Aug. 26, 1958 J. M. LESTER 2,848,920

KEY CONTACT SYSTEM FOR ELECTRONIC ORGANS

Filed March 2, 1955 2 Sheets-Sheet 1

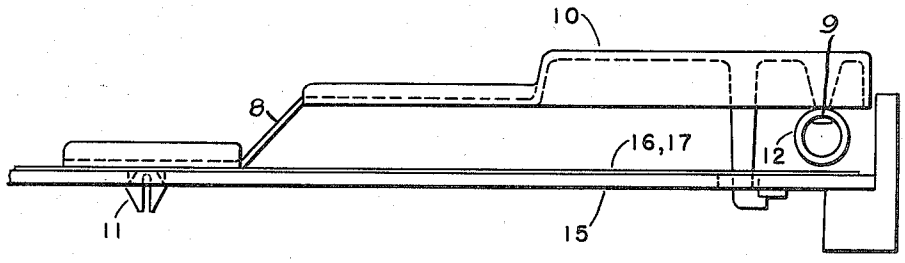

FIG. 1

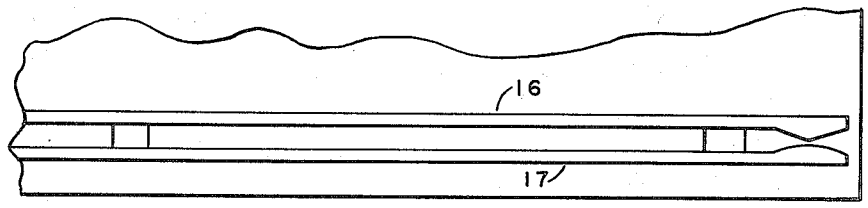

FIG. 2

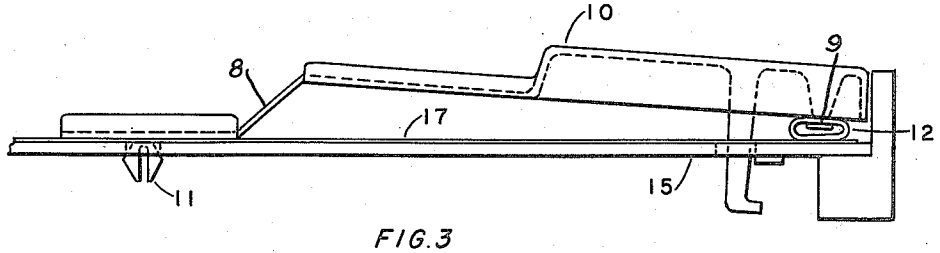

FIG. 3

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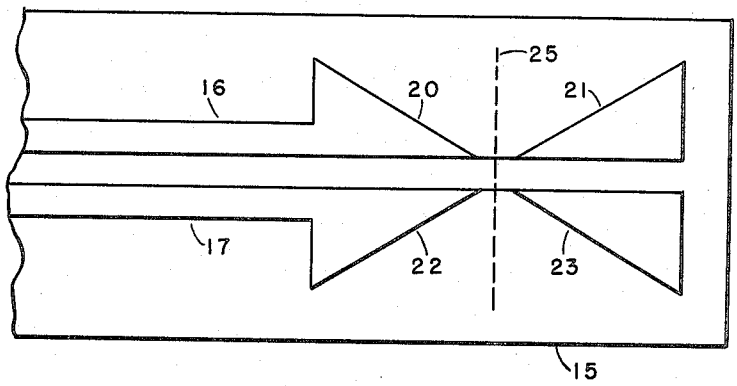

FIG. 4

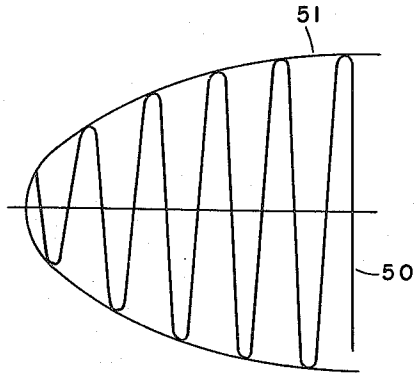

FIG. 5

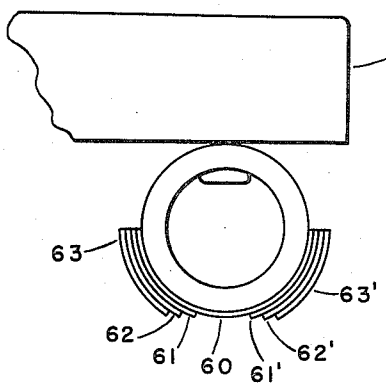

FIG. 6

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United States Patent Office 2,848,920 Patented Aug. 26, 1958

2,848,920

KEY CONTACT SYSTEM FOR ELECTRONIC ORGANS

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Application March 2, 1955, Serial No. 491,561

1 Claim. (Cl. 84—1.27)

This invention relates to electronic contacts. More specifically, to contacts for use in electronic instruments, such as, electronic organs, utilizing a conductive rubber member as a mechanical and electrical element.

The primary object of the invention is to provide an improved contact for electronic instruments of the organ type permitting of a simple and inexpensive construction.

Another object of the invention is to provide an instrument contact which eliminates undesirable key clicks.

A further object of the invention is to provide a contact for electrical instruments in which the volume of the tone generated by the contact may be varied by key depression.

A still further object of the invention is to provide electronic instrument contacts in which the rate of attack may be controlled.

A still further object of the invention is to provide a key contact for an electronic instrument which supplied mechanical cushioning upon key depression.

Other objects of the invention will become apparent by reference to the following detailed description taken in connection with the accompanying drawings in which:

Figure 1 is a vertical sectional view of a contact constructed in accordance with the present invention.

Figure 2 is a plan view of the embodiment shown in Figure 1 with the key removed.

Figure 3 is a vertical sectional view of the embodiment shown in Figure 1 in which the key is depressed.

Figure 4 is a horizontal sectional view showing an ultimate embodiment of the invention, and

Figure 5 is a graph illustrating one of the features of the invention.

Figure 6 is a detail of another embodiment of the invention.

Referring now to the drawings wherein like numbers refer to like and corresponding parts throughout the several views. The particular embodiment of the invention disclosed in Figures 1, 2 and 3 comprises, in general, a key member **10** having a flexible portion **8**, such as a plastic organ key, which is supported by plastic lock member **11**. Attached to the underside and the forward end of key member **10** at point **9** is a cylindrical member **12** which is constructed of conductive material such as conducting rubber tubing. This may be rubber with a finely divided conductor, such as graphite interspersed throughout the rubber mass. Beneath key member **10** is contact plate **15** on which is supported a pair of conductive contacting elements **16** and **17** which are spaced from each other and from contacting member **12**. The axis of contacting member **12** is normal to the longitudinal axis of conductors **16** and **17** and the length of the contacting member **12** is sufficient to bridge the space between the conductors **16** and **17**. The conducting members **16** and **17** are electrically connected in a conventional manner to a tone generator in such a manner that upon electrically bridging these conductors **16** and **17**, a tone will be generated.

As key member **10** is depressed by the finger of the operator, the contacting member **12** electrically bridges the conductors **16** and **17** at the instant it contacts these members. This bridging of conductors **16** and **17** permits the creating of a tone in the normal manner. However, since contacting member **12** is constructed of a pliable substance, such as conducting rubber, further depression of key member **10** permits the contacting member **12** to assume an oval shape such as shown in Figure 3. Since the impedance between conductors **16** and **17** is controlled by the unit impedance of contacting member **12** and the area of this member **12** which bridges conductors **16** and **17**, increased depression of key member **10** decreases the impedance between conductors **16** and **17**. As a result, the amplitude of the tone generated by depression of key **10** may be increased by further depression until the contacting member **12** assumes a flattened shape. As a result, the operator is not only able to create a tone associated with a particular key **10**, but is further able to increase the volume of the tone generated by additional pressure on key **10**. Further, since the volume of the tone generated may be inversely proportional to the impedance of the bridge eliminated by the conductors **16** and **17**, the rate of "attack" may be controlled by the operator in accordance with the rate of depression of the key itself.

Since the contacting member itself is of a resilient material, not only does it permit actual electrical contacting or closing of the circuit at the tone generated, but its resiliency provides a cushioning effect as the key is depressed.

In the embodiment of the invention disclosed in Figures 1, 2, and 3, it is readily recognized that an approximately linear relationship is established between the depression of key **10** and the bridge resistance or impedance between conductors **16** and **17**. In particular embodiments it may be desired to have the impedance decreased more rapidly than linearly with depression of key **10**. To achieve such a result the embodiment shown in Figure 4 is utilized. In this embodiment, conductor **16**, supported by plate **15** terminates in a pair of wedge shaped members **20** and **21** having their points directed towards each other on opposite sides of center line **25**. In like manner, conductor **17** is terminated in a pair of wedge shaped plates **22** and **23** which are supported in a base plate **15** in symmetrical fashion to plates **20** and **21** on opposite sides of center line **25**. The center line **25** is mechanically aligned with the axis of contacting member **12**. In this embodiment, as key **10** is depressed, contacting member **12** bridges between conductors **16** and **17**, creating the tone as in the previous embodiment. However, further depression of key **10** not only causes the contacting member **12** to be compressed and assume an oval shape, but due to the positions of contacting switches **21**, **22**, and **23**, the bridging impedance between conductors **16** and **17** decreases at a much faster rate with depression of key **10**. As a result of this configuration, the intensity of the tone produced increases at a predetermined rate with linear depression of key **10**. Figure 5 discloses how the amplitude of the tone generated, signified by curve **50**, increases with depression of key **10**. The envelope of this curve **51** is a representation of the resulting amplitude. It may be seen that by proper design of the conductors this envelope may be made to have any desired curve.

In an embodiment of this invention constructed by the inventor, a conducting rubber member which gives a change of impedance from 100,000 ohms at contact depression to 5,000 ohms upon full depression of the key. The change of impedance in this particular change gives a somewhat exponential curve to the volume of the tone produced with key depression. This produces a pleasing

organ effect as the tone builds to maximum amplitude.

The material for the contacting member may have a very low or a very high impedance depending upon the amount and density of the conductive material used in the construction of the pliable material. It is readily seen that while the cross section shown for the contacting member is circular in the open position, other shapes may be used with equal convenience.

It is readily seen that the key contacting construction disclosed lends itself readily for use in printed circuit techniques. The conductors **16** and **17** in the embodiment shown are metal strips on a base plate **15** and may be plated elements, such as copper or silver supported by a nonconducting base plate such as a plastic material. It is further recognized that while the embodiment shown discloses a "single-pole, single-throw" type of switch, other switching combinations can, of course, be obtained by utilizing the principle of the present invention.

Although two modifications of the simple embodiment of the present invention are disclosed and described in detail, it is quite obvious to one skilled in the art that many changes may be made in the size, shape, arrangement and details of the elements of the structure and the proportioning thereof without departing from the spirit and scope as defined by the appending claim.

Figure 6 shows another embodiment of the invention for obtaining non-linear response. This is obtained by selectively painting coats of conducting rubber cement on the tubing member **10**. The layers of paint or rubber cement in the manner shown in Figure 6 wherein the first coat **60** is put on about one-half of the surface of

the tube. The next coat **61**, **61'** is placed on each side of the bottom, but not at the point of contact on the bottom. The third coat **62**, **62'** is further spaced as is the fourth coat **63**, **63'**. For purposes of illustration these conductive coats are shown much thicker than they might be in practice. Therefore, when the key is depressed, the impedance will decrease in a non-linear manner proportionate to the amount of pressure.

I claim:

A key switch for use in an electronic musical instrument comprising a movably plastic key member, a pair of conductive members below said member and forming part of a tone generating circuit, a tubular, flexible, conductive member attached to said key and having selective bridging contact with said conductive members to close said circuit, the flexibility of said tubular member providing a variable impedance between said conductive members.

References Cited in the file of this patent

UNITED STATES PATENTS

1,778,374	Spielmann	Oct. 14, 1930
1,849,724	Pudelko	Mar. 15, 1932
1,899,884	Severy	Feb. 28, 1937
2,260,412	Stephens	Oct. 28, 1941
2,303,516	Mehren	Dec. 1, 1942
2,470,148	Demuth	May 17, 1949
2,510,608	Stephen	June 6, 1950
2,528,086	Schenck	Oct. 31, 1950
2,694,128	Maurin	Nov. 9, 1954