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[21] Appl. No. **793,109**
[22] Filed **Jan. 22, 1969**
[45] Patented **Oct. 5, 1971**
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[32] Priority **Jan. 22, 1968**
[33] **Italy**
[31] **50218-A/68**

[54] **HALL EFFECT KEYBOARD**
4 Claims, 8 Drawing Figs.

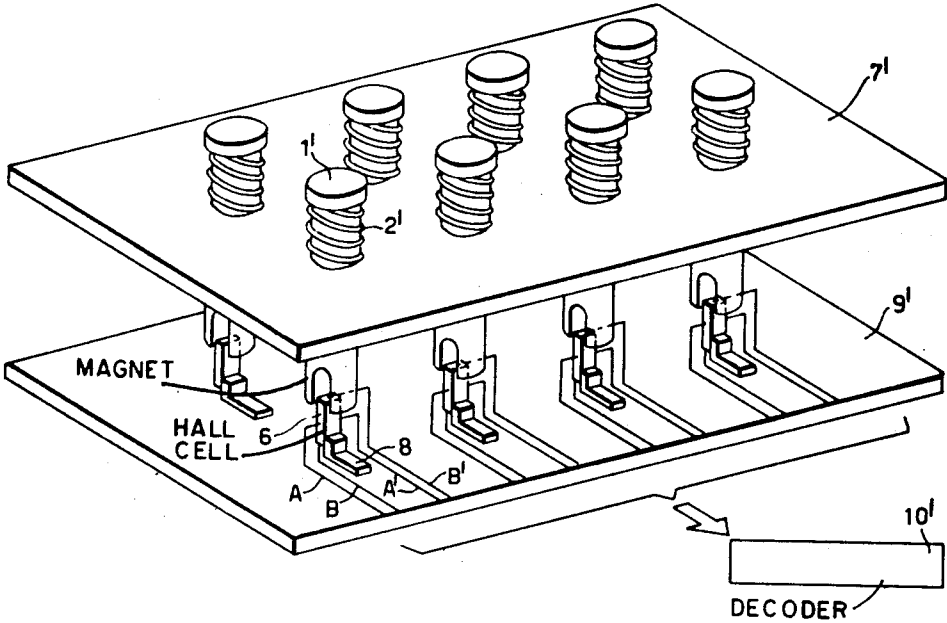
[52] U.S. Cl. **340/365,**
340/174 HA
[51] Int. Cl. **H04I 15/06**

[50] **Field of Search**..... **340/365,**
174 PM, 174 HA; 178/79, 17

[56] **References Cited**
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ABSTRACT: A keyboard device wherein the operation of each key generates a relevant electric signal. Each key is associated with a magnetically responsive element and is provided with means for producing a magnetic field variation in said element in response to operation of the involved key.



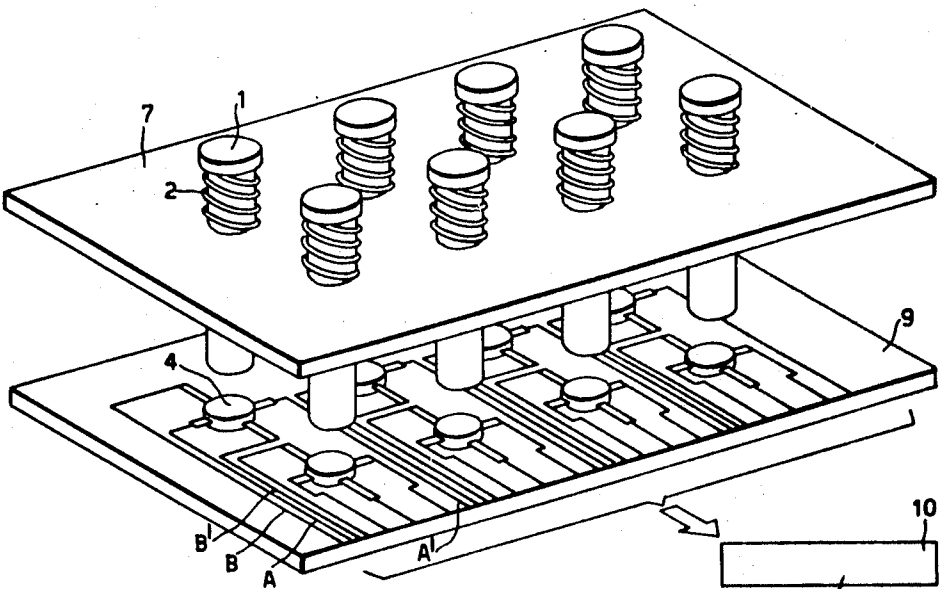


Fig. 1

DECODER

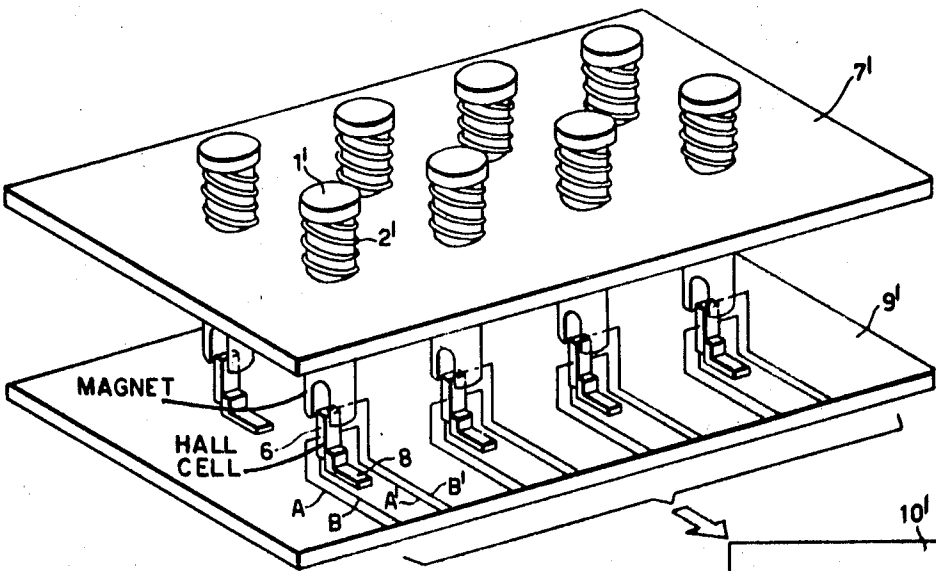
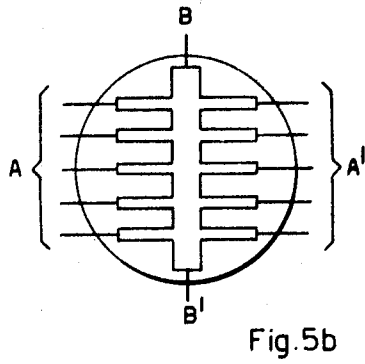
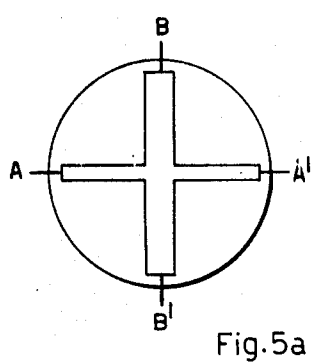
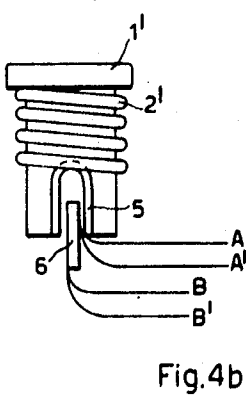
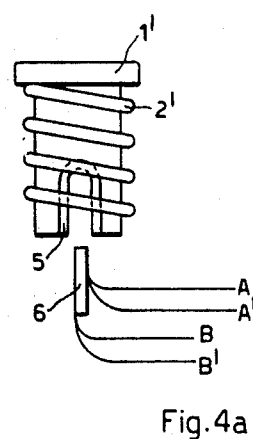
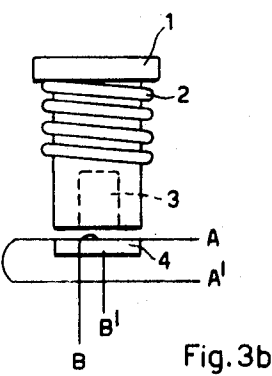
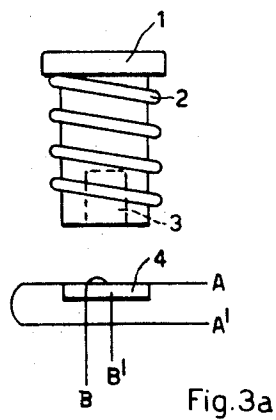


Fig. 2

DECODER

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HALL EFFECT KEYBOARD

CROSS REFERENCE TO RELATED APPLICATION

Applicant claims priority from corresponding Italian patent application Ser. No. 50218-A/68, filed Jan. 22, 1968.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a keyboard device having Hall effect elements.

2. Description of the Prior Art

Keyboard devices acting mechanically on a key wherein the state of an electric circuit without contacts is varied are known. This eliminates the disadvantages of contact devices such as relays and the switches that transform mechanical action into electrical action. In one known device, the operation of a key produces the energization of a photoelectric cell and consequently the generation of an electric signal in correspondence with the operated key.

Keyboard devices of this type require excessive space and are expensive because the components that transform the mechanical action into an electric signal are intricate and expensive.

SUMMARY OF THE INVENTION

These and other disadvantages are obviated by the keyboard device according to the invention wherein the operation of each key generates a relevant electric signal. Each key is associated with a magnet responsive element and is provided with means for generating a magnetic field variation in said element in response to operation of the involved key.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a keyboard with horizontal Hall cells;

FIG. 2 shows a second example of a keyboard with vertical Hall cells;

FIGS. 3a and 3b show details of the key, magnet and horizontal Hall cell;

FIGS. 4a and 4b show details of a key, magnet and vertical Hall cell;

FIG. 5a and 5b show two types of Hall cells.

The Hall effect is well known; if through a thin metal plate an electric current is flowing in a given direction and a variable magnetic field is applied in perpendicular relationship to the plate then at the sides of the plate through which the current is flowing, in perpendicular direction to the current and on the same plane thereof, a potential difference is produced.

With reference to FIG. 1, support plate 7 with keys 1 (in specific example, eight keys) having corresponding Hall cells 4, horizontally inserted on a plate with printed circuit 9 is shown. The electric signals supplied by plate 9 may be applied to decoder 10 which transforms them according to predetermined codes for the processing operation. In the Hall cell shown in FIG. 5a, the signal produced is picked up from terminals AA' and the feeding voltage is applied to terminals BB'. The cell comprises a plate made of bismuth, gallium arsenide, indium antimonide or material having similar characteristics. Associated with each key 1 and Hall cell 4 is a cylindrical permanent magnet 3 that is inserted into the key, as shown in FIG. 3a.

The position of key 1 and corresponding permanent magnet 3 with respect to Hall cell 4 is shown in FIG. 3a. The mutual position of permanent magnet 3 and of cell 4 resulting when the key is depressed is shown in FIG. 3b. As permanent magnet 3 approaches the corresponding Hall cell, it varies the magnetic field generated by the permanent magnet on the thin plate of the cell through which is flowing the current fed to terminals BB'. Then, because of the Hall effect, an electric signal is produced at terminals AA' that is applied to decoder 10. Spring 2 resets the key into its initial position. In this manner it is possible to transform a mechanical operation car-

ried out on a key into an electrical signal without using any contacts by using a Hall cell matrix wherein each cell is correspondingly associated with a key of the keyboard. At the same time such mechanical operation is transformed into an electric signal independently of the speed of the mechanical action.

A different embodiment of the present invention having a keyboard with a vertically positioned Hall cell matrix is shown in FIG. 2. The keys are indicated by reference numeral 1', the recall springs by reference numeral 2', and the support plate by numeral 7'. A printed circuit plate 9' having angle pieces 8 backing the vertical Hall cell 6 is also shown. The vertical Hall cell is completely similar to the horizontal Hall cell already described in the first embodiment of the invention with reference to FIG. 3a. In the embodiment of the keyboard having a vertical Hall cell matrix, the variable magnetic field is not supplied by a cylindrical permanent magnet as provided for in the first embodiment, but by permanent magnet 5 in the shape of a horseshoe. FIGS. 4a and 4b schematically represent the respective positions of the key, the magnet and the relevant cell, in the initial and depressed positions, respectively. Vertical Hall cell 6 is fed through terminals BB' and is subjected to a magnetic field generated by horseshoe permanent magnet 5. Upon depressing the key, permanent magnet 5 approaches Hall cell 6 varying the perpendicular magnetic field and causing the generation of a signal at terminals AA' of the cell because of the Hall effect. In both embodiments described, a permanent magnet is associated with each key that affects only a single Hall cell of the type shown in FIG. 5a, thereby establishing an univocal correspondence between each key and its associated cell.

A further embodiment of the present invention is shown in the FIG. 5b and there the Hall cell is made of a thin plate having a current flowing in direction BB' and projections that are perpendicular to the thin plate positioned in the same plane thereof. The output signals are applied to projections AA'.

I claim:

1. A manipulative keyboard device for generating electric signals, including a plurality of manually depressible keys, a plurality of key stems each one connected to one of said plurality of keys, means for guiding said key stems for a rectilinear movement upon depression of the connected key, and spring means for individually restoring the key stem of the depressed key, wherein the improvement comprises:

a plurality of Hall cells, each one associated with one of said plurality of keys and including a pair of feed current terminals and a pair of output signal terminals,

a support for said plurality of Hall cells, and

a plurality of permanent magnets each one secured to one of said key stems, whereby upon depression of one of said keys, the magnet secured to the corresponding key stem produces in the associated Hall cell a magnetic field variation generating a corresponding electric signal.

2. A keyboard device as recited in claim 1, wherein each one of said plurality of permanent magnets is secured to a free end of the corresponding key stem, and wherein each one of said Hall cells includes a thin metal plate including a first pair of projections each of said pair being connected to one of said pair of feed current terminals and a second pair of projections each of said second pair connected to one of said pair of output terminals and directed perpendicular to said first pair of projections, said thin metal plate facing the corresponding magnet and being located in a plane perpendicular to the direction of movement of said key stem.

3. A keyboard device as recited in claim 2, wherein the metal plate of each Hall cell comprises a plurality of second pairs of projections perpendicular to said first pair of projections and a plurality of pairs of output terminals, each pair connected to a pair of said second pairs of projections.

4. A keyboard as recited in claim 1, wherein each of said plurality of permanent magnets is horseshoe shaped and is inserted into a notch of a free end of the corresponding key stem, said notch being parallel to the direction of movement

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of the corresponding key stem, and wherein each of said plurality of Hall cells includes a thin metal plate including a first pair of projections connected to said pair of current terminals and a second pair of projections connected to said pair of out-

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put terminals and directed perpendicular to said first pair of projections, said thin metal plate being adapted to enter the horseshoe magnet of the associated key stem upon depression of the corresponding key.

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