March 24, 1959 D. P. MOSSMAN, JR 2,879,345

SELECTIVE SWITCHING APPARATUS

Filed Feb. 1, 1956

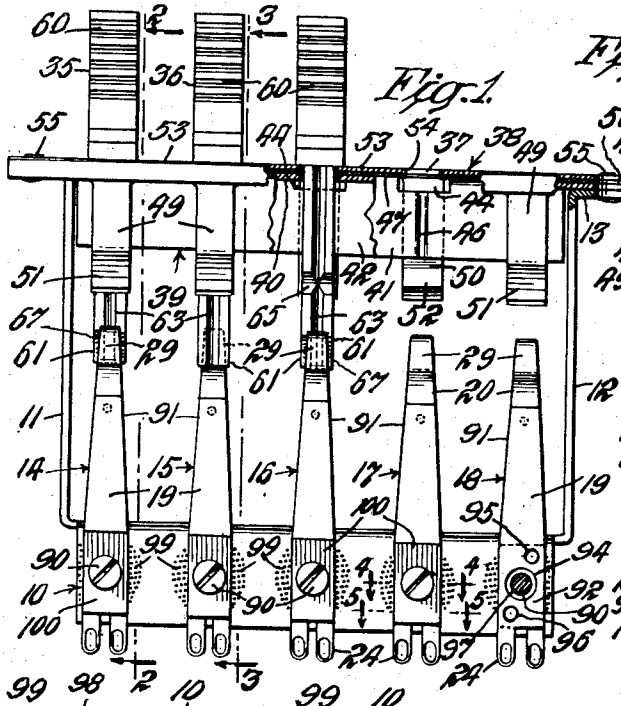

Fig. 1.

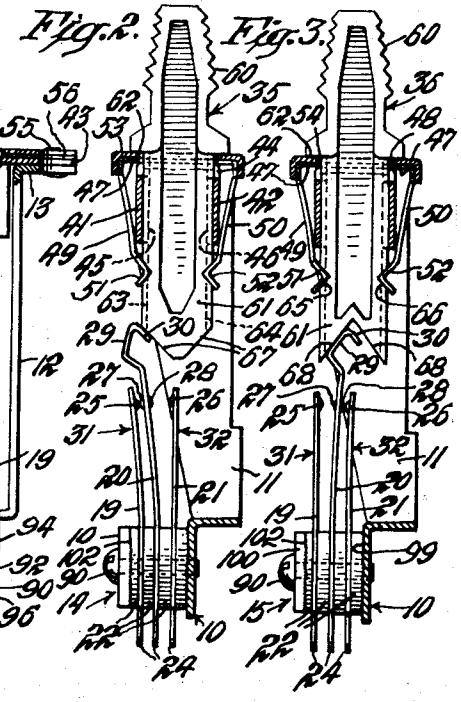

Fig. 2.

Fig. 3.

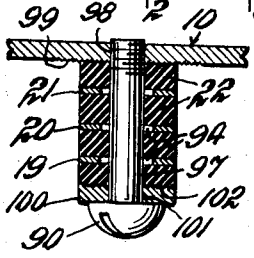

Fig. 4.

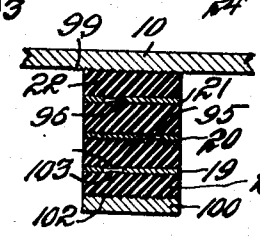

Fig. 5.

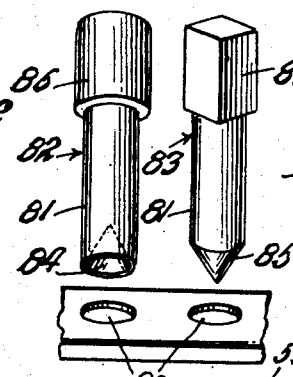

Fig. 6.

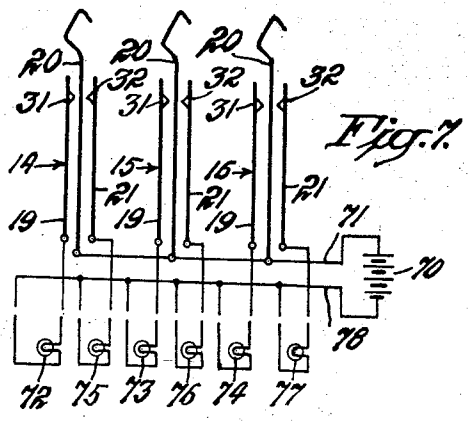

Fig. 7.

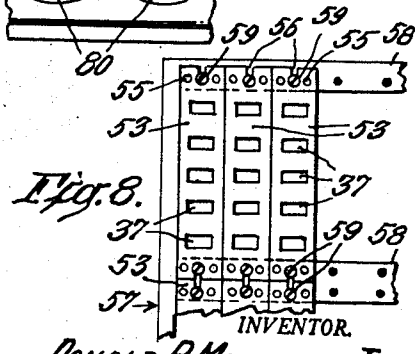

Fig. 8.

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United States Patent Office 2,879,345 Patented Mar. 24, 1959

2,879,345

SELECTIVE SWITCHING APPARATUS

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Application February 1, 1956, Serial No. 562,765

13 Claims. (Cl. 200—5)

The present invention relates to electric circuit makers and breakers and more particularly to a switching apparatus for selectively controlling circuits.

One of the objects of the present invention is to provide an improved switching apparatus of the type indicated in which each of a plurality of switches of a switch assembly may be selectively closed by one of a plurality of interchangeable operating elements for the different switches.

Another object is to provide an economical and inexpensive but rugged and reliable switching apparatus of the type indicated.

To these ends I utilize individual switch operating elements in the form of inexpensive plugs or keys of molded plastic or the like, and having identifying characteristics so that the proper plug or key may be selected to operate a particular switch.

Another object is to provide a switching apparatus of the type indicated in which the closed or open condition of the switch is obvious from a casual inspection. To this end I have used distinctively different plugs or keys to operate different switches of an assembly; and similar plugs are used to operate corresponding switches of different assemblies.

Another object is to provide a switch assembly in which switch blades and insulating blocks are both mounted and keyed to each other by a single fastening screw.

Still another object is to provide switching apparatus and plugs of the type indicated which are of simple and compact construction, adapted for economical manufacture and reliable in performing their intended function.

Although in the accompanying drawings I have shown a preferred embodiment of my invention and have described the same and various modifications thereof in this specification, it is to be understood that these are not intended to be exhaustive but, on the contrary, are chosen for the purpose of illustrating the invention in order that others skilled in the art may so fully understand the invention, its principles and the application thereof that they may embody it and adapt it in numerous forms, each as may be best suited to the requirements of its particular use.

Further objects and numerous advantages of the invention will become apparent from the following detailed description and annexed drawing wherein:

Fig. 1 is an elevational view of a switching apparatus incorporating the novel features of the present invention with certain parts sectioned to the central longitudinal plane.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1 to show the contour of the cam faces on one of the plugs for closing one switch of a switch assembly.

Fig. 3 is a transverse sectional view taken on line 3—3 of Fig. 1 to show the contour of the cam faces on another plug for closing the other switch of the assembly.

Fig. 4 is a transverse sectional view on line 4—4 of Fig. 1 to show the single screw for connecting the interleaved switch blades and insulating blocks of each assembly.

Fig. 5 is a transverse sectional view on line 5—5 of Fig. 1 to show the interlocking keys between adjacent elements of each switch assembly.

Fig. 6 is a perspective view of plugs or modified construction having different shapes for identification, and

Fig. 7 is a diagrammatic view of an electric circuit incorporating three switch assemblies of a gang illustrated in Fig. 1 and showing the plurality of switches in each assembly.

Fig. 8 is a plan view of a plurality of the switching units mounted on a supporting frame.

The invention relates generally to a selective switching apparatus having one or a plurality of switch assemblies with a socket for each assembly located at a fixed position relative thereto. These switch assemblies respectively, have multiple contacts movable to close or open the switches. For each individual switch assembly or for corresponding switches of different assemblies a particular form of plug is provided and each plug has a cam face for operating the movable member in a direction to operate the switch or switches in a particular manner. The socket for each switch assembly is adapted to receive and properly locate the interchangeable plugs for the different switches respectively, and each plug has identifying means such as a color or shape to adapt it to be selected to operate its particular switch.

Such a switching apparatus has a multitude of applications in feeding bits of information into a circuit which is to operate upon it, e.g., to a remote indicator or annunciator, digital computer or memory device or to operate a punch to transfer the information to a tape. For example, each switch assembly may comprise two separate switches for indicating any step of a three step program and the plurality of switch assemblies may correspond to the number of such programs. An open circuit of both switches would then indicate one of the steps, the closing of one of the switches would indicate another step and the closing of the other switch would indicate a third step. Such a system could be used to indicate the vacant, reserved or confirmed seats of airplanes, trains or buses or indicate the location of the different trucks of a fleet, the condition of an inventory or the progress of the steps of an industrial process. Thus, the insertion of a particular plug in a particular socket could transmit such information to some remote point or insert the information into a computer or memory device or transfer the information to a tape.

One embodiment of a selective switching apparatus incorporating the novel features of the present invention is illustrated in Figs. 1 to 6 of the draking. The switching apparatus as shown in Fig. 1 as comprising a U-shaped frame having a mounting plate **10** and parallel arms **11** and **12**. The ends of the arms **11** and **12** have right angular extensions **13** for mounting the frame in a box or other receptacle. Any desired number of switch assemblies may be mounted in a gang on plate **10** of the frame and for purposes of illustration, five such assemblies **14**, **15**, **16**, **17** and **18** are shown. The various switch assemblies **14**, **15**, **16**, **17** and **18** may have the same or different switch arrangements, but in the illustrated embodiment, all of the switch assemblies are of the same construction with each comprising three leaf spring switch blades **19**, **20** and **21** (see Figs. 2 and 3), spaced from each other by insulating blocks **22**. Each blade **19**, **20** and **21** has a terminal portion **24** at one end for connection to a conductor and the blades **19** and **21** have contacts **25** and **26**, respectively, on adjacent sides at their opposite ends. The intermediate or central blade **20** is movable relative to and extends beyond the blades **19** and **21**. Contacts **27** and **28** are

provided at opposite sides of blade 20 in alignment with the contacts 25 and 26 on blades 19 and 21 and the extended end is folded back on itself to provide oppositely disposed inclined cam faces 29 and 30 for a purpose as will later appear. Blades 19, 20 and 21 are spaced so that contacts 27 and 28 on blade 20 are out of engagement with contacts 25 and 26 on blades 19 and 20, but movable contact is adapted to flex in one direction, or to the left as viewed in Fig. 2, to engage its contact 27 with contact 25 of blade 19 constituting one switch 31 or in another direction, to the right as viewed in Fig. 3, to engage its contact 28 with contact 26 on blade 21 constituting another switch 32. Thus, each switch assembly 14, 15, 16, 17 and 18 comprises two separate switches 31 and 32 and is capable of indicating three different conditions when both switches are open, one switch is closed or the other switch is closed.

The switch assemblies 14, 15, 16, 17 and 18 are located in a fixed position on the frame for operation by interchangeable plugs 35 and 36 adapted to be inserted in any of a plurality of sockets 37 in a bridge 38 extending between the arms 11 and 12 of the frame and overlying and attached to extensions 13. A socket 37 is provided for each switch assembly 14, 15, 16, 17 and 18 and is located at a fixed position in the bridge 38 relative to its switch assembly. Each of said sockets 37 constitutes a keyhole and each of said plugs 35 and 36 constitutes a key for operating its particular switch.

The bridge assembly 38 and sockets 37 therein are formed by a plurality of elements comprising an inverted U-shaped channel member 39, see Figs. 1 and 2, having a web 40 and depending sides 41 and 42. Web 40 extends beyond the ends of the side walls 41 and 42 to provide mounting flanges 43 overlying the right angular extensions 13 of the frame arms 11 and 12 to which the flanges are attached. The web 40 has a plurality of rectangular openings 44, one for each switch assembly 14, 15, 16, 17 and 18, and the depending sides 41 and 42 have opposed pairs of inwardly projecting ribs or guide rails 45 and 46 aligned with the openings 44. The next adjacent element of the bridge assembly 38 is a detent base plate 47 having ends overlying the mounting flanges 43 of channel member 39 and frame extensions 13, an open slot 48 overlying the web 40 of channel member, and opposed pairs of spring fingers 49 and 50 for each opening 44 and in alignment with the pair of ribs 45 and 46. Plate 47 is of greater width than the web 40 of channel 39 so that the pairs of spring fingers 49 and 50 are positioned outside walls 41 and 42, project inwardly toward each other and are bent to provide detents 51 and 52 adjacent their ends located below and inwardly of the walls of the channel. The next adjacent element of the bridge assembly 38 is a cover plate 53 overlying the detent base 47 and web 40 of channel 39 and having openings 54 in alignment with the openings 44. The overlying ends of the channel 39, detent base 47 and cover 53 are connected to the right angular extensions 13 of the frame arms 11 and 12 by suitable fastening means such as rivets 55 and the connected ends have slots 56 for receiving fastening means when the frame is mounted in a box or other receptacle.

A plurality of the switching units S may be mounted in a frame, box or other receptacle 57 to provide a board of the units as illustrated in Fig. 8. As illustrated, the units S are arranged in adjacent side by side and end to end relation so that cover plates 53 of the individual units abut each other to provide a continuous surface. The frame extensions 13 of each unit S overlie spaced rails 58 of the mounting frame, box or other receptacle and are attached thereto by fastening screws 59 extending through the slots 56 and screwed into the rails.

Each of the interchangeable plugs or keys 35 and 36 has a knob 60, a shank 61 of rectangular cross-section adapted to fit snugly in any of the sockets 37 and a shoulder 62 intermediate the knob and shank adapted to seat on the cover plate 53 surrounding an opening 54 therein. As stated above, the plugs or keys 35 and 36 may be made inexpensively of molded plastic. The shank 61 of each plug or key 35 or 36 has longitudinal grooves 63 and 64 at its opposite sides for receiving the tongues 45 and 46 of a particular socket 37 and transverse grooves 65 and 66 for engagement by detents 51 and 52 on the spring fingers 49 and 50. The interlocking tongues and grooves 45, 63 and 46, 64 and detents and grooves 51, 65 and 52, 66 align a plug or key 35 or 36 in a fixed position in any socket 37 relative to its corresponding switch assembly 14, 15, 16, 17 or 18. Plug or key 35 has a V-shaped end providing opposed cam faces 67 while plug or key 36 has an inverted V-shaped or notched end providing opposed cam faces 68 inclined oppositely from the cam faces 67.

Each socket 37 is located and displaced from the axis of the movable contact 20 of its switch assembly but less than half the width of key 35 so that when the plug is inserted therein, its face 67 or 68 engages the cam face 29 or 30, on the extension of the movable contact 20. When plug 35 is inserted in any socket 37 its outwardly inclined cam face 67 engages cam face 30 on movable contact 20 to actuate the latter to the left as viewed in Fig. 2 to close switch 31. When plug 36 is inserted in any socket 37, its inwardly inclined cam face 68 engages cam face 29 on movable contact 20 to actuate the latter to the right as viewed in Fig. 3 to close switch 32.

The separate plugs 35 and 36 have identifying means such as a different color, shape or other distinguishing feature or characteristic. In the preferred embodiment of the invention illustrated in Figs. 1 to 6, the plugs 35 and 36 are distinguished by color, for example, the plugs 35 being red and the plugs 36 being yellow. The different plugs may also be distinguished by differently shaped knobs such as the square and round shapes illustrated in Fig. 6.

The switches 31 and 32 of each of a plurality of switch assemblies 14, 15, 16, 17 and 18 may be connected to control a plurality of branch circuits as illustrated in Fig. 7. In the arrangement illustrated in Fig. 7 all of the movable switch blades 20 of a plurality of switch assemblies 14, 15 and 16 are connected to one side of a source of current 70 by a conductor 71, blades 19 are connected to one set of remotely located indicating devices 72, 73 and 74, blades 21 are connected to another set of remotely located indicating devices 75, 76 and 77 and the plurality of indicating devices are connected by a common return conductor 78 to the other side of the source of current 70. For purposes of illustration, the indicating devices 72 to 77 are shown as lights which might be used in an annunciator system but it will be understood that they may comprise electric responsive devices of a digital computer or memory device or may comprise electric responsive elements for actuating a punch or other mechanism.

With a switching arrangement of the present invention as illustrated in Figs. 1 to 6 applied in a circuit as illustrated in Fig. 7, an operator may select a plug 35 or 36 by its color or shape and insert it in any one of the sockets 37 for the various switch assemblies 14, 15, 16, 17 or 18 to close a particular switch 31 or 32. The closing of switch 31 or 32 of a particular switch assembly indicates at a remote place the completion of one step of a particular three-step program to which that particular switch assembly corresponds or may record the information. Thus, an operator by inserting the proper plug 35 or 36 in the socket 37 for the proper switch assembly 14, 15, 16, 17 or 18 may transmit bits of information as they occur from one or a plurality of stations for integration and observation of the integrated information at a remote point. It will be observed that only one of a plurality of conditions can be indicated by any one switch assembly at one one time as a socket 37 can have either

no plug or one or the other of the two plugs **35** or **36** therein. It will also be noted that regardless of how a plug **35** or **36** is inserted, one or the other of the opposed cams **67** or **68** formed by the V-shaped end or inverted V-shaped notch will engage cam face **30** or **29** at the extended end of the switch blade **20** to actuate it into engagement with blade **19** or **21**, respectively.

Fig. 6 illustrates a modified construction in which the sockets **80** are of circular form and the shanks **81** of the plugs **82** and **83** are of cylindrical form to adapt them to be readily inserted into the sockets. The plug **82** has a conical recess **84** in its end to actuate the movable contact **20** in one direction to close switch **32** and the end of plug **83** is in the form of a cone **85** to actuate the movable contact in the opposite direction to close switch **31**. Plug **82** has a cylindrical knob **86** while plug **83** has a square knob **87** so that they may be distinguished and easily and quickly selected to close their particular switch **31** or **32**. Although not shown, it will be understood that a suitable positioning and detachable latching means would be provided.

Another feature of the present invention resides in the manner in which the interleaving contact blades **19, 20** and **21** and insulating blocks **22** of each switch assembly are secured and interlocked one with the other by a single screw **90**. The contact blades **19, 20** and **21** are punched from thin resilient sheet-metal stock, such as brass or Phosphor bronze, in a shape to provide a tapered arm portion **91**, a rectangularly shaped attaching portion **92** and a narrow terminal extension **24** for connection to a conductor, see assembly **18** in Fig. 1. Each contact blade **19, 20** and **21** is provided with a centrally located clearance hole **94** in the attaching portion **92** through which the attaching screw **90** passes and a pair of keying means in the form of round holes **95** and **96** at opposite sides of the screw clearance hole and the axis of the blade. Preferably the screw clearance hole **94** and keyways **95** and **96** are punched simultaneously with the punching of the blade from sheet stock.

The insulating blocks **22** may be formed of an electric insulating material which is capable of limited compression or flow under pressure, such as paper impregnated with a phenol formaldehyde resin varnish. Blocks **22** of the insulating material are punched from such a sheet and each block is provided with a hole **97** substantially fitted to the screw **90**. Screw hole **97** in the insulating blocks **22** is of smaller diameter than the clearance hole **94** in the switch blades **19, 20** and **21** to center the shank of screw **90** relative o the hole in each blade. After such insulating blocks **22** have been formed, their faces may be sanded to provide flat roughened surfaces which are then dipped in, or otherwise coated with, an electric insulating varnish.

The plate **10** of the frame on which the switch assemblies **14, 15, 16, 17** and **18** are mounted has a tapped hole **98** for each assembly and the area around each hole is serrated at **99** by striking the surface with a staking tool. The insulating blocks **22** and contact blades **19, 20** and **21** of each switch assembly are stacked in alternate arrangement in a suitable jig with an insulating block positioned between the mounting plate **10** and first contact blade and an insulating block between the last blade and a metal cover plate **100**. The jig holds the sides of insulating blocks **22** and portions **92** of blades **19, 20** and **21** in alignment so that the periphery of the screw clearance holes **94** are spaced from the peripheries of the smaller holes **97** in the blocks, see Fig. 4. Metal cover plate **100** has a screw hole **101** therein and a serrated surface **102** contacting the adjacent insulating block **22**.

The assembly is attached to the supporting plate **10** by inserting screw **90** through the aligned holes **101, 97** and **94** in the cover plate **100**, insulating blocks **22** and contact blades **19, 20** and **21** and turning the screw into the tapped hole **98** in supporting plate **10**. Screw **90** compresses the assembly with sufficient pressure to cause the surfaces of the insulating blocks **22** at opposite sides of each switch blade **19, 20** or **21** to be deformed into the depressions of the serrated surfaces **99** and **102** in the supporting plate **10** and cover plate **100** and interlock therewith. The compression of the assembly also causes keys **103** of the material of each insulating block **22** to be pressed from its opposite sides into the keyways **95** and **96** of adjacent contact blades **19, 20** and **21**. It has been found that a stack as illustrated in the drawing is compressed about 4% and that this degree of compression together with the insulating varnish on the roughened surfaces of insulating blocks **22** produces keys **103** of sufficient height to lock the elements against relative movement. Thus, each block **22** and contact blade **19, 20** or **21** is locked to the next adjacent element of the stack by the serrated surfaces **98** or **102** or keys **103** and keyways **95** and **96** to lock the whole switch assembly in its proper position relative to its socket **37** in the frame.

It will now be observed that the present invention provides an improved switching apparatus in which each switch of an assembly may be selectively closed by its particular interchangeable plug or key. It will further be observed that the different plugs or keys have identifying characteristics so that the proper plug for a particular switch may be easily and quickly selected. It will further be observed that the different plugs or keys are interchangeable in the sockets to operate different switches of an assembly or similar switches of different assemblies. It will also be observed that the present invention provides a novel switch assembly in which the pressure produced by a single fastening screw keys the alternate switch blades and insulating blocks of a stack to adjacent elements throughout the height of the stack. It will still further be observed that the present invention provides a novel selective switching apparatus and operating plugs or keys therefore which are of simple and compact construction, adapted for economical manufacture, and reliable in operation.

While a single embodiment of selective switching apparatus and several forms of plugs or keys are herein illustrated and described, it will be understood that further modifications may be made in the construction and arrangement of elements without departing from the spirit or scope of the invention. Therefore, without limitation in this respect, the invention is defined by the following claims:

I claim:

1. An electric circuit making and breaking apparatus comprising a positioning member having a socket, a plurality of switches mounted adjacent said socket, an individual plug for each of the different switches and adapted for interchangeable insertion in said socket, each of said plugs having individual means for selectively operating its particular switch, and each of said interchangeable plugs having identifying means to adapt it to be selected to operate its particular switch.

2. An electric circuit making and breaking apparatus comprising a positioning member having a keyhole therein, a plurality of switches mounted in a particular relation to the keyhole in the positioning member, a different key for each of said switches, all of said keys being adapted for interchangeable insertion in said keyhole, each of said keys having individual means for selectively operating its particular switch, and said keys having identifying means so that the proper key may be selected to operate a particular switch.

3. An electric circuit making and breaking apparatus comprising a frame having a positioning member with a socket therein, a plurality of switches mounted on said frame in a fixed position relative to the socket, said plurality of switches having a common operating member movable in different directions, an individual plug for each switch of said plurality of switches and adapted for insertion in said socket, each of said interchangeable plugs

having an individual cam face for slectively actuating the common operating member in a particular direction to close its particular switch, and said plurality of interchangeable plugs having identifying means so that the proper plug may be selected to close a particular switch.

4. An electric circuit making and breaking apparatus comprising a frame having a positioning member with a socket therein, a switch assembly mounted on said frame in a fixed position relative to said socket, said switch assembly comprising a pair of fixed contacts of separate switches and a common contact therebetween in spaced relation thereto, said common contact being movable in opposite directions for engagement with one or the other of the fixed contacts of the separate switches, an individual plug for each switch and adapted for insertion in said socket, each of said interchangeable plugs having an individual cam face for selectively actuating the common contact into engagement with the fixed contact of its particular switch and each of said individual plugs having identifying means for selecting the proper plug to close a particular switch.

5. An electric circuit making and breaking apparatus comprising a frame having a positioning member with a plurality of sockets therein, a plurality of switches adjacent each socket, an individual plug for each switch of said plurality of switches and adapted for insertion in any of the sockets, each of said plugs having individual means for selectively operating at least one of the switches, and said plugs having identifying means for selecting the proper plug to operate a particular switch.

6. An electric circuit making and breaking apparatus comprising a frame having a positioning member with a plurality of sockets therein, a switch assembly adjacent each socket, each switch assembly having a plurality of switches and a common operating member movable in different directions to operate the different switches of the assembly, an individual plug for each switch of an assembly and said plugs being adapted for insertion in any of the sockets, each of said individual plugs having an individual cam face for selectively actuating the movable switch operating member of a switch assembly in one direction to close its particular switch, and said plugs having identifying means for selecting the proper plug to close a particular switch.

7. An electric circuit making and breaking apparatus comprising a frame having a mounting plate and a bridge overlying the mounting plate, a gang of switch assemblies mounted in spaced relation on the mounting plate, a socket in the bridge for each switch assembly, each switch assembly comprising a plurality of switch blades having contacts thereon, at least one of said blades being movable in opposite directions to engage separate fixed blades constituting separate switches, an individual plug for each switch of an assembly, each of said individual plugs being adapted for insertion in any of the sockets and having an individual cam face for selectively actuating the movable contact of a switch assembly to close one of the switches, and said plugs having identifying means for selecting the proper plug to close a particular switch.

8. An electric circuit making and breaking apparatus in accordance with claim 1 in which the socket and interchangeable plugs have cooperating guiding means to properly locate a plug with respect to its switch.

9. An electric circuit making and breaking apparatus in accordance with claim 1 in which a spring detent means is provided for yieldingly holding a plug seated in the socket in switch closing position.

10. An electric circuit making and breaking apparatus in accordance with claim 1 in which the interchangable plugs and socket have interlocking tongues and grooves at the sides thereof, and an interengaging notch and spring detent structure for yieldingly latching a plug in switch operating position.

11. An electric circuit making and breaking apparatus in accordance with claim 1 in which the plug and socket have cooperating guiding means to insure a fixed location of the plug relative to the switches, and the interchangeable plugs for operating different switches having oppositely inclined cam faces for selectively actuating their particular switches.

12. An electric circuit making and breaking apparatus in accordance with claim 4 in which one of the plugs has a V-shaped end for actuating the common contact in one direction, and another plug has an inverted V-shaped end for actuating the common contact in the opposite direction.

13. An electric circuit making and breaking apparatus in accordance with claim 4 in which the end of one of the plugs is in the form of a cone and the end of another plug is recessed in the form of an inverted cone.

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