

PATENT SPECIFICATION

(11)

1 602 763

1 602 763

(21) Application No 21494/78

(22) Filed 23 May 1978

(31) Convention Application No 68166

(32) Filed 23 May 1977 in

(33) Italy (IT)

(44) Complete Specification Published 18 Nov 1981

(51) INT. CL.³ B41J 5/08

(52) Index at Acceptance B6F CL H1N 441 45X 54X 649 700 744

(72) Inventors: Michele Bovio, Pietro Castellano



(54) ELECTRIC KEYBOARD OF SNAP-CONTACT TYPE

(71) We, ING. C. OLIVETTI & C., S.P.A., of via G. Jervis 77, 10015 Ivrea, Italy, a body corporate organized and existing under the laws of Italy, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to an electric keyboard having snap contacts.

There are many keyboards in which the depression of a key leads to an electrical connection between two areas of a circuit affected by the snap action of metallic laminae. These laminae are very elastic and, for example, are given a bow-shaped or dome-shaped form. Each lamina is supported at the edges and depression of a key leads to the compression of the lamina through an intermediary spring. Its deformation into an unstable configuration leads to the sudden production of a curvature in the opposite direction to that present initially and to the formation of the desired electrical connection. On releasing the key the elasticity of the material overcomes the load of the intermediary spring and restores the lamina to its initial stable form.

Known keyboards of this type have the advantage of being economical. However, the working load of the key is found to be greater than that in the best release keyboards; besides this, the release behaviour of the individual key depends essentially on the physical and dimensional characteristics of the material employed on the physical and dimensional characteristics of the material employed for the lamina and on its processing, with particular reference to wear of the stamps used in manufacture. In order to ensure uniform wear of different keys in a keyboard, it is generally necessary to test the keys, which means a considerable increase in the cost of the keyboard. Finally, the present values of the working load exclude the use of these keyboards in sectors of typing machines and apparatus for data transmission where the ergonomic demands by users are very severe.

The object of the present invention is to provide a keyboard with snap-acting keys which employ deformable laminae, whose operating

load is very low and whose ergonomic behaviour is uniform even with materials from different batches and treated in equipment having different degrees of wear.

According to the present invention there is provided a keyboard comprising a key which, when depressed, elastically deforms a conductive lamina which thereby goes with a snap action from a stable configuration to an unstable configuration and wherein an electrical circuit is completed through the lamina in only one of the two configurations, the lamina having the form of two mutually transverse pairs of parallel edge strips spanned by a diagonal strip is bowed in the stable configuration towards the key.

This structure, when used with a standard key, provides very flexible laminae by using relatively long strips of limited transverse dimensions and such that they are not very sensitive to changes in the thickness of the material. Also, the use of simple folds in the lateral strips makes the lamina fairly insensitive to the extent of wear of the key.

The invention will be described in more detail, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a plan view, partially in section, of a keyboard embodying the invention;

Figure 2 is a schematic sectional elevation of the keyboard according to Figure 1;

Figure 3 is a section of one key of the keyboard, on an enlarged scale compared with that shown in Figure 1;

Figure 4 is a bottom view of the form of key shown in Figure 3;

Figure 5 is a perspective view of a detail of Figure 4;

Figure 6 is a section of a detail in Figure 4;

Figure 7 is a work diagram of the key of Figure 3;

Figure 8 is an enlargement of a different form of key of the keyboard in Figure 1;

Figure 9 is a view from below of the form of key of Figure 8;

Figure 10 is a work diagram of the form of key of Figure 8.

With reference to Figure 1, a keyboard with contacts comprises a frame 12 provided with

holes 13 into which are inserted individual keys 14. The keys 14 rest on the insulating support of a printed circuit 15, which for each key 14 is furnished with a pair of conducting areas 17 and 17a. The keyboard finally comprises a bottom closure 18; screws 20 to hold the different parts together and a rubber lining 21 renders the return to rest of the keys 22 noiseless.

Each key 14 (Figure 3) comprises a body 25, substantially parallelepipedal with a square section having bevelled corners internally hollow and having an open bottom. This body 25 is provided, in its upper portion, with a reduced cylindrical part 26, and in its lower part and internally with two rectangular-section guides 23 (Figure 4), which guide in a sliding manner a key shank 27 supporting a key button 22 (Figure 3). In a cavity 28 of the shank 27 there slides an actuator 29, which is urged downwardly by a spring 30. Two arms 31 of the actuator 29 are guided in grooved flanges 33 of the shank 27 and can be stopped by these by means of two lugs 32, while two stops 34 are provided to hold towards the base two arms 35 of the shank 27. The lower part of the body 25 houses a metallic lamina 36, which, by compressing the spring 30, normally holds the key 22 in the raised position, with a crossbar 38 of the arms 35 held against a check surface 39 of the body 25.

The actuator 29, the shank 27 and the body 25 are of thermoplastic material and are assembled in a very simple manner. In particular, having inserted the spring 30 in the cavity 40 of the actuator 29, the latter is inserted in the cavity 28 of the leg 27. The lugs 32 of the arms 31 are sprung apart by the edges of flanges 33, whereby the arms 31 enter corresponding grooves 41. The shank 27 is in turn inserted in the bottom of the body 25, guided by two lugs 42 in the guides 23. By pressing the arms 35 against the stops 34 the latter are overcome, thus completing the assembly of the parts.

With reference to Figures 4 and 5, the lamina 36 is sheared from a spring steel ribbon of 0.1 mm thickness.

The lamina is of generally square outline but with bevelled corners and comprises two opposite and parallel edge strips 47 and two opposite and parallel edge strips 48 connected by four corner strips 44 at 45° to the edge strips. Two generally triangular windows 45 are cut through the lamina so that two diagonal opposite corner strips are spaced by a diagonal strip 46. Lugs 49 and 50 project outwardly from the other two corner strips. Each edge strip has a bend line 51 across the width of the strip nearer to the corner strips with lugs than the corner strips which are spanned by the diagonal strip 46. On the underside of the lamina at the centre of the diagonal strip 46 and in the lug 49 are soldered contact pads 52 and 53 respectively for contact with the printed circuit areas 17 and 17a.

The bends 51 of the two pairs of strips 47

and 48 (Figure 5) are all downwardly concave which causes the strip 46 to bow downwardly.

The lamina 36 is located in the body 25 (Figure 4) with the lug 50 engaged therewith by bearing on edge 65. The lug 50 is shorter than lug 49 and it is lodged in a corner groove 60 and with parts of the strips 47 and 48 next to the lug 50 resting downwards against two lugs 61 of the body 25. The lug 49 is lodged in a groove 62 and may be held by two lugs 63 of the body 25 without being prevented in its upward movement. The corner strips 44 at the ends of the diagonal strip 46 bear against two corresponding inclined surfaces 64 of the body 24, which cause further bowing of the strip 46 and the raising of the actuator 29 and shank 27.

The keys 14 are assembled in the keyboard by inserting the cylindrical parts of the bodies 25 in the holes 13 (Figure 1) of the frame 12, with a small lug 70 engaged in a corresponding notch 71. Through two windows 67 (Figure 6) in the bodies 25, through the surfaces 39, there protrude upwards upper extensions 68 of the arms 35, which thus bear against the rubber lining 21 instead of by the surfaces 39. Having arranged the printed circuit 15 (Figure 3) against the lower edges of flanges 25, (Figure 2) the contact pads 53 rest elastically on the areas 17a while the pads 52 face the areas 17 (Figure 1). The screws 20, screwed through holes 73 (Figure 1) hold all parts together. The key buttons 22 are then fitted onto the shanks 27.

With further reference to the diagram of Figure 7, showing the force in grams as a function of the displacement of the key 22 expressed in mm, the key 14 is normally pushed upwards against the stops by a force generated by the lamina 36 of about 20 gm. Initial depression of key 14, line 80, induces gradual compression of the spring 30, with a rising force on the key 14, until there is a sudden yield of the diagonal strip 46 of the lamina 36, at a force of about 60 gm, line 82 and at a depression of about 2.6 mm for the key 14. At this point there occurs the snap contact of the pad 52 (Figure 3) on the area 17 and unfailing electrical contact is made between the two areas 17a and 17. The spring 30 lengthens and the load decreases; further depression of the key 14 to a travel of about 4 mm, line 83, causes a further increase of the load on the key without any other practical effect. Later release of the key, line 84 by extending the spring 30, lowers the load on the key 14 down to a value of about 30 gm and a position of about 1.5 mm, at which the elastic reaction of the lamina 36 overcomes the action of the spring 30 on the actuator 29, with a snap action which returns the strip 46 to its initial conformation and compresses the spring, thus making the load on the key 14 increase, line 85. Further release of key 22 leads to final lowering of the normal rest conditions, with the cushioned and silent abutment of the protrusion 69 of the shank 27 against the rubber lining 21.

In consistent lots of laminae 36, coming from various parts of steel stock and produced by presses having different degrees of wear, the ergonomic conditions of key functioning described above having turned out to be closely comparable among themselves. The forces on the keys 14 for snap deformations of the laminae 36 and for the contact are sufficiently low, the extent of travel is equal among them, and comparable respectively with analogous loads in the best electro-mechanical keyboards. As a result, this type of keyboard may also be used in typewriters, without any appreciable difference being noticed by the operators with respect to motor powered keyboards.

With reference to Figure 8, there is shown at 89 another form of key according to the invention which may also be used to obtain special functions such as "repeat". This comprises a parallelepipedal body 90 with a rectangular section, having the same width as the body 25 but twice the length, which houses two laminae 36 in the manner already described for the body 25. The shank 91 of the key 88 is also guided by rectangular guides 23 of the body 90, and is lengthened in form. This is provided on one side with a cylindrical body 89 with a cavity in which are lodged the spring 30 and the actuator 31 in contact with the laminae 36, as described above for the form 14. On the other side, the shank 91 has a rigid actuator 93 arranged above the second laminae 36 at a distance greater than the stroke required by the leg 91 to make the first laminae 36 snap down.

In its central part the shank 91 is provided with a cylindrical central cavity 94, in which is lodged a small cylinder 95, this also being hollow and urged away from the key button 88 by a spring 96. Two U-shaped arms 97 of the small cylinder 95, by means of two pairs of lugs 98, opposed by two pairs of shoulders 86 of the shank 91, prevent exit of the small cylinder 95 from the cavity 94. The shank 91 finally has two horizontal arms 99 and 100 (Figure 9) which come out radially from the body 89 and the actuator 93, at 45° to the horizontal axis of the body 90. These arms 99 and 100 are provided with two upper parts 101 and 102 which protrude through the windows 103 and 104 of the body 90 and are stopped by the rubber lining 21 of the keyboard.

Referring again to the diagram of Figure 10, normal depression of key 88 leads initially to contact of lamina 36 below the actuator 31, as previously described, until the base 105 of the small cylinder 95 is held against the support of the printed circuit 15. Further lowering of the shank 91, as it approaches the small cylinder 95, compresses the spring 96 and then brings the rigid actuator 93 into contact with the other lamina 36, snapping it down to contact the pad 52 with the underlying area 17. The pre-load of the spring 96, line 110 equal to about 8 times that of the spring 30 gives the feeling of execution of the function "repeat"

and the second contact not represented in the diagram, occurs at about 4.8 mm depression of the key 89.

The shank 91 can be mounted in the body 90 in a position rotated by 180° with respect to that described, thus positioning the rigid actuator 93 above the first lamina 36 and the actuator 31 above the second lamina. The protrusion 101 and 102 of the arms 99 and 100 protrude from the holes 104 and 105 respectively of the body 90. With this arrangement it is possible to obtain, on two different pairs of adjacent areas 17 and 17a normal and "repeat" functions.

WHAT WE CLAIM IS—

1. A keyboard comprising a key which, when depressed, elastically deforms a conductive lamina which thereby goes with a snap action from a stable configuration to an unstable configuration and wherein an electrical circuit is completed through the lamina in only one of the two configurations, the lamina having the form of two mutually transverse pairs of parallel edge strips spanned by a diagonal strip, the edge strips having permanent bends set into them such that the diagonal strip is bowed in the stable configuration towards the key.
2. A keyboard according to Claim 1, wherein the lamina co-operates with the two conductors of which one is permanently contacted by a first contact on the lamina adjacent one end of the diagonal strip, a second contact on the lamina the central region of the diagonal strip being spaced from the other conductor in the said stable configuration but making contact therewith in the unstable configuration.
3. A keyboard according to Claim 2, wherein the lamina is housed inside a hollow body of internal section corresponding substantially to the outline of the lamina but with the second contact on a lug projecting at a corner of the lamina through an aperture at a corner of the hollow body.
4. A keyboard according to Claims 1, 2 and 3 wherein a single key actuates two laminae, one through an actuator resiliently coupled to the key and the other through an actuator fixed to the key.
5. A keyboard according to Claim 4, wherein the single key acts on one lamina by way of an actuator resiliently connected to the key by a spring and acts on the other lamina, by way of a second actuator fixed to the key, only after the first lamina has been snapped into its unstable configuration, a second spring being arranged to increase the resistance of the key when the key has been depressed far enough to snap the first lamina into its unstable configuration.
6. A keyboard according to Claim 5, wherein the key is mountable in either of two orientations related by a rotation of 180°, the first and second actuators actuating first and second ones respectively of the two laminae in



In consistent lots of laminae 36, coming from various parts of steel stock and produced by presses having different degrees of wear, the ergonomic conditions of key functioning described above having turned out to be closely comparable among themselves. The forces on the keys 14 for snap deformations of the laminae 36 and for the contact are sufficiently low, the extent of travel is equal among them, and comparable respectively with analogous loads in the best electro-mechanical keyboards. As a result, this type of keyboard may also be used in typewriters, without any appreciable difference being noticed by the operators with respect to motor powered keyboards.

With reference to Figure 8, there is shown at 89 another form of key according to the invention which may also be used to obtain special functions such as "repeat". This comprises a parallelepipedal body 90 with a rectangular section, having the same width as the body 25 but twice the length, which houses two laminae 36 in the manner already described for the body 25. The shank 91 of the key 88 is also guided by rectangular guides 23 of the body 90, and is lengthened in form. This is provided on one side with a cylindrical body 89 with a cavity in which are lodged the spring 30 and the actuator 31 in contact with the laminae 36, as described above for the form 14. On the other side, the shank 91 has a rigid actuator 93 arranged above the second laminae 36 at a distance greater than the stroke required by the leg 91 to make the first laminae 36 snap down.

In its central part the shank 91 is provided with a cylindrical central cavity 94, in which is lodged a small cylinder 95, this also being hollow and urged away from the key button 88 by a spring 96. Two U-shaped arms 97 of the small cylinder 95, by means of two pairs of lugs 98, opposed by two pairs of shoulders 86 of the shank 91, prevent exit of the small cylinder 95 from the cavity 94. The shank 91 finally has two horizontal arms 99 and 100 (Figure 9) which come out radially from the body 89 and the actuator 93, at 45° to the horizontal axis of the body 90. These arms 99 and 100 are provided with two upper parts 101 and 102 which protrude through the windows 103 and 104 of the body 90 and are stopped by the rubber lining 21 of the keyboard.

Referring again to the diagram of Figure 10, normal depression of key 88 leads initially to contact of lamina 36 below the actuator 31, as previously described, until the base 105 of the small cylinder 95 is held against the support of the printed circuit 15. Further lowering of the shank 91, as it approaches the small cylinder 95, compresses the spring 96 and then brings the rigid actuator 93 into contact with the other lamina 36, snapping it down to contact the pad 52 with the underlying area 17. The pre-load of the spring 96, line 110 equal to about 8 times that of the spring 30 gives the feeling of execution of the function "repeat"

and the second contact not represented in the diagram, occurs at about 4.8 mm depression of the key 89.

The shank 91 can be mounted in the body 90 in a position rotated by 180° with respect to that described, thus positioning the rigid actuator 93 above the first lamina 36 and the actuator 31 above the second lamina. The protrusion 101 and 102 of the arms 99 and 100 protrude from the holes 104 and 105 respectively of the body 90. With this arrangement it is possible to obtain, on two different pairs of adjacent areas 17 and 17a normal and "repeat" functions.

WHAT WE CLAIM IS—

1. A keyboard comprising a key which, when depressed, elastically deforms a conductive lamina which thereby goes with a snap action from a stable configuration to an unstable configuration and wherein an electrical circuit is completed through the lamina in only one of the two configurations, the lamina having the form of two mutually transverse pairs of parallel edge strips spanned by a diagonal strip, the edge strips having permanent bends set into them such that the diagonal strip is bowed in the stable configuration towards the key.

2. A keyboard according to Claim 1, wherein the lamina co-operates with the two conductors of which one is permanently contacted by a first contact on the lamina adjacent one end of the diagonal strip, a second contact on the lamina the central region of the diagonal strip being spaced from the other conductor in the said stable configuration but making contact therewith in the unstable configuration.

3. A keyboard according to Claim 2, wherein the lamina is housed inside a hollow body of internal section corresponding substantially to the outline of the lamina but with the second contact on a lug projecting at a corner of the lamina through an aperture at a corner of the hollow body.

4. A keyboard according to Claims 1, 2 and 3 wherein a single key actuates two laminae, one through an actuator resiliently coupled to the key and the other through an actuator fixed to the key.

5. A keyboard according to Claim 4, wherein the single key acts on one lamina by way of an actuator resiliently connected to the key by a spring and acts on the other lamina, by way of a second actuator fixed to the key, only after the first lamina has been snapped into its unstable configuration, a second spring being arranged to increase the resistance of the key when the key has been depressed far enough to snap the first lamina into its unstable configuration.

6. A keyboard according to Claim 5, wherein the key is mountable in either of two orientations related by a rotation of 180°, the first and second actuators actuating first and second ones respectively of the two laminae in

(16)

4

1 602 763



4

one orientation and the second and first ones respectively of the two laminae in the other orientation.

7. A keyboard according to any of Claims 1 to 6, wherein a plurality of keys are mounted through a panel having a resilient layer on its under-side and against which stops of the keys bear to cushion and silence return of the keys as their laminae spring back to their stable configurations.

8. A keyboard according to any of Claims 1 to 5, wherein the or each lamina is of substantially square outline and comprises two bevelled corners aligned with the diagonal strip.

9. A keyboard according to Claim 8, wherein the or each lamina comprises at least one lug on a corner of the transverse strips,

further comprising a support of the lamina including means engaging the lug and two inclined surfaces on which bear the bevelled corners for further bowing the diagonal strip.

10. A keyboard substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 6 of the accompanying drawings.

11. A keyboard substantially as hereinbefore described with reference to and as illustrated in Figures 8 and 9 of the accompanying drawings.

REDDIE & GROSE
16 Theobalds Road
London WC1X 8PL
Agents for the Applicants

Printed for Her Majesty's Stationery Office by MULTIPLEX medway Ltd., Maidstone, Kent, ME14 1JS, 1981. Published at the Patent Office, 25 Southampton Buildings, London WC2 1AY, from which copies may be obtained.