Sept. 2, 1969 E. R. HERR ET AL 3,464,531

MANUAL ELECTRONIC KEYBOARD

Filed May 16, 1967

FIG. 1

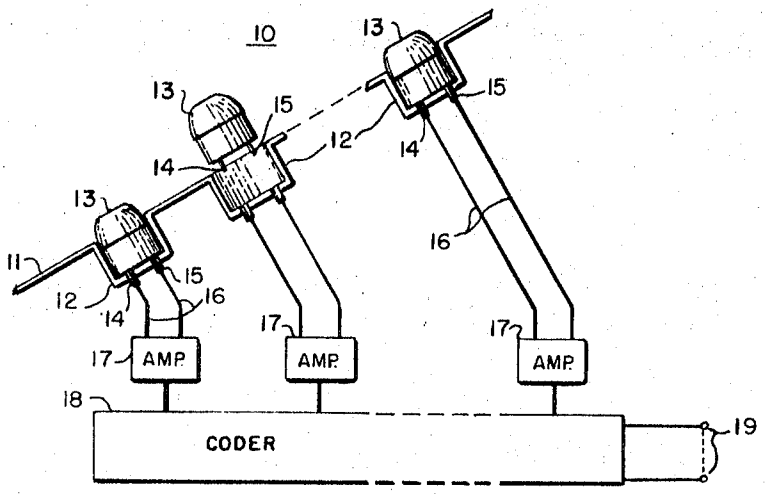


FIG. 2

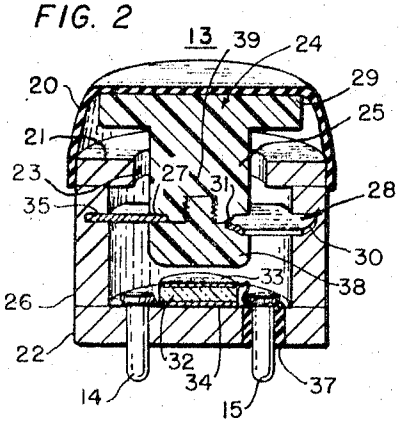


FIG. 3

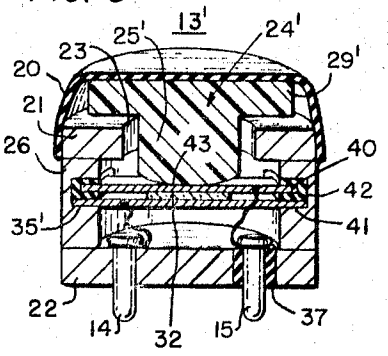


FIG. 4

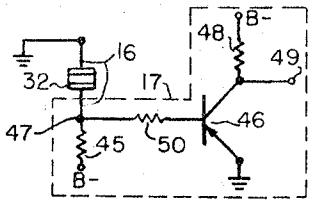
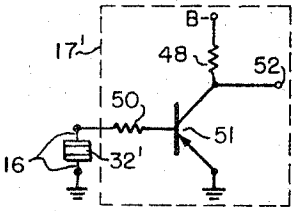


FIG. 5



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MANUAL ELECTRONIC KEYBOARD

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U.S. Cl. 197—98 2 Claims

ABSTRACT OF THE DISCLOSURE

This manual keyboard has a plurality of electronic keys arranged thereon. Each key includes a plunger slidably mounted in an opening provided in a housing which contains a piezoelectric or piezoresistive electro-mechanical transducer therein. A pair of output terminals is connected to the transducer and extends from the housing. The plunger is designed to be depressed by the fingers of an operator to compress or bend the transducer so as to generate an electrical signal. The signal is then detected by a coder.

Background of the invention

The present invention relates to a manual information input device and more particularly to electronic keyboards.

In the field of automatic data processing it has been the general practice to use manual keyboards which employ complicated mechanical levers, sliding bars, and other sundry gadgets which may work scatisfactorily in the controlled environment such as found in offices but fail rather quickly when exposed to the elements of a military environment.

It is, therefore, an object of the present invention to provide an electronic keyboard which is relatively immune to the effects of temperature, humidity, shock, dust, etc.

Another object is to provide an electronic keyboard which will operate in a manner which will impose no restrictions on the standard typist or his techniques.

A further object of the invention is the provision of an electronic keyboard which will be relatively quiet when being operated.

Brief description of the drawings

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing in which like reference characters designate like or corresponding parts throughout the figures thereof and wherein:

FIGURE 1 shows a schematic diagram of the electronic keyboard;

FIGURES 2 and 3 show isometric views in section with parts broken away of two alternative forms of a portion of the invention shown in FIGURE 1; and

FIGURES 4 and 5 show circuit diagrams of two alternative forms of a portion of the invention shown in FIGURE 1.

Description of the preferred embodiments

Referring now to the drawing, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIGURE 1 an electronic keyboard **10** having a mounting plate **11** and a plurality of receptacles **12** distributed in any desired fashion. A plug-in sensing key **13** is inserted in each receptacle **12**. Key **13** has a pair of contact plugs **14** and **15** which contact a pair of conductors **16** extending from each of the receptacles **12** to an amplifier circiut **17**. The

output of amplifiers **17** are connected to a coding circuit **18**, such as a diode matrix, which has a plurality of output terminals **19**. A flexible cover **20** is mounted on each key **13** and is arranged to be depressed by the fingers of an operator. The amplifiers **17** will detect the operation of the associated key and transmit a signal to the coder **18** thereby producing a coded output on lines **19**.

FIGURES 2 and 3 show two variations of the keys **13**. The key **13** of FIGURE 2 includes a cylindrical housing **26** having removable top and bottom walls **21** and **22** respectively. Top wall **21** has an opening **23** for the reception of the plunger **24**. Plunger **24** consists of a two-piece cylindrical shaft portion **25** and a circular cap portion **29**. The bottom portion **38** of shaft **25** is screwed into the top portion **39** to provide a circumferential groove **27** for the reception of a steel leaf spring **28**. Spring **28** is substantially rectangular in shape and has a central opening **31** to fit into groove **27** of shaft **25**. A pair of grooves **35** in the interior surface of housing **26** is provided for the reception of the curved ends **30** of spring **28**.

Bottom wall **22** has centrally located thereon an electromechanical transducer **32**. Transducer **32** should preferably be of durable material which is relatively immune to the effects of temperature, humidity, dust, etc. Most standard piezoelectric and piezoresistive materials meet these limitations. A pair of conductive contacts **33** and **34** are mounted on opposite sides of the transducer **32**. A pair of conductive plugs **14** and **15** extend through wall **22**. Plug **14** is connected to contact **34** and cover **22** and will be used as the ground terminal. Plug **15** is connected to contact **33** and is insualted from cover **22** by a dielectric bushing **37**. A flexible cover **20** is placed over cap **29** and into intimate contact with the exterior of housing **26**. The flexible cover **20** provides a finger engaging surface for the operator and a seal for protection of the interior of housing **26** from dust, moisture, etc.

The key **13** of FIGURE 2 is arranged to operate in the compression mode such that upon compression of transducer **32** a signal is generated on lines **16**. FIGURE 3 shows a modification wherein the transducer **32** is mounted to operate in a bending mode.

In FIGURE 3 the key **13'** includes a plunger **24'** having a cap **29'** and a shaft **25'** extending through an opening **23** in the top wall **21** of the housing **26**. The interior of housing **26** includes a pair of opposed grooves **35'**. The ends of a pair of leaf springs **40** and **41** are inserted in grooves **35'**. Springs **40** and **41** are made of conductive material. The ends of spring **40** are covered with an insulating material **42** and the ends of spring **41** are in contact with the conductive housing **26**. An electro-mechanical transducer **32** is sandwiched between the springs **40** and **41**. A pair of contact plugs **14** and **15** which extend through the bottom wall **22** are connected to springs **40** and **41** respectively. Plug **14** is in contact with the wall **22** and plug **15** is insulated from wall **22** by a dielectric bushing **37**. A flexible cover **20** covers cap **29'** and extends over housing **26** and into intimate contact therewith.

In the device of FIGURE 3, upon depression of plunger **24'** by an operator the transducer **32** will be flexed by the curved end portion **43** of plunger **24'**. In the case where the transducer **32** is a piezoelectric crystal a voltage will be developed between plugs **14** and **15** due to the bending of the transducer **32**. A change in resistance between plugs **14** and **15** will be produced by the bending of a piezoresistive transducer.

FIGURES 4 and 5 show circuit diagrams of the amplifiers **17** and the modification **17'** respectively and the relationship of the transducer in the circuit. The transducer **32** of FIGURE 4 would be of a piezoresistive type and is one side of a voltage divider circuit which includes transducer **32** and resistor **45**. The base electrode of

transistor **46** is connected through a high impedance resistor **50** to the midpoint **47** of the divider so that transistor **46** will be normally in the off condition. With a change in the resistance of transducer **32**, due to the operation of the key **13**, current will flow through transistor **46** and bias resistor **48**. Terminal **49** will therefore show a change in voltage which will be coded by coder **18**.

A piezoresistive transducer **32** may also form one leg of a balanced bridge the output of which could be applied to a transistor **46** for amplification and application to coder **18**.

The circuit of FIGURE 5 shows a piezoelectric transducer **32'** applied through a high impedance resistor **50** to the base of a transistor **51** for amplification of a voltage produced across transducer **32'**. The output terminal **52** of transistor **51** is to be applied to coder **18**.

These amplifiers **17** and **17'** could be located in the output lines **19** thereby reducing substantially the number of amplifiers. Of course, the outputs of the keys **13** would have to be of a sufficient amplitude to drive the coder **18**.

What is claimed is:

1. A manually operated electronic key comprising a housing; electromechanical transducer means mounted in said housing; a pair of conductive terminals extending from one side of said housing; conductive means for connecting said terminals to said transducer means; said transducer means having crystal means for providing an electrical signal at said terminals upon mechanical deformation of said crystal means; said housing having an opening on the side opposite said one side; a plunger upon movement of said plunger toward said crystal having a shaft and a cap mounted on one end of said shaft; said plunger being slidably mounted in said opening with said one end protruding from said housing and the other end of said shaft extending towards said crystal means; the length of said shaft being greater than the distance from said crystal means to said opening; a leaf spring means having two spaced leaves mounted in said housing for providing a restoring force to said plunger upon movement of said plunger toward said crystal means; said crystal means being sandwiched between and in contact with said leaves; and said leaf spring means being mounted in a plane transverse to the direction of motion of said plunger and with opposite ends thereof lying in slots formed in the walls of said housing.

2. The device according to claim **1** further including a flexible cup means extending over said cap and into frictional contact with the outside walls of said housing; and said cap being in contact with said cup means and said other end of said shaft being in contact with said leaf spring means.

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ERNEST T. WRIGHT, JR., Primary Examiner

U.S. Cl. X.R.

197—102; 310—8.3, 9.1

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,464,531 September 2, 1969

Edward R. Herr et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 32, "scatisfactorily" should read -- satisfactorily --. Column 3, line 32, cancel "upon movement of said plunger toward said crystal".

Signed and sealed this 21st day of April 1970.

(SEAL)
Attest:

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Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents