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Dyle et al.

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[54] **ARPEGGIO KEYBOARD**

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[63] Continuation of Ser. No. 272,681, July 17, 1972, abandoned.

[52] **U.S. Cl.** ..... **84/423;** 84/425; 84/DIG. 7; 200/1 R; 200/5 A; 200/250; 340/365 A

[51] **Int. Cl.**[2] **G10C 3/12**

[58] **Field of Search** ..... 84/1.01, 1.17, 439, 440, 84/DIG. 7, DIG. 22, 423, 425, 427, 433; 200/1 R, 1 A, 5 R, 5 A, 159 R, 159 B, 250, DIG. 1; 340/365 R, 365 A

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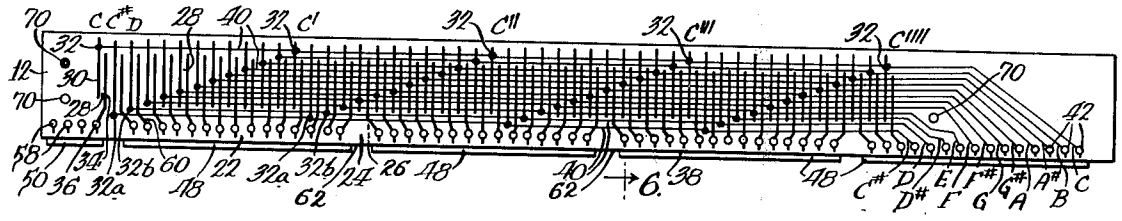
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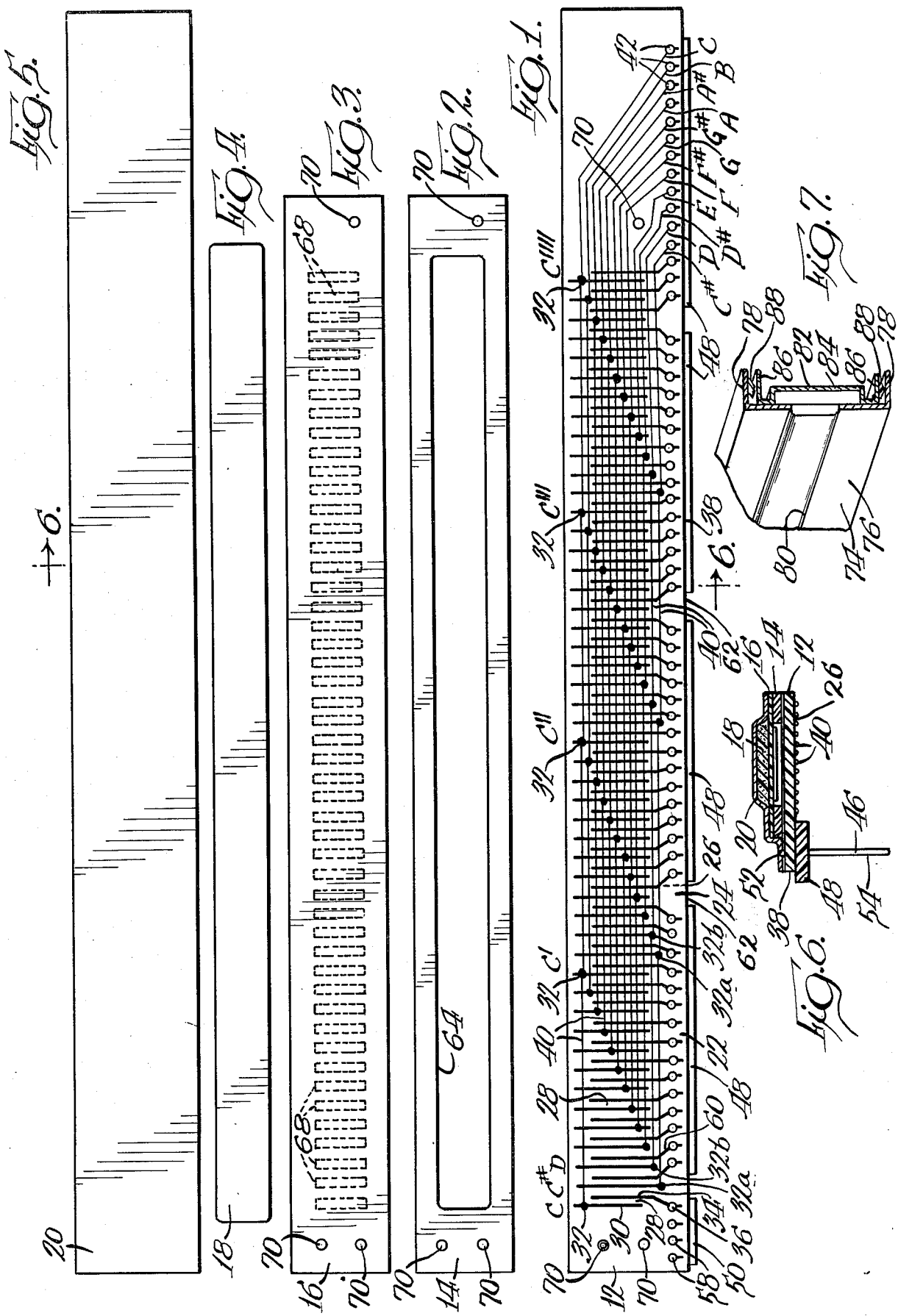
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[57] **ABSTRACT**

An arpeggio keyboard assembly for an electronic organ characterized by extreme simplicity and a major reduction of parts.

2 Claims, 7 Drawing Figures




Fig. 5.
Fig. 4.
Fig. 3.
Fig. 2.
Fig. 1.
Fig. 7.
Fig. 6.
6.
20
18
70
16
68
64
12
14
C
C#
D
D#
E
F
F#
G
G#
A
A#
B
C'
C''
C'''
C''''
22
24
26
28
30
32
32a
32b
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76'
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ARPEGGIO KEYBOARD

This is a continuation, of application Ser. No. 272,681 filed July 17, 1972, and now abandoned.

BACKGROUND OF THE INVENTION

In U.S. Pat. No. 3,358,070 to Alan C. Young dated Dec. 12, 1967, and U.S. Pat. No. 3,358,091 to Charles Dyle dated Dec. 12, 1967, there is shown an arpeggio device upon which the present invention is intended to improve. A keyboard is formed of uniform, aligned, small rounded keys spanning all notes of three octaves, such that a thumb or finger may be run over the keyboard smoothly, and all the keys will be consecutively depressed and released. Each set of octavely related keys is connected to a separate bus which is connected in series to the like octavely related notes of the principal lower keyboard of the instrument and each key is connected individually to a keyer for the tone generators. Thus, as a note or chord is sounded on the principal lower keyboard and a finger is run along the arpeggio keyboard, only those notes the same or octavely related to the notes played on the principal keyboard will be sounded, securing perfect consonance of the arpeggio with the note or chord.

The arpeggio keyboard described in the above patents incorporates as separate elements individual keys, switch contacts, biasing springs, etc., for each individual note of the arpeggio, amounting, in all, to about 300 parts with the attendant complexity of assembly.

SUMMARY OF THE INVENTION

The simplified arpeggio keyboard of the present invention effects a vast reduction in the number of basic parts to simplify assembly greatly and reduce the cost substantially.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of a printed circuit board with terminal pins attached;

FIG. **2** is a plan view of the spacer;

FIG. **3** is a plan view of the contact strip;

FIG. **4** is a plan view of the pressure pad; and

FIG. **5** is a plan view of the cover strip, all of which, sandwiched together, form the keyboard of the present invention;

FIG. **6** is a transverse section through the assembled keyboard taken along the line **6—6** of FIGS. **1–5**; and

FIG. **7** is a perspective view of the keyboard mounted in the front strip of an electronic organ, the front strip being in the front strip of an electronic organ, the front strip being broken away in part to show the method of mounting.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In a preferred embodiment the keyboard **10** consists of five laminations; a printed circuit board **12,** a spacer **14,** a contact strip **16,** a pressure pad **18,** and a cover **20.**

The circuit board **12** consists of an epoxy-glass substrate **22** with both sides thereof having circuit elements printed thereon; an outer, switch side **24** and an inner, bus side **26.** The circuits of both sides are shown in Fig. **1,** their interrelation being best understood from such superposed presentation. The circuitry on the switch side **24** is shown in relatively thick, scaled lines and the circuitry on the bus side **26** in thin lines, not

necessarily to scale. It will be appreciated that the actual busses may be of any suitable width. The switch side has printed 49 switches **28** thereon, thus providing four chromatic octaves and a top C, consisting of spaced pairs of conductive strips extending transversely across the board **12.** As illustrated, the left strip **30** of each of these switches includes a bus connection **32** and the right strip **34** extends to a note pin receptacle **36** adjacent the lower edge **38** of the board.

The reverse or bus side **26** has 12 parallel busses **40** printed thereon, one for each of the tones of the chromatic scale, extending longitudinally of the board in space relation and sloping at the right hand end toward the lower edge **38** of the board where they terminate in bus pin receptacles **42.**

The note pin receptacles **36** and bus pin receptacles **42** are perforations arranged in a line along the lower edge **38** of the board **12** surrounded by conductive material, the plating of the bus pin receptacles extending from the bus side through the perforations to the outer or switch side **24** of the board for convenience of pin connection as will be later described.

In the configuration illustrated, the uppermost bus is assigned to the note C, the lowermost to C **#** , the next above to D, and so on up to the C bus. The left-most switch is assigned to the note C, and from that C, the switches are successively assigned to the next adjacent semitone through four octaves of the chromatic scale to C''''. At each point of crossing of the left hand elements **30** of the C, C', C'', C''', C'''' switches and the C bus, the board is perforated as at **32** with the plating extended through the perforations to connect those switch elements to the C bus. Similarly, the left element of each of the C **#** switches is connected to the C **#** bus as at **32***a*, the D switches to the D bus as at **32***b*, etc.

The invention contemplates a grouping of terminal pins for convenience of assembly. In the illustrated embodiment, the terminal pins **46** are molded in a line in five blocks, four blocks **48** carrying 15 terminal pins and one block **50** carrying four pins. The pins **46** extend through the block a short distance above **52** for soldered connection to the circuit board and a greater distance below **54** for plug-in circuit connection. The blocks are placed against the bus side of the circuit board with the short ends **52** of the pins extending up through the pin receptacles **36** slightly above the switch side where they are soldered to the conductive surrounds.

The particular grouping of the pins on the blocks and on the board is highly specific to a particular engineered embodiment. Needless to say, the division of pins between blocks and the number of blocks is wholly arbitrary and can vary widely. In the specific embodiment, however, the right hand pin of the block **50** of four is connected to the C switch terminal, the other pins being engaged in dummy receptacles **58** where they play a purely supportive function. The remaining 60 bus and switch terminal receptacles are divided among the blocks **48** of 15 pins. The right hand switch elements **34** of the groups of fifteen progressively converge toward their center at their ends as at **60** to enable a separation **62** between the pin mounting blocks **48** and **50** for keyboard mounting purposes as will be later described.

The spacer **14** is a rectangular strip of paper board or the equivalent, .008 inches thick having a window **64** therein proportioned to expose all the switches **28.** The

width of the spacer is such that it aligns with the edge of the board remote from the pins **46** and falls just short of the pins on its other edge. The length is such as to expose only the switches. Thus, with the left hand end of the spacer **14** aligned with the left hand end of the board **12,** the right hand end of the spacer ovelies the area of the buses **40.** The spacer **14** has a pressure sensitive adhesive on each side thereof to stick the spacer to the circuit board **12** and the contact strip **16** to the other side of the spacer.

The contact stip **16** is a sheet of Mylar having a series of transversely extending rectangular conductive contacts **68** plated on the bottom surface thereof. The contacts are arranged such that each overlies one of the switches **28.** The contact strip is, of course, mounted to the assembly with the contact strips down so as to confront the switches **28.**

The circuit board **12,** spacer **14** and the contact strip **16** have index holes **70** formed therein such that the three components may be assembled on appropriately located pins to establish an exact relation between the parts.

A pressure pad **18** conforming essentially to the window **64** of the spacer **14** is placed on top of the contact strip **16** and in registry with the window **64.** The pressure pad is a flexible vinyl from 1/16th of an inch thick any may have a pressure sensitive adhesive on its bottom surface for adherence to the Mylar contact stip.

The cover **20** is a strip of Teflon, 3½ mils. thick and dimensioned like the circuit board **12.** The Teflon has a pressure sensitive adhesive on one side thereof by means of which it is secured to the pressure pad, the exposed areas of the contact strip **16,** and the exposed areas of the circuit board **12.** Teflon is the material of choice in this application by virtue of the ease with which a finger may slide over it. In a characteristic application of this keyboard, the busses will be each connected to like busses serially connected to the key switches of the left hand or lower keyboard of an electronic organ such that depressing any C key, for instance, of the lower keyboard has the effect of energizing or grounding the C bus **40** of the arpeggio keyboard. Thus, the bus side **30** of each of the arpeggio C switches **28** is energized. The note sides **34** of each of the switches **28** are connected individually to keyers controlling the output of individual tone generators to the output system of the organ. Thus, as a finger is run along the Teflon cover **20,** all of the switches **28** will be closed by the progressive depression of the contacts of the contact strip in to bridging relation with the two switch elements of each of the successive switches. Since, however, only the C switches will be energized, only the C keyers will be operated and successive C's sounded. Likewise, if the chord CEG is played anywhere on the lower keyboard, the C, E, and G busses willl be energized and all of the C, E, and G note switches conditioned for keyer operation.

This functional incorporation of the arpeggio keyboard an electronic organ and its mode of operation is all fully set forth in the above mentioned U.S. Pat. No. 3,358,070 to Young, and as the invention here resides in the keyboard itself and not in its circuitry or mode of note sounding, illustration is believed irrelevant and unnecessary.

The keyboard of the present invention can be mounted in a variety of ways as shown in the above mentioned U.S. Pat. No. 3,358,070. A specific means of mounting has been devised, however, (Fig. 7) which provides good accessibility of the keyboard to a player's hands involved with the principal keyboards and lends itself well to the wanted design characteristics of the organ. The front strip **74** of the organ is that vertical panel between the upper, right hand keyboard and the lower, left hand keyboard. In the specific embodiment it is a metal channel with the base **76** exposed and decoratively finished and the flanges **78** thereof inwardly turned. A slot **80** is formed in the base **76** proportioned to accommodate generously the bulge in the Teflon cover **20** occasioned by the pressure pad **18.** Clips **82** having a central portion **84** adapted to embrace the backside and the longitudinal edges of the keyboard engage the keyboard in the spaces **62** between the pin blocks **48** and **50.** The ends of the clips are backwardly bent as at **86** to approach closely and parallel the flanges **78** of the front strip **74** and have struck-out points **88** which engage the flanges **78.**

From the foregoing description it will be appreciated that a keyboard has been devised here which offers enormous advantage in terms of cost of components and cost of assembly over that shown in the above mentioned patents to Young and Dyle.

Some dimensions are of interest in that the keyboard should be short to minimize the sweep of the finger necessary to operate it and yet it should be possible to sound a single note without closing adjacent switches. The spacing of the elements **30** and **34** of each switch **28** is .031 inches and the switch elements are .031 inches wide, so the width of each switch is .093 inches. The spacing of the switches center-to-center is .172 inches. The contact members of the contact strip are also .093 inches wide, and, of course, equally spaced with the switches. The circuitry is, conventioanlly, gold on nickel on copper. The overall length of the keyboard proper as represented by the pressure pad **18** is about 9 inches.

The dimensions given herein are, of course, illustrative and not critical, but in order to obtain a clean arpeggio effect, it is desirable that one note of the arpeggio release before the next note is sounded. Arpeggios and chords conventioanlly used seldom incorporate semitone intervals. The spacing of the switches, taken together with the recited thicknesses and materials which go to make up the combined keyboard sandwich, result in an assembly sufficiently locally responsive such that the pressure of a tip of a finger will make positive closure of the switch directly under the fingertip with a slight effort, but at the same time not close adjacent switches. In other words, the pressure of a finger might close two adjacent switches if it were centered over the space between, but if it were centered directly over one switch, the adjacent switches would not be closed. It the area of pressure contact were broadened, of course, as with the ball of the thumb, as many as five or six adjacent switches would be closed which might be desired in some arpeggio effects.

It must again be emphasized that the above described embodiment of this invention is a highly specific commercial model, and many variations may be readily imagined without departing from the basic concept thereof. It is, therefore, desired that this invention be regarded as being limited only as set forth in the following claims.

1. A miniature keyboard for an electronic musical instrument comprising:

a circuit board having a plurality of mutually spaced conductive contract fingers printed on one side thereof, in a single row, said contact fingers being grouped in pairs with each of said pairs associated with one unique note of at least two octaves of musical notes;

An electrically insulating spacer sheet disposed on said circuit board over said contact pairs and defining a single window therein exposing at least a portion of each finger of each contact pair with no intervening spacer material between respective adjacent contact pairs;

a flexible sheet of electrically insulating material having mutually spaced regions of conductive material thereon and being mounted on said spacer sheet, each of said regions of conductive material being dimensioned and positioned to overlie a single one of said contact pairs and being normally spaced therefrom by said spacer sheet;

said keyboard being dimensioned such that adjacent contact pairs over the entire length of the keyboard are rapidly connected and disconnected in succession by the pressure of a single fingertip moving therealong.

2. Apparatus as claimed in claim **1**, wherein said circuit board further comprises a plurality of mutually spaced conductive keying signal busses printed on the other side of said board with each of said busses being associate with a unique note of the musical scale, a first one of said contact fingers in each of said pairs being conductively connected through said board to an associated one of said keying signal busses such that a keying signal on said bus will be communicated to each of at least two contact pairs associated with octavely spaced musical tones, and a second one of said contact fingers in each of said pairs being adapted to be connected to keying circuitry for said associated tone.

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