

June 30, 1942.

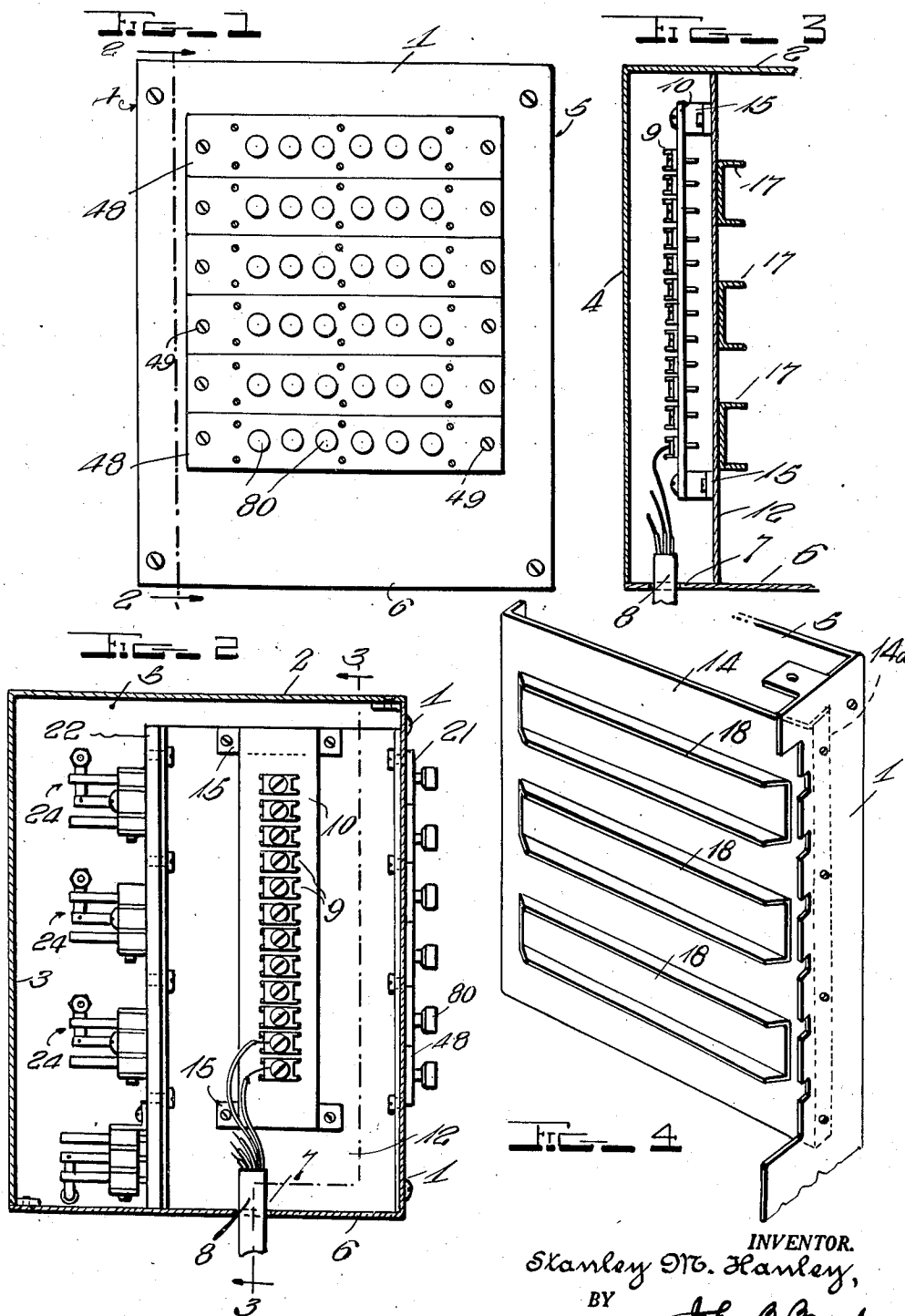
S. M. HANLEY

2,287,797

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Filed July 29, 1939

5 Sheets-Sheet 1



INVENTOR.
Stanley M. Hanley,
BY John C. Brady
ATTORNEY.

June 30, 1942.

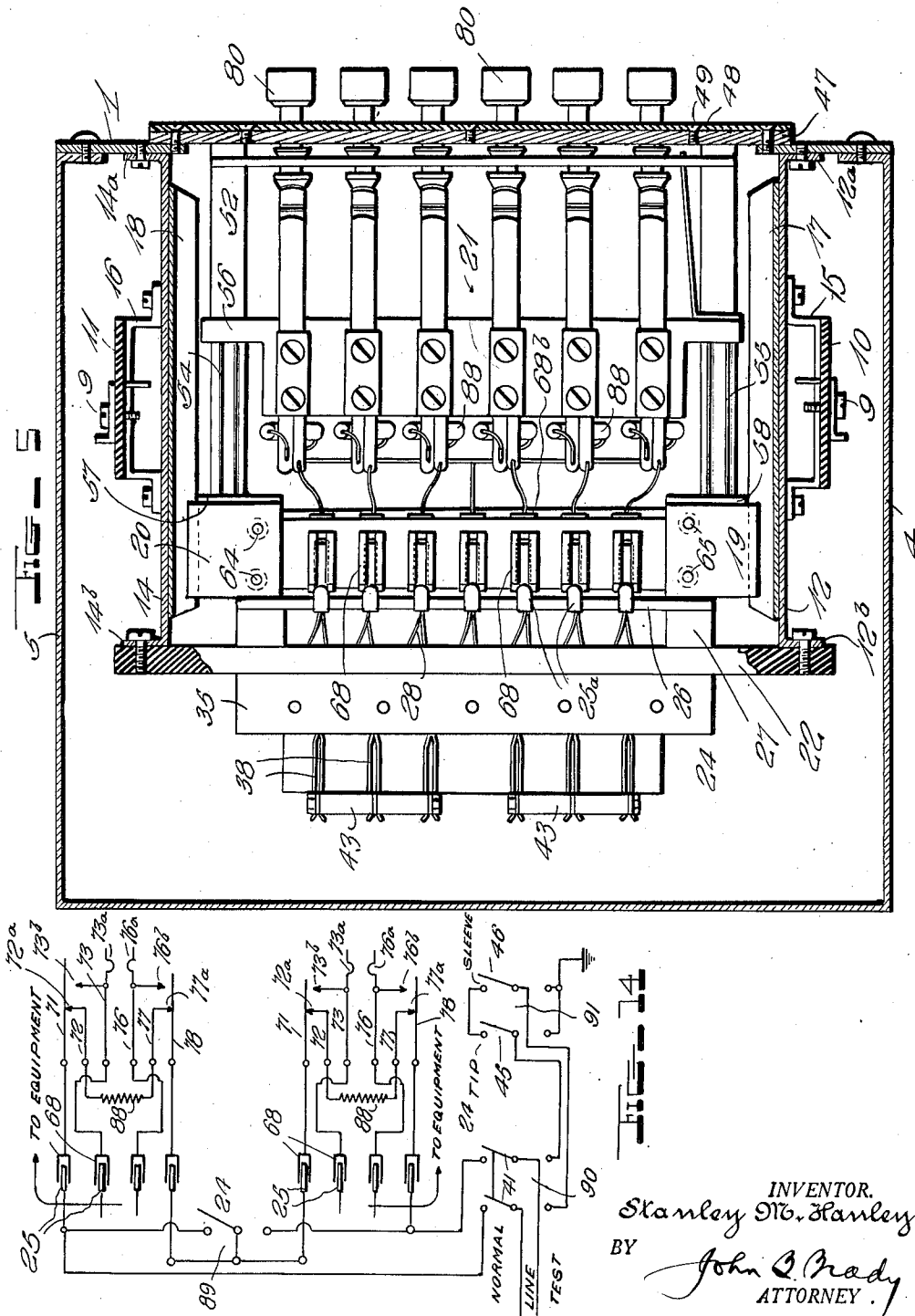
S. M. HANLEY

2,287,797

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Filed July 29, 1939

5 Sheets-Sheet 2



INVENTOR.
Stanley M. Hanley.
BY John S. Brady
ATTORNEY.

June 30, 1942.

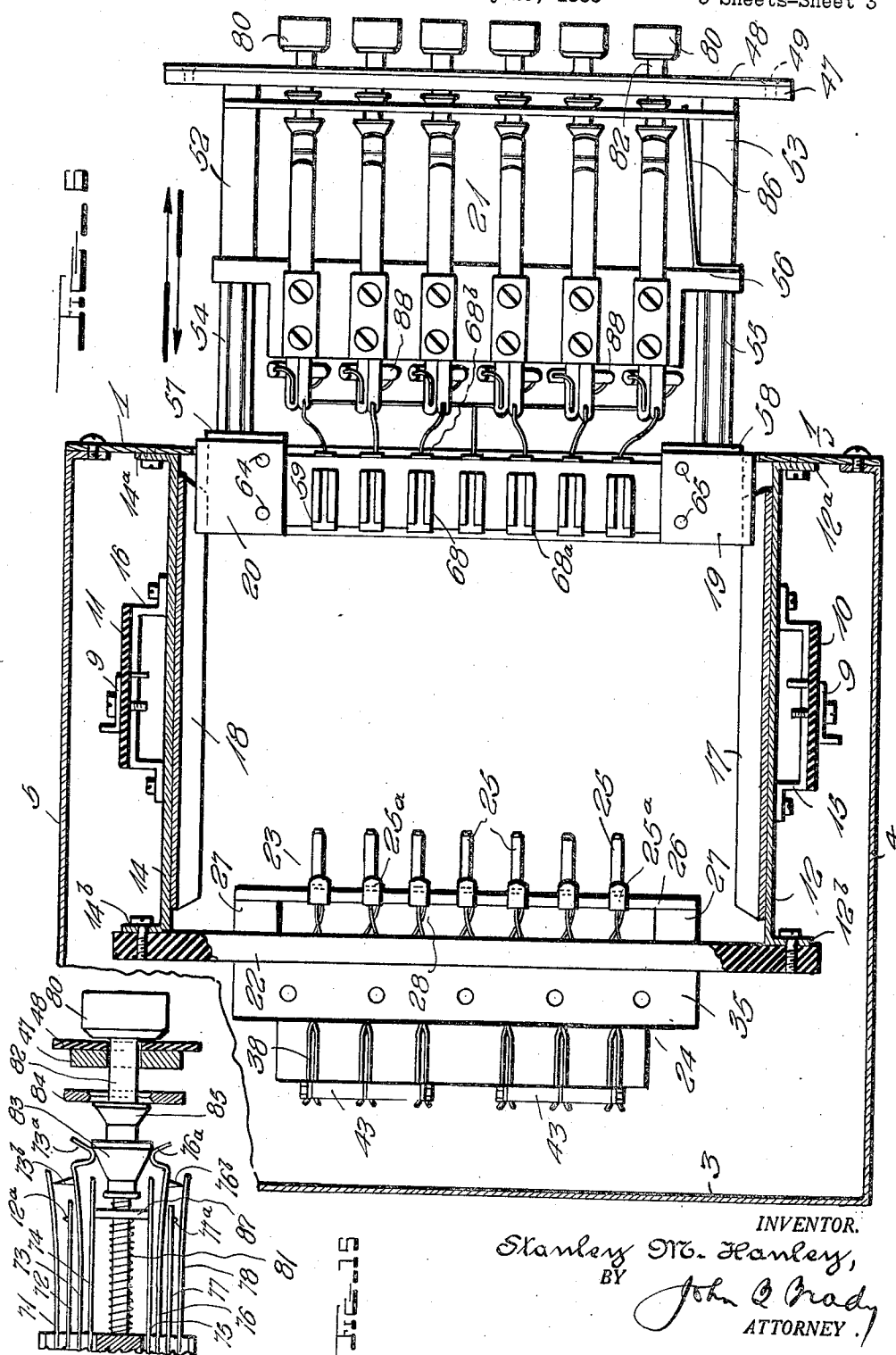
S. M. HANLEY

2,287,797

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Filed July 29, 1939

5 Sheets-Sheet 3



INVENTOR.
Stanley M. Hanley,
BY John Q. Brady
ATTORNEY.

June 30, 1942.

S. M. HANLEY

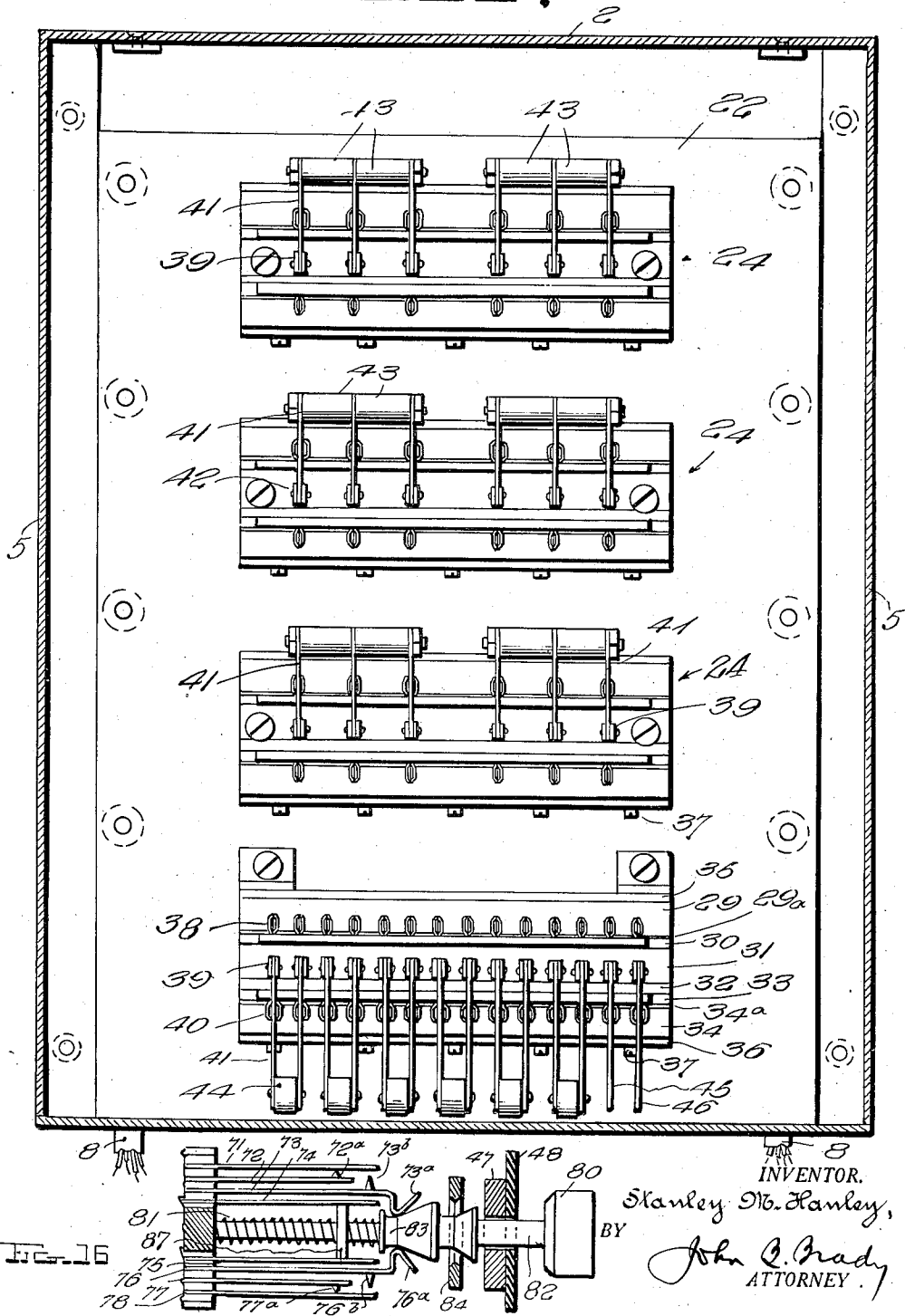
2,287,797

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Filed July 29, 1939

5 Sheets-Sheet 4

7



June 30, 1942.

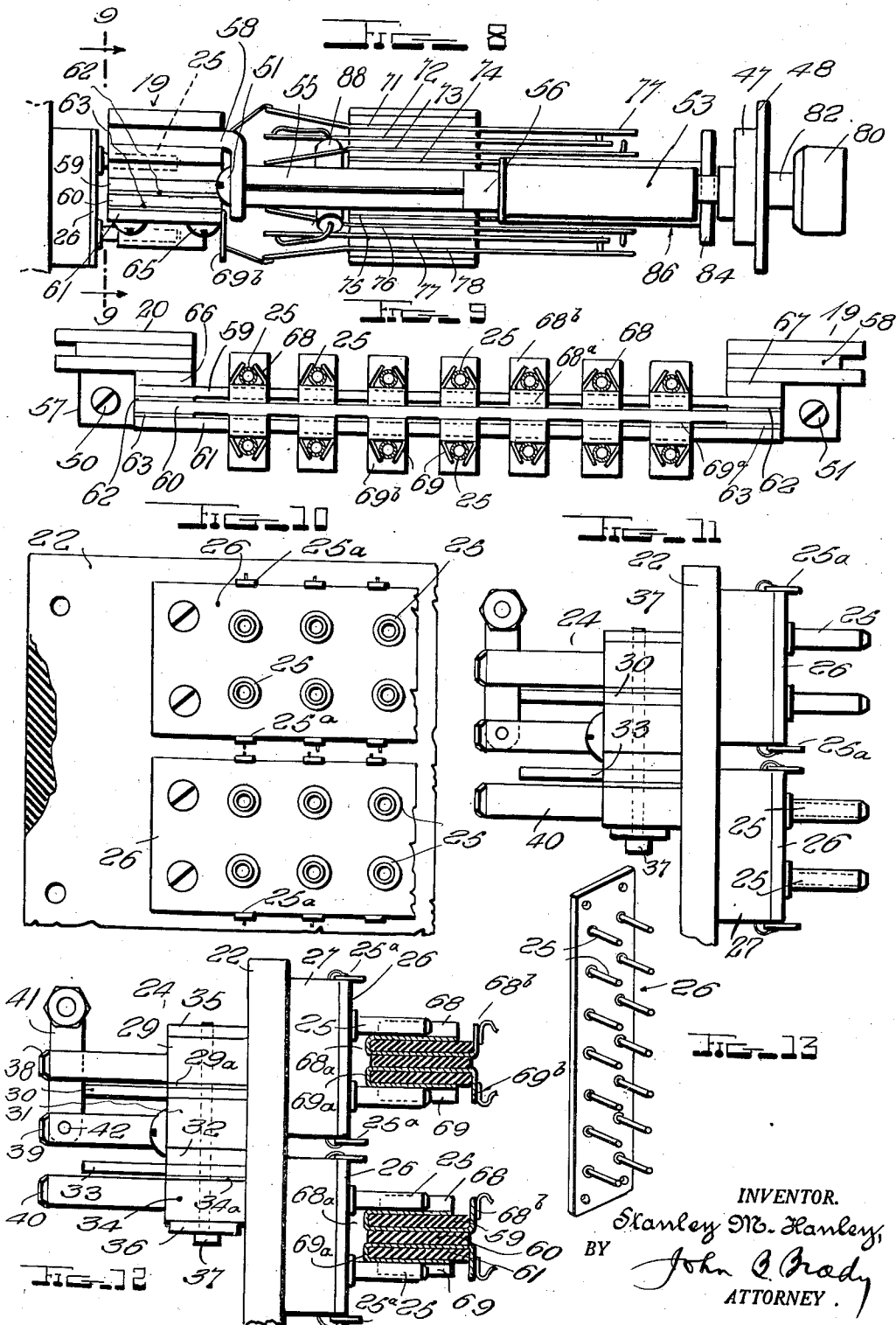
S. M. HANLEY

2,287,797

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Filed July 29, 1939

5 Sheets-Sheet 5



UNITED STATES PATENT OFFICE

2,287,797

APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS

Stanley M. Hanley, Grosse Pointe, Mich., assignor
to Power Equipment Company, Detroit, Mich.,
a partnership

Application July 29, 1939, Serial No. 287,425

5 Claims. (Cl. 175-298)

My invention relates broadly to an improved apparatus for controlling electric circuits and more particularly to means for establishing detachable electrical connection between a multiplicity of interlocking push key switches and a terminal system associated with a selective switching system and an improved construction of apparatus embodying such means.

One of the objects of my invention is to provide apparatus for controlling electric circuits in which a multiplicity of coacting push key switches are arranged in units which may be readily detached and replaced with respect to a plurality of circuit terminals which are associated with selected switching apparatus.

Another object of my invention is to provide an improved construction of switching system in which circuit terminals are arranged in groups and electrically connected through selective switching means and in which the circuit terminals are adapted to be detachably engaged by contact means associated with groups of interlocking push key switches, the groups of push key switches being readily removable and replaceable with respect to the circuit terminals.

Still another object of my invention is to provide a construction of guide for a push key unit which is adapted to be inserted or removed with respect to a supporting frame structure and detachable electrical connection established with circuit terminals in accordance with the act of inserting the push key switches with respect to the supporting frame structure.

A further object of my invention is to provide a construction of electrical circuit control apparatus in which a multiplicity of interlocking push key switches are arranged in interchangeable groups and adapted to be inserted into or removed from a frame structure for establishing electrical connection with circuit terminals alignable with contact members carried by the groups of push key switches.

A still further object of my invention is to provide an arrangement of interlocking push key multiple contact switches which are detachably removable by a translatory movement with respect to a plurality of aligned circuit terminal members for establishing various electrical circuit permutations and combinations in coaction with a multiplicity of selector switches operative to selectively shunt or test certain of the circuits through the multiple contact switches.

Other and further objects of my invention reside in a circuit controlling unit including selector switches and detachably mounted interlock-

ing multiple contact push key switches as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

5 Figure 1 is a front view of a multiplicity of removable push key strips showing the switch actuators; Fig. 2 is a vertical sectional view taken on line 2-2 of Fig. 1 and showing the coactive relation of the removable push key switch units and the selective switching mechanism associated therewith; Fig. 3 is a fragmentary vertical sectional view taken on line 3-3 of Fig. 2 and showing the guide means for the removable push key switch units adjacent one side of the supporting structure and illustrating the manner in which terminal connections are made to the electrical contacts supported from the fixed panel structure within the apparatus; Fig. 4 is a fragmentary perspective view of the guide means at one side of the fixed frame structure; Fig. 5 is an enlarged plan view of the apparatus of my invention with certain of the parts shown in horizontal section and illustrating the position of the push key switches wholly in engagement with the electrical circuit terminals which extend from the supporting panel within the apparatus; Fig. 6 is a view similar to the view shown in Fig. 5 but illustrating one of the groups of the push key switch units partially removed from the cabinet structure and with the detachable electrical connections thereof disengaged from the circuit terminals supported by the panel structure within the apparatus; Fig. 7 is a rear view of the panel structure within the apparatus illustrating the selective switching mechanism supported by the panel structure; Fig. 8 is a side elevational view of one of the groups of removable push key interlocking switch units shown on an enlarged scale; Fig. 9 is a vertical sectional view taken on line 9-9 of Fig. 8 and showing the multiple contacts carried by the removable multiple contact interlocking push key switch units and the circuit terminals which extend from the insulated panel structure in the apparatus; Fig. 10 is a fragmentary front elevational view on an enlarged scale looking toward the circuit terminals which are carried by the insulated panel structure; Fig. 11 is a side elevational view of the circuit terminals illustrated in Fig. 10 and showing the association thereof with the selective switching means carried by the panel structure; Fig. 12 is an enlarged elevational view showing the contacts carried by the removable push key switch unit in electrical and mechanical engagement with the circuit terminals on the

insulated panel structure within the apparatus and in association with the selective switching means; Fig. 13 is a small perspective view showing one of the individual insulated panels carrying the electrical circuit terminals with which connection is established when the push key switch unit is moved into operative position; Fig. 14 illustrates one of the electrical circuit arrangements which may be employed in the apparatus of my invention for establishing various circuit permutations and combinations and performing various electrical tests with respect thereto; Fig. 15 shows the actuated position of one of the push key switches; and Fig. 16 shows the restored position of one of the push key switches.

My invention is directed to apparatus for controlling electric circuits in which quick detachable electrical connection may be established, broken and reestablished between a plurality of electric circuit terminals associated with selective switching mechanism and a plurality of interchangeable interlocking multiple contact push key switches. In the system of my invention, the selective switching mechanism is supported adjacent one side of an insulated panel structure while circuit terminals connected therewith project with respect to the opposite side of the panel structure. Guide means are arranged in alignment with the panel structure and adapted to form means for guiding multiple contact push key interlocking switch units into position for establishing detachable mechanical and electrical connection with the circuit terminals. The multiple contact interlocking push key switches are arranged in groups in frames which carry guide means engageable with the guide means adjacent the panel structure with insulation means supported intermediate the guide means on the removable push key switch frame structure on which there are mounted contact terminals adapted to establish detachable connection with the contact terminals on the panel structure. The groups of interlocking push key switches are quickly interchangeable and when one group of push key interlocking switches is removed, another group may be functioning. The interlocking arrangement of the push key switches enables various circuit permutations and combinations to be established through the functioning of individual push key switch actuators. The fact that mechanical and electrically engageable detachable connections are provided between the insertable and removable push key strip unit and circuit terminals aligned with the contacts carried by the removable unit permits a quick breaking of the circuit connections without the necessity of unsoldering a multiplicity of electrical conductors when an operation is to be performed with respect to perhaps only a single conductor or circuit. Moreover, the slack and lost motion connection which must normally be allowed in any arrangement which contemplates the removal of a multiple contact push key switch is a source of annoyance and congestion in positions where space is restricted. The construction provided in the system of my invention permits the quick removal of an entire push key multiple contact switch unit, the adjustment of circuits terminating in the exposed circuit terminals and the quick replacement of the push key switch unit after adjustment of the several circuits. The selective switching means mounted with respect to the panel structure enables test to be carried out in the circuits leading to mul-

multiple contacts of the interlocking multiple contact push key switches.

Referring to the drawings in more detail, reference character 1 designates the front of the cabinet structure in which the apparatus of my invention is housed and with respect to which a closed housing is provided by means of a removable top section 2 integrally connected with the back section 3 and integrally connected with the side wall sections 4 and 5. The front wall 1 is formed integral with the base plate 6 which is apertured as represented at 7 for the passage of multiple conductor cable 8 through which the conductors extend for establishing electrical connection with the sets of terminals 9 mounted on insulated panels indicated at 10 and 11. The insulated panels 10 and 11 are supported in spaced relation to vertically extending panels 12 and 14 by means of suitable brackets indicated at 15 and 16. The vertical panels 12 and 14 serve as means for supporting horizontally extending guide means 17 and 18 in the form of panels having inwardly directed portions which serve as guide rails or tracks for the guide means 19 and 20, respectively, of each of the removable and replaceable multiple contact push key switch units that I have designated generally at 21.

The vertically extending panels 12 and 14 are connected through flanges 12a and 14a with the rear of panel 1. The opposite ends of panels 12 and 14 are connected through flanges 12b and 14b with insulated panel 22. The insulated panel 22 provides a support at one side for circuit terminals indicated generally at 23, Fig. 6, and on the opposite side for selective switches indicated generally at 24. The circuit terminals indicated at 23 are constituted by pins 25 which are mounted on insulated strips 26 supported in spaced relation to panel 22 by means of spacer members 27. The pins 25 are each provided with lugs 25a which grip the sides of the insulated strips 26 and provide soldering terminals for the connecting leads indicated generally at 28 which lead to the terminals and contacts of selective switches 24 on the opposite side of insulated panel 22. The selective switches 24 are mounted on insulated supports constituted by strips of insulation material shown at 29, 29a, 30, 31, 32, 33, 34 and 34a, Figs. 7 and 12, which are assembled in position between end strips 35 and 36 and secured together by means of through bolts indicated generally at 37. The assembly of strips 29-34 between end strips 35 and 36 permits the secure mounting of the contact members and jaws of the switches 24. The strips 29, 31 and 34 are each slotted in predetermined spaced relation to receive the sets of contact switch jaws 38, switch hinge posts 39 and contact switch jaws 40, respectively. The switch hinge posts 39 provide pivot means in which the switch blades 41 are pivotally mounted at 42. In the case of the three upper selective switches mounted on panel 22 as illustrated in Fig. 7 the switch blades 41 are arranged in triple units, the blades being interconnected by insulation means constituting actuators as represented at 43. The switches thus arranged constitute three pole double throw switch units. In the lower switch unit on panel 22 in Fig. 7 the hinge switch blades 41 are pivotally connected to switch hinge posts 39 which are spatially related in close proximity to each other and adjacent blades 41 interconnected by insulation means 44 for actuating pairs of adjacent switch blades 42 simultaneously. This arrangement is carried out for each of the switches

in the lower switch unit except for the two switch blades in the lower right hand corner which are designated at 45 and 46 and are left free for independent actuation as will be understood more clearly from the test circuit diagram which I have indicated in Fig. 14. That is to say, for purposes of forming a test provided by the circuit of Fig. 14, switches 45 and 46 may be actuated as single pole double throw switches whereas the remaining switch units in the lower set of switches operate as double pole double throw switches.

The removable push key switch units indicated generally at 21 constitute units which are insertable into and removable from the cabinet structure with the guides 19 and 20 on the removable push key switch units engaging guides 17 and 18 within the cabinet structure. The push key switch units 21 comprise a frame formed by a metallic strip 47 having an insulated facing 48 fastened thereto by screws 49, the strip 47 constituting a fastening means for bolts 50 and 51, Fig. 9, which extend through sets of tubular spacer members 52 and 53 and hexagonal spacer members 54 and 55 with an intermediate transversely extending frame 56 disposed therebetween. The headed ends of the bolts 50 and 51 pass through angle pieces 57 and 58 which form the supports for the guide means 19 and 20. The angle pieces 57 and 58 have the guide members 20 and 19 fastened to opposite sides thereof. The angle pieces 57 and 58 serve as supports for the strips of insulation material which I have shown at 59, 60 and 61. The strips of insulation material are superimposed with respect to each other and are spaced at their ends by separator plates 62 and 63 and the stack thus formed, centralized with respect to the operating mechanism of the interlocking coacting key switches by the inclusion of spacer members 66 and 67, is firmly secured together by sets of screws 64 and 65. The guides 19 and 20 project beyond the limits of the angle pieces 57 and 58 and engage opposite sides of the flanges 18 and 17 respectively, to permit the push key switch unit to be moved into position or to be removed from the cabinet structure.

The strip of insulation material 59 carries sets of resilient jaw members 68 which have lug portions extending around the edge of the strip and beneath the strip as indicated at 68a and terminating in a connecting portion indicated at 68b, Fig. 12. The connecting portion 68b is substantially aligned with the multiple contacts of the individual push key switches. The parallel extending strip 61 also carries a multiplicity of resilient contact members indicated at 69. These resilient contact members 69 have portions extending around strip 61 and between strips 61 and 60 as indicated at 69a and terminating in lugs 69b which are also aligned with the contacts of the multiple contact push key switches and establish electrical connection with the contacts thereof as illustrated. The resilient contacts 68 and 69 establish transitory connection with the contact terminal pins 25 supported on panels 26 mounted with respect to the insulated panel structure 22. The slidable mechanical and electrical engagement and disengagement between contacts 68 and 69 and pins 25 is shown more clearly in Fig. 12 in which the contacts are illustrated fully engaged but adapted to be disengaged by an outward sliding action. The pins 25 are electrically connected with the selective switches 24 and so establish a complete circuit

through the contacts of the multiple contact push key switches when contacts 68 and 69 are in the positions shown in Fig. 12.

The push key switches each comprise sets of multiple contacts constituted by superimposed leaf spring contact members and strips of insulation material, which are illustrated more clearly in Figs. 8, 15 and 16. The contact arrangement is of the continuity type arranged for make before break operation so that the electrical circuit is maintained continuous at all times. The leaf springs are indicated at 71, 72, 73, 74, 75, 76, 77 and 78 with insulation strips therebetween and secured in a stack as represented in Figs. 8, 14 and 15. Leaf springs 73 and 76 are each provided with cam shaped ends 73a and 76a and with contact members 73b and 76b. The spring pressed key actuators 80 each operate against a coil spring 81 which surrounds the key actuating stem 82 and exerts a continuous force against the end of the frusto-conical cam device 83 carried by actuating stem 82. The actuating stem 82 passes through strips 47 and 48 and through the transversely movable locking bar 84. An interengaging cone 85 is carried by each actuating stem 82 and is adapted to pass freely through an aperture in locking strip 84 or to abut with and be obstructed by transversely movable locking bar 84 according to the position of the transversely movable locking bar.

Referring to Fig. 6, it will be seen that spring member 86 maintains continuous tension on transversely movable locking bar 84. Accordingly, when any one of the push key actuators 80 is pushed in, the frusto-conical shaped member 85 passes freely through the aperture in transversely movable locking bar 84 and contacts are established as represented in Fig. 15. It will be seen that the cam shaped member 83 which is of insulation material spreads leaf springs 73 and 76 establishing contact with leaf springs 71 and 78 while breaking contact between leaf springs 72 and 71 and 77 and 78. However, it will be observed that before breaking the contact between leaf springs 71 and 72 and 77 and 78, contact is first made between strips 73 and 71 and 76 and 78. This is highly important in order to maintain the continuity of the circuits connected with the contacts of the push key switches. As represented in Fig. 16 the transversely movable locking bar 84 has been shifted by the depression of another key actuator in the group of key actuators in the unit, as a result of which cone shaped member 85 is no longer retained or obstructed whereupon spring 81 restores the actuator back to normal position as illustrated in Fig. 16. Here again however it will be observed that circuits are made between the leaf springs 72 and 71 and 77 and 78 before circuits are broken between leaf springs 71 and 73 and 76 and 78 and the switch restored to the position illustrated in Fig. 16. During the reciprocal movement the actuating stem 82 is centered with respect to the leaf springs by insulated member 87 extending between leaf springs 74 and 75. The contact points for leaf springs 72 and 77 are illustrated at 72a and 77a adapted to make contact with coacting contacts carried by strips 71 and 78 when in the position illustrated in Fig. 16.

In order to provide proper compensation when the circuit leading to the equipment is opened, I provide a resistor 88 which extends at an angle to each of the push key switches and accordingly

may be arranged within the limits of the external physical dimensions of the push key switches.

Fig. 14 illustrates diagrammatically and schematically the arrangement of the push key switches illustrating the contacts thereof and the sleeve-like connections 68 which detachably connect with the pins 25. I have shown the compensating resistors 88 adapted to be connected in lieu of equipment upon depression of the key actuators 80. I have illustrated one of the selector switches 24 at 89 arranged to selectively connect either of two equipments directly to the circuit leading to the transfer switch 90 by shunting the circuit through the other. The switch indicated at 90 permits the line to be transferred from conditions of normal operation to conditions of test. Test conditions are carried out by actuation of either of the switches indicated at 91 by which either the "tip" or the "sleeve" side of the line may be tested. That is to say, the single pole double throw switches 45 or 46 as shown in the lower left hand corner of panel 22 may be used to effect independent test on either the tip or sleeve side of the circuit of a telephone or telegraph system.

The apparatus of my invention is applicable generally to any system in which various circuit permutations and combinations are to be selectively set up and utilized at various times. The fact that so many different circuits may be controlled by the apparatus of my invention renders the apparatus particularly applicable in telephone and telegraph systems. I realize that my invention has wide and various applications and I do not intend my invention to be limited to any particular field of use. I realize that modifications may be made in the construction of apparatus of my invention and I intend no limitations upon my invention other than may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A switching system comprising in combination, a fixed frame, insulated panel means mounted on said fixed frame, pin connectors supported with respect to one side of said insulated panel means, selector switches connected with said pin connectors and mounted with respect to the other side of said insulated panel means, apertured front panel means mounted in parallel relation to said insulated panel means opposite said pin connectors, a removable frame insertable into and removable from said fixed frame through the aperture in said front panel means, said removable frame carrying a multiplicity of electrical switches operative to effect various circuit permutations and combinations, and socket connectors insulatingly supported on said removable frame and electrically connected with certain of the contacts on said electrical switches, said socket connectors being aligned to mechanically engage said pin contacts on said insulated panel means when said removable frame is inserted in position with respect to the front panel means of said fixed frame for establishing an electrical circuit between the contacts on said electrical switches and the selector switches on said insulated panel means.

2. In a system for controlling electrical circuits, a panel structure containing a multiplicity of rows of pin terminals projecting from one side thereof, selector switches supported with respect to the opposite side of said panel structure and electrically connected with selected pin terminals, a face panel mounted in fixed parallel relation

to said panel structure opposite said pin terminals, a multiplicity of removable frame members, each of said frame members carrying a multiplicity of electrical switches operative to effect various electrical circuit permutations and combinations, a multiplicity of resilient socket members insulatingly mounted on each of said removable frame members and electrically connected with selected contacts on said electrical switches, said face panel being apertured for passage of said removable frame members, and said resilient socket members being mechanically engageable in groups with said pin terminals as the respective removable frame means are inserted in position with respect to said panel structure.

3. In a circuit controlling system, a frame structure including forward and rearward panel members maintained in parallel relation, a multiplicity of electrical contactors insulatingly supported by the rearward panel member in said frame structure, a removable electrical switch unit adapted to be inserted into or removed from said frame structure, said forward panel member being apertured for passage of said removable switch unit, electrical contactors carried by said removable electrical switch unit and adapted to establish mechanical and electrical connection with the contactors carried by said rearward panel member, selector switches carried by said rearward panel member and electrically connected with the electrical contactors thereon, said switch unit including a multiplicity of multiple contact switches, said multiple contact switches having separate sets of contacts, input connections between one set of said contacts and selected electrical contactors carried by said switch unit, output connections between another set of said contacts and other electrical contacts carried by said electrical switch unit, and individual circuits compensating means connected and supported between other sets of said contacts whereby upon actuation of said electrical switches various circuit combinations and permutations may be effected.

4. In a control system for electrical circuits, a frame structure including an insulated panel member, selector switches mounted on one side of said panel member and electrical contactors mounted on the opposite side of said panel member and electrically connected with said selector switches, an apertured front panel member mounted in parallel relation to said insulated panel member opposite said electrical contactors, guide means carried by said frame structure, a multiplicity of electrical switch units insertable and removable through the aperture in said front panel member, guide means on said units engageable with the guide means on said frame structure, a multiplicity of multiple contact electrical switches carried by said units and electrical contactors carried by said switch units and electrically connected with selected contacts of said multiple contact switches, the last said contactors being engageable with the contactors mounted on said insulated panel member, said electrical switches being operative to establish various electrical circuit permutations and combinations and said selector switches being operative to selectively shunt and to test the circuits through the multiple contacts of said electrical switches when said switch units are inserted in said frame structure.

5. Switching apparatus for interconnecting a plurality of transmission lines with a like plu-

ality of electrical devices in various system arrangements, comprising a cabinet having a combined base and front panel structure and a cover member forming an enclosure, said base and panel structure being removable from said cover member and including an inner panel mounted on the base portion in fixed parallel relation to the front panel portion of said structure, said front panel portion being apertured, a plurality of interchangeable electrical switch units mounted in said cabinet through the aperture in said front panel portion and related respectively to said plurality of electrical devices, each of said switch units including a plurality of switch means related respectively to said plurality of transmission lines, said switch units and said inner panel having coacting electrical contactors mounted thereon and engaged when said switch units are positioned in said cabinet, and a multiplicity of shunting switches mounted on the back of said

inner panel and having connectors extending through said inner panel to certain of the contactors mounted on the front thereof, said switches being operable to shunt the transmission lines across the switch means of any of said switch units for leading the transmission lines to the remaining switch units, whereby the shunted switch units related to certain of said electrical devices may be removed from said cabinet for inspection or replacement without precluding the operation of unshunted switch units for connecting the electrical devices related thereto to any one of the transmission lines, said switch means having individual circuit compensating means supported by direct connection on the switch means for connection with the transmission line related thereto when the electrical device related thereto is disconnected or connected with another of the transmission lines.

STANLEY M. HANLEY.