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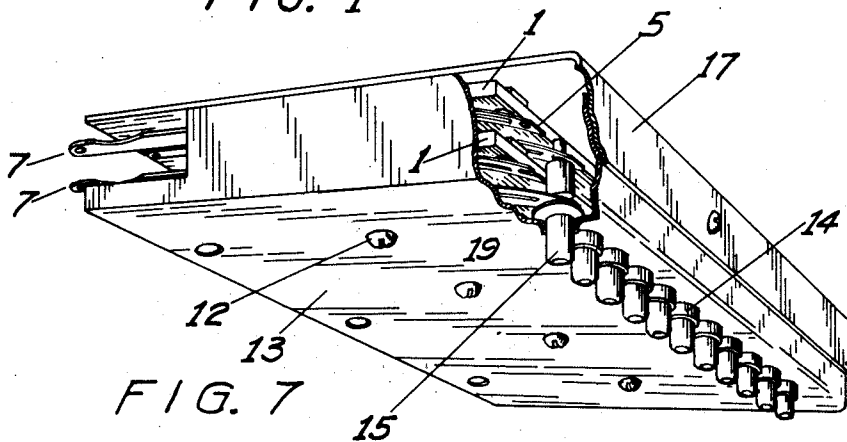
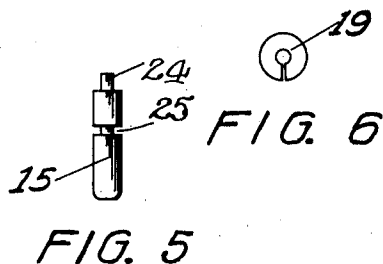
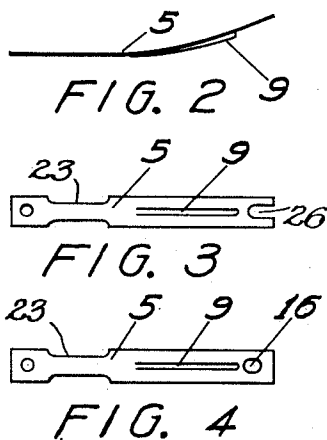
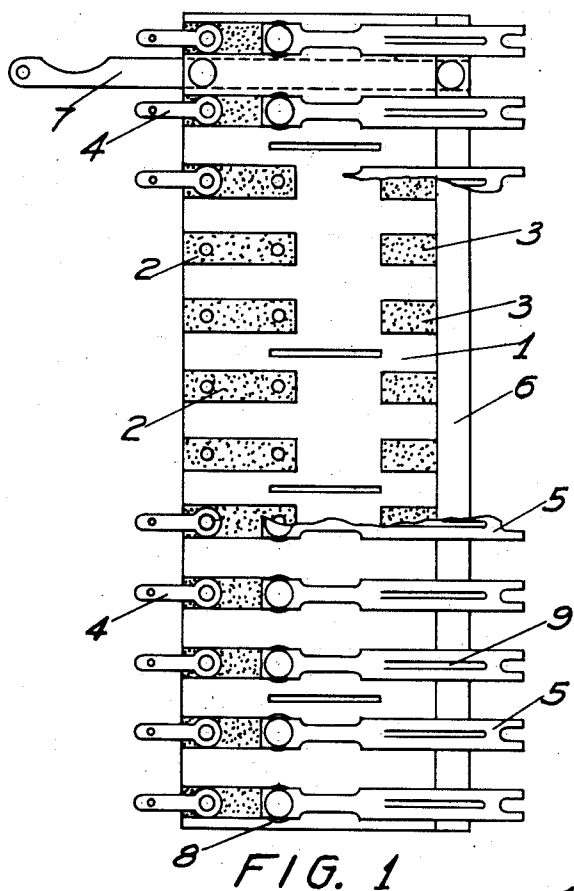
W. E. KOCK ET AL

2,215,124

ELECTRICAL CONTACT

Filed Aug. 2, 1938

2 Sheets-Sheet 1



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Sept. 17, 1940.

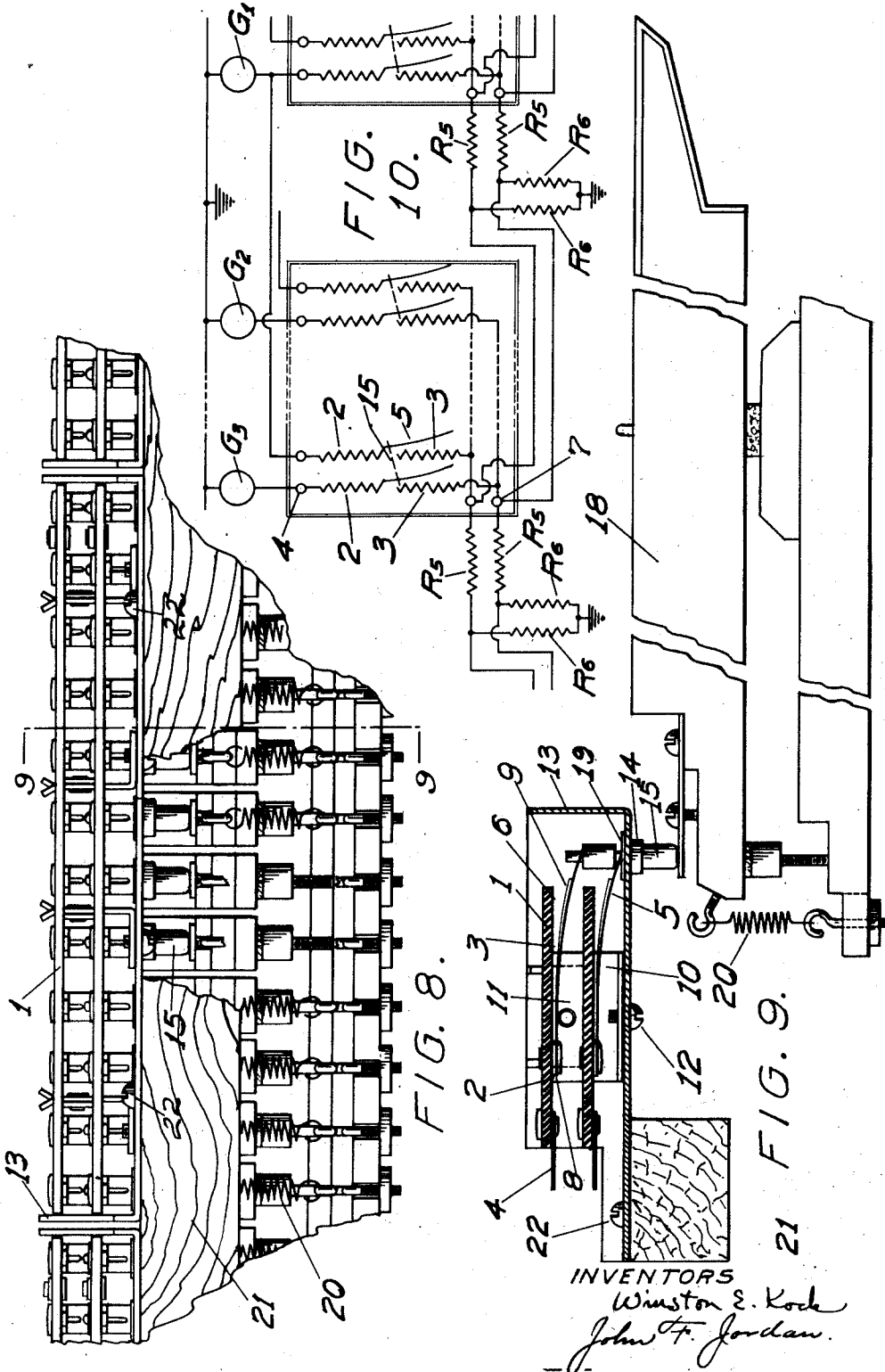
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UNITED STATES PATENT OFFICE

2,215,124

ELECTRICAL CONTACT

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Application August 2, 1938, Serial No. 222,677

9 Claims. (Cl. 201—48)

This application is a continuation-in-part of our application Serial No. 78,440 filed May 7, 1936, in our joint names and bearing a title similar to the present application.

5 In musical instruments of the class in which tones are generated electrically, and wherein tones are produced by the actuation of key operated switches in connecting the corresponding sources of electric oscillations to output and
10 sound reproducing devices, there is ordinarily encountered a sudden electrical surge when the switch is closed and/or opened. This surge manifests itself as a "thump" or "click" which is extremely annoying and detracts from the beauty
15 of the tone produced.

With the above difficulty in mind, it is an object of our invention to provide means whereby a switch may be actuated in tone production without any initial or terminal thump.

20 It is another object of our invention to provide means as above indicated which will comprise a switch of simple and relatively cheap construction having relatively few moving parts so that it is not readily subject to wear over long
25 periods of time and by reason of oft repeated actuations. With this is an object to provide a switch in which the operation of the switch exerts a cleaning action on its contacts.

It is a further object of our invention to provide
30 a simple switch such as outlined above which will close a circuit gradually by causing the initial flow of current to pass through high resistance and by subsequently and continuously reducing the resistance through which the current passes until the circuit is fully closed. With
35 this is an object to provide a key-operated switch that will make adequate contact as above, under the influence of the small forces desired in actuating the playing keys of a musical instrument.

40 It is a still further object of our invention to assemble a plurality of switches as above outlined in such a manner that more than one of them may be operated at one time and whereby a playing key may operate a plurality of the
45 switches. It is also an object to provide a construction in which a plurality of the switches may be economically assembled into a unit and conveniently installed or removed as such from a musical instrument. With this is an object to
50 provide certain important switch circuit elements in the unit.

55 These and other objects of our invention which will be described hereinafter or which will be apparent to those skilled in the art upon reading this specification, we accomplish by those certain

constructions and arrangements of parts of which we shall describe certain exemplary embodiments. For clearness, reference is made to the drawings forming a part hereof and in which:

Figure 1 is a plan view of a plate of insulating character having mounted thereon resistive coatings, conductive coatings, contactor members of a leaf type, and terminals;

Figure 2 is a side view of a leaf contactor member;

Figure 3 is a plan view of a leaf contactor having one form of free end;

Figure 4 is a plan view of a leaf contactor having another form of free end;

Figure 5 is a side view of a plunger for actuating the contactors;

Figure 6 is a plan view of an insulating washer;

Figure 7 is a perspective view of a switch assembly, displaying in a cut-away portion two plates similar to Figure 1 and the various other parts illustrated in the foregoing figures;

Figure 8 is a rear view of switch assemblies mounted on a rail in a musical instrument;

Figure 9 is a side view taken on the sectioning plane 9—9 of Figure 8; and

Figure 10 illustrates various electrical circuits which may be combined with the switches of this invention.

Referring specifically to Figure 1, we have shown a plate 1 of insulating material such as phenol resin or the like, and on this plate we spray two sets of interspaced resistive coatings 2 and 3. The coatings 2 begin each at one edge of the plate and extend inwardly a short distance to terminate as shown. To the outer ends of the respective coatings 2 we attach soldering lugs 4 by riveting them to the plate 1, as shown, and to each inner end of these coatings we rivet a leaf contactor member 5. Corresponding to the resistive coatings 2 are respectively the inwardly extending resistive coatings 3 beginning a short distance inwardly from the other edge of the plate; and extending along this other edge of the plate we have sprayed a strip of conductive deposit such as silver 6, this deposited strip being so placed that it is in electrical contact with the outer ends of the coatings 3.

The conductive strip 6 is a common electrical collector for all the switches on the plate 1 and a convenient electrical connection to the strip is provided by the copper bar 7 riveted to the plate and strip as shown, this bar being attached on the other side of the plate. The leaf contactors 5, riveted to the inner ends of the resistive coat-

ings 2 are each of the form shown in Figures 2 and 3. These contactors are of metal and we preferably make them of copper-beryllium alloy. As attached to the plate 1 they are spaced slightly away therefrom on washers 3 (see Figure 9); and they extend over the respective coatings 3 and beyond the edge of the plate 1. As shown particularly in Figure 2 (and in Figure 9) these contactors 5 are of arcuate form and as placed on the plate 1 are normally bowed away from the respective coatings.

The assembly thus formed may comprise, as indicated, twelve independently operated switches which may be actuated by the keys of an octave in a keyboard, according to the requirements of music. The closing of each of these switches comprises the moving of a leaf contactor 5 toward its resistive coating 3 the contactor rolling along the coating and finally making contact with the silver strip 6. The resistive coating 3 may be of carbonaceous deposit and may have an overall resistance of one megohm. Thus as the switch first closes the contactor 5 is in contact with the inner end of the coating 3, the switch resistance at this point being at least one million ohms. As the closure progresses the contactor engages a continuously lessening extent of the resistor 3, thus smoothly lowering the switch resistance until finally, as the contactor 5 contacts the silver strip 6, the switch is of negligible resistance.

In this way we have succeeded in effecting a type of switch construction which avoids the annoying thumps ordinarily encountered on the closing and/or opening of circuits in electrical musical instruments. To provide an adequate switch contact for the purpose we have formed a linear bead 9 on the contacting part of the member 5, extending centrally and lengthwise on that part of the member and presented toward the coating 3, as shown; this bead 9 provides a relatively large pressure between the member 5 and the coating 3 during contact, for a relatively small force required to operate the member. We have also increased the flexibility of a section of the member 5 near its riveted end by reducing the width of the section, as shown at 23; this, together with the bowed and beaded—and thus relatively stiff—contacting part of the member provides a small amount of sliding action between the member 5 and the coating 3 as the member rolls on the coating. In this way the action of the switch tends to keep the contact surfaces clean.

While we have shown in conjunction with each of the switches above described a resistive coating 2, it will be understood that this coating is not essential to the gradual type of action secured with our switch. This coating 2 is a current limiting resistor and it may be placed elsewhere in the switch circuit. We combine it with a switch for convenience in assembling, and as it appears in the switch circuit it is advantageous in preventing its circuit from interacting upon other switch circuits, thus insuring adequate flow of current through each switch no matter how many of the circuits are operated in parallel. Figure 10 is an electrical diagram indicating this resistance 2 in conjunction with the other electrical parts of the switches above described, and is the manner in which our switches may be incorporated in a musical instrument circuit arrangement. We have added to Figure 10 electrical oscillation generators which may be of unlimitative form for purposes of the present in-

vention, these generators being indicated as G₁, G₂, G₃. We have also added to Figure 10 a number of resistors R_s and R_a. These resistors are for purposes of tonally balancing an instrument and their purpose is more completely described in the copending United States patent application No. 196,484 of Winston E. Kock, filed March 17, 1938, for improvements in Electrical organs.

Coming now to Figure 7 we show a box type of construction in which we have shown two plates 1, with their various parts attached thereto, these plates being placed in parallel adjacency and held spaced apart by metal and fibre spacers 10 and 11. (For explanation of the assembly of Figure 7 we also refer to Figures 8 and 9.) These spacers are attached by screws 12 to the casing 13 in which the two plates 1 are thus contained, and in the bottom of the casing are a plurality of extruded holes 14 arranged in a line and corresponding in number to the number of switches on each of the plates.

As shown in the various Figures 7, 8, and 9, the two plates 1 are arranged in the combined assembly so that their contactors and coatings are on their lower surfaces, and for actuating the various contactors we provide a number of plungers 15 which may be composed of oiled wood, these plungers engaging each two contactors in vertical correspondence on the plates. The plungers are guided in their lower parts in the holes 14 and extend below the casing 13 so as to be actuated by playing keys. The upper part of each plunger is turned down to form a shoulder 24 (Figure 5). This upper part engages the upper one of a contactor pair and for this upper contactor we place an elongated hole 16 in the free end of the contactor. This hole in which the reduced end of the plunger is inserted acts as a guide for the upper part of the plunger and as a means whereby the plunger pushes on the contactor. The intermediate part of a plunger 15 is turned down to form an annulus type of shoulder 25 and into this is inserted the free end of the lower one of a contactor pair, the free end of this contactor being slotted at 26 to conform, as shown in Figure 3. We provide a cover 17 for this assembly, shown in Figure 7 but omitted for convenience from Figures 8 and 9.

In this way we have succeeded in providing a multiple switch assembly and a gang switch assembly. Each of the plungers 15 may be actuated by a corresponding playing key 18 as shown in Figure 9, and the operation of the plunger actuates two switches simultaneously. We have indicated this kind of operation in Figure 10 by the dashed line 15 (corresponding to the plunger). Moreover we have thus formed a plurality of such gang switches into a multiple assembly and we find this arrangement to be a great convenience in the construction and repair of a musical instrument.

The casing 13 is preferably of metal, and to prevent a switch from short-circuiting to the casing, we provide a fibre washer 19 loosely fitting on the plunger 15 between the lower contactor of a switch pair and the casing 13.

We have found that switches constructed according to our invention require very little pressure to operate them. In the playing of an organ, for instance, the key pressure is usually of the order of 4 ounces. We find that our switches, even in pairs, may be properly actuated by a pressure considerably less than this. Hence, as shown in Figure 9, we provide a tension spring 20 which is adjustable and is employed to effect

the proper touch pressure. The other parts shown in Figure 9 are for purposes of "leveling" the keys and the switches. These parts are of a usual construction and require no further description.

As placed in an instrument a multiple gang switch assembly is mounted on a rail 21 through the screws 22 in conjunction with the casing 13, and as shown in Figure 8, a plurality of assembly units may be mounted on this rail at the rear of a complete keyboard of keys, each plunger lying over its respective key and moving upward on the depression of the forward part of the key, to operate its pair of switches.

It will be understood that modifications may be made in our invention without departing from its spirit. Thus, for instance, the silver strips 6 may be resistive in character and thus, as an example, may be employed as such to replace the balancing resistors R_s , indicated in Figure 10. The present examples of the invention are submitted as illustrative since the invention may find expression in various forms within the definition of the accompanying claims. Accordingly the claims point out the scope of the invention, and comprise:

Having thus described our invention, we claim:

1. In a musical instrument wherein tones are to be controlled through electrical switches actuated by manually operable playing keys, a switch for use with a manually operable playing key comprising an insulating base, a coating of resistive substance on said base, a metal strip supported as a cantilever extending adjacent said coating but interspaced therefrom, said strip being bowed lengthwise convex to said coating and having a relatively narrow bead extending along it presented toward said coating, and means for connecting the free end of said strip and said key for moving said strip toward said coating upon depression of said key—whereby in closing said switch said strip contacts said coating and essentially rolls thereon to close said switch first through a high resistance and thence through a continuously lowering resistance upon progressive key depression, and whereby a relatively small force exerted upon said key actuates said switch but provides a relatively large pressure between said strip and said coating.

2. A switch as in claim 1, wherein said strip in a portion adjacent its support has a section of increased flexibility relative to the remainder of said strip, so that in contacting said coating said strip rolls along said coating but slides a small amount relative thereto—whereby the operation of said switch exerts a cleaning action on the contact surfaces of said strip and said coating.

3. In a musical instrument wherein tones are to be controlled through electrical switches actuated by manually operable playing keys, a switch for use with a manually operable playing key comprising an insulating base, a resistive member comprising a coating of resistive substance on said base, a strip-like metallic member supported as a cantilever extending adjacent said resistive member but interspaced therefrom, one of said members being arcuate in its co-extension with the other member convex to said other member, one of said members being of such a cross-section as to present to the other member for contact purposes a surface co-extending with said other member, of a width relatively small as compared with the main width of the member presenting said surface, and means for con-

necting the free end of said metallic member and said key for moving said metallic member toward said resistive member upon depression of said key—whereby in closing said switch said metallic member contacts said resistive member and essentially rolls thereon to close said switch first through a high resistance and then through a continuously lowering resistance upon progressive key depression, and whereby a relatively small force exerted upon said key actuates said switch but provides a relatively large pressure between said members.

4. A switch as in claim 3, wherein said metallic member in a portion adjacent its support has a section of increased flexibility strength relative to the remainder of said member, so that in contacting said resistive member said metallic member rolls along said resistive member but slides a small amount relative thereto—whereby the operation of said switch exerts a cleaning action on the contact surfaces of said members.

5. In a musical instrument wherein tones are to be controlled in electrical circuits through switches contained therein and actuated by manually operable playing keys, and wherein current limiting resistances are to be included in said circuits, a combination multiple switch and resistance assembly for use with a plurality of manually operable playing keys and associated circuits comprising an insulating base, a plurality of interspaced coatings of resistance substance extending inwardly on said base, a second and corresponding plurality of interspaced coatings of resistance substance extending inwardly on said base toward but terminating short of said first mentioned coatings, terminal means for the outer ends of said first mentioned coatings, individual terminal means for the outer ends of said second mentioned coatings, respective switch members for said first mentioned resistive coatings, connected respectively to the inner ends of said second mentioned coatings and adapted upon movements to make progressive contacts along said first mentioned coatings respectively, toward said first mentioned terminal means, and means for connecting said switch members and said keys individually for moving said members as set forth—whereby an economical assembly is provided wherein switches are closed independently first through high resistances and thence through continuously lowering resistances on progressive depressions of the corresponding said keys, and whereby residual resistances for current limiting purposes remain in circuits connected to said terminal means, when said switches are fully closed.

6. A multiple switch mechanism for use in a musical instrument wherein tones are to be controlled through electrical switches actuated at a keyboard, comprising a unified structure containing resistors interspaced at intervals corresponding generally in intervals of keys at said keyboard, movable switch members located respectively adjacent said resistors and adapted upon movements to make progressive contacts respectively thereon, plungers for moving said members as set forth upon depressions of the corresponding said keys, said plungers engaging said members respectively in connections locating said plungers at said members but permitting swiveling of said plungers thereabout from their paths in moving said members as set forth, and respective means locating said plungers at points on said paths interspaced from said connections,

said means permitting motions of said plungers in said paths while also permitting swiveling of said plungers about said means from said paths—whereby said plungers are confined to said paths by co-action between said connections and said means and move freely under the small forces desired in depressing said keys.

7. Mechanism as set forth in claim 6, including additional resistors and switch members, similar to said first-mentioned resistors and members and co-related similarly thereto, said additional members being connected respectively to said plungers by notches in said additional members engaging freely in grooves in said plungers.

8. In a musical instrument wherein tones are to be controlled through electrical switches actuated by manually operable playing keys, a switch for use with a manually operable playing key comprising an insulative base, a resistive member on said base, and a resilient metallic member fixed at one end so as to coextend adjacent said resistive member and adapted to be deflected toward said resistive member by depression of said key, one of said members being arcuate in its coextension with the other member,

whereby in closing said switch said metallic member contacts said resistive member and essentially rolls thereon to close said switch first through a high resistance and thence through a continuously lowering resistance upon progressive key depression, said metallic member having a relatively inflexible portion for contacting said resistive member and a relatively flexible portion between said inflexible portion and the fixed end of said metallic member—whereby in contacting said resistive member said metallic member rolls along said resistive member but slides a small amount relative thereto, so that the operation of said switch exerts a cleaning action on the contact surfaces of said members.

9. A switch as in claim 8, wherein one of said members is of such a cross-section as to present to the other member for contact purposes a surface co-extending with said other member, of a width relatively small as compared with the main width of the member presenting said surface—whereby a relatively small force exerted upon said key actuates said switch but provides a relatively large pressure between said members.

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