

[54] ELECTRONIC MUSICAL INSTRUMENT  
MECHANICAL CONSTRUCTION[75] Inventors: Howard M. Thomas; Robert F.  
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[58] Field of Search ..... 84/423, 1.01, 433, 343,  
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172 B, 1 R

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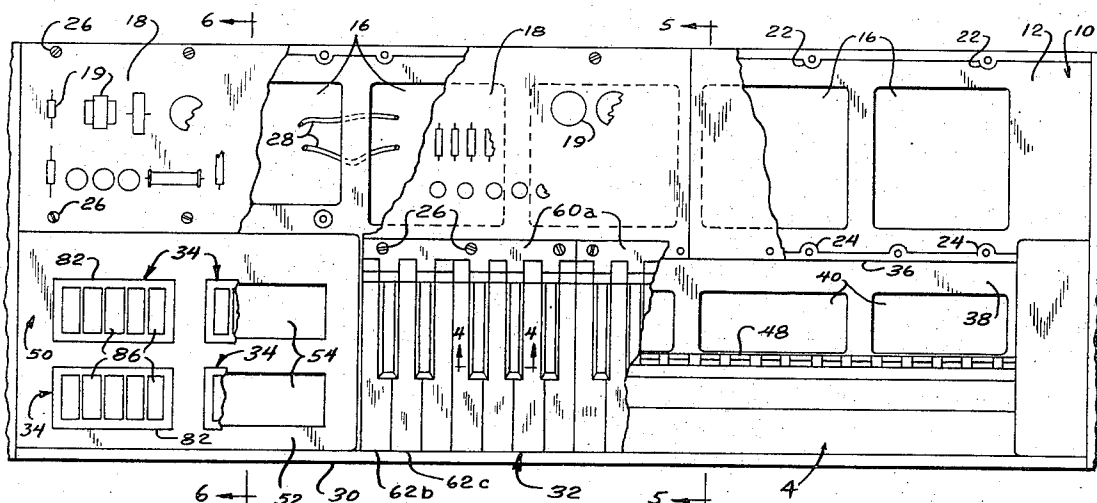
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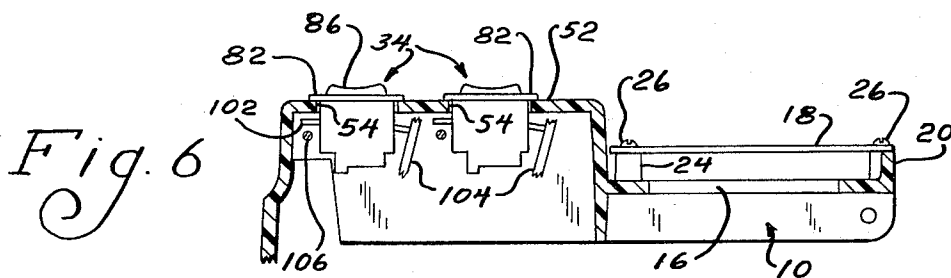
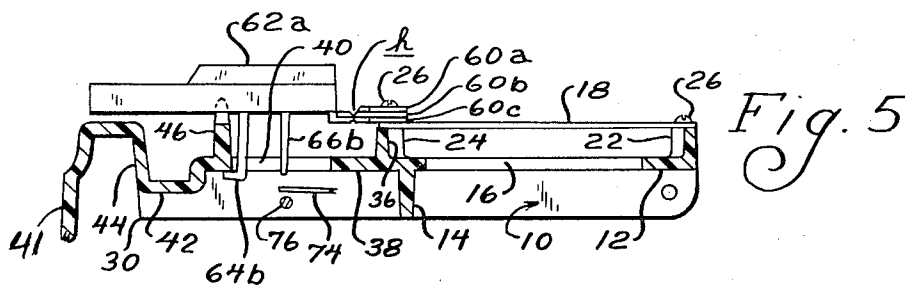
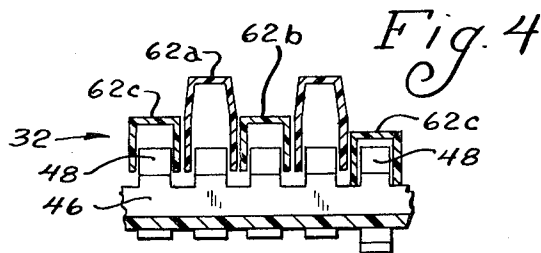
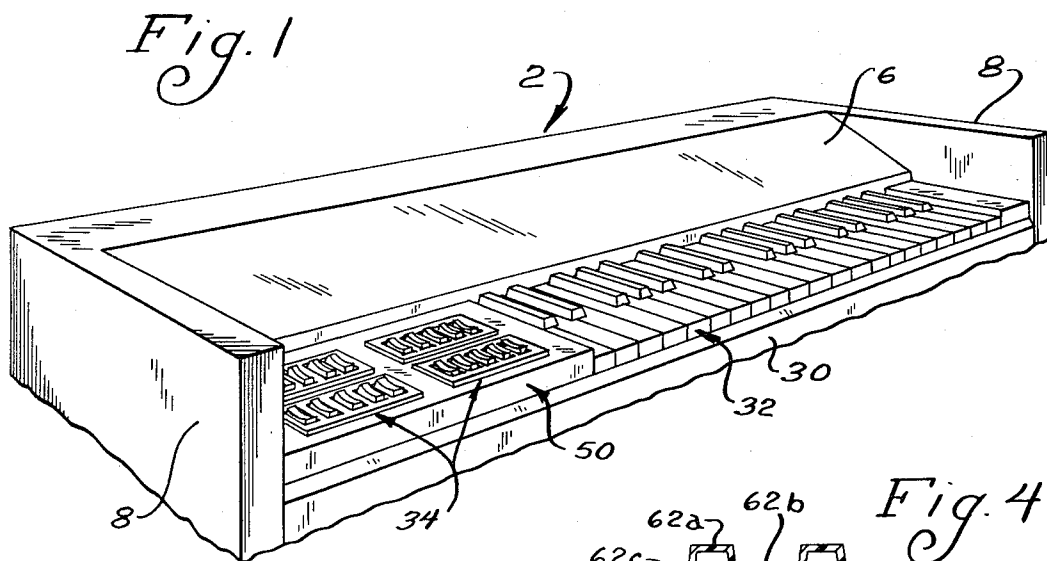
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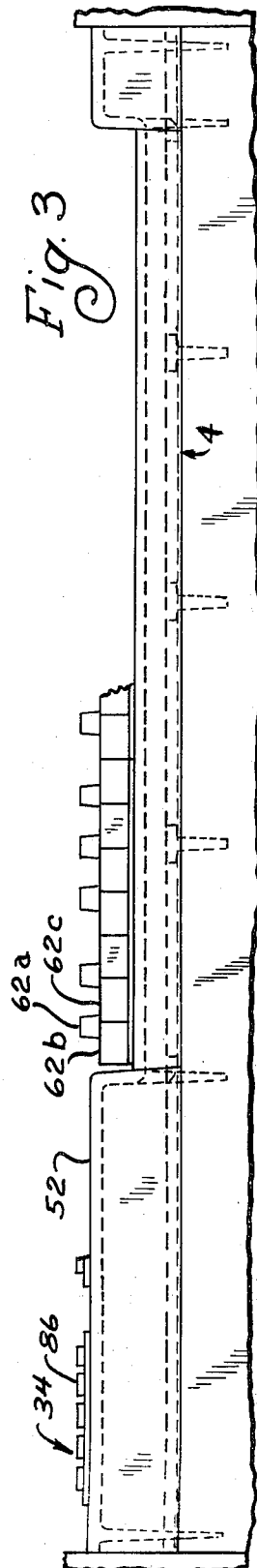
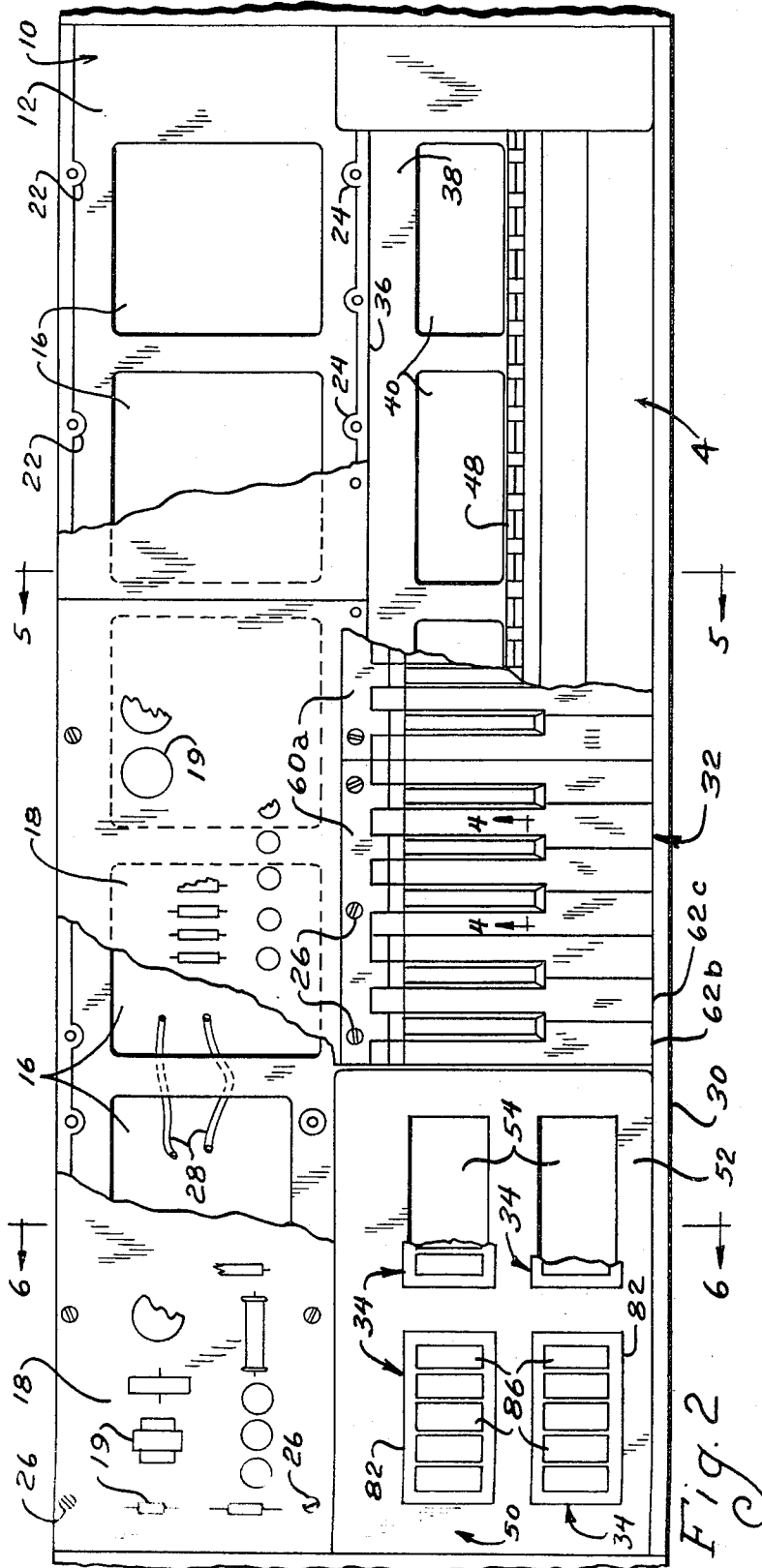
## [57] ABSTRACT

A mechanical construction for an electronic musical instrument, such as an organ, comprises a one-piece plastic key bed for mounting the keys, the stop tablet assemblies, and printed circuit boards. The keys are made up of a series of one-piece plastic key groups, the keys in each group being hingedly connected to a mounting strip. The keys of each group are alternates, namely non-successive steps in the chromatic scale. However, when the key groups are assembled they provide an octave group, and in such assembly the mounting strips are stacked and supported on the key bed such that all of the keys flex or hinge approximately about the same hinge axis. The stop tablet construction comprises a one-piece plastic housing and a number of one-piece plastic stop tablets rockably mounted in the housing and retained therein by keepers on the stop tablets. Protuberances are provided on the housing that cooperate with each stop tablet for retaining each stop tablet in either its "off" or its "on" position.

18 Claims, 18 Drawing Figures







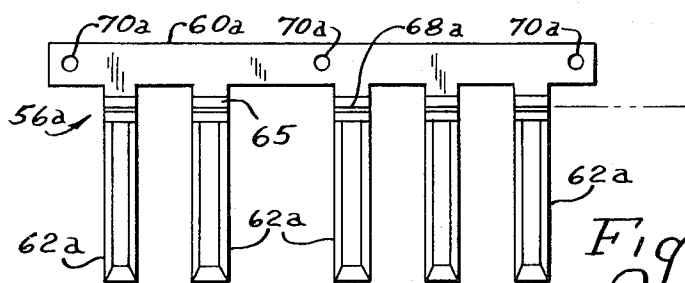


Fig. 7

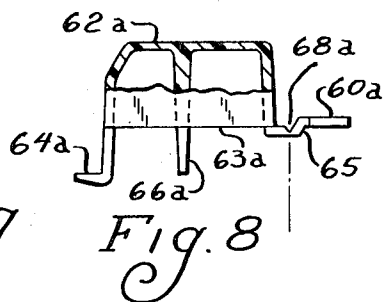


Fig. 8

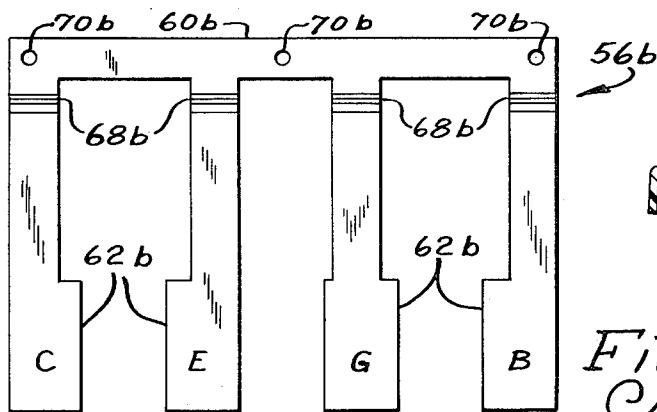


Fig. 9

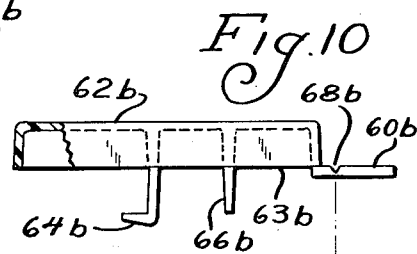


Fig. 10

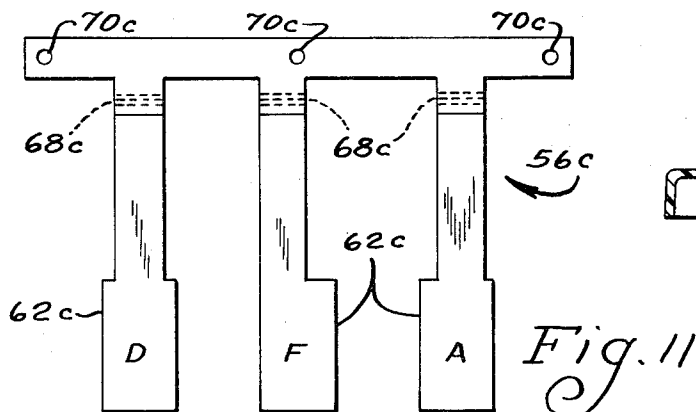


Fig. 11

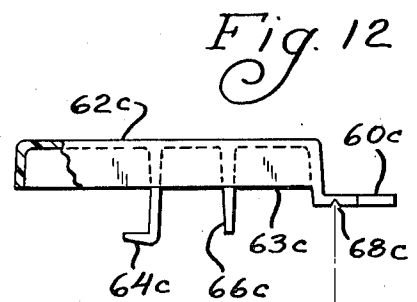


Fig. 12

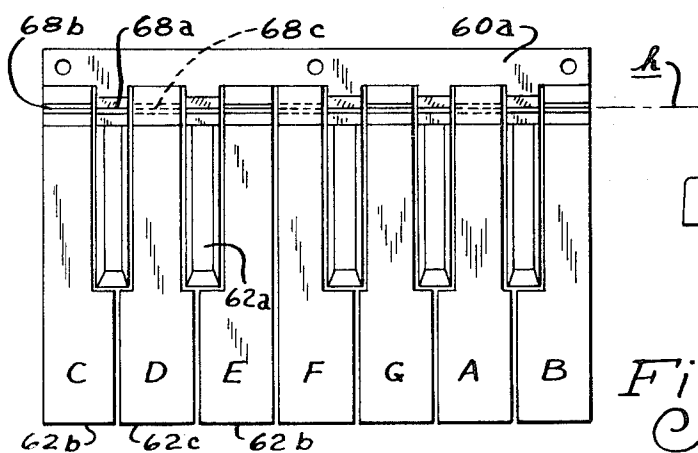


Fig. 13

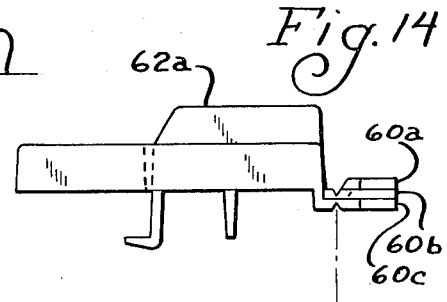


Fig. 14



## ELECTRONIC MUSICAL INSTRUMENT MECHANICAL CONSTRUCTION

### BACKGROUND OF THE INVENTION

This invention relates to improvements in electronic musical instruments, more particularly improvements in the mechanical construction of electronic organs and like instruments.

In the construction of electronic organs, it is a common practice to make up a series of components that are ultimately assembled to provide a key frame. Such procedure, of course, results in a cost of production that increases as the number of components increase, and for this reason the number of components making up the key frame should be kept to a minimum.

Another practice in the manufacture of electronic organs is the provision of stop tablets that are pivoted on cross rods. This also is an expensive type of construction since the number of parts, such as the stop tablets proper, pivot rods, bearing supports, etc., must be fabricated and then assembled.

A still further common technique in the manufacture of electronic organs is to mount pivotally the individual keys at their respective inner ends. This means that each key is separately formed and separated pivotally attached in place, all of which requires considerable labor costs.

### OBJECTS AND SUMMARY OF THE INVENTION

It is an object of this invention to provide an electronic musical instrument which is so designed as to be fabricated at relatively low cost.

A further object of this invention is to provide an electronic musical instrument of the type stated in which the number of individual components that need to be manufactured are considerably reduced as compared to arrangements of the prior art, thereby contributing to the low cost of construction of the instrument.

In accordance with the foregoing objects the instrument comprises a one-piece molded plastic key bed having first and second portions. The first portion has a panel with openings therein, and means are provided adjacent to the openings for supporting circuit boards over the openings such that the openings provide access spaces for conductors interconnecting the circuit boards. The second portion of the key bed is arranged to support a series of keys in a cantilever fashion such that the keys pivot or rock about approximately the same pivot axis. In addition, the second portion has a panel with openings offset from the keys for receiving stop tablet assemblies. These stop tablet assemblies include individual stop tablets rockably mounted in a one-piece housing, one housing being mounted in each of the aforesaid openings in the second portion of the key bed.

In accordance with a further aspect of the invention the keys are made up of an octave group that is formed of a plurality of one-piece plastic structures, each structure having a group of keys representing the predetermined musical tones. Each structure includes a mounting strip and each key of a structure is joined to the mounting strip at a zone of flexure for hinge connection therewith such that the keys of each structure hinge about a substantially common axis. When the keys are assembled on the key bed, the mounting strips are superimposed. The hinge connections are so formed that

in the assembled instrument the hinge axes of the respective structures are at least approximately coincidence, and are nearly the same for all practical purposes. The key groups are molded with alternate keys rather than with adjacent keys of the chromatic scale. Typically, for an octave group there will be two groups of natural keys and one group of keys containing the sharps. Thus, one natural key group will contain C, E, G and B while the other natural key group will contain D, F and A. The third group contains the five sharps.

Each of the keys is a hollow downwardly opening member that is joined to the mounting strip by a thin notched connecting strip with the result that there is limited lateral rigidity of the keys. Accordingly, the key bed is integrally formed with a castellated bar which projects into the hollow of the keys to inhibit lateral movement of the keys during use of the instrument.

In accordance with another aspect of the invention, the stop tablet construction comprises a housing with side-by-side cavities for receiving individual stop tablets. Each stop tablet and the housing is a one-piece molded plastic member, and each stop tablet is a downwardly opening member that is U-shaped in cross section to provide opposed sides. The cavities of the housing include arcuate bearing surfaces which engage edges on the stop tablet sides for rockably supporting the stop tablets without the need for pivot pins. The housing has opposed slots on opposite sides of each cavity for receiving a contact wire that is depressed by the stop tablet when the latter is rocked to its "on" position. To retain the stop tablet in either its "off" or "on" position, the transverse walls of the housing have protuberances that engage resilient fingers depending from the stop tablet whereby the resilient fingers will flex and override the protuberances upon rotation of the stop tablets from one position to the other. In addition, the resilient fingers have keepers that underlie the lower edges of the aforesaid transverse walls to maintain the stop tablet assembled with the housing. The opposed sides of the stop tablet flex to facilitate rapid mounting of the stop tablet within the housing and snapping of the keepers into position.

### BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a fragmentary perspective view of the upper end of an electronic organ constructed in accordance with and embodying the present invention;

FIG. 2 is a fragmentary top plan view thereof, partially broken away;

FIG. 3 is a fragmentary front elevational view of the instrument of FIG. 2;

FIGS. 4, 5 and 6 are fragmentary sectional views taken along lines 4—4, 5—5 and 6—6, respectively, of FIG. 2 certain parts being omitted in order to illustrate the invention more clearly;

FIG. 7 is a top plan view of a key group according to the present invention;

FIG. 8 is a side elevational view, partially broken away and in section, of the key group of FIG. 7;

FIG. 9 is a top plan view of another key group according to the present invention;

FIG. 10 is a side elevational view, partially broken away and in section, of the key group of FIG. 9;

FIG. 11 is a top plan view of still another key group according to the present invention;

FIG. 12 is a fragmentary side elevational view, partially broken away and in section; of the key group of FIG. 11;

FIG. 13 is a top plan view of the key groups of FIGS. 7, 9 and 11 after assembly thereof;

FIG. 14 is a side elevational view of the assembly of FIG. 13;

FIG. 15 is a fragmentary exploded perspective view of a stop tablet construction in accordance with the present invention;

FIG. 16 is a fragmentary sectional view taken along line 16—16 of FIG. 15 but showing a contact wire and bus bar as might be used in the instrument;

FIG. 17 is a fragmentary sectional view taken along line 17—17 of FIG. 16; and

FIG. 18 is a fragmentary sectional view taken along line 18—18 of FIG. 7.

### DETAILED DESCRIPTION

Referring now in more detail to the drawings and more particularly to FIGS. 1—6, there is shown an electronic organ 2 comprising a key bed 4, a name rail 6 upwardly inclined from the rear marginal portion of the key bed 4, and opposed side members 8, 8. FIG. 1 shows only the upper part of the organ, which is the part with which the present invention is concerned. Other conventional structural details of the organ are omitted for purposes of clarity.

Referring to the key bed 4, it will be seen that this mechanical component of the organ is a one-piece molded plastic member having a first portion 10 that includes a panel 12 and a depending longitudinal rib 14 adjacent to the forward longitudinal edge of the panel 12. Formed in the panel 12 are openings 16 over which are mounted printed circuit boards 18 that contain electrical components 19 of the instrument. Typically, these are tone generators, amplifiers, etc., which function in the usual manner to provide output signals to the loudspeaker of the instrument. The rear margin of the first portion 10 has a longitudinal flange 20 that includes upwardly opening bosses 22. At or adjacent to the forward longitudinal margin of the panel 12 are upstanding bosses 24. Screws 26 are threaded into the bosses 22, 24 to retain the circuit boards 18 in upwardly spaced relation from the respective opening 16.

As best seen in FIG. 2 the openings 16 provide access for wiring between the several circuit boards. The wiring 28 and circuit components, shown fragmentarily in FIG. 2, is illustrative of the principles of the invention. However, in order to avoid obstructing salient features of the invention, the wiring and circuitry components have been omitted in FIGS. 5 and 6.

The key bed 4 also includes a second portion 30 for supporting a piano-type keyboard 32 and a number of stop tablet assemblies 34. Included in the second portion 30 is an upstanding flange 36 that runs longitudinally of the rear edge of the keyboard and which includes a number of the bosses 24. As will be described more fully hereinafter, the bosses 24 on the flange 36 provide a cantilever mounting of the keys of the keyboard.

Forwardly of the flange 36 the second portion 30 of the key bed has a shelf 38 with openings 40 therein which underlie the keyboard. At the forward longitudinal margin of the shelf 38 the second portion 30 has adjacent channel-shaped portions 41, 42 that open oppositely and have a common wall 44. The inner longitudi-

nal margin of the channel portion 42 comprises an upstanding longitudinal bar 46 having a series of castellations that project upwardly into the hollow of the keys as best seen in FIG. 4 and for purposes presently more fully appearing.

Adjacent to the keyboard 32 is a key block 50 that includes a top panel 52 having a number of rectangular openings 54. Each rectangular opening receives a stop tablet assembly 34 which is supported on the panel 52. If desired, the name rail 6 may also be provided with like openings 54 for receiving stop tablet assemblies 34. Also, a key block with stop tablet assemblies may be provided at the right hand (FIG. 2) or upper end of the keyboard.

Referring now more particularly to FIGS. 7—14, the keys of the keyboard are formed of octave groups, and each octave group consists of three one-piece plastic key groups 56a, 56b, 56c. The key group 56a is made up of the five sharps while the key group 56b consists of keys representing C, E, G and B. The key group 56c has keys representing D, F and A. Thus, when the key groups 56a, 56b and 56c are assembled as shown in FIGS. 13 and 14, they form the octave group. Any number of adjacent octave groups may make up the keyboard 32 and with breaks as desired.

Each key group 56a, 56b and 56c is a one-piece member formed of a suitable plastic such as polypropylene. The key group 56a comprises a mounting strip 60a from which the keys 62a perpendicularly project. The keys 62a are downwardly open hollow structures each including an L-shaped depending upper limit stop finger 64a and a switch actuator 66a. Also, each key 62a is joined at its rear margin to the mounting strip 60a along a zone of flexure that includes a notch 68a. As seen in FIG. 8, the zone of flexure including the notch 68a is on a strip portion 65 that angles upwardly to join the mounting strip 60 so that the latter is upwardly displaced or offset from the lower edge 63a of the key 62a. The amount of offset or displacement of the mounting strip 60a is approximately the thickness of the plastic of the mounting strip whereby the lower edge of the mounting strip is about coplanar with the lower edge 63a of the key 62a. Finally, the mounting strip 60a has holes 70a which are spaced apart a distance equal to the center-to-center spacing of the bosses 24 that are formed in the flange 36.

The key groups 56b, 56c have parts corresponding to those in the key group 56a and are identified with the same reference numeral followed by the subscript b and c, as the case may be. However, in the key group 56b the mounting strip 60b has its upper edge approximately coplanar with the lower edge 63b of each key 62b. The key group 56c has a mounting strip 60c, the upper surface of which is downwardly offset from the lower key edge 63c by an amount approximately equal to the thickness of the plastic of the mounting strip. In addition, it will be noted that the notch 68c opens downwardly whereas the notches 68a, 68b open upwardly.

It will be apparent that all of the keys of any one group will hinge or flex about a hinge axis that is substantially coincident with the base of the notch 68a, 68b, 68c, as the case may be. Of significance, however, is the fact that when the key groups 56a, 56b, 56c are assembled, as shown in FIGS. 13 and 14, with the mounting strips 60a, 60b, 60c stacked, the hinge axes of all of the keys will be substantially coincident. The

mounting strips 60a, 60b, 60c are secured by the screws 26 to the bosses 24 such that the flange 36 provides a cantilever support for each key. The hinge axis *h* for each key is approximately coincident with the base of each notch 68a, 68b, 68c. The bases of the notches are not in exact axial alignment, but they are sufficiently close for practical purposes to define approximately a common hinge axis for all of the keys. The approximate axial alignment of the hinge axes of the keys is due to the provision of two "natural" key groups having alternate keys and one key group containing sharps and flats. Since no key group has adjacent keys, each notch in any one key group is offset from the notch of an adjacent key of another group. The relative vertical offsetting of the mounting strips 60a, 60b, 60c of the respective key groups relative to the common or coplanar lower edges 63a, 63b, 63c of the keys allows for approximate alignment of the hinge axes of the keys in an efficient and inexpensive manner.

As seen in FIGS. 3-5, the fingers, such as 64b, engage under the flange 46 to limit the upward movement of the keys. The actuators 66a, 66b, 66c of the respective keys engage a contact wire, such as shown at 74 (FIG. 5), to make contact with a fixed contact bar 76 to generate a tone in a known manner. The castellated part 48 projects into the hollow of each key, as best seen in FIG. 4, to impart lateral stability thereto. The right-hand most key 62c of FIG. 4 is shown depressed to illustrate the down position of the key relative to the castellated part 48.

FIGS. 15-18 show details of the stop tablet construction or assembly 34. This assembly 34 comprises a one-piece molded plastic housing 80 of generally rectilinear configuration and comprising opposed longitudinal flanges 82, 82 that seat upon the top panel 52 of the key block 50 as shown in FIGS. 1, 2 and 6. The housing 80 also includes a number of cavities 84 for receiving individual, one-piece molded plastic stop tablets 86. The cavities 84 are defined by front and back walls 88, 90 end walls 92, 94 and a series of intermediate parallel walls 96.

The front and back walls, 88, 90 have opposed vertical slots 98, 100 which extend to the lower margins of the front and back walls 88, 90 for respectively receiving spring wire electrical contacts 102 in the cavities 84. Thus, one spring wire contact transversely spans each cavity 84 for actuation by a stop tablet 86 therein. The wire contacts 102 extend from a printed circuit board 104 and are adapted to contact a fixed bus bar 106. The printed circuit board (which may contain the stop filter circuit) and bus bar are fragmentarily shown as they may be mounted in the organ in any conventional manner. Also provided on the front and back walls are inwardly offset depending lips 108, 110 that support stop pad cushions 112, 114 that limit the movement of the respective stop tablets 86 to and from their off and on positions, as will presently be more fully described.

Each stop tablet 86 has a top 116 and depending sides 118. The lower edges of the depending sides at the corners 124 thereof are adapted to ride on arcuate bearing surfaces 120, 122 in each cavity 84, the bearing surfaces being formed on the front and back walls 88, 90. These arcuate bearing surfaces are cylindrical and provide a low friction journal for each stop tablet about its pivot axis and thereby eliminate the need for a pivot pin. The side walls 118, 118 of each stop tablet 86 are

also formed with a plurality of outwardly projecting dimples 126, that provide a low friction sliding engagement of the sides of each stop tablet with the adjacent walls 84 and/or 92, 94 as the case may be.

Depending from the lower edges of the side walls 118, 118 are fingers 128, 128, the lower ends of which have keepers 130, 130. The keepers 130, 130 are tapered from their upper ends toward their lower ends to facilitate assembly of each stop tablet 86 within a cavity 84. Thus, when a stop tablet 86 is assembled with the housing, the stop tablet is pushed into a cavity 84. The fingers 128, 128 will resiliently deflect until the upper ends of the keepers 130 have reached the lower edges of the transverse walls 96, 96. At that time the keepers 130, 130 will snap under the transverse wall to retain stop tablet assembled with the housing 80. For the end-most stop tablets one keeper 130 will snap under the end wall 92 or 94, as the case may be. Furthermore, it will best be noted from FIG. 17 that immediately above the keepers 130 there are dimples 132, 132 which provide low friction bearing surfaces at which the fingers 128, 128 ride against the side walls of the cavity 84.

The transverse wall 84 and the insides of the end walls 92, 94 are integrally provided with detents or protuberances 134 and over which the fingers 128, 128 ride in the region of the dimples 132. These protuberances 134 serve to hold the stop tablet 86 either in its "off" position, shown in full lines in FIG. 16, or in its "on" position shown in broken lines therein. Upon pressing of the stop tablet to change its position, the fingers 128, 128 ride past the protuberances 134 because the finger 128 will flex inwardly. However, the fingers 128 will snap back as they pass by the protuberances 134 whereby the latter act to retain the stop tablet in the position to which it has been shifted.

The one-piece stop tablet and one-piece housing contribute to the low cost and ease of assembly of the instrument. The stop tablets may be each individually assembled with the housing and the entire assembly 34 mounted in place. Furthermore, the fact that each stop tablet is symmetrical (relative to section line 17-17) means that it may be assembled with the housing as shown or turned 180° about its vertical axis from the position shown.

The invention is claimed as follows:

1. In an electronic musical instrument, a one-piece molded plastic key bed, said key having a first portion and a second portion, said first portion having a panel with openings therein, means for supporting circuit boards over said panel and facing said openings such that the openings provide access spaces for conductors interconnecting the circuit boards, said second portion having first means for supporting a series of keys and second means for supporting stop tablet assemblies, said second means comprising a panel portion offset from said first means and having an opening through which a stop tablet assembly projects.

2. In an electronic musical instrument according to claim 1, said first means including an upstanding flange for cantilever mounting of said keys.

3. In an electronic musical instrument according to claim 1 in which said key bed has adjacent channel-shaped portions in the second portion, said channel shaped portions having a common wall and opening oppositely.

4. In an electronic musical instrument according to claim 1 in which the stop tablet assembly comprises a

plurality of stop tablets, a common one-piece housing for said stop tablets, said housing having arcuate surfaces for pivotally supporting each stop tablet.

5. In an electronic musical instrument according to claim 1 in which said second portion includes a castellated part for projection into said keys.

6. In an electronic musical instrument according to claim 1 including a plurality of keys and a mounting strip from which the keys project, the mounting strip and the keys being a one-piece molded structure and with there being a zone of flexure between each key and the mounting strip.

7. In a musical instrument, a keyboard comprising a plurality of three one-piece plastic structures each having a group of keys representing predetermined musical tones, each structure including a mounting strip and each key of a structure being joined to the mounting strip thereof for hinge connection therewith such that the keys of a structure hinge about a substantially common hinge axis, said mounting strips being juxtaposed in stacked relationship and such that successive keys represent a predetermined musical sequence, each hinge connection being at a zone of flexure that is a reduced thickness portion of the plastic formed by a notch therein, the keys of said three structures having means defining a common horizontal plane, two of said mounting strips being on opposite sides of said common plane and a third of said mounting strips being intermediate said two mounting strips to position the respective zones of flexure of all of the keys in substantial horizontal alignment and thereby locate the hinge axes of all of the keys in substantial coincidence.

8. In a musical instrument according to claim 7 including a key bed, and means securing said mounting strips to said key bed, said last-named means including bosses on said key bed that receive fasteners projecting through said mounting strips.

9. In a musical instrument according to claim 7, the notches in one structure opening downwardly and the notches in the two other structures opening upwardly.

10. In a musical instrument according to claim 7 in which the keyboard comprising said structures provides keys representing a chromatic scale, one of said structures having keys representing the five sharps and flats, a second of said structures having keys representing four alternate natural keys, and a third of said structures having keys representing three alternate natural keys and with the natural keys providing recesses for receiving the keys representing the sharps and flats.

11. A stop tablet construction for an electronic organ comprising a housing having means defining cavities receiving side-by-side stop tablets, means for individually

ally pivotally supporting said stop tablets in said housing for movement between two positions, said pivotal supporting means including arcuate surface in said cavities that engage edge portions of said stop tablets, first cooperating means on said stop tablets and said housing for retaining said stop tablets individually in said housing, and second cooperating means on said housing and stop tablets for individually retaining each stop tablet in one of said positions.

12. A stop tablet construction according to claim 11 having opposed slots on opposite sides of each cavity for receiving contact wires that are adapted to span the cavities respectively.

13. A stop tablet construction according to claim 11 in which said first cooperating means comprises keeper means on each stop tablet that underlie wall portions of the housing that separate said cavities, each stop tablet having resilient depending fingers that carry said keeper means.

14. A stop tablet construction according to claim 11 in which said housing has wall portions that separate said cavities, said wall portions have lateral protuberances, each stop tablet has resilient fingers with means for engaging said protuberances and said resilient fingers riding over said protuberances as a stop tablet is moved from one of said positions to the other position.

15. A stop tablet construction for an electronic organ comprising a one-piece plastic housing having a cavity with opposed walls, a one-piece stop tablet rockably mounted in said cavity and having opposed sides adjacent to said opposed walls respectively, said sides including resilient elements, and cooperating means on said walls and elements for retaining said stop tablet in said housing.

16. A stop tablet according to claim 15 further including cooperating means on said walls and said fingers for retaining said stop tablet in either of two positions of rotation.

17. A stop tablet construction for an electronic organ comprising a one-piece plastic housing having means providing side-by-side cavities, a one-piece plastic stop tablet in each cavity, means for rockably mounting each stop tablet in its associated cavity for individual movement about a pivot axis, said rockably mounting means for each stop tablet comprising an arcuate bearing surface centered on the pivot axis, and means for retaining said stop tablets in said housing.

18. A stop tablet according to claim 17 in which said housing has slots intersecting the bearing surfaces respectively for receiving a contact wire.

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