Dec. 29, 1970 A. FRENKEL 3,551,865

KEYBOARD SWITCH MEANS

Filed Aug. 20, 1968

FIG. 1

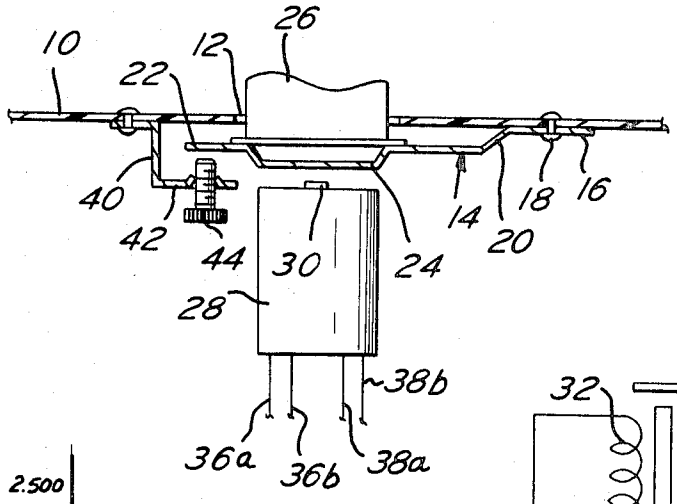
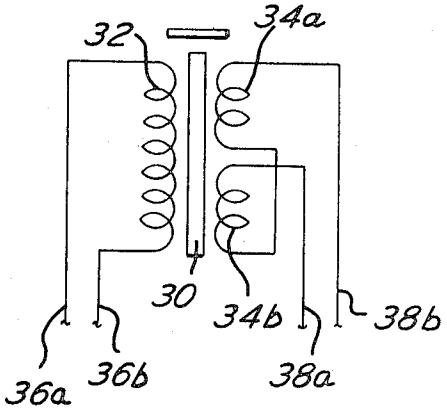


FIG. 3



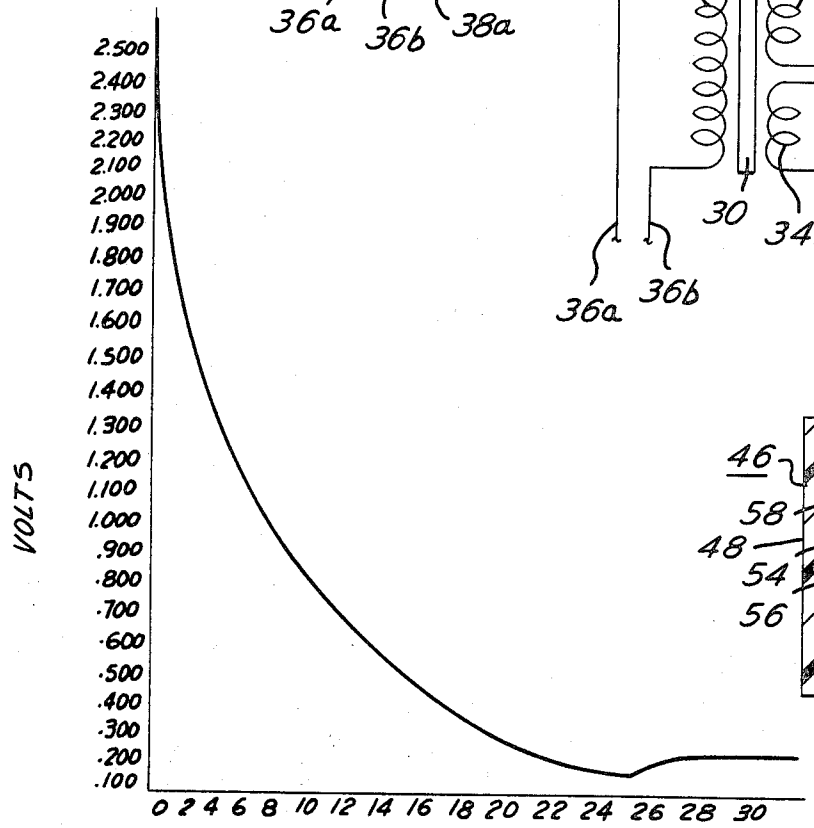


FIG. 2

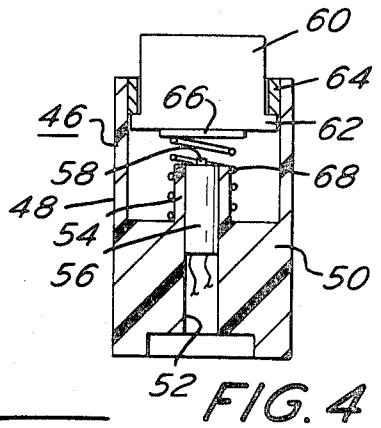


FIG. 4

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KEYBOARD SWITCH MEANS

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ABSTRACT OF THE DISCLOSURE

A pushbutton operated switch for a keyboard comprising a pushbutton mounted on a member of magnetic metal, a proximity transducer mounted beneath the member with the end of the core of the transducer being in closely spaced relation with the member, and spring means normally holding the member in spaced relation with the core but permitting the member to be moved toward the core. When the pushbutton is pressed the member is moved closer to the core of the transducer so as to increase the electrical output of the transducer.

The keyboards of computers and other electrically operated equipment generally use contact type switches operated by pushbuttons on the keyboard. When the pushbuttons are pushed, the switches are opened or closed to control the flow of current to the mechanism of the equipment being controlled by the pushbutton. All presently known contact type switches have many limitations, such as contact wear, surface corrosion of the contacts, noise level, speed of operation, wear of mechanical linkages, and adverse effects of external environmental conditions. Thus, the usable life of such contact switches is generally less than the usable life of the equipment being controlled so that it is often necessary to replace or repair the switches from time to time during the life of the equipment.

The pushbutton of the present invention includes a proximity transducer having a core. A member which may be of a magnetic metal is mounted adjacent to one end of the core. The member is supported on a spring which in its normal position holds the member in closely spaced relation with respect to the core of the transducer, but permits movement of the member toward the core. A pushbutton is mounted on the member whereby the member can be moved toward the core of the transducer. The transducer is of the type that provides an increase in electrical output when the member is moved closer toward the core. Thus, when the pushbutton is pressed, the member is moved closer to the core of the transducer so as to provide an increase in the electrical output of the transducer. This electrical signal can be used to operate a mechanism being controlled by the switch. The switch can be connected on a panel with the pushbutton projecting through a hole in the panel.

For the purpose of illustrating the invention there is shown in the drawings forms which are presently preferred; it being understood however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a side view of a panel having the switch of the present invention mounted thereon.

FIG. 2 is a graph showing the electrical characteristics of a proximity transducer of the type utilized in the switch of the present invention.

FIG. 3 is a schematic circuit diagram of a proximity transducer of the type utilized in the switch of the present invention.

FIG. 4 is a transverse sectional view of a modification of the switch means of the present invention.

Referring to FIG. 1 of the drawings there is shown a

panel **10** having an opening **12** therethrough. A leaf spring **14** is positioned beneath the panel **10**. One end **16** of the leaf spring **14** is secured to the panel **10**, such as by a rivet **18**, at a point adjacent to but spaced from the opening **12**. The spring **14** has a bend **20** adjacent to the end **16** so that the free end **22** of the spring **14** extends substantially parallel to but slightly spaced from the undersurface of the panel **10**. A downwardly extending depression **24** is provided in the free end **22** of the spring **14** directly under the opening **12** in the panel **10**. A pushbutton **26** is mounted on the free end **22** of the spring **14** and projects through the opening **12** in the panel **10**.

A proximity transducer **28** is mounted beneath the free end **22** of the spring **14** with the core **30** of the transducer **28** being adjacent to but slightly spaced from the bottom surface of the depression **24** in the spring **14**. The construction of a proximity transducer is well known to those skilled in the art. As shown in FIG. 3, such a transducer includes the core **30**, a primary winding **32**, and a pair of secondary windings **34***a* and **34***b*. The primary winding **32** has a pair of input terminals **36***a* and **36***b*. The secondary windings **34***a* and **34***b* are electrically connected in bucking arrangement and have a pair of output terminals **38***a* and **38***b*. The secondary windings **34***a* and **34***b* are electrically coupled to the primary winding **32** through the core **30** so that an electrical input to the primary winding **32** produces an electrical output from the secondary windings **34***a* and **34***b*. With the electrical input to the primary winding **32** being held constant, the output from the secondary windings **34***a* and **34***b* can be increased by bringing a member of magnetic materials, such as the spring **14**, into close proximity to the end of the core **30**. The closer the member is brought to the core **30** the higher the output from the secondary windings **34***a* and **34***b*. FIG. 2 is a graph from a typical proximity transducer showing the output voltage of the transducer **28** for various distances between the core **30** and the magnetic member. As can be seen from this graph, a small movement of the spring **14** toward the core **30** can cause a relatively large incraese in the electrical output of the transducer **28**.

In the operation of the switch of the present invention, an electrical input is applied to the primary winding **32** of the transducer **28**, and the output terminals **38***a* and **38***b* are electrically connected to a mechanism to be controlled so that an increase in the output of the transducer **28** will operate the mechanism. Thus, when the pushbutton **26** is pressed downwardly, the spring **14** is moved closer to the core **30** of the transducer **28**. This provides an increase in the output of the transducer **28** so as to operate the mechanism. To ensure that the same output of the transducer **28** is obtained each time the pushbutton **26** is pushed, the switch may be provided with means for limiting the movement of the spring **14** toward the core **30** of the transducer **28**. As shown in FIG. 1, such a stop means can comprise a bracket **40** second to the undersurface of the panel **10** and extending downwardly across the free end of the spring **14**. The bracket **40** has a ledge **42** at its bottom end which extends beneath the free end of the spring **14**. A screw **44** is threaded through the ledge **42** and extends toward the spring **14**. Thus, each time the pushbutton **28** is pressed, the spring **14** will engage the end of the screw **44** so as to obtain a uniform output from the transducer **28**. By properly positioning the screw **44**, an output can be obtained from the transducer **28**. Thus, the stop means not only provides a uniform output of the transducer **28**, but also permits an adjustment of the output.

Thus, there is provided by the present invention of a switch which has no moving or contacting parts which can become worn, corroded or otherwise damaged so as to adversely affect the operation of the switch. Although

the spring **14** moves, the extent of its movement is so small that the spring **14** has an extremely high cycle life, 10,000,000 or more. Also, the switching characteristics of the switch cannot be adversely affected by external environmental conditions. In addition, the output of the switch can be either an A.C. signal or a detected D.C. signal so that the switch can be used to operate any type of mechanism. Thus, the switch of the present invention will have an operating life as long as that of the equipment in which it is to be used. Although FIG. 1 shows a panel having only one switch of the present invention, it should be understood that the panel can contain any desired number of the switches according to the requirements of the equipment being controlled.

Referring to FIG. 4, a modification of the switch means of the present invention comprises a cup-shaped housing **46** having a cylindrical wall **48** and a base **50** extending across one end of the wall **48**. The base **50** has a hole **52** extending through the center thereof, and a cylindrical boss **54** projects upwardly from the base **50** around the hole **52**. A proximity transducer **56** is secured in the hole **52** with the end of the core **58** of the transducer **56** being positioned at the upper end of the boss **54**. The transducer **56** is of the same type as the transducer **28** of the switch means shown in FIG. 1.

A pushbutton **60** is positioned in the upper, open end of the housing wall **48**. The outer diameter of the pushbutton **60** is smaller than the inner diameter of the housing wall **48**, and an annular flange **62** projects radially from the bottom end of the pushbutton. A retainer ring **64** is secured in the upper end of the housing wall **48**. The retainer ring **64** extends around the pushbutton **60** and over the flange **62** of the pushbutton. A disk **66** of a magnetic metal is secured to the bottom surface of the pushbutton **60**. A helical spring **68** surrounds the boss **54** and is compressed between the disk **66** and the housing base **50**. The spring **68** normally presses the disk **66** and the pushbutton **60** upwardly until the pushbutton flange **62** engages the retainer ring **64**.

In the use of the switch means **46** the spring **68** normally holds the disk **66** away from the core **58** of the transducer **56**. When the pushbutton **60** is pressed downwardly, the disk **66** is moved toward the core **58** and thereby increases the electrical output of the transducer **56** in the manner previously described with regard to the switch means of FIG. 1. If desired, the switch housing **46** can be mounted on a panel with the pushbutton **60** projecting through an opening in the panel.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

What is claimed is:

1. A switch means comprising a proximity transducer having opposite ends, having a primary winding for receiving an alternating energizing signal, a secondary winding with sections connected in opposing relationship, said primary and secondary windings being about a core opening and a fixed magnetic core within said core opening, extending the full length of the primary and secondary windings, having an end at one end of said transducer; a member of metallic material; and means positioning said member external to said transducer and normally in closely spaced relation with respect to the end of the core of said transducer while permitting movement of said member for changing its spacing with the end of said core; the secondary winding of said transducer providing a change in electrical output when said member is moved with respect to said core.

2. Means in accordance with claim **1** in which said means positioning said member comprises a spring permitting movement of said member from its normal position toward the end of the core of said transducer.

3. Means in accordance with claim **2** in which said spring is a leaf spring fixedly supported at one end and positioning said member at its other end.

4. Means in accordance with claim **2** in which the secondary winding of said transducer provides an increase in electrical output when said member is moved toward the end of the core of said transducer.

5. Means in accordance with claim **1** including a housing having an opening therein, said transducer being received within the opening of said housing, said member positioning means comprising a coil spring received within the openng of said housing having an end proximate to the transducer and another end proximate to said member.

6. Means in accordance with claim **5** including a pushbutton received at least partially within the opening of said housing and having an externally exposed end and an internal end engaging said member, said housing being provided with retaining means for retaining said pushbutton within the opening of said housing while allowing the pushbutton to slide within the housing for compressing said spring and moving said member toward said transducer.

7. A switch comprising a proximity transducer having opposite ends, having a primary winding for receiving an alternating energizing signal, a secondary winding with sections connected in opposing relationship, said primary and secondary windings being about a core opening, and a fixed magnetic core within said core opening, extending the full length of the primary and secondary windings, having an end; a member of metallic material; spring means normally holding said member in closely spaced relation with respect to the one end of the core but permitting movement of said member toward said core; said transducer providing an increase in electrical output when the member is moved closer to the core; a panel having an opening therethrough; said spring means being a leaf spring with an end secured to the panel adjacent to but spaced from the opening and another end extending across the opening in the panel; and a pushbutton mounted on the other end of the spring and projecting through the opening in the panel.

8. Means in accordance with claim **7** including a stop means engageable by the other end of the spring to limit the movement of the other end of the spring toward the core of the transducer.

9. Means in accordance with claim **8** in which the stop means comprises a bracket secured to the undersurface of the panel and extending across the other end of the spring, a ledge extends from the end of the bracket beneath the other end of the spring, and a screw is threaded through the ledge and extends toward the other end of the spring.

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336—134; 340—365