

June 13, 1933.

E. L. MABIE

1,913,992

SWITCHING DEVICE

Filed Oct. 15, 1931

3 Sheets-Sheet 1

Fig. 1

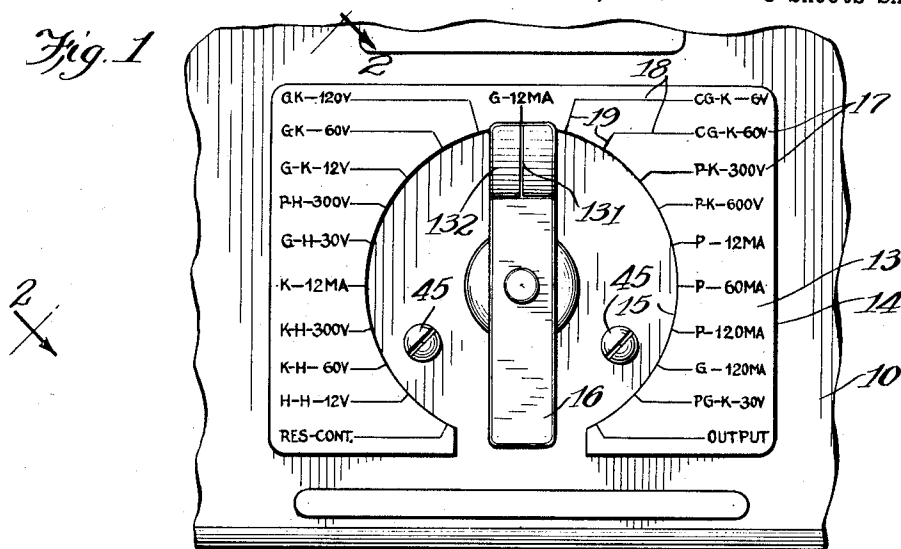
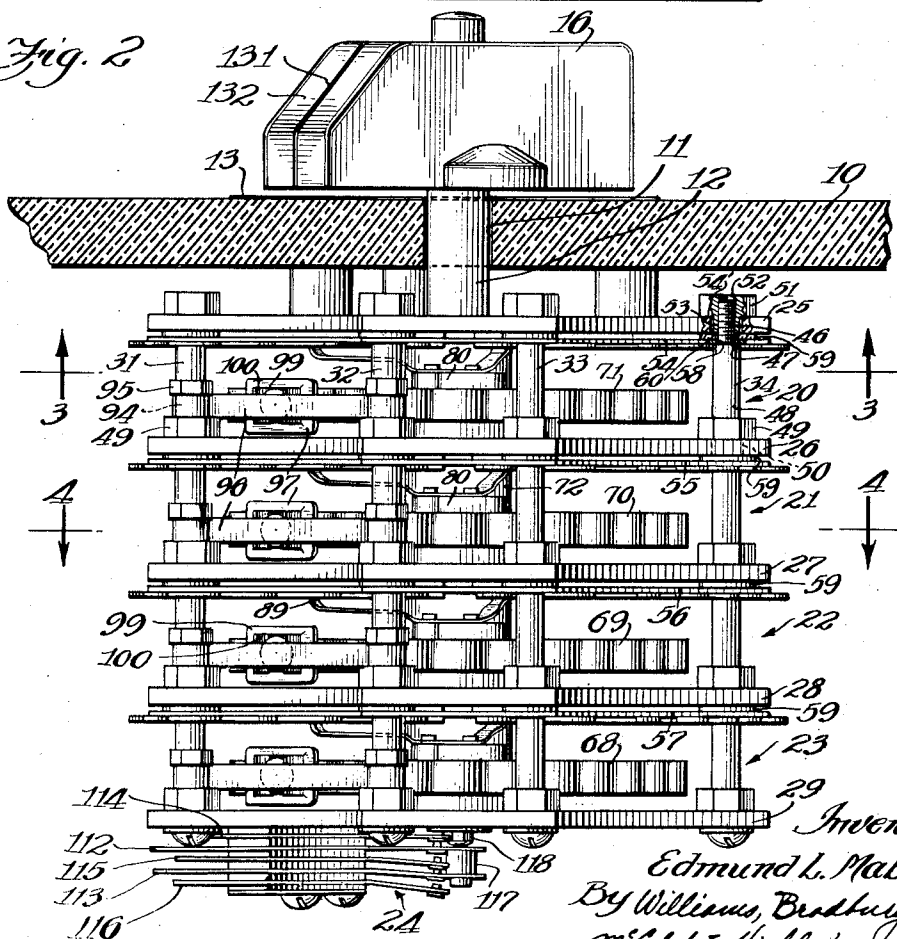


Fig. 2



Inventor.
Edmund L. Mabie
By Williams, Bradley,
McClell & Linker. Attys.

June 13, 1933.

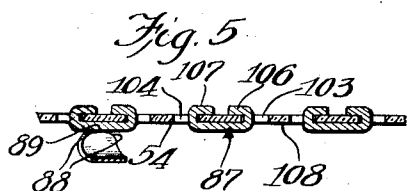
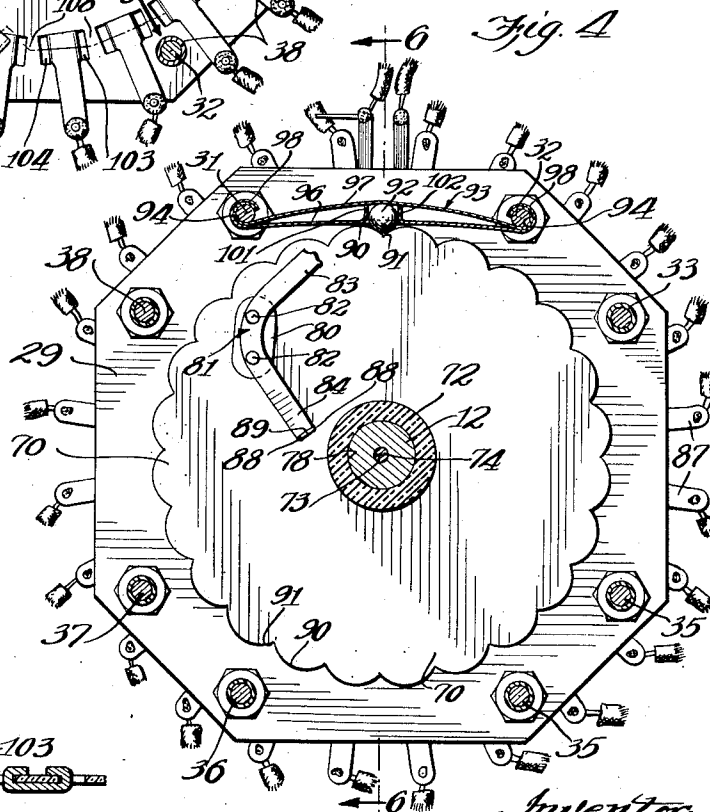
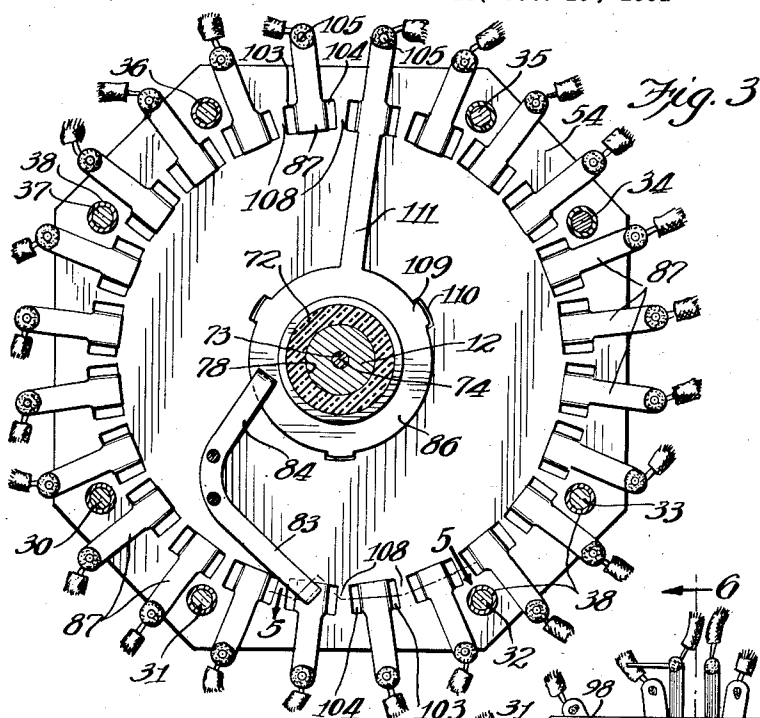
E. L. MABIE

1,913,992

SWITCHING DEVICE

Filed Oct. 15, 1931

3 Sheets-Sheet 2



6 *Inventor:*
Edmund L. Mabie

By Williams, Bradbury, M^cCall
& Hinkle. Attys.

June 13, 1933.

E. L. MABIE

1,913,992

SWITCHING DEVICE

Filed Oct. 15, 1931

3 Sheets-Sheet 3

Fig. 6

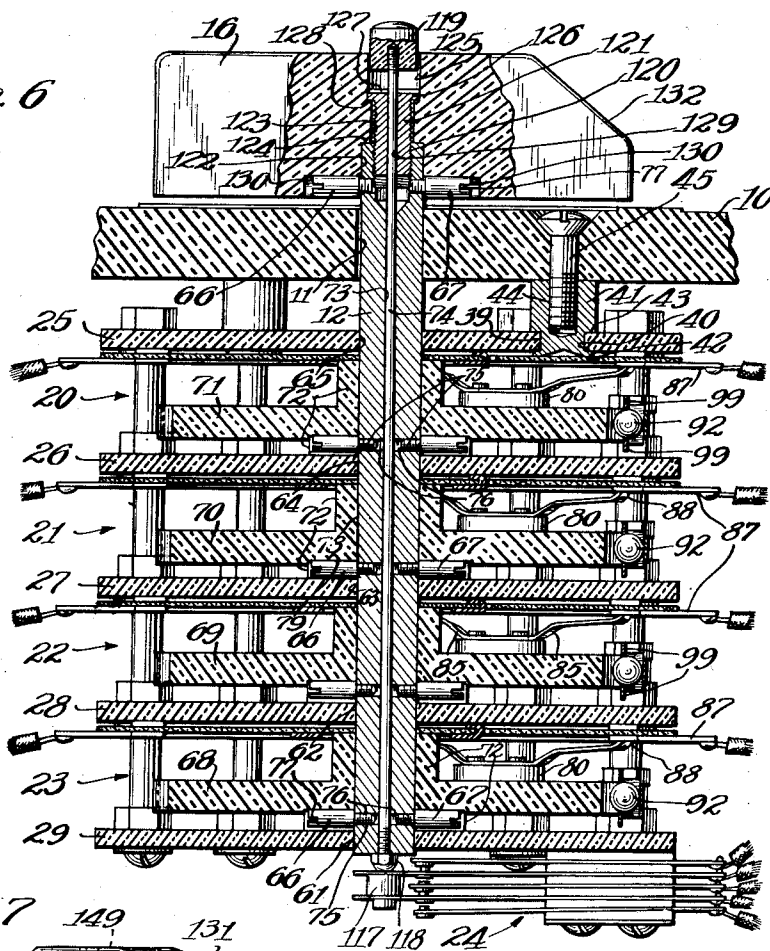


Fig. 7

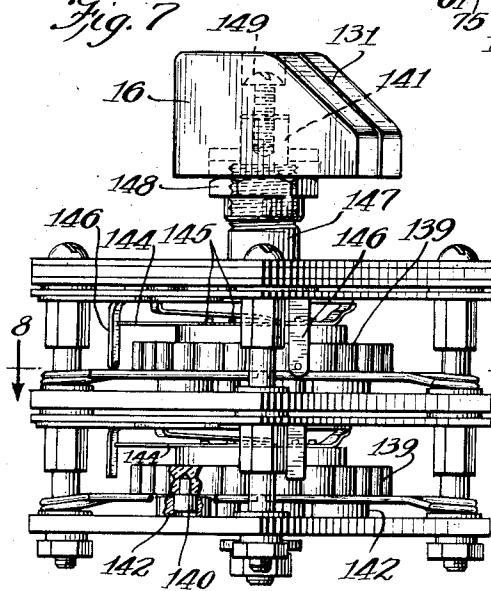
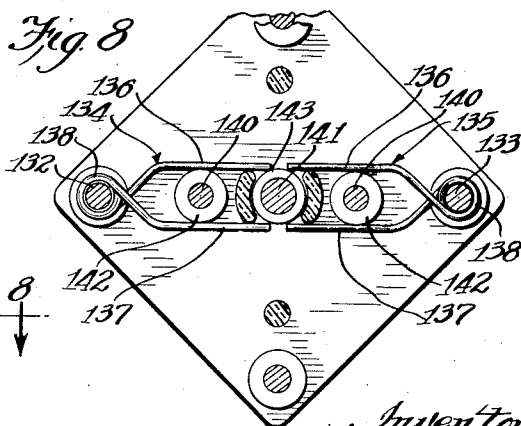


Fig. 8



Inventor:
Edmund L. Mabie
By Williams, Bradbury,
McClell & Hinkle
Attys

UNITED STATES PATENT OFFICE

EDMUND L. MABIE, OF CHICAGO, ILLINOIS, ASSIGNOR TO JEWELL ELECTRICAL INSTRUMENT COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF NEW JERSEY

SWITCHING DEVICE

Application filed October 15, 1931. Serial No. 568,956.

The present invention relates to switching devices and is particularly concerned with improved switching devices adapted to control the connection of electrical measuring instruments to a multiplicity of different circuits for the purpose of effecting measurements of the electrical conditions in the circuits. While the present devices are particularly adapted to perform these functions and have particular advantages for such a purpose, the switching devices are also of general application and may be utilized for many other different purposes.

One of the objects of the invention is the provision of an improved rotary selector switch peculiarly adapted to be utilized for controlling the connection of electrical measuring instruments in devices for measuring and analyzing the electrical conditions existing in radio receiving set testers.

Another object of the invention is the provision of an improved switching device of the type in which a movable contact slides from one fixed contact to another fixed contact across an insulating support, in which the trouble which would ordinarily result from leakage across the insulation between the contacts is eliminated. When a metallic contact slides across the insulation from one fixed contact to another there is a tendency for the metal to wear off and form a metal coating across the intervening surface of the insulation which would provide a leakage path from one fixed contact to another. In the present contact stretcher this trouble has been eliminated by the provision of air gaps adjacent one or both of the fixed contacts, thereby providing a break in the stream line of worn metal on the insulation.

Another object of the invention is the provision of an improved rotary selector switch which is adapted to have substantially constant resistance so as to give substantially uniform circuit characteristics for the use of electrical measuring instruments. A varia-

ble contact resistance in the circuit of the electrical measuring instrument would cause an apparent difference in the resistance of the circuit and cause the readings on the instrument to vary, depending upon the condition of the contacts.

Another object of the invention is the provision of an improved rotary selector switch which is adapted to be used for controlling an extremely large number of different circuits, and the provision of a switch which is adaptable to the control of practically any number of circuits simultaneously or separately.

Another object of the invention is the provision of an improved bank switch of the class described having a plurality of separate banks of contact together with means for effecting a quick make and break and for assuring the definite location of the movable contact of each bank upon the fixed contacts of the switch.

Another object of the invention is the provision of an improved electric switch of the class described, the structure of which lends itself readily to manufacture by molding, stamping and punching operations so that the device may be constructed at a minimum cost of labor and materials and so that the device may be placed within the reach of a larger number of users.

Another object of the invention is the provision of an improved snap switch of the bank type which is adapted to be used for performing a multiplicity of different functions.

Other objects and advantages of the invention and its various elements will be set forth in detail in the description of the parts of the device and will be apparent from the following description and the accompanying drawings.

Referring to the three sheets of drawings accompanying this description,

Fig. 1 is a plan view of a panel and the

switch actuating member of one of the rotary switches embodying the present invention when utilized for the testing of a radio receiving set or audion tubes;

5 Fig. 2 is a side elevational view of the same switch with fragments of the structure in section taken on the plane of the line 2—2 of Fig. 1;

10 Fig. 3 is a horizontal sectional view taken on the plane of the line 3—3 of Fig. 2 looking in the direction of the arrows showing a plan view of one of the banks of fixed contact;

15 Fig. 4 is a similar view taken on the plane of the line 4—4 of Fig. 2 showing one of the movable contact members and the structure of the snap mechanism;

20 Fig. 5 is a sectional view taken on the plane of the line 5—5 of Fig. 3 showing the structure of the fixed and movable contacts;

Fig. 6 is a vertical sectional view taken on the plane passing through the line 6—6 of Fig. 4 and passing through the axis of the switch;

25 Fig. 7 is an elevational view of a modification utilized for momentary contact in carrying out certain tests;

30 Figure 8 is a horizontal sectional view taken on the plane of the line 8—8 of Figure 7 looking in the direction of the arrows showing a plan view of the biasing device.

Referring to Figs. 1, 2 and 6, 10 indicates the panel of a radio receiving set tester or some other electrical device embodying one of the present switches. The panel 10 is preferably molded of a phenolic condensation compound and is provided with an aperture 11 for receiving the switch shaft 12. The supporting panel 10 is preferably 40 formed with a raised surface 13, the outer outline 14 of which may be substantially rectangular and the inner outline 15 may be circular and formed on a radius substantially equal to one-half the length of the switch actuating member 16. The raised surface 13 is provided with depressed indicia or letters 17 each having an appropriate lead line 18 terminating in a radial mark 19 adapted to serve as a dial for indicating the position of the switch actuating member 16 for any predetermined number of different tests. The letters 17 and lines 18, 19 may be grooved 50 formations in the raised surface 13, which are formed by complementary elevated portions of the die which is used in molding the panel 10. The grooves of the indicia 17—19 are preferably filled with some contrasting material such as white printer's wax used on 55 a brown or black phenolic condensation compound.

60 The present switching device may consist of any number of different banks of fixed contacts but the various banks are preferably substantially similar in construction and it 65 would only be necessary to describe one of

the banks in detail. For instance, the rotary switch of Fig. 2 is provided with the separate banks 20, 21, 22, 23 and with a reversing switch or cutout switch indicated in its entirety by the numeral 24. Any number 70 of banks may be utilized, depending upon the number of contacts which it is desired to open or close simultaneously in any position of the switch. The uppermost bank will now be described in detail. 75

The supporting framework of the switch may consist of a plurality of insulating plates 25—29, which are secured together in spaced relation by a multiplicity of supporting studs or posts 30—37 (Fig. 3). The 80 plates 25—29 preferably consist of stiff insulating members formed of a multiplicity of laminations of canvas, cambric, or other fabric or paper, impregnated with a phenolic condensation compound or varnish and subjected to heat and pressure. The plates 25—29 may take any desirable shape or outline, depending upon the size and number 85 of contacts but regular polygonal shapes such as squares, hexagons or octagons are preferred for reasons of elimination of waste in the cutting of the plates. In the embodiment of Figs. 7 and 8 only a few contacts are employed and supporting plates 90 are made square but in the embodiment of Figs. 1 to 6 a large number of contacts are arranged in a circle and the corners of the square have been eliminated in order to avoid the necessity for making the connect- 95 or arms of the fixed contacts so long as would otherwise be necessary to cause them to project beyond the plate as shown in Fig. 3. 100

Each of the supporting plates 25—29 is preferably provided with a multiplicity of 105 punched circular apertures 38 located to register with similar apertures in the other plates and adapted to receive portions of the supporting studs 33—37.

The uppermost supporting plate 25 may 110 be utilized for supporting the switch upon the panel 10 and for this purpose the plate 25 is preferably provided with a plurality of equally spaced circular apertures 39, preferably three, each adapted to receive the 115 reduced end 40 of metallic stud 41. The reduced end 40 is riveted over at 42, thereby confining the plate 25 between the riveted end 42 and the annular shoulder 43 and the stud 41 is provided with a threaded bore 44 120 adapted to receive the end of a screw bolt 45. The screw bolt 45 passes through panel 10 into stud 41 and secures the switch in fixed position upon the panel 10. Each of the 125 studs 33—37 is preferably formed with a reduced threaded portion 46, an annular shoulder 47, a substantially cylindrical body 48, a non-circular or hexagonal portion 49 and a cylindrical portion 50. The upper 130 nut 51 of each stud is preferably provided

with a non-circular or hexagonal portion, a threaded bore 52 and with a reduced cylindrical portion 53. The reduced cylindrical portion of the nut 51 is adapted to be received in the aperture 38 in the plate 25 and the lower surface 54' of the nut engages the upper side of plate 25 to secure the plate to the stud 33. Each of the supporting plates 25 except the lowermost one 29 is preferably provided with an insulating contact plate 55 which may be constructed of the same laminated fabric just described with respect to the plates 25—29 but the contact supporting plates 54—57 are made of relatively thin material which is more flexible and resilient and which is adapted to permit punching operations for the formation of a multiplicity of fine slots and other apertures utilized in securing the contacts in place. The supporting plate 25 thus serves as a relatively stiff backing plate or frame member for the switch while the contact supporting plate 54 serves as a resilient support for the contacts. The contact supporting plate 54 with relatively small apertures 58 is adapted to receive the reduced threaded portion 46 of the stud 33. The apertures 58 register with the apertures 38 and the contact plate 54 is spaced from the frame member 25 by insulating metallic washers 59. The annular end 60 of the cylindrical portion 53 of nut 51 is adapted to engage the upper side of washer 59 so that the contact plate 54 and washer 59 are confined between the end 60 of the nut and the annular shoulder 47 of the stud 33. The nut 51 is thus adapted to clamp both the frame member 25 and the contact plate 54 to the stud 33. It will be noted that the lower end of stud 33 is provided with formations 49 and 50 corresponding to the portions 51 and 53 on the upper nut and thus each succeeding supporting plate and contact plate are clamped to each succeeding stud to form a switch having a plurality of banks of contacts. Each of the ordinary studs and contact plates are secured together in the same manner and consequently it is unnecessary to describe more of these parts in detail.

The framework of the switch may thus be built up of a plurality of insulating plates supported in spaced relation to each other by appropriate studs preferably located at each corner. The switch shaft 12 preferably comprises a cylindrical metal member which may be formed of brass or other material capable of being easily worked and the shaft 12 is rotatably supported in the centrally located apertures 61—65 in the insulating plates 25—29 and 54—57. Reciprocation of the shaft 12 is prevented by a plurality of pins 66, 67 which pass through or are secured in the shaft 12 and which engage one of the supporting plates 25—29

on the lower side and engage the lower surface of a movable contact supporting member 68—71 on the other side. Each movable contact supporting member 68—71 is provided with a hub 72 above and below and fitting between the adjacent insulating plates so that axial movement of the shaft 12 is prevented by the use of the pins 66, 67 and the hubs on the movable contact supporting member 68—71.

In the case of a simple rotary selector switch having no axial push button the pins 66, 67 may be replaced by an ordinary cylindrical pin having a frictional fit in an aperture passing through the shaft 12. In the embodiment shown in Fig. 6, however, the shaft 12 is provided with an axially extending circular bore 73 for slidably receiving a push button pin or rod 74. It is therefore impossible to use a single pin passing through the shaft in such case, and each of the pins 66, 67 is preferably formed with a reduced threaded portion 75 which is threaded into a radially extending aperture 76 to secure the pin. Each of the pins 66, 67 is preferably provided with a slot or kerf 77 for receiving the end of a screwdriver or other tool and the pins 66, 67 cause the insulating plates 68—71 to rotate with the shaft 12. Each of the movable contact supporting plates 68—71 may be identical in form and consequently only one of these plates will be described in detail.

The plate 70, preferably comprises a substantially circular member of molded phenolic condensation compound, a plan view of which is shown in Figure 4. As previously stated, the plate 70 is provided with hub formations 72 and with a substantially cylindrical aperture 78 for receiving the shaft 12. The lower part of the hub 72 is formed with a radially extending slot 79 of sufficient size to receive the pins 66, 67 and the shaft 12 is so located axially with respect to the plate 70 that the pins 66, 67 are located in the slot 72. The body of the plate 70 is provided with an upwardly projecting elongated lug 80 adapted to provide a support for a movable contact member 81.

The movable contact member 81 may be secured to a plate 70 by a pair of rivets 82 which extend through apertures in the contact member 81 and through apertures in lug 80 and plate 70. The movable contact member 81 may consist of a resilient sheet metal member formed of a strip of sterling silver. The strip is provided with a pair of arms 83, 84 both of which are bent up from the lug 80, being provided with offset portions 85 to improve the resilient qualities of the contact arms.

Contact arm 84 extends inwardly in a substantially radial direction toward the hub 72 in order to engage with a fixed contact member 86 while contact arm 83 may extend

outwardly toward the periphery of the plate 70 in position to engage with any of a multiplicity of fixed contact members 87. The ends of both contact arms 83, 84 are preferably bent laterally toward the fixed contacts with which they cooperate in order that the body of the contact arm may not engage the fixed contact and the end of each contact arm is preferably rounded off as at 88 at each corner to provide a camming surface which is adapted to ride upward over any obstructions. The rounded contact end 89 also serves to provide a point contact between the movable contact and the fixed contact, which has a substantially constant contact resistance but which is not sharp enough to wear off so readily as a relatively sharp contact would do, thereby preserving the same contact resistance for a longer period of time.

The periphery of the plate 70 and each of the other plates is provided with a plurality of substantially circular formations 90, which might be termed scallops, with grooves 91 of arcuate formation between the "scallops". The circular formations 90 act as camming members for engagement with a ball 92 to produce a snap action, while the grooves 91 serve to facilitate the snap action and maintain the switch in predetermined switching position with the contacts in definite engagement with each other.

Referring to Figure 4, the supporting studs 31, 32 of the framework may also serve as a support for the spring arrangement 93 of the snap switch. For this purpose the posts 31, 32 are preferably provided with substantially cylindrical formations 94 between the non-circular members 49, 95. The non-circular members 49, 95 serve as thrust members for retaining the spring arrangement 93 in definite position axially of the posts 31, 32.

The spring arrangement 93 preferably comprises a pair of springs 96, 97, the former of which is adapted to serve as a ball retainer and the latter of which serves to provide a resilient backing against which the ball may react. The spring 96 comprises a strip of resilient metal such as spring brass or steel having its ends 98 curled about the posts 31, 32 forming a bearing about each post.

Midway between the ends of the spring 96 it is preferably provided with an enlarged body 99 having a substantially rectangular aperture 100. The aperture 100 is of sufficient size to receive the ball 92 and the aperture 100 is preferably formed by punching out two tongues 101, 102 from the body 99, the tongues 101, 102 extending rearwardly to form the walls of a socket for the ball 92. The spring 96 extends across the post 31 to post 32 in such position and the ball 92 projects sufficiently from its sup-

porting socket so that the ball 92 is in engagement with the periphery of plate 70 but the spring 96 does not engage the plate.

The ball is also so located peripherally with respect to the grooves 91 in plate 70 and with respect to the ends of contact arms 83, 84 so that when ball 92 is in groove 91 the contact arms 83, 84 are in electrical connection with predetermined fixed contacts 86, 87.

The spring 97 comprises a similar strip of resilient metal which is bowed between the posts 31, 32 and which at its ends is also curled about the posts 31, 32. Spring 97 engages the ends of flanges 101, 102 and prevents the ball 92 from passing through the aperture 100. The springs 96, 97 effectually provide a resilient socket for the ball 92 and permit the ball to advance and recede in a radial direction with respect to the plate 70 as the ball is engaged either by the grooves 91 or the camming formations 90.

The operation of this snap arrangement is substantially as follows:

When the shaft 12 is actuated by actuating member 13 in either direction from the position of Figure 4, the circular camming formation 90 causes the ball 92 to ride upward out of the groove 91 until the summit of the camming formation is reached, after which the reaction of the springs 96, 97 against the ball causes the ball to aid in the rotation of the switch until the ball falls into the next groove. The amount of force necessary to turn the switch is such that when the switch has been turned it quickly snaps from one position to the other, thereby effecting a quick make and break and the ball assures the stopping of the switch in such a position that the contacts are in proper engagement. With such an arrangement the switch can not under ordinary conditions be stopped with the contacts in an intermediate position and there is no danger of improper positioning of the switch contacts.

Each bank of contacts, that is to say each of the movable plates 68, 71, is preferably provided with its own snap mechanism for the reason that where a large number of separate movable contacts are secured to the same shaft, the lost motion or play between different contact supporting members might otherwise permit one of the movable contacts to be in proper position while another movable contact lagged sufficiently behind to produce an improper or faulty contact.

When each movable contact plate is provided with its own snap mechanism and its own movable contact arm fixedly secured to the contact supporting plate, that movable contact arm will be assured of the proper location on the fixed contact by its own snap mechanism. In the use of a multiple contact switch with electrical measuring in-

struments it is of primary importance that the movable contact of each contact bank be assured of a definite location and engagement with respect to the fixed contacts.

5 Referring to Figure 3, this is a bottom plan view of a bank of fixed contacts carried by the resilient insulating plate 54 of Figure 2. The fixed contact plates 54—57 are each identical in structure and therefore
10 only one of these contact plates and contact need be described in detail.

The plates consist of a plurality of layers of cambric, duck, canvas or other fabric impregnated with a phenolic varnish or a
15 phenolic condensation compound and each of the plates like the plate 54 is provided with a multiplicity of spaced slots 103, 104. The slots are located so as to extend radially with respect to the center of plate 54 or
20 shaft 12 and the ends of the slots are located in a pair of concentric circles.

The slots are preferably formed by punching operations and the plates 54 are sufficiently thin to permit of this type of operation. Each pair of slots 103, 104 is adapted
25 to permit the securement of one of the fixed contacts 87 to the plate 54. Each of the fixed contacts 87 may comprise a strip of metal such as brass formed with an aperture 105 at its outer end to serve as a connector and with a pair of downwardly extending tabs 106, 107. The contact may be
30 secured to plate 54 by passing tabs 106, 107 through slots 103, 104 respectively and bending over the tabs or ears 106, 107 on the lower side of the plate.

The end of each contact 87 preferably projects beyond the edge of the plate 54 to facilitate connection of various wires or
40 conductors to the contacts 87. A wire may be secured by merely passing it through the aperture 105 and placing a drop of solder upon the wire and contact 87 at the aperture 105.

45 The slots 103, 104 of adjacent contacts are separated by an insulating portion 108 of the plate 54 located between each of the contacts and the end 89 of movable contact arm 83 rides over the contacts 87 and across the
50 intervening insulation 108. There is a tendency for the metal to be worn off the movable contact and to deposit a streak of metallic material upon the intervening insulation 108 between adjacent contacts 87. This
55 streak of metal deposit would otherwise tend to short circuit two adjacent contacts and cause errors in the measurement of electrical conditions in the radio receiving set or other device under test and in the case of
60 higher voltages a leakage path would be provided between the contacts which might change the electrical conditions in the set under measurement when the fixed contacts were connected to the circuit.

65 This defect is corrected in the present construction by providing slots 103, 104 of

substantially greater width than the thickness of the ears 106, 107, thereby providing air gaps by means of the provision of slots 103, 104 at each side of the intervening insulation 108. The rounded end 89 of contact arm 83 is adapted to slide from one contact 87 across the air gap on the insulation 108 and thence across the air gap to the next adjacent contact 87 without any possibility of short circuiting any of the contacts or any of the circuits of the apparatus under test. 70 75

It will be understood that when the switching device is being used the various fixed contacts 87 are usually connected by a cable and appropriate connectors to the electrical circuits of the receiving set at a predetermined socket and the receiving set is usually measured under operating conditions. The short circuiting of any contacts under these conditions would probably result in injury to the apparatus. The center contact 86 comprises an annular member of the same metal provided with a plurality of metal ears 109 which pass through slots 110 and are bent over on the lower side of plate 54 to secure this contact member in position. A radially extending arm 111 is of sufficient length to extend out beyond the plate 54 so that the end of arm 111 is located in a similar manner to the ends of contacts 87. Contact arm 111 may be connected to one of the terminals of an electrical measuring instrument, the other terminal being connected to the circuit under measurement while the other side of the circuit under measurement may be connected to one of the contacts 87. 80 85 90 95 100

It will thus be observed that a multiplicity of different circuits or parts of circuits may be measured or tested with the same instrument by using one of the contact banks, and a multiplicity of different connections may be made in the same circuit by the use of a number of different contact banks. 105 110

Among the various measurements which may be made and which have appropriate indicia on the panel 106 are the following: G-K-120V, voltage from grid to cathode, 120 volt scale; G-K-60V, voltage from grid to cathode, 60 volt scale; G-K-12V, voltage from grid to cathode, 12 volt scale; P-H-300V, voltage plate to heater, 300 volt scale; G-H-30V, voltage grid to heater, 30 volt scale; K-12MA, cathode current, 12 milliamperes scale; K-H-300V, voltage cathode to heater, 300 volt scale; K-H-60V, voltage cathode to heater, 60 volt scale; H-H-12V, voltage across heater terminals, 12 volt scale; RES-CONT, resistance and continuity tests; G-12MA, grid current, 12 milliamperes scale; CG-K-6V, voltage control grid to cathode, 6 volt scale; CG-K-60V, voltage control grid to cathode, 60 volt scale; P-K-300V, voltage plate to cathode, 300 volt 115 120 125 130

scale; P-K-600V, voltage plate to cathode, 600 volt scale; P-12MA, plate current, 12 milliamperes scale; P-60MA, plate current, 60 milliamperes scale; P-120MA, plate current, 120 milliamperes scale; G-120MA, grid current, 120 milliamperes scale; PG-K-30V, pentode grid to cathode, 30 volt scale; output indicator.

It will thus be observed that the present switching device is adapted to be used for measuring the voltage and currents between the various elements of an audion tube circuit. In some cases it will be found that for direct current measurements the instrument is so connected that it will read in the wrong direction. In such case the connection of the direct current instrument must be reversed in order to effect the measurement and it is desirable to provide a switching arrangement which permits the reversal of the connections. The push button switch 24 is adapted to be utilized either for a reversing switch for the instrument or for a disconnecting switch. In the case of a reversing switch the electrical instrument would be directly connected to the movable contact members 112, 113 (Fig. 2).

The reversing switch 24 is also provided with the fixed contacts 114, 115, 116. The contacts 112, 114 are normally engaged while the contacts 113, 115 are normally disengaged. Movable contacts 112, 113 are joined by an insulating block 117 and contact 112 is engaged by a cap nut 118 carried by the threaded end of rod 74.

The upper end of rod 74 is provided with a push button 119 preferably comprising a member molded of phenolic condensation compound and threaded on the end of rod 74. When the push button 119 is pushed contact is broken between contacts 112 and 114 and between contacts 113 and 115. Contact is made between contacts 112 and 115 and between contacts 113 and 116.

It will be evident therefore that by properly connecting the contacts 112-116 in circuit with the electrical measuring instrument the connection of the instrument to the bank contacts can be reversed by pressing on the button 119 and the voltage or current between any of the elements of the circuit can be read on a direct current meter with the meter properly connected.

The present push button switch is also adapted to be used as a disconnect switch for disconnecting the meter from the circuit while the rotary selector switch is being moved from one position to another. When the meter and fixed contacts are connected to the switch it will be evident that in order to reach any predetermined position of the switch it is sometimes necessary to pass through all of the intervening positions, thereby subjecting the meters to a multiplicity of different impulses of voltage or

current and this may be avoided if the push button switch is used as a disconnect and is pressed with one finger while the voltage switch is turned to the desired position.

In such case, of course, the push button switch must be so arranged to provide a simple disconnection or it must be pushed to the intermediate position in which the circuit is broken from the meter but the reverse connection is not yet made.

Referring to Figure 6, the shaft 12 is preferably provided with a threaded bore 120 for receiving a securing member 121. The switch actuating member 16 preferably comprises an elongated insulating member of a molded phenolic condensation compound which is provided with a bore 122 of sufficient size to receive the end of shaft 12. The switch actuating member 16 is also provided with a counter bore 123 forming an annular shoulder 124 which engages the end of shaft 12.

It is also preferably provided with an enlarged counter bore 125 adapted to receive the enlarged head 126 of the securing nut 121 which is provided with a slot 127. The actuating member 16 may then be secured on the end of shaft 12 by threaded nut 121 into bore 120, the head 126 of the nut engaging the annular shoulder 128. The nut or securing member 121 is, of course, provided with an axial bore 129 similar in size to the bore 73 in the shaft 12 for slidably receiving the shaft 74 and the counter bore 125 is of sufficient size to slidably receive the push button 119 which projects above the actuating member 16.

In order to assure the fixity of the actuating member 16 relative to shaft 12, the actuating member is provided with a molded slot 130 extending radially in opposite directions from the sides of bore 122 and similar pins 66, 67 are located in the slots 130 and threaded into the shaft 12. The engagement of the sides of the pins 66, 67 with the walls of slots 130 positively prevents actuating member 16 from rotating with respect to the shaft 12.

The actuating member 16 is also preferably provided with a longitudinally extending groove 131 located upon a downwardly inclined surface 132 and filled with a material of contrasting color such as white printer's wax to serve as a pointer in indicating the position of the switch. The line of groove 131 registers with each of the radial lines 19 of the switch dial.

Referring to Figure 7, this is an illustration of a modification of the present bank switch which may be utilized for controlling a lesser number of different circuits. For instance, a switch similar to that of Figure 7 may be used for controlling the connection of an alternating current milliammeter so arranged as to measure the A. C. heater voltage

or A. C. current or relatively A. C. voltages such as the plate-heater or grid-heater voltage on an 800 volt scale.

The switch shown in Figure 7 may also be used for momentary connection for predetermined tests such as a tube test. In such case it is desirable that the switch be automatically returned to the off position and for this purpose the switch is provided with one or more springs for automatically returning the switch to the off position.

Referring to Figure 8, the posts 132, 133 may be provided with springs 134, 135. Each of the springs may consist of a wire having parallel ends 136, 137 and an intermediate coiled portion 138 which is coiled about a post 132 or 133.

The movable contact supporting plate 139 is provided with a pair of downwardly projecting lugs 140 located on a line between the posts 132, 133 and shaft 141. Each of the lugs 140 is provided with a metal roller 142 which engages the parallel legs 136, 137 of the springs 134, 135. The shaft may also be provided with a washer or roller 143 for engaging the ends of the legs 136, 137.

When the switch actuating member 16 of Figure 7 is turned in a clockwise direction looking from the top the shaft 141 would be rotated in a clockwise direction. The left-hand roller 142 would then engage the left-hand leg 136 and the right-hand roller 142 would engage the right-hand leg 137.

The rotation of springs 134, 135 is prevented by engagement of the opposite legs with the center roller 143 and it will thus be evident that the tension of the legs of the springs resists rotation of the switch. The tension of these springs 134, 135 is sufficient to cause the switch to return to its off position, which is the position shown in Figure 8, but the switch can be turned either to the left-hand or the right-hand to momentarily produce a connection for a tube test with normal grid excitation of the tube, or a test with normal excitation on the control grid.

The movable contact supporting plate also preferably supports a radially extending metal plate 144 secured thereto by rivets 145. Certain of the fixed contacts may have their ends 146 bent down into the path of the plate 144, thereby providing a stop for definitely determining the final position of the switch of Figure 7 in either the left-hand or the right-hand position. The use of these contacts as stop members assures the location of the movable contact in proper position on the fixed contact.

The shaft is also preferably provided with a bushing 147 projecting from the upper end of the shaft and provided with a nut 148. The bushing 147 and nut 148 may be used for securing the switch to a panel, while the actuating member 16 may be secured to the

shaft by a screw 148, 149 threaded in the end of shaft 141.

All of the other details of the switch may be substantially as described with respect to the larger bank switch except that no snap action device is required.

It will thus be observed that the present switch structure is adaptable to a multiplicity of different conditions and may be used as a rotary selector switch where a snap switch is required or for an automatic return switch where a momentary connection is required for a predetermined test.

The parts of the present switch lend themselves to construction by molding, stamping and punching operations, thereby greatly decreasing the cost of the switch and bringing the switch within the reach of a larger number of producers.

The contact arrangement is adapted to give a substantially constant contact resistance and it is also adapted to prevent any short circuiting of the instruments or circuits across the metallic leakage path which would otherwise be present on the insulating contact support.

The provision of a snap arrangement for each of the banks assures the definite location of each movable contact upon the contacts of its bank and the present device is very sturdy, efficient and economical.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. In a switching device the combination of an insulating support with a pair of fixed contacts carried by said support, and a movable contact member adapted to slide from one fixed contact across the surface of the intervening insulation to the other contact member, said insulation being provided with an air gap between said contacts to break the line of electrically conductive deposition on the insulating surface between said fixed contacts.

2. In a switching device the combination of an insulating support with a pair of fixed contacts carried by said support, and a movable contact member adapted to slide from one fixed contact across the surface of an intervening insulation to the other contact member, said insulation being provided with an air gap between said contacts to break the line of electrically conductive deposition on the insulating surface between said fixed contacts and said movable contact comprising a resilient arm formed with a

rounded end adapted to ride up from the insulating support on the fixed contact when said movable contact is moved in a lateral direction.

5 3. In a switching device the combination of an insulating support with a pair of fixed contacts carried by said support, a movable contact member adapted to slide from one fixed contact across the surface of an inter-
10 vening insulation to the other contact member, said insulation being provided with an air gap between said contacts to break the line of electrically conductive deposition on the insulating surface between said fixed
15 contacts, and resilient means for locating said movable contact on one of said fixed contacts.

4. In a switching device the combination of a supporting framework with a thin contact supporting plate of insulating material,
20 a plurality of fixed contacts carried by said plate, and a movable contact for slidably engaging said fixed contacts and said plate, said plate being formed with air gaps be-
25 tween said fixed contacts.

5. In a switching device the combination of a supporting framework with a thin contact supporting plate of insulating material,
30 a plurality of fixed contacts carried by said plate, and a movable contact for slidably engaging said fixed contacts and said plate, said plate being provided with a multiplicity of spaced slots, one of said slots being lo-
35 cated on each side of said fixed contacts.

6. In a switching device the combination of a supporting framework with a thin contact supporting plate of insulating material,
40 a plurality of fixed contacts carried by said plate, a movable contact for slidably engaging said fixed contacts and said plate, said plate being provided with a multiplicity of spaced slots, one of said slots being located on each side of said fixed contacts and in-
45 tegral metal ears carried by said fixed contacts passing through said slots and having curved formations for engaging a fixed contact and camming said contact into prede-
50 termined position to slide on said fixed contact.

7. In a bank switch the combination of a supporting framework with a movable contact for each bank, a plurality of fixed contacts arranged in an arc on fixed contact supporting plates and an individual
55 snap mechanism associated with each of said movable contacts for predetermining the position of each movable contact on the fixed contacts of its bank.

8. In a switching device the combination of a supporting framework with a pair of insulating plates, one of said plates being provided with a multiplicity of fixed con-
60 tacts arranged in an arc, a shaft rotatably mounted in said plates, a molded insulating contact supporting member carried by

said shaft between said plates, said molded member being provided with grooves and raised formations on its periphery and resilient means for engaging said grooves and raised formations, said resilient means being
70 adapted to give in a radial direction whereby said movable contact supporting member is held in predetermined contact engaging position and caused to snap from one position to the other upon manual actuation of
75 said shaft.

9. In a snap switch the combination of an insulating plate with a fixed contact carried by said plate, an insulating disc, a shaft rotatably mounted in said plate and adapted
80 to actuate said disc, a movable contact carried by said disc for engagement with said fixed contact, a plurality of curved formations on the periphery of said disc and a spring pressed ball adapted to ride on said
85 curved formations and to urge said disc into a predetermined position.

10. In a snap switch the combination of an insulating plate with a fixed contact carried by said plate, an insulating disc, a shaft
90 rotatably mounted in said plate and adapted to actuate said disc, a movable contact carried by said disc for engagement with said fixed contact, a plurality of curved formations on the periphery of said disc and a
95 spring pressed ball adapted to ride on said curved formations and to urge said disc into a predetermined position, said ball being supported by a transversely extending leaf spring having an aperture for receiving said
100 ball and a second leaf spring for engaging said ball and resiliently urging said ball into engagement with the periphery of said disc.

11. In a switching device the combina-
105 tion of a plurality of posts with a pair of insulating plates joined by said posts, a fixed contact carried by one of said plates and a shaft passing through said plates and rotatably mounted therein, an insulating disc
110 carried by said shaft between said plates, a movable contact carried by said disc for engagement with said fixed contact, spring means having its ends carried by two of said posts, a ball supported by said spring means
115 for engagement with the periphery of said disc, said disc being provided with a depression and a camming surface adapted to cause said ball to ride out of said depression when said shaft is rotated.
120

12. In a switching device the combina-
125 tion of a plurality of posts with a pair of insulating plates joined by said posts, a fixed contact carried by one of said plates and a shaft passing through said plates and rotatably mounted therein, an insulating disc carried by said shaft between said plates, a movable contact carried by said disc for en-
130 gagement with said fixed contact, spring means having its ends carried by two of said

posts, a ball supported by said spring means for engagement with the periphery of said disc, said disc being provided with a depression and a camming surface adapted to cause said ball to ride out of said depression when said shaft is rotated, said camming surface on said disc leading to a second depression whereby said spring and ball are adapted to cause said disc to rotate to a predetermined position after said ball has passed the point of maximum radius between said depressions.

13. In a switching device the combination of a plurality of posts with a pair of insulating plates joined by said posts, a fixed contact carried by one of said plates and a shaft passing through said plates and rotatably mounted therein, an insulating disc carried by said shaft between said plates, a movable contact carried by said disc for engagement with said fixed contact, spring means having its ends carried by two of said posts, a ball supported by said spring means for engagement with the periphery of said disc, said disc being provided with a depression and a camming surface adapted to cause said ball to ride out of said depression when said shaft is rotated, said spring means being provided with curved ends engaging two of said posts and having a pair of flanges extending laterally from an aperture to form a socket for said ball.

14. In a switching device the combination of a plurality of posts with a pair of insulating plates joined by said posts, a fixed contact carried by one of said plates and a shaft passing through said plates, and rotatably mounted therein, an insulating disc carried by said shaft between said plates, a movable contact carried by said disc for engagement with said fixed contact, spring means having its ends carried by two of said posts, a ball supported by said spring means for engagement with the periphery of said disc, said disc being provided with a depression and a camming surface adapted to cause said ball to ride out of said depression when said shaft is rotated, said disc being formed with a transverse groove and with a hub engaging said plates, and a pin passing through said shaft and located in said groove to prevent axial movement of said shaft relative to said plates and secure said disc to said shaft.

15. In a switching device the combination of a supporting panel with a plurality of insulating plates supported in spaced relation to each other and to said panel, said insulating plates supporting a plurality of fixed contacts, a plurality of rotatable discs one mounted between each pair of insulating plates, a movable contact carried by each of said insulating discs, a shaft fixedly secured to said insulating discs and project-

ing from said panel, an insulating actuating member carried by said shaft above said panel, said panel being provided with indicia grooved in its surface and a material of contrasting color filling said grooved indicia for indicating the position of said switch actuating member.

16. In a switching device the combination of a pair of stiff supporting plates with a plurality of studs joining said plates and holding said plates in fixed relation to each other, a resilient insulating plate located between said stiff plates and slightly spaced from one of said plates to provide a resilient support, a plurality of fixed contacts carried by said resilient support, an insulating member located between said plates, a resilient contact arm carried by said latter insulating member and a shaft rotatably mounted in said first mentioned plates for actuating said movable contact.

17. In a switching device a contact bank comprising a thin plate of laminations of fabric impregnated with a phenolic condensation compound, said plate being formed with a multiplicity of radially extending slots located on an arc and a plurality of fixed contact members, each contact member having an integral portion extending through one of said slots and the parts of said contact member being bent into engagement with said insulating plate to secure said contact member in fixed position on said plate.

18. In a switching device the combination of a plurality of studs with a pair of insulating plates secured in spaced relation by said studs, a molded insulating disc located between said plates, a shaft secured to said disc and rotatably mounted in said plates, a movable contact carried by said disc, a plurality of fixed contacts carried by one of said plates, a spring mounted around one of said studs and having a pair of radially extending legs adapted to engage said shaft and a lug located between said legs and carried by said disc for engaging the legs of said spring to return said disc to central position between two rotative positions of said switch.

19. In a switching device the combination of a plurality of studs with a pair of insulating plates secured in spaced relation by said studs, a molded insulating disc located between said plates, a shaft secured to said disc and rotatably mounted in said plates, a movable contact carried by said disc, a plurality of fixed contacts carried by one of said plates, a spring mounted around one of said studs and having a pair of radially extending legs adapted to engage said shaft and a lug located between said legs and carried by said disc for engaging the legs of said spring to return said disc to central position between two rotative positions of said

switch, a stop member carried by said disc and a pair of stop members carried by said plate comprising fixed contacts having portions bent up to engage said first mentioned stop member.

20. A rotary selector switch for a radio set tester comprising a plurality of banks of fixed contacts, a pair of movable contacts for each bank adapted to be connected to a measuring instrument, a shaft for rotating said movable contacts, a manual actuating member, a reversing switch carried by one of said banks and adapted to reverse the relation of said movable contacts to said fixed contacts and an actuating member for said reversing switch comprising a push rod slidably mounted in said shaft and projecting from said first mentioned actuating member.

21. In a multiple contact switch, the combination of an insulating support having a plurality of radially extending slots arranged in an arc with a plurality of sheet metal contacts, each of said contacts having a pair of ears disposed in two adjacent slots clamping said contacts to said insulating support, and said slots extending beyond said contacts in both directions peripherally of the arc to cause a break in the metallic deposit made by a sliding contact on the insulating support and to prevent leakage of high frequency currents from one contact to another.

22. In a multiple contact switch, the combination of an insulating support having a plurality of radially extending slots arranged in an arc with a plurality of sheet metal contacts, each of said contacts having a pair of ears disposed in two adjacent slots clamping said contacts to said insulating support, and said slots extending beyond said contacts in both directions peripherally of the arc to cause a break in the metallic deposit made by a sliding contact on the insulating support and to prevent leakage of high frequency currents from one contact to another, and a movable contact arm and a resilient stop mechanism for holding said movable contact arm in registry with the contacts on said insulating support and for preventing said movable contact from stopping in registry with said slots or the intervening insulating support.

In witness whereof, I hereunto subscribe my name this 12 day of October, 1931.

EDMUND L. MABIE.