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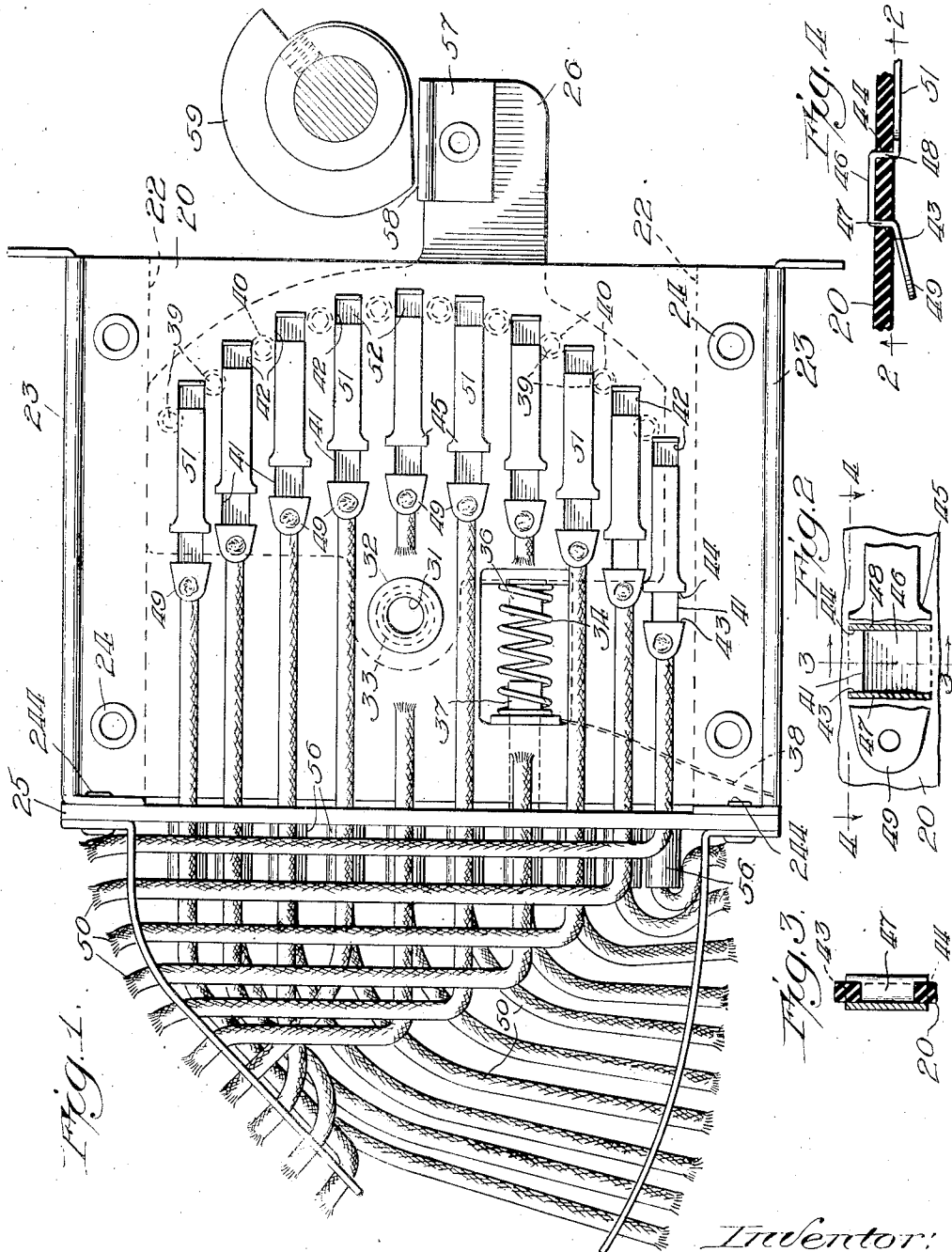
V. J. MOHLER

2,222,085

ELECTRIC SWITCH

Filed May 22, 1939

4 Sheets-Sheet 1



Inventor:
Valentine J. Mohler;
by James A. S. Koehl
Atty.

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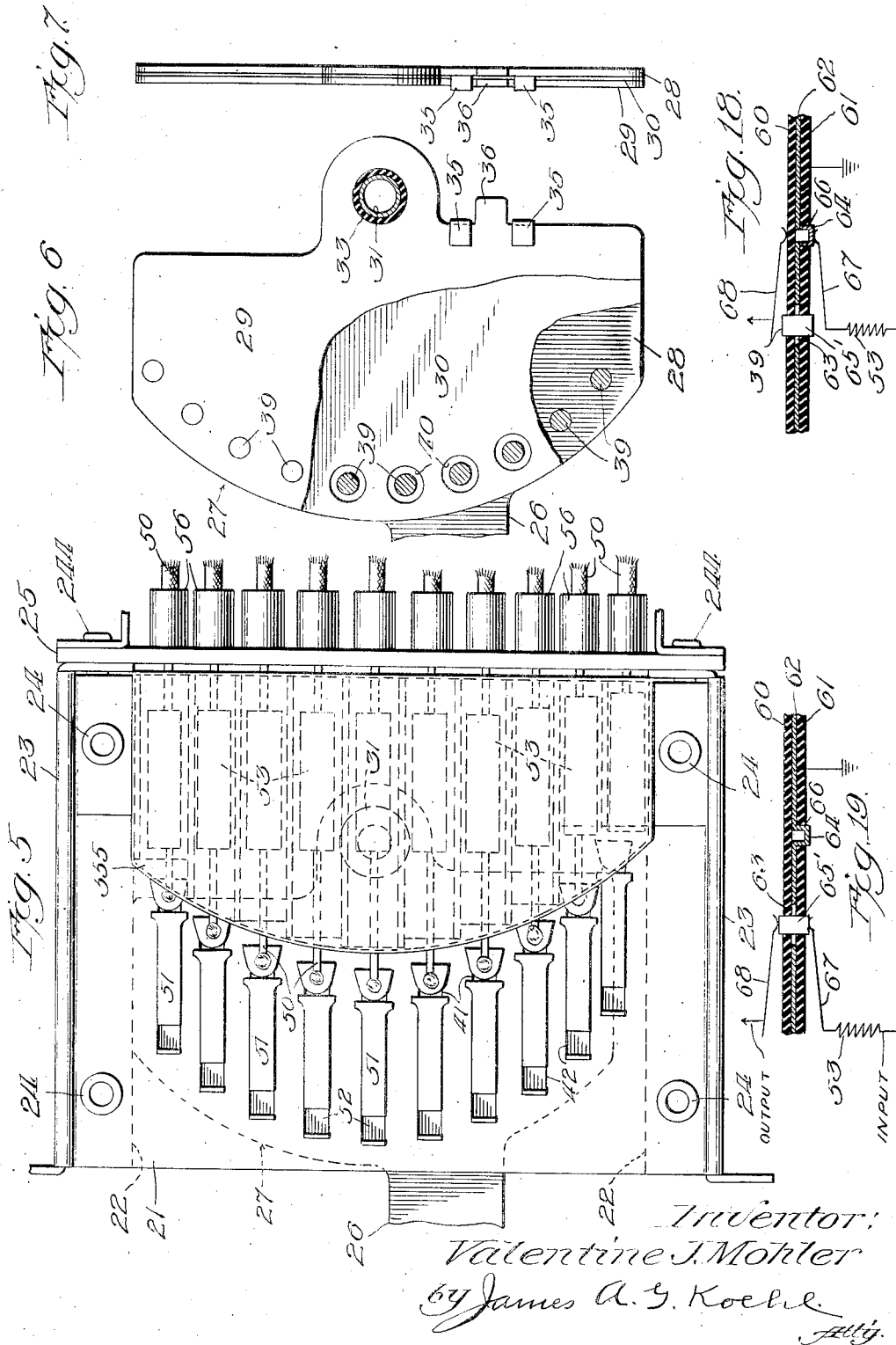
V. J. MOHLER

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ELECTRIC SWITCH

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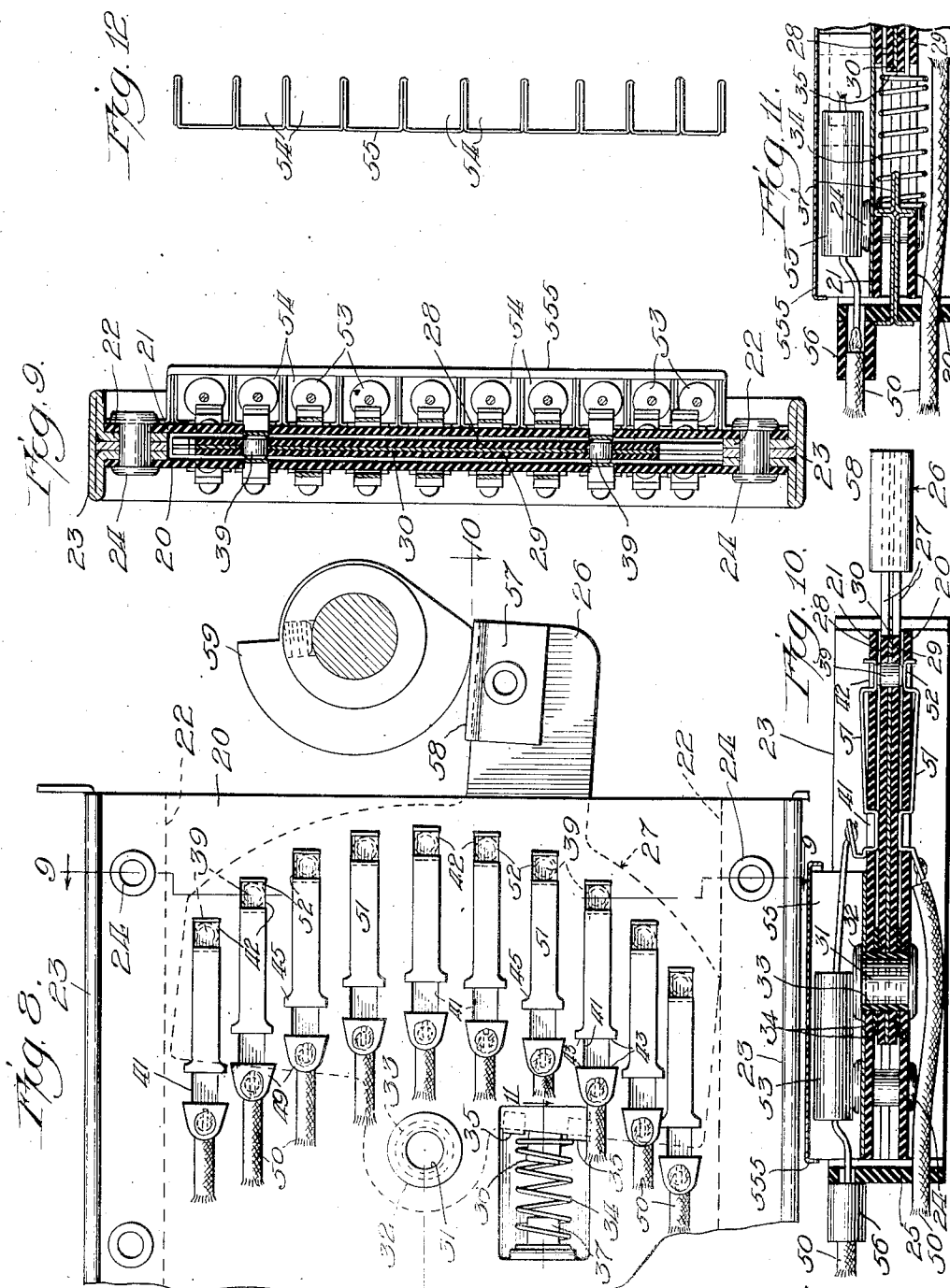
V. J. MOHLER

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ELECTRIC SWITCH

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Inventor:
Valentine J. Mohler
by James A. S. Koehle
Atty.

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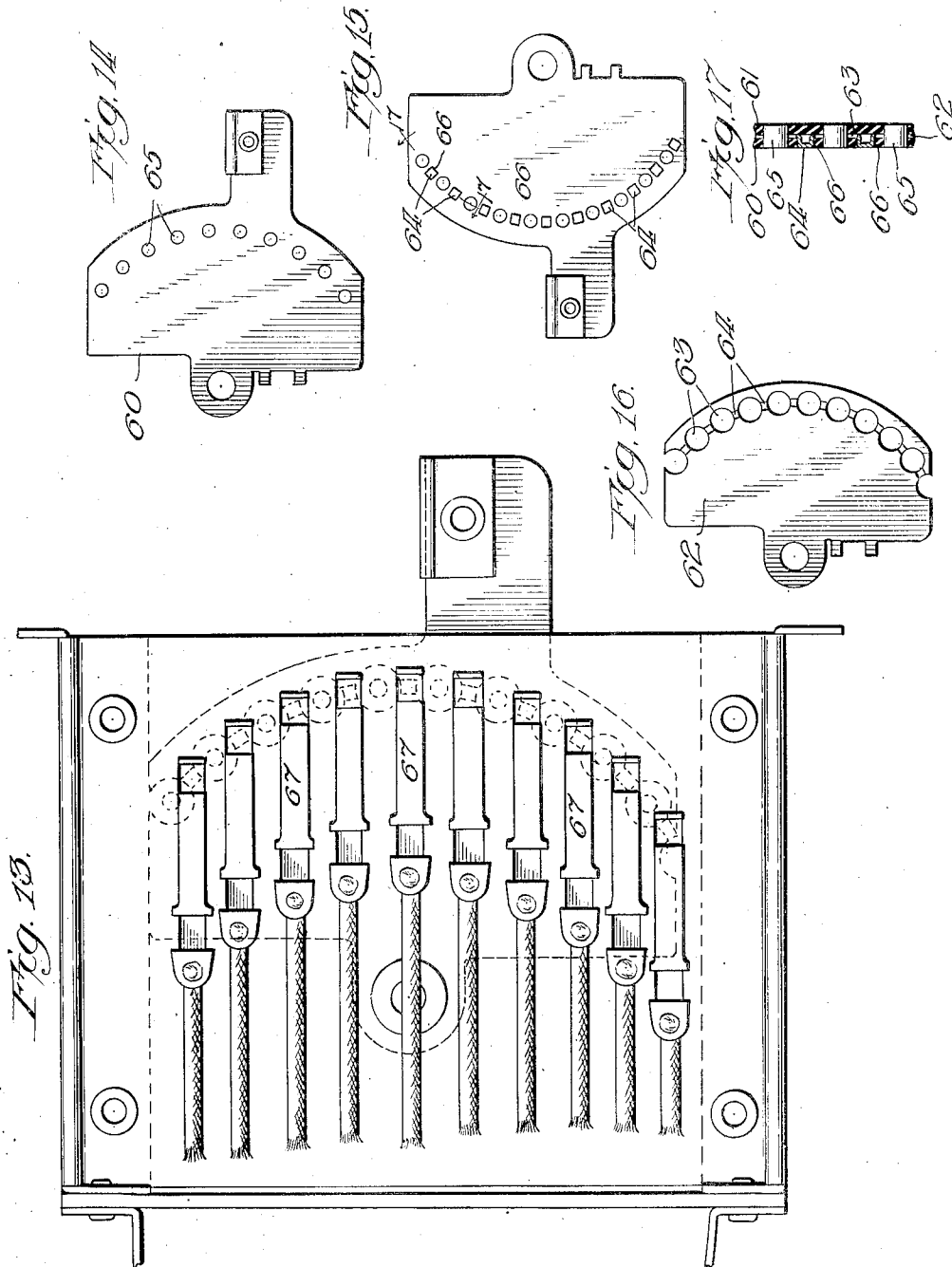
V. J. MOHLER

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ELECTRIC SWITCH

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Inventor:
Valentine J. Mohler
by James A. G. Koehn
Atty.

UNITED STATES PATENT OFFICE

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ELECTRIC SWITCH

Valentine J. Mohler, River Forest, Ill., assignor to
Central Commercial Company, Chicago, Ill., a
corporation of Illinois

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6 Claims. (Cl. 200—11)

This invention relates to electric switches.

The invention is particularly designed, intended and adapted for use in connection with electrical musical instruments in which multiple contact switches are controlled by selectors such as the playing keys of a manual and function to place different alternating current sources in closed circuit with an electrical network upon depression of said selectors.

In musical instruments of the class stated, continuously varying condensers are sometimes employed as sources for developing harmonically related tone frequencies, there being one such source for each frequency. When polarized upon selective actuation of the aforestated selectors and connected in closed circuit with different frequency transmission channels, alternating voltages at harmonically related tone frequencies, electrostatically developed by said condensers are impressed upon the input circuit of a space discharge tube, in the output circuit of which is an electrical sound producer which converts the amplified frequencies into audible sounds corresponding to different musical tones.

Condensers of the type and for the purpose herein stated must be properly shielded from each other so as to guard them from the effects of stray or shifting flux fields, and must be connected in an electrical network which, itself, is carefully designed to prevent modulation of the individually developed waveforms of alternating voltages, whereby, when these waveforms of voltage are impressed upon the input circuit of an amplifier, they will have the waveform characteristics of the tones intended to be sounded.

Certain of the more important objects of my invention are as follows:

To simplify the general construction of a multiple contact switch.

To provide a switch having a flat casing enabling many of the switches to be placed in longitudinal row formation, one substantially against another or very close thereto so that said switches will be complementary to as many closely associated keys of a standard playing manual.

To provide a switch characterized by a novel arrangement of shielding which guards the switch from the effects of shifting flux fields.

To provide a switch which is silent and positive in action and adapted to prevent generation of "ground noise" at an electrical sound producer when conducting alternating current to an amplifier in the output circuit of which said sound producer is electrically coupled.

To provide a switch, the various input terminals of which supply polarizing potential to different continuously varying condensers in a manner to insure against inductive coupling between said terminals and conduction of voltages at controlled intensities to the output terminals of the switch.

The invention will be more fully understood by reference to the following description read in conjunction with the accompanying drawings, in which:

Figure 1 is a view in side elevation of my improved switch showing the circuit making and breaking device in a position of open circuit adjustment.

Figure 2 is a view partly in elevation and partly in section of a circuit terminal of the switch.

Figure 3 is a section taken on the line 3—3 of Figure 2.

Figure 4 is a section taken on the line 4—4 of Figure 2.

Figure 5 is a view in elevation similar to Figure 1 showing the reverse side of the switch.

Figure 6 is a view partly in elevation and partly in section of the circuit making and breaking device.

Figure 7 is an edge view of said circuit making and breaking device.

Figure 8 is a view similar to Figure 1 showing the circuit making and breaking device in a position of closed circuit adjustment.

Figure 9 is a vertical section taken substantially on the line 9—9 of Figure 8.

Figure 10 is a section on line 10—10 of Figure 8.

Figure 11 is a detail section taken substantially on the line 11—11 of Figure 8.

Figure 12 is a view in edge elevation of an element of the shielding for the output terminals of the switch.

Figure 13 is a view similar to Figure 1 illustrating a slightly modified embodiment of the switch.

Figure 14 is a view in side elevation of the circuit making and breaking device for the switch shown in Figure 13.

Figure 15 is a view looking toward the reverse side of the device shown in Figure 14.

Figure 16 is a view in elevation of the shield for the circuit making and breaking device shown in Figures 14 and 15, and

Figure 17 is a detail section taken substantially on the line 17—17 of Figure 15.

Figure 18 is a schematic section through the circuit making and breaking device employed

in the alternative embodiment of my invention, showing the resisted input terminal connected to ground as when the device is in an open circuit position.

5 Figure 19 is a view similar to Figure 18 showing the circuit making and breaking device in a closed circuit position and disconnected from ground.

In the embodiment of my invention shown in 10 Figures 1-12, inclusive, use is made of two similar rectangular side walls 20 and 21 of stiff, sheet insulating material, equi-distantly spaced apart from each other in parallel relation and secured by rivets 24 to flanges 22 of metallic end strips 23, 15 the latter secured to a side strip 25 to constitute a relatively narrow, rigid casing, such that the space between said walls 20 and 21 opens at the side of the casing opposite the strip 25, thereby enabling vertical motion of an actuator-controlled switch lever 26.

The switch lever 26 forms a part of a circuit making and breaking device which comprises two strips 28 and 29 of stiff sheet, insulating material, secured flatwise against the opposite sides of an 25 intermediate metallic shield 30 of thin gauge sheet copper or the like. Said device is disposed between the casing walls 20 and 21, and as illustrated in Figure 10 said walls and the strips 28 and 29 receive a rivet 31, the ends of which are 30 upset at 32 against external surfaces of the walls 20 and 21. The rivet passes through a tubular bushing 33 of insulating material, the ends of which pass through the walls 20 and 21 and terminate beneath the upset ends 32 of said rivet. 35 Spacing washers 34, also of insulating material are received by said bushing and disposed between the outer faces of said strips 28 and 29 and the inner faces of the casing walls 20 and 21. The rivet forms a mounting for said circuit making 40 and breaking device, enabling same to be tilted vertically against the action of a coil spring 34 which serves normally to urge a portion 35 of the device against the flange 22 of the lower strip 23 of the casing as shown in Figure 8, the strip 45 thus functioning as a stop for said device.

The aforementioned metallic shield 30 has integral, bendable lugs 35 which are upset against one side of strip 29. Lugs 36 on the strips 28 and 29 receive one end of the coil spring 34, said end 50 bearing against the metal lugs 35. The opposite end of the spring encircles a metal lug 37 within the switch casing and as shown in Figure 1, said lug is connected to the lower metallic strip 23 of the casing by a wire 38, whereby the intermediate metallic shield strip 30 is always 55 grounded to said casing.

Disposed in an arcuate series about the circuit making and breaking device are equi-distantly spaced apart terminal-bridging contacts 39 in the 60 form of rivets secured to the strips 28 and 29 in a manner to be exposed from the outer faces of said strips 28 and 29, the shanks of the rivets passing through large openings 40 in the shielding strip 30 as shown in Figure 6, so as not to 65 engage said strip. The rivets 39 serve not only as bridging contacts for input and output terminals which I will describe presently, but in addition thereto, as securing means to hold the strips 28 and 29 firmly attached flatwise against the opposite 70 flat sides of said shielding strip 30. In this manner, the device constitutes a thin, flat stiff structure having perfectly parallel sides as shown in Figures 7, 9 and 10.

The side walls 20 and 21 of the switch casing 75 are each thereof formed with a plurality of pairs

of spaced apart slots 41 and 42. Each wall has slits 43 and 44 which open into the slots 41 as shown in detail in Figure 2. For each pair of slots 41 and 42 is a circuit terminal 45 comprising 5 a strip of sheet bronze, a portion 46 of which is disposed in back of the wall in which said slots are formed and is upstruck thereagainst as shown in Figure 4. Angular branches 47 and 48 pass 10 through the respective slits 43 and 44, the body portion of the terminal being bent to provide (a) a branch 49 which is electrically connected to a circuit lead 50, and (b) a resilient arm 51, the free end of which passes through the slot 42 and is 15 freely movable therein and provided with a contact surface or extremity 52. The circuit terminals 45 of the wall 21, each enables conduction of polarizing voltage to an individual, continuously varying condenser, not shown. The terminals 45 of the wall 20 are disposed directly opposite 20 to the terminals 45 of the wall 21, the latter being the input side of the switch and the wall 20, the output side thereof. Upon referring to Figure 10, it is noted that the upstruck extremities 52 of the pair of oppositely disposed terminals 45 therein shown, are in axial alignment 25 with each other and normally urged into the space between said casing walls 20 and 21 but in such manner that said terminals never touch each other.

The circuit terminals 45 upon each of said walls 30 20 and 21 are placed in parallel relation to each other but in a stepped order, so to speak, whereby their extremities 52 are disposed in an arc of a circle, the axis of which is the rivet 31. The length of each arm 51 is such that the extremity 35 52 thereof will engage an associated contact 39 when the circuit making and breaking device is in a closed circuit position. Each of the walls 20 and 21 may have any desired number of said circuit terminals, depending upon the number of 40 continuously varying condensers to be simultaneously polarized. The construction of the switch to this point in the description, is such, that if there are ten terminals per wall of the casing, there will be ten contacts 39. In other words, for 45 each pair of input and output terminals, there will be one bridging contact 39 which is active in the circuit when the circuit making and breaking device is in closed circuit.

The input circuit leads 50 to the terminals 45 50 of the casing wall 21, each has connected thereto a series resistor 53, each contained in an individual receptacle 54 formed by crimping a single strip 55 of suitable metal shielding as shown in Figure 12. As shown in Figures 5, 9, 10 and 11, 55 the open sides of said receptacles are covered by a housing strip 555 of similar metal shielding material. The resistor containing portions of the input leads 50 pass through insulating bushings 60 56, secured in the casing strip 25 and are each thereof adapted to receive direct current from a source of potential, not shown.

When the circuit making and breaking device is in a position of open circuit adjustment as 65 shown in Figure 1, the input and output terminals of the switch are electrically insulated from each other. During movement of said device in a closed circuit direction, the extremities 52 of said terminals ride freely against the outer smooth 70 surfaces of the insulating strips 28 and 29 until the motion of the device is arrested by the stop flange 22 of the bottom casing strip 23 as shown in Figure 8, at which time, each pair of said input and output terminals bear yieldingly against the 75

oppositely disposed flat ends of a complementary contact 39.

The arm 26 of the circuit making and breaking device consists of integral extensions of the strips 28 and 29, secured together by a metal clip 57 having a flat upper surface 58 adapted to be engaged by an actuator 59 as will be appreciated on reference to Figures 1 and 8. The actuator is a cam in the instant illustration, but obviously, may be of any suitable form, such as means upon a piano key or a foot pedal which will exert downward pressure upon the arm 26. Such means may be of the form shown in my Patent No. 2,187,911, dated January 23, 1940.

In the form of my invention shown in Figures 13-19, inclusive, the parts of the switch are the same in every essential respect as the switch shown in Figures 1-12, inclusive, the main difference being that in this modified embodiment, a somewhat different construction of circuit making and breaking device is employed. In this respect, it is noted that the device consists of strips 60 and 61 of insulating material between which is disposed a metal shield 62 having an arcuate series of large holes 63 which are separated from each other by lugs 64. These lugs are upstruck from the shield and extended in the same direction from one side thereof. An arcuate row of ten contacts 65 is shown in Figures 14 and 15. These pass through both strips 60 and 61 and through the aforementioned large holes 63, the diameter of each of which is considerably greater than the diameter of the contact which passes through it, thereby holding the contact from engaging any part of said shield. The strip 61 has slots 66 formed therein in alternation with the positions of said contacts 65', each said slot receiving one of the lugs 64 of said shield 62.

In the schematic illustration shown at Figure 18, the circuit making and breaking device of the above stated alternative embodiment of the invention occupies an open circuit position, at which time, the resisted input terminal 67 engages a complementary grounding lug 64 of the metal shield 62, the latter connected to ground, as shown. The output terminal 68 merely bears yieldingly against the outer smooth surface of the strip 60.

In the schematic illustration shown at Figure 19, the circuit making and breaking device occupies a closed circuit position, at which time, terminal 67 has moved off of the grounding lug 64 and onto one end of the contact 65', the output terminal 68 engaging the opposite end of the contact to complete the circuit.

The material structural difference between the two embodiments of the invention is found in the fact that in the embodiment shown in Figures 1-12, inclusive, the input and output terminals of the switch are never grounded, whereas, in the embodiment shown in Figures 13-19, inclusive, said terminals are grounded when the circuit making and breaking device is in an open circuit position.

In each embodiment of the invention, I stress particularly those novel structural features which insure maintenance between the input terminals of an effective dielectric functioning to electrically insulate the terminals from each other when the switch is in open circuit. I stress also the forms and arrangements of parts which, as stated herein afford proper shielding for the input terminals, to thereby guard the switch against stray capacitance effects generated any place in or about the electrical system in which the switch

is connected, and which also prevents electric coupling between said input terminals. All of these features are necessary to the end that unwanted frequencies shall not be conducted through said system, where they very readily could distort the waveforms of voltages intended to be converted into audible sound and result in the production of highly objectionable "ground noises."

In each embodiment of the invention, I stress the fact that the extremities 52 of the input and output terminals of the switch casings and the flat ends of the contact devices of the circuit making and breaking devices are self cleaning, so to speak, due to the wiping action of said terminals across said contacts, thus insuring good circuit connections when the circuit making and breaking devices are in closed circuit positions. When a contact enters between the free extremities of a pair of input and output terminals of the switch, the long branches 51 of said terminals are stressed or tensioned and bear against said contact with substantial yielding pressure. This is because the ends of the contacts are not exactly flush with the outer surfaces of the strips of insulating material of which the circuit making and breaking device is formed. In other words, the axial dimensions of a contact may be said to be approximately equal to the width of the space between the walls of the switch casing and may thereby wipe the inner faces of said walls when moving the circuit making and breaking device from one possible position of adjustment to the other. This will be readily understood upon reference to Figures 9 and 10 of the drawings.

What I claim as my invention is:

1. In an electric switch of the class employing oppositely disposed, laterally resilient circuit terminals and a metallic grounding element, a tiltable circuit making and breaking member comprising a laminated structure embodying similar plies of insulating material, an intermediate ply of sheet metal interposed between said insulating plies and means spaced apart from said ply of sheet metal riveting together said insulating plies and said metallic ply and having ends disposed to engage and electrically bridge said terminals when the tiltable member is moved to a circuit making position, said metallic ply having electrical connection with said grounding element, the free extremities of said terminals having yielding engagement with the outer faces of said insulating plies when said member is in a circuit breaking position, and means for yieldingly urging said member to a circuit breaking position.

2. In an electric switch of the class employing a pair of oppositely disposed, laterally resilient circuit terminals; a tiltable circuit making and breaking device comprising plies of insulating material disposed back to back and a single ply of sheet metal against the opposite sides of which the backs of the respective insulating plies are firmly secured and provided with an aperture extending from one side of the sheet to the other side thereof; a bridging element passing through said aperture and disposed wholly out of contact with the walls thereof and having opposite ends exposed from the outer faces of the respective insulating plies, said circuit terminals having free extremities disposed and adapted freely to ride against said outer faces during motion of said device as to engage the opposite ends of said bridging element when the device is in a circuit making position, said single ply of metal having a lug up struck therefrom and passing through one of

said insulating plies and disposed so as to be engaged by one of said circuit terminals when said device is in a circuit breaking position.

3. An electric switch comprising a casing, open at one side and having side walls of stiff, sheet insulating material, metallic end sections spacing said side walls apart from each other in parallelism, and a strip of stiff insulating material closing the opposite side of said casing and secured to said metallic end sections; a tiltable circuit making and breaking device comprising plies of stiff sheet, insulating material and intermediate metallic shielding interposed therebetween, said device having a control lever projecting from the open side of said casing; a metallic bridging element comprising a rivet firmly securing together said plies of material and said intermediate shielding and being wholly out of contact with said shielding and provided with flat ends exposed from said plies of material; and circuit terminals on the respective side walls of said casing and provided with yieldable extremities disposed in the space between said walls and in positions to wipe against said flat ends of the rivet during tilting motion of said circuit making and breaking member and adapted to be bridged by said rivet when said member is tilted to one position.

4. An electric switch comprising a casing having side walls of sheet insulating material and metallic end sections spacing said side walls apart from each other in parallelism; circuit terminals mounted on the respective side walls and provided with yieldable extremities disposed in the space between said walls; a tiltable circuit making and breaking member comprising plies of insulating material and an intermediate ply of sheet metal the latter having a ground connection with one of said metallic end sections of said casing; and a contact device passing through and securing together said plies of insulating material and said ply of sheet metal and having flat ends disposed and spaced apart from said ply of sheet metal adapted for wiping engagement with the respective circuit terminals during tilting mo-

tion of said member and to bridge said terminals when said member is tilted to one position.

5. In an electric switch of the class employing a pair of oppositely related, laterally yieldable circuit terminals; a tiltable circuit making and breaking device comprising a relatively flat, rigid structure embodying laminations of electrical insulating material and a single lamination of metal interposed between and firmly secured to said insulating laminations, said lamination of metal having an aperture extending therethrough; a bridging element passing through said insulating laminations and through said aperture and being wholly out of contact with the walls of the latter; a casing having side walls of electrical insulating material; and a rivet passing through said insulating laminations and through said lamination of metal and insulated from said lamination of metal and having opposite ends up set against the outer faces of said casing walls, said rivet serving as a pivotal mounting for said device and said bridging element adapted to engage said circuit terminals when the device is tilted to a circuit making position.

6. In an electric switch, a circuit making and breaking device comprising a flat, rigid structure embodying laminations of electrical insulating material and a single lamination of metal interposed between and firmly secured to said insulating laminations; a terminal bridging element passing through all of the aforementioned laminations and being wholly out of contact with said lamination of metal and having electrically effective terminal engaging ends exposed from the outer faces of said insulating laminations, at least one of said insulating laminations having a lug at one edge thereof for the reception of a coil spring, bendable tongues on said lamination of metal and upset against the outer face of one of said insulating laminations and disposed at the opposite sides of said lug and providing a seat for one end of said spring; and means providing a pivotal mounting for said device.

VALENTINE J. MOHLER.