposition of the complete operational sequence.

In general, the arrangement of Figure 9 comprises, inter alia, a schematic representation of the switch device hereinbefore described, a battery 109 (for example, a 6-volt storage battery, if the apparatus is employed in an automobile), a rotary switch having a rear section 119 and a front section 120, suitable pretuned station-selecting circuits 121, and an actuating solenoid 114 which, when energized from the storage battery 109, is effective to step or rotate the rotary switch from a given switch position to a succeeding position. The front and rear sections of the rotary switch, the actuating solenoid, and the pretuned station-selector device 121 are mechanically ganged by conventional means (illustrated diagrammatically by the broken line 116) so that upon each operation of the actuating solenoid 114 the station-selector device 121 is switched from one position, in which a predetermined station is received, to another position in which a different station is received. Such station-selecting arrangements are well-known in the art and it is unnecessary here to describe this device in additional detail.

The actuating solenoid 114 is of a type, well known in the art, which, when energized, functions to effect a step-by-step rotation of the rotary switch. In the arrangement illustrated there are three switch points per quadrant, and the solenoid is adapted to step the rotary switch through a sector of 30° per step.

The circuit condition illustrated in Figure 9 is that obtaining as the result of a prior actuation of switch 21. This, as will be understood hereinafter, can be determined from the fact that top gap 118 in the front section of the rotary switch is opposite the contactor associated with branch or conductor 21a which, in turn, is associated with switch 21. The mode of operation of the circuit in response to the actuation of any of the push-buttons will be readily understood by tracing the actions resulting from a depression of a specific push-button, for example, that associated with the switch 20. When switch 20 is depressed a connection is effected between the contact elements 55 and 70 associated with the said switch 20. This completes the actuating solenoid circuit, which circuit comprises the grounded negative terminal of the battery, switch-key grounding conductor 41, switch-keys and key interconnectors 53, contact elements 55 and 70 associated with selector switch 20, conductor 20a, the rotary switch contactor (117) associated with the conductor 20a, front section of the rotary switch, conductor 112, commutating switch 113, and finally the upper terminal of the actuating solenoid 114. As soon as the circuit is completed through the solenoid 114, as above outlined, the actuating solenoid is energized and functions, in known manner, to step

or advance the rotary switch, clockwise, through an angle of 30°. This stepping action of the actuating solenoid will be continued step-by-step, until the above-described circuit is broken. In the present instance the circuit is broken immediately upon the first 30° rotation of the rotary switch, for in that position the gap 118 in the front section of the switch falls beneath the contacting element associated with the conductor 20a. Upon the return of the selector switch 20 to its rest position (shown) the indicator lamp 115 is energized and serves to identify the selected station. The circuit which results in the illumination of the lamp corresponding to the station-selector switch 20 may be traced as follows: the upper terminal of the selected lamp is connected directly to ground through the agency of the rear section 119 of the rotary switch which, through the action previously outlined, has been turned to a position 30° clockwise from that illustrated. The lower terminal of the lamp is connected through all of the remaining lamps and through the conductors 15a, 17a, 18a, 19a and 21a to the front section 120 of the rotary switch and thence through the conductor 112, commutator switch 113, and the solenoid 114 to the positive terminal of the battery 109. It will be observed that the current which energizes the lamp shown at 115 divides equally between the other five remaining lamps, the current in the latter lamps being insufficient to effect incandescence therein. It is to be noted that none of the lamps is illuminated during the period of rotation of the rotary switch. The illumination from lamp 115 is, of course, conducted to the region of the dial in the manner described hereinabove.

I claim:

1. In a switching device, an insulating base member provided with a plurality of recesses, a plurality of conducting keys each disposed in a corresponding one of said recesses and movable therein between operative and rest positions, a plurality of conductor elements each disposed in others of said recesses and normally making contact with said keys and connecting the same in series circuit relation, and a plurality of contacts supported by said base member and each associated with a corresponding one of said keys and normally spaced therefrom, each key being engageable with its associated contact in response to movement of the key to operative position, whereby to provide for closing of a circuit which includes the contact engaged by the key and at least certain of said conductor elements.

2. In a switching device, an insulating base member provided with a plurality of recesses, a plurality of conducting keys each disposed in a corresponding one of said recesses and movable therein between operative and rest positions, a plurality of conductor elements each disposed in others of said recesses and normally making contact with said keys and connecting the same in series circuit relation, said keys and conductor elements being individual members readily insertable in and withdrawable from said recesses whereby to facilitate assembly and disassembly of said switching device, a plurality of contacts supported by said base member and each associated with a corresponding one of said keys and normally spaced therefrom, each key being engageable with its associated contact in response to movement of the key to operative position whereby to provide for closing of a circuit which includes the contact engaged by the key and at

least certain of said conductor elements, and cover means effective to retain said keys and conductor elements in assembled relation.

3. In a switching device, an insulating base member provided with a plurality of recesses, a plurality of conducting keys each disposed in a corresponding one of said recesses and movable therein between operative and rest positions, and a plurality of conductor elements each disposed in others of said recesses and normally making contact with said keys and connecting the same in series circuit relation, said keys and conductor elements being individual members readily insertable in and withdrawable from said recesses whereby to facilitate assembly and disassembly of said switching device.

4. In a switching device, an insulating base member having surface portions provided with a plurality of outwardly-facing recesses, a plurality of conducting keys each disposed in a corresponding one of said recesses and movable therein between operative and rest positions, a plurality of conductor elements each disposed in others of said recesses and normally making contact with said keys and connecting the same in series circuit relation, said keys and conductor elements being individual members readily insertable in and withdrawable from said recesses whereby to facilitate assembly and disassembly of said switching device, and cover means disposed across the surface of said base member and effective to retain said keys and conductor elements in assembled relation within said recesses.

5. In a switching device, an insulating base member provided with a plurality of recesses, a plurality of conducting keys each disposed in a corresponding one of said recesses and movable therein between operative and rest positions, a plurality of conductor elements each disposed in others of said recesses and normally making contact with said keys and connecting the same in series circuit relation, said keys and conductor elements being individual members readily insertable in and withdrawable from said recesses whereby to facilitate assembly and disassembly of said switching device, a plurality of contacts supported by said base member and each associated with a corresponding one of said keys and normally spaced therefrom, each key being engageable with its associated contact in response to movement of the key to operative position, and cover means effective to retain said keys and conductor elements in assembled relation, at least certain of said keys being provided with a

notched portion so disposed that movement of a key to operative position breaks contact between the moved key and an adjacent conductor element.

6. In a switching device, an insulating base member provided with a plurality of recesses, a plurality of conducting keys each disposed in a corresponding one of said recesses and movable therein between operative and rest positions, a plurality of conductor elements each disposed in others of said recesses and normally making contact with said keys and connecting the same in series circuit relation, said keys and conductor elements being individual members readily insertable in and withdrawable from said recesses whereby to facilitate assembly and disassembly of said switching device, a plurality of contacts supported by said base member and each associated with a corresponding one of said keys and normally spaced therefrom, each key being engageable with its associated contact in response to movement of the key to operative position, and a plurality of lamps each disposed within still others of said recesses and each associated with a corresponding one of said keys and adapted to be illuminated in response to movement of the corresponding key to operative position.

7. A construction in accordance with claim 6, and further including a plurality of light-conducting members supported upon said base member in cooperative light-conducting relation with respect to said lamps, said light-conducting members extending to a predetermined visible region of said base member, whereby to provide indicating illumination in said region.

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