Nov. 12, 1963 D. W. ELBRECHT 3,110,211

ELECTRONIC ORGAN CONSTRUCTION

Filed Aug. 6, 1959

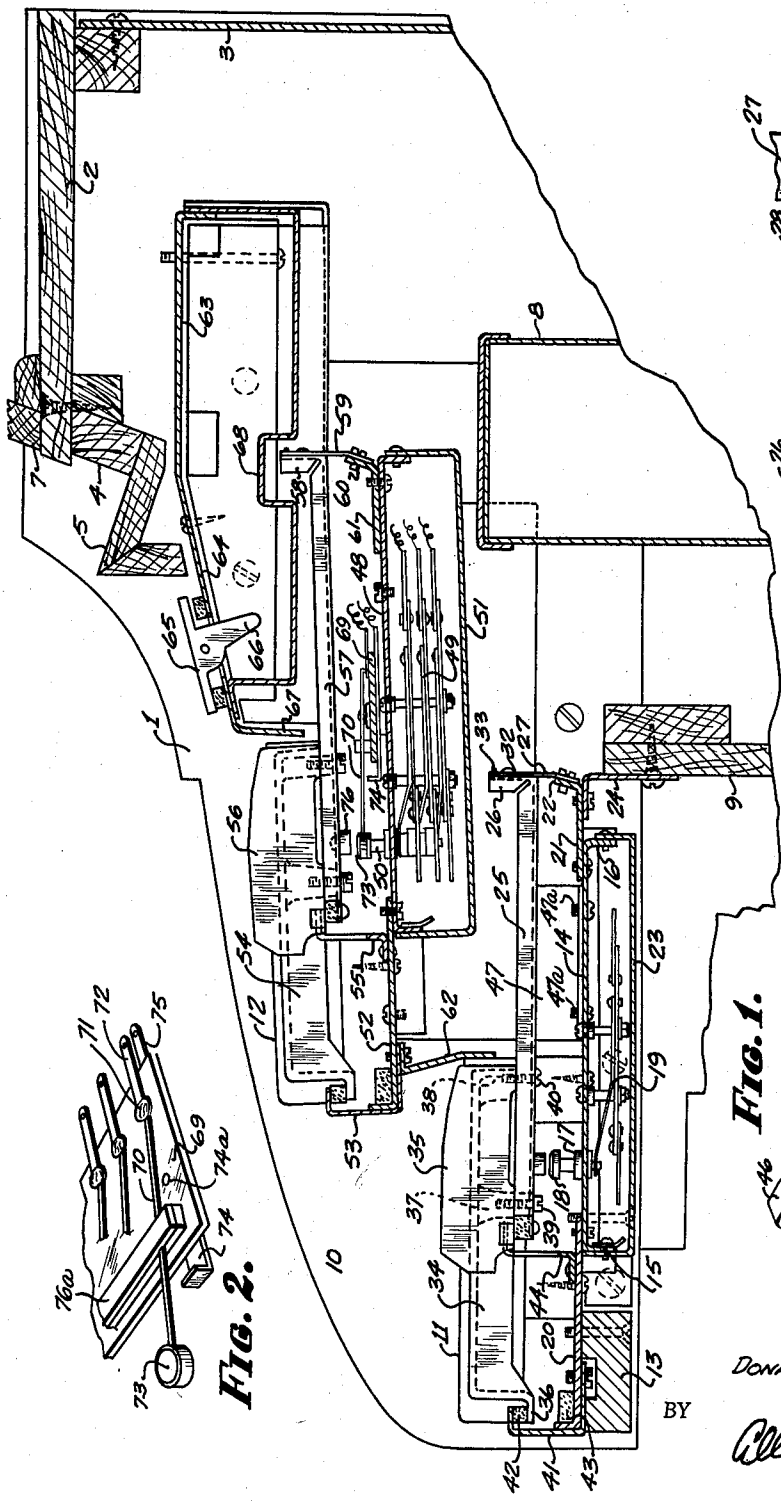


FIG. 1.



FIG. 2.

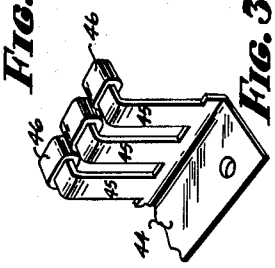


FIG. 3.

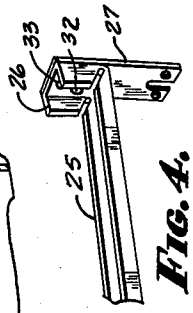


FIG. 4.

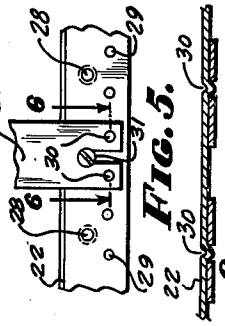


FIG. 5.

FIG. 6.

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United States Patent Office 3,110,211 Patented Nov. 12, 1963



3,110,211

# ELECTRONIC ORGAN CONSTRUCTION

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Filed Aug. 6, 1959, Ser. No. 831,984
12 Claims. (Cl. 84—423)

This invention relates to the provision of improved constructions of keys, key mountings, key switches, and tone color housings in electronic musical instruments; and it has for its principal object the provision of integrated structures of simple character forming a readily assembled combination, and having a cost which is exceptionally low.

It is an object of this invention to provide an assembly of the type set forth having a cost low enough to be advantageous for use in relatively inexpensive electronic organs such as are being bought in greater quantities for use in the home.

It is an object of the invention to provide structures consisting of elements as above enumerated, which elements coact in a new way.

It is an object of the invention to provide structures facilitating the combination of gradual contact switches for use in the production of normal organ tones, and simple make-and-break switches such as may be used in the provision of percussive voices.

These and other objects of the invention, which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, are accomplished by that structure and arrangement of parts of which an exemplary embodiment will now be described.

Reference is made to the accompanying drawings wherein:

FIG. 1 is a partial vertical sectional view through that part of an organ console which houses and supports the combination to which reference has been made.

FIG. 2 is a partial perspective view of elements going to make up a key-operated make-and-break switch.

FIG. 3 is a partial perspective view of a member which serves not only as a stop means for the black keys of a keyboard, but also as key aligning means.

FIG. 4 is a partial perspective view of the end of a key, such as is used in the practice of this invention.

FIG. 5 is a partial elevational view of a key supporting means.

FIG. 6 is a partial sectional view on an enlarged scale taken along the section line 6—6 of FIG. 5.

The new manner in which the parts coact will best be appreciated from a description of them in sequence. Reference is made to FIG. 1 wherein 1 represents a typical organ console for a small organ. The console has a top board 2, a removable back board 3, and, preferably, a partial top board assembly, marked 4 and providing a ledge 5 for use with a music desk 7 which lies wholly above the top board 2. It will be understood that modifications may be made in the console of the organ without departing from the spirit of this invention.

While the use of this invention is by no means confined thereto, it will be described in connection with an organ of the general organization of that shown in United States Patent 2,233,948 in the name of Kock, issued March 4, 1941. In an organ of this type, there is provided a rank of electronic generators producing electrical oscillations in accordance with the tempered scale. The generators in the rank are divided into groups, the generators in each group being octavely related, and there being twelve groups in the generator rank. In each group the oscillator having the highest frequency is a master oscillator and controls the submultiple frequency oscillations of the other generators in the group.



Electrical oscillations are derived from the generators through gradual contact switches operated by the keys of the several manuals and by the pedal keys. These gradual contact switches usually include a plurality of switches for each key, so that the oscillations from the generators can be distributed to various headers, such as 4-ft., 8-ft., and 16-ft. headers. Oscillations from the headers are sent through linear or formant filter circuits for the production of different voices, these circuits being selected by switches operated by stop tabs. Oscillations from different headers may be combined to form a particular voice or voices, and in some instances 4-ft. and 8-ft. oscillations are combined in out-of-phase relationship to accentuate the odd-order harmonics, as in the production of woodwind tones. The oscillations produced by the generators are, of course, of complex wave form and rich in harmonics, so that a wide variety of voices may be obtained by linear filtering means. The oscillations from the filter circuits are finally combined in an output system including an amplifier and a loud speaker.

In the case of electronic musical instruments having provision for percussive effects, oscillations are derived from the same generators through additional switches on the playing keys in the manual or section thereof in which the percussive effects are to be obtained. These key switches are simple make-and-break switches. The oscillations so derived from the generators are sent individually to a plurality of gating circuits which serve to cause the oscillations to die way gradually after the key switches are opened. In this way percussive effects having a tone envelope similar to that of bells, bars, or plucked strings are obtained; and oscillations having the desired tone envelope are transmitted through vacuum tube filters on their way to an output system so as to impart to them tonalities or voices appropriate to the particular tone generating means, e.g. a bell, which is being simulated. Percussive effects are usually most apparent when the instrument is played in a staccato fashion, and are regarded as an adjunct to the normal organ voices.

In FIG. 1 the housing for a rank of electronic generators will be apparent at 8. It will be supported in any convenient way within the organ console. The organ console has a front board 9 which, as will be readily understood by the worker in the art, will have an opening in it for access to an expression pedal (not shown) and, in a relatively small instrument, will usually have one or two openings or grilles behind which loud speakers are fastened. At the bottom of the console there will be a series of pedal keys forming a pedal clavier. These may take varying forms, constituting no limitation on this invention. The console 1 has side arm members 10 between which the manuals of the Great and Swell organ sections are mounted. If, as is frequent in small organs, the length of the manuals is not equivalent to the distance between the arms of the console, or if the manuals are of different length, end blocks will be used. End blocks are shown in FIG. 1 at 11 and 12. Across between the arms of the console there will be a supporting member. This is shown in FIG. 1 in the form of a wooden rail 13, although it may take other forms. In some structures a metal supporting element may be employed.

Starting now with the construction of the lower manual, as shown in FIG. 1, the lower key switch assembly will be mounted upon a plate 14. The side edges of this plate will be turned downwardly, as indicated at 15 and 16. The plate is perforated and carries bushings 17 for plungers to be actuated by the individual keys. One of these plungers is indicated at 18. The gradual contact

switch assembly, generally indicated by the numeral 19 for the lower manual, is mounted to the plate 14. The preferred construction of the gradual contact switch assembly is that described in U.S. Patent 2,215,124 in the names of Kock and Jordan. It is sufficient for the purposes of this description to indicate that it comprises an insulative base having adjacent each edge resistive coatings in parallel spaced relationship and extending in the transverse direction. These coatings are usually deposited by spraying. The coatings adjacent one end of the insulative panel are provided with lugs to which wires may be soldered. At points inwardly spaced from the lugs on the resistive coatings, flexible switch blades are attached at their ends. The opposite ends of the switch blades overlie the resistive coatings at the opposite edge of the panel, and are connected with the plungers 18. The outer ends of the coatings at the said opposite edge of the panel are interconnected by a low resistance conductor which forms a header or collector, and is usually in the form of a sprayed-on metallic coating. Output leads from the generators may be connected to the lugs and the adjacent resistive coatings will serve as anti-robbing resistors. The switch blades are somewhat arcuate in conformation, and as the plungers 18 are depressed, they first contact the inner ends of the resistive coatings at the opposite edge of the base, and then progressively roil over these coatings until they approach or contact the collector, thereby providing the desired gradual contact.

While a single switch assembly has been shown at 19 for the lower manual, it will be understood that the switch assemblies may be ganged so that each key operates more than one resistive switch where this is desired, the plunger being elongated in such instances so as to engage and operate a plurality of the switch blades.

At the front side of the plate 14, another plate 20 is attached as by screws, rivets, or welding; and this plate overlies and is attached to the rail 13 or equivalent support. At the rear edge of the plate 14, another plate 21 is attached in a similar fashion, and has a turned-up outer end 22. Needless to say, the plates 14, 20 and 21 may be integral if desired, the downturned edges 15 and 16 being provided by means of brackets. The element 23 in FIG. 1 is a dust cover, of fibreboard, although it may be made of metal for shielding properties if so desired. It has upturned edges, as shown. It is usually necessary only to bolt one of these upturned edges to one of the downturned edges 15 or 16 of the plate 14, since the opposite edge of the dust cover can usually be adequately held in place by friction.

An L-shaped bracket 24 is shown as having its upper horizontal leg attached to the plate 21 and its lower vertical leg attached by screws to the front board 9 of the organ console. The gradual contact switch assembly is thus supported rigidly between forward and rear supports extending across between the arms of the console, although these supports may take various forms.

The keys of the lower keyboard each comprise a channel-shaped piece of sheet metal 25. Near the rear end, the legs of the channel have been notched as indicated and turned up, the upwardly turned portion being marked 26. While the channel-shaped elements 25 may be made of light metal such as aluminum or its alloys, the metal will be of such stiffness that the part 26 will be rigid with respect to the part 25 as against any strains which will be encountered in the playing of the instrument.

The upturned portion 26 of the channel member 25 is connected to the upturned portion of the plate 21 by a leaf spring element 27. This element is substantially as wide as the channel 25, and it is necessary that it be attached both to the parts 26 and 22 in a non-pivotal fashion as by rivets 33. Reference to FIG. 5 will indicate that in the exemplary embodiment the upturned portion 22 of the plate 21 is provided with threaded holes 28 for the reception of screws. Below these holes the part 22 is provided, in a position spaced from the holes 28, with a line of indentations 30 or holes 29. The legs of the bifurcated leaf spring member 27 may be provided with identations which provide protuberances on the other side. These protuberances enter the identations or holes 29 of the member 22 and prevent pivotal movement of the leaf spring element about the attaching screw 31. The arrangement, however, may be reversed as shown in FIG. 6. A similar arrangement may be effected at the top of the leaf spring element, where it is shown attached to the upturned part 26 of the key channel element by means of a screw 32 and cooperating hole and indentation means. Other ways of fastening the leaf spring element non-pivotally to the parts 26 and 22 may be employed; but if the connections are non-pivotal as indicated, the leaf spring serves not only as a pivot for the key structures, but also as a key aligning means.

The portions of the keys which are contacted by the fingers of the musician are preferably hollow elements formed from suitable plastics. In FIG. 1 in the lower keyboard, there is shown a white key 34 and a black key 35. The white key at its front lower portion has an out-turned ledge 36. Each plastic element has a pair of bosses 37 and 38 which enable the element to be affixed to the end of one of the channel-shaped means 25 through the agency of screws 39 and 40.

At the front of the lower keyboard, there is a metallic element 41, having a lower horizontal portion which is attached to the plate 20, an intermediate vertical portion which serves as a key strip for the instrument, and a horizontally turned top portion which overlies the ledge 36 of the white keys. A strip 42 of sound deadening material is affixed to the top turned-over portion of the element 41; and the element 41 is thus enabled to serve as a means for leveling or determining the inactive height of the white playing keys. Another strip 43 of sound deadening material may be located adjacent the end of the plate 20 where it will be struck by the ledges 36 of the white keys of the instrument. This will serve as an abutment to determine the lowermost positions of the white keys.

In controlling the black keys, use is made of a structure such as that shown in FIG. 3. This structure has a horizontal portion 44 carrying upstanding, spaced fingers 45, the upper ends of which are turned over horizontally and fitted with tubular elements 46 of sound deadening material. These lie within the hollow interior of the plastic members 35 which constitute the playing portions of the black keys; and thus the turned-over portions of the fingers are enabled to serve as stops for leveling the black keys in their uppermost position by contacting the ends of the channel-shaped elements 25, and stops for determining the lowermost positions thereof, since the sound deadening elements 46 will contact the under sides of the top portions of the black keys within their hollow interiors. The element 44, 45 is affixed to the plate 20 as shown. Additionally, the comparatively thin side walls of the hollow playing key members lie side-by-side between the fingers 45, so that the element shown in FIG. 3 is capable of acting as alignment means for the keys of the keyboard, acting thereon at positions near the forward ends of said keys.

While the lower keyboard assembly has been shown as mounted to the rail 13 and to the front board 9 of the organ, additional mounting means may be employed, particularly at the ends of the assembly. Thus, the assembly of plates 14, 21 and 20 has been indicated as attached by screws 47*a* to a bracket 47 which, in turn, may be attached to the organ console or to the keyboard structure of the upper manual of the organ.

The upper manual assembly is constructed in a similar fashion. A plate 48 is provided, corresponding to the plate 14 below, to which an assembly of gradual contact switches 49 is mounted. These switches are similar to the switches 19 heretofore described; but for illustrative

purposes the assembly 49 is shown as comprising a gang of three switching means, as will be evident from the drawing. The plunger 50 has been correspondingly elongated so as to engage the switch blades of all three layers of the gang. The switch assembly of the upper manual is provided with a dust cover 51 held in place as previously described for the dust cover 23.

A plate 52, corresponding to the plate 20 below, is shown affixed to the plate 48 and extending in the forward direction. At its outer end it carries an element 53 which serves as a key strip for the upper manual, and a leveling stop for the white keys 54. An element 55, corresponding to the device shown in FIG. 3, is also attached to the plate 52 and serves to provide upper and lower stops for the black keys 56, as has been described, serving also the alignment function. The keys of the upper keyboard are similar to those of the lower keyboard and comprise the metallic channel-shaped elements 57 with upturned ends 58 attached by leaf springs 59 to the upturned edge 60 of a plate 61 attached to the plate 48. The upper keyboard assembly may be supported from the lower keyboard assembly as previously suggested; it may have a supporting connection with the tone color box hereinafter to be described, or it may be supported in the organ console by separate end brackets. Combinations of these supporting means may be employed if desired.

A plate 52 has a depending member 62 attached to it, which member serves as a finishing strip at the rear edge of the lower keyboard.

A tone color box is indicated at 63. It has a downwardly sloping front portion 64 which extends beyond the console assembly 4 and serves as a convenient mounting panel for various stop tabs, one of which is indicated at 65. The skilled worker in this art will understand that the stop tabs are provided with dead-center controlling means, and that inner projecting portions 66 of the stop tabs are employed to operate certain switches within the tone color box. The linear filters or formant means, which are used to obtain the voices in the organ of the Kock patent, will be located within the voicing box 63. Where the instrument makes provision for percussive tones, various elements which are required to produce such tones may also be located in the voice box, although it is generally convenient to locate them elsewhere. The slanting panel portion 64 of the voice box, however, is generally utilized for the mounting of such control elements (in addition to sets of stop tabs for the manuals and the pedal clavier) as an off-and-on switch for the power leads, a signal light to indicate when the power is on, adjustable means for determining the rate of vibrato, and continuously adjustable means for determining the all-over brilliance of the tones of the organ.

The front part of the slanting portion 64 is carried forwardly and terminates in a downturned element 67, serving as a top finishing strip behind the keys of the upper manual. The elements 64, 67, 53, 62, and 41, which are exposed at the front of the organ, will, of course, be finished in some suitably attractive way comporting with the general finish of the organ console.

The organ of the exemplary embodiment is closely coupled, and it will be noted in FIG. 1 that the lower face of the voicing box 63 may be cut away or recessed as indicated at 68 to accommodate the upturned portions 58 of the channels of the individual keys.

The structure described herein is designed for use in an organ which has or may have provision for percussive effects. As has been indicated, percussion requires the provision of additional switches to be operated by the keys; but these switches are make-and-break switches, of less general expense than the gradual contact switches hereinabove described. A new and advantageous form of make-and-break switch structures is illustrated in FIG. 2, and is well adapted for use with the assembly thus far described. The structure just referred to comprises an insulative panel 69 which is adapted to be mounted on suitable supports above the plate 48. On this plate there is mounted a series of spring wire elements, one of which is shown at 70, by means of grommets or rivets 71, which also engage soldering lugs 72 to which connections can be made in the ordinary manner. The spring wire element 70 constitutes a movable switch blade. It may be made of any suitable resilient metallic wire capable of carrying electric current. The wire elements 70 may, if desired, be coated or electroplated with some metal suitable for contact-making purposes, and reasonably resistant to oxidation, as the skilled worker in the art will readily understand.

The forward end of the wire element 70 is inserted in a drum-shaped plunger element 73. To coact with the element 70 another element 74 is fastened on the underside of the insulative panel 69. The elements 74 are usually connected together; and they may be formed as forwardly extending fingers on a metal strip serving as a header. The fingers may be slightly bent before attachment to the insulative panel so that when the header is affixed thereto (which may be done by riveting as at 74*a*) the elements will lie accurately against the insulative panel to avoid adjustment. The header may be connected with another soldering lug indicated at 75. There are various ways in which this may be done. The connection between the elements 74 and 75 may be effected on the underside of the panel 69 by means of a suitably configured coating or layer of metallic substance applied as in printed circuitry; and the elements 74 and 75 may be soldered thereto. It is also possible to effect the attachment of elements 74 and 75 to the insulating panel 69 in other ways, as by riveting or grommeting. The outer or forwardly projecting end of the element 74 is turned upwardly as shown, and is so located that when the wire element is depressed by pressure exerted on the member 73, it will be brought into contact with the member 74. A structure of elastic foamed plastic 76*a* embeds the wire members 70 and deadens vibrations as well as preventing the wire elements from contacting other parts of the assembly.

As indicated in FIG. 1, the drum-shaped element 73 is so located (when the switch assembly is mounted on the plate 48) that the drum will underlie the channel-shaped body of one of the playing keys and will overlie the top of the plunger 50. The key body 57 may be provided with a striking pad preferably of insulative substance indicated at 76. It will be clear that operation of the key will result in a closing of the make-and-break switch 70, 74 as well as a closing of the corresponding gradual contact switches making up the assembly 49. It will be understood that other switches 70, 74 will be located on the insulative panel 69 in such a way that one of the switches will underlie the body of each key in the manual throughout the range of application of percussion.

Percussion, as herein referred to, contemplates the application of signals from several oscillators to gating circuits which may take various forms, but which act to cause the transmitted oscillations to die away gradually after the switch is opened. Numerous such circuits are available, most of them being characterized by an R-C time delay circuit. In a common form of gating device, an electron tube is employed which is normally biased to cut-off. The operation of the switch 70, 74 destroys this bias and permits the tube to transmit oscillations. When the key is released and the switch opens, the cut-off bias is gradually restored as the condenser of the time delay circuit charges so as to produce the desired tone envelope.

Modifications may be made in the invention without departing from the spirit of it. The invention having been described in an exemplary embodiment, what is claimed as new and desired to be secured by Letters Patent is:

1. In an electrical organ a key and switch assembly comprising a plate, switching means mounted below

said plate, plungers for operating said switching means extending through said plate and mounted for reciprocable action, key structures comprising channel-shaped bodies with upturned ends, said plate having in connection therewith a member having an upturned flange and a leaf spring connection between the upturned portion of said channel-shaped bodies and said upturned flange providing a pivot for said channel-shaped bodies at the rear ends of said bodies, said bodies carrying at their forward ends structures to be contacted by the fingers of a person playing the organ, and said channel-shaped bodies being located respectively above said plungers so as to operate them when said keys are depressed.

2. The structure claimed in claim 1 wherein the said keyboard comprises white key structures having outturned ledges at their lower forward ends and wherein a member of the length of said keyboard is supported in connection with said plate and has a portion extending upwardly to form a keyslip for said keyboard, and an upper portion extending rearwardly and overlying the said ledges of the keys to form an upstop and a key leveling means.

3. The structure claimed in claim 2 including an upstop and leveling means for the black keys of said keyboard, said means comprising a metal element having a portion supported in connection with said plate and spaced upstanding fingers with turned over upper ends having sound deadening material thereon, and ledge means formed in connection with said black keys, above which said ends are positioned.

4. The structure claimed in claim 3 wherein the structures on the ends of said channel-shaped bodies are hollow interiorly and have depending relatively thin walls, the said walls being located between the said upturned fingers.

5. The structure claimed in claim 4 wherein said plate has bracket means at its forward and rear edges with respect to which it may be mounted in an organ console.

6. The structure claimed in claim 5 wherein the said switch means is a gradual contact switch means and wherein a removable dust cover is mounted with respect to said plate and encloses said switch means.

7. The structure claimed in claim 6 having mounting means including an upwardly extending bracket at each end of said plate which bracket is connected to the plate



portion of a second switch and key assembly having the same elements as those heretofore included so that a second manual comprising playing keys is mounted above and in offset relationship to the structure of claim 6 which comprises a first manual.

8. The structure claimed in claim 7 wherein a depending metal strip is mounted with respect to the plate structure of the said second manual to form a finishing strip for the first manual.

9. The structure claimed in claim 8 including a tone color box mounted in offset relationship above the said second manual, the said tone color box having a depending front edge portion forming a finishing strip for the said second manual.

10. The structure claimed in claim 9 in which said tone color box has a slantwise disposed front top portion exposed behind the said second manual and carrying stop tabs for the selection of voices in the said organ.

11. The structure claimed in claim 7 wherein a supplementary switch structure is mounted above the plate of said second manual, said supplementary switch structure comprising an insulative panel, a series of first switch elements mounted beneath said panel and extending beyond the forward edge thereof, a series of second switch elements comprising resilient wires mounted above said panel and extending beyond the forward edge thereof, said wires carrying at their forward ends insulative elements underlying the channel-shaped bodies of said keys and overlying the tops of said plungers whereby depression of said keys will operate said last mentioned switch elements and through said insulative elements will operate switch elements lying below said plate.

12. The structure claimed in claim 11 in which the switch elements mounted beneath said insulative panel are resilient elements so configured as to maintain parallelism with said panel when said switches are in the non-actuated position, whereby adjustment of said element is avoided.

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