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[73] Assignee **General Electric Company**

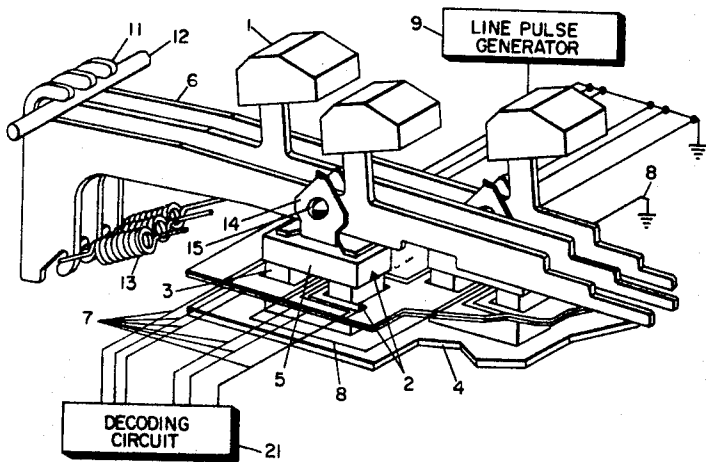
[54] **BALL AND CLIP FOR ATTACHING FERRITE  
CORES TO KEY BARS**  
**8 Claims, 7 Drawing Figs.**

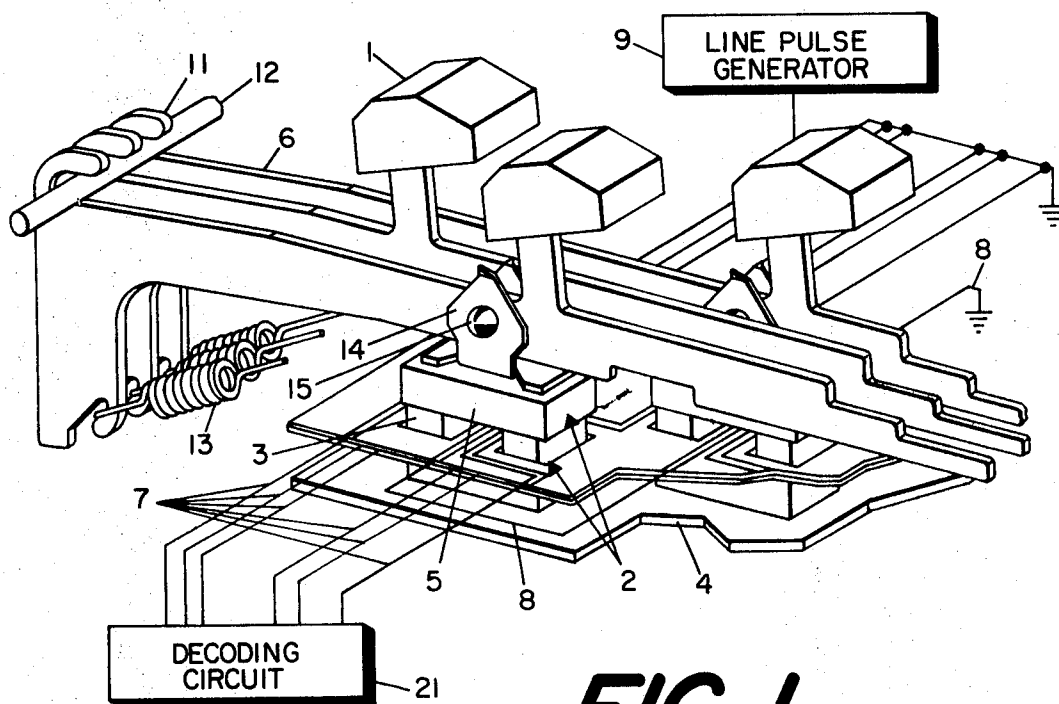
[52] U.S. Cl. .... **340/365,**  
**178/17 R, 178/17 C, 200/5 E, 197/98**  
[51] Int. Cl. .... **G08c 1/00**  
[50] Field of Search .... **340/365;**  
**178/17 R, 17 C; 235/145, 146; 200/5 E; 197/98;**  
**287/100, 101**

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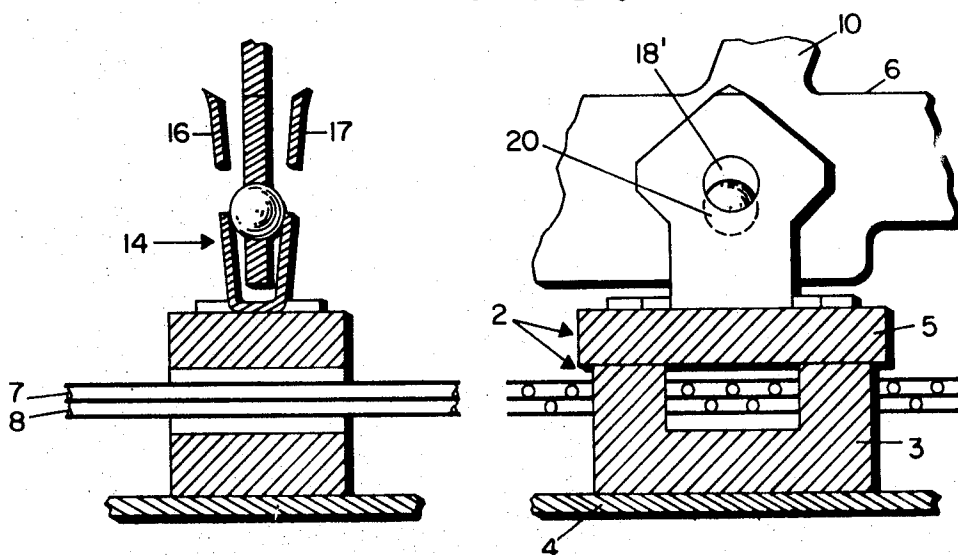
**ABSTRACT:** A ball joint suspension which permits accurate self-alignment of a magnetic plate movable through space to intimately close magnetic core circuit for producing electrical signals.





**FIG. 1**

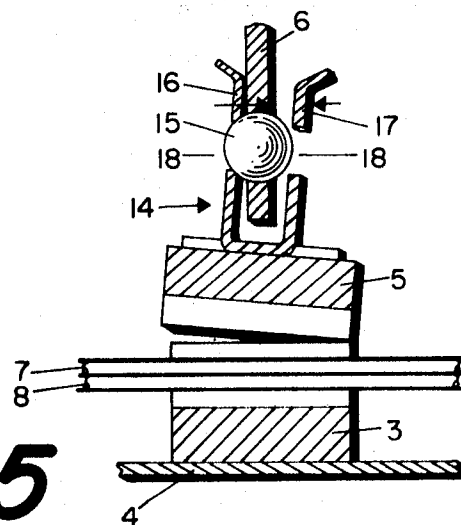
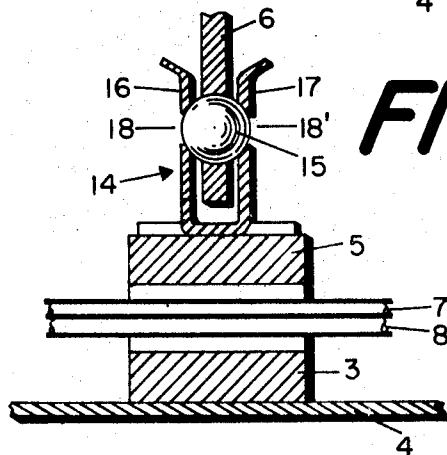
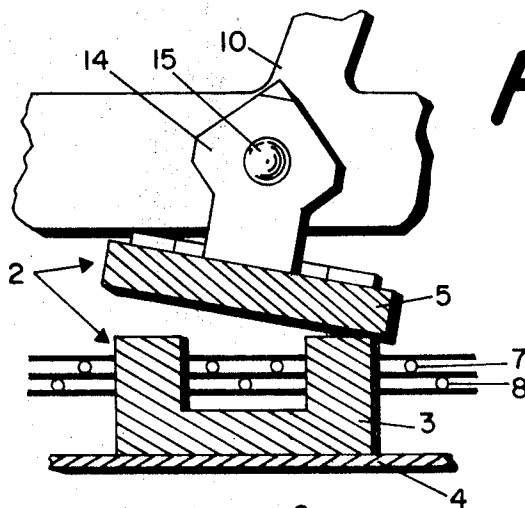
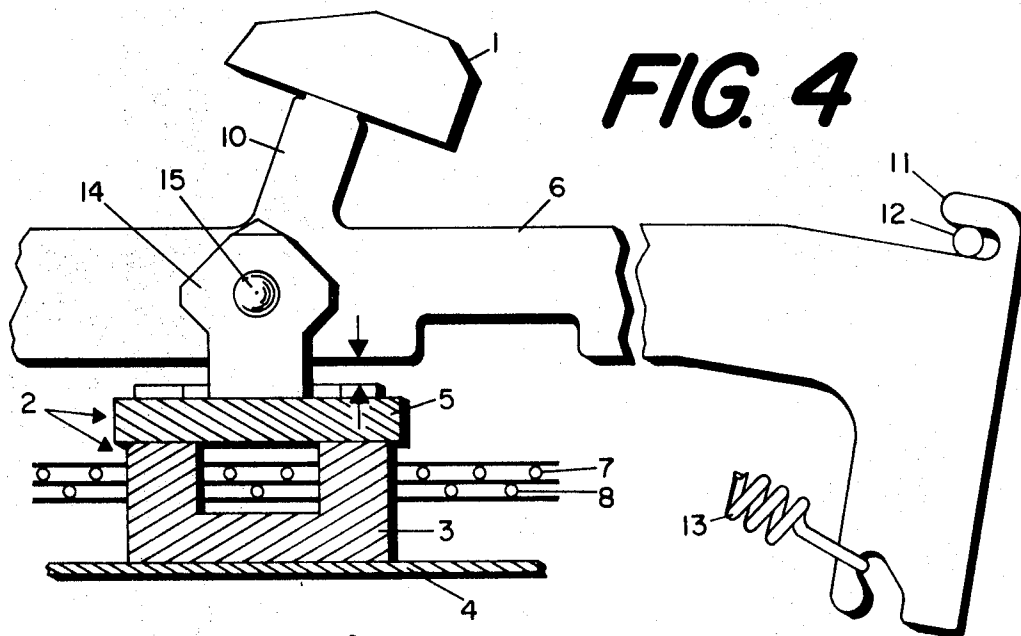
**FIG. 6b**



**FIG. 6a**

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## BALL AND CLIP FOR ATTACHING FERRITE CORES TO KEY BARS

### BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to magnetizable core circuit keyboards having a controllable air gap for developing signals in response to operation of the keyboard and particularly to arrangements for facilitating attachment and operation of a movable magnetizable core member.

Many applications exist of code generators which generate coded signals representing alphanumeric characters. There are many such generators in existence. One useful way in which coded signals may be generated from the operation of keys as found on a keyboard is to provide a matrix including a plurality of interrogation lines intersecting a plurality of readout lines. Partially open magnetic core circuits are formed around the intersections of these lines. Operation of the various keys selectively completes certain of the core circuits in accordance with the digital and denominational designations associated with the intersection. Each key carries a core segment attached thereto for completing the corresponding one of the partially open magnetic core circuits. By pulsing the interrogation lines successively by denominational orders, the readout lines are pulsed in accordance with a multidimensional number set up of said keying means. Reference may be had to U.S. Pat. No. 2,814,031 dated Aug. 26, 1955 for a typical such arrangement. Reference may also be made to U.S. Pat. No. 3,119,996 entitled "Code Generator With Noncontacting Coupling to Character Keys" issued Jan. 28, 1964.

As will be described shortly, an intimate mating must occur between a first or U-core section and the corresponding second or I-core section in order to ensure such successful operation. Thus, for example, if intimate contact is not made, as by a residual gap between ferrite pieces of the order of 0.002 inch or more, that particular key may not produce a usable coded signal. In addition to the requirement for intimate mating, it is desirable that the core retain its precise mating position after the key has been initially depressed rather than hanging loose and having to be repositioned for every stroke. Also, it is desirable that there be accurate, self-alignment possibilities, as by freedom around the plane of the core faces in two directions to facilitate core closure and also some "give" perpendicular to the plane of the faces in order to protect the cores from overzealous pounding on the keys. Accordingly, it is an object of this invention to provide an improved magnetizable core keyboard.

Another object is to provide an improved arrangement for attaching and/or operating magnetizable, movable core member.

Another object is to provide a shock resistant mounting for a magnetizable, movable core member.

According to the present invention, coded signals are generated by depressing keys which close a magnetic circuit, causing circuit changes representing the coded signal to be made. Each key has associated with it a key bar. A universal ball joint and spring clip mechanism associated with the key bar supports one of the mating ferrite core pieces, i.e., a ferrite I-bar. This is designed to allow the ferrite bar to mate precisely with a mating ferrite core, i.e., a ferrite U-core in a predetermined manner regardless of the initial relative angular positions of the core and bar.

### BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will further become apparent hereinafter and in the accompanying drawings in which like references identify like components, and in which:

FIG. 1 illustrates schematically the general features of a keyboard-operated code generator.

FIG. 2 is a schematic drawing showing a side view of the key bar in a different stage of operation wherein the magnetic structures are in a process of being closed.

FIG. 4 illustrates in schematic form a side view of a key bar arrangement incorporating the invention and illustrating a properly closed core.

FIG. 5 is an end view of the arrangement shown in FIG. 4.

FIGS. 6a-6b illustrate a protective feature guarding against excess key pressure.

### DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to FIG. 1, there is illustrated schematically the general features of a keyboard operated code generator. In such an arrangement, the keyboard usually comprises a plurality of key buttons 1 representing various symbols to be generated in coded form, usually digital, in response to operation of each key button. For simplicity, the keyboard is shown with only two buttons illustrated. A plurality of magnetic structures 2 are provided, each associated with a respective one of said key buttons. The magnetic structure comprises a first ferrite core member 3, for example U-shaped, fixed to the supporting member 4 and positioned to mate with an associated second ferrite core member 5. Members 5 are attached to respective key bars 6 and key buttons 1 and are movable with respect to an associated core member 3 to open and close an air gap in the magnetic circuit comprising a first and second core member. Threaded through the first core members are sense lines 7 and a drive line 8 which respond to the opening and closing of the magnetic circuits comprising the first and second core members to provide desired signals corresponding to the symbols associated with the operated key button 1. Essentially, a drive or line pulse generator 9 is connected to a drive line which threads its way through each of the cores for generating electrical pulses so as to create a magnetic flux within each of the cores. A plurality of sense lines 7 are threaded according to a predetermined code through the core members 3. These sense lines 7 are threaded in a given direction relative to the flow of current through the drive line and respond to the flow of current in accordance with the open or closed positions of the core members 3 and 5 associated with each key button to produce a pulse signal in decoding circuit 21. For greater details of the functioning of the operation of the sense lines and drive lines to generate desired coded signals, reference be made to the copending application, Ser. No. 830,427 entitled "Neutralizing of Unwanted Signals by Location of Conductors on Contiguous Printed Circuit Boards" filed on June 4, 1969 in the name of John J. Larew et al. and assigned to the common assignee.

In order to achieve the desired quality of signal generation in response to the operation of the key button 1, it is important that the faces of the mating core members 3 and 5 be coincident, have a given mating cross-sectional area, and achieve intimate contact during closure in order to ensure that the necessary operation flux densities are achieved for proper signal generation. Referring to FIG. 2, there is shown in schematic form a preferred embodiment of the magnetic structure and mechanical drive elements illustrating properly closed pair of core members. FIG. 3 at the same time provides an end view of the arrangement shown in FIG. 2. Key button 1 is attached by a connecting arm 10 to the key bar 6. Operating or depressing the key button 1 overcomes the retaining spring tension of spring 13 and causes the key bar 6 to pivot at its pivot arm 11 about pivot rod 12. Pivot rods 12 and return spring 13 are carried on the supporting keyboard supporting structure. In the position shown, the button has been fully depressed against the restraining action of the spring causing the ferrite core member 5 to descend and close on the magnetic circuit comprising U-core member 3 through which the sense and drive lines 7 and 8 are threaded. The core member 3 is shown attached to the support member 2. The movable core member 5 is shown carried by retaining clip 14. The key bar 6 associated with each key button has a steel ball 15 pressed in a retaining hole formed in the key bar. The retaining clip 14 has two spring arms 16 and 17 with holes 18 and 18' aligned for mating with the opposite side of the protruding surface of ball

sioned such that a predetermined space shown by the double arrows in FIG. 2 is established between the clip arms 16 and 17 and the key bar 6. This spacing controls the degree of angular displacement possible between the clip sides and the key bar as the key rotates around the protruding ball face transverse of the plane of the key bar. This is more clearly shown in FIG. 2 of the drawings in which core member 5 is shown in the process of closing with one end of ferrite core member 3 touching the lower core member causing this segment to rotate transverse of the plane of the key bar until closure of the magnetic circuit gap is achieved.

The clip 14 further comprises a retaining portion 19 which is cemented to or otherwise made to support the core member 3. The spacing between this retaining portion 19 and the bottom edge of the key bar shown by the double arrows in FIG. 4 is dimensioned to control or limit the angular displacement of the bar in the plane of the key bar. A mating U-core member 3 is fixed to a supporting member and positioned to mate an associated movable core member 5. Threaded through the U-core are sense lines and drive lines which respond to opening and closing of magnetic circuits comprising the core members 3 and 5 to provide the desired signals. The figures show that the movable member 5 is made longer and wider than the associated core member 3 to accommodate dimensional tolerances during manufacture and minor misalignments between the mating faces of members 3 and 5 during key button operation.

If excess force is applied to the key bar assembly by operation of a key button, the ferrite components may crack. To minimize this possibility, the retaining clip is made of spring material. The spring tension of arms 16 and 17 is dimensioned to permit the spring clip openings 18 and 18' to ride up the side faces of the ball 14 (as shown in FIG. 6) from their normally aligned positions (as shown in dotted lines at 20) to cushion the shock and then to automatically return to the aligned position upon removal of the excess force. This is shown in FIG. 6 wherein the holes 18 and 18' in the spring clip 14 also permits easy attachment and detachment of movable core members from key bars 6. It firmly grips the ball 15 during key operation, but can force off the ball if replacement is desired.

Thus it is seen that the present invention provides several advantages. The movable core member is permitted angular movement in planes parallel and transverse to the key bar in the course of operation of the key button to facilitate closure with a mating core member. Also, movable core member 5 is permitted spring restraining movement in a plane perpendicular to the first-mentioned plane. In addition to these operational advantages, the present invention provides easy replacement of the movable core member 5. If, for some reason, replacement of the member 5 is desired, this may be done by the operator merely pulling on the clip, causing it to slide from the ball and then mounting and inserting a replacing clip movable core member 5 in the reverse process.

While the foregoing has been a description of particular embodiments illustrating the invention, the appended claims are considered to intend to cover all forms which fall within the scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a magnetizable core circuit keyboard having a controllable air gap for developing binary signals, the improvement comprising a plurality of individually operable keys, a plurality of magnetic circuits individually associated with said keys, each of said circuits having a fixed core member and a mating core member movable through an air gap, means attached to each of said keys so as to close the air gap between a fixed core and movable core member when an associated key is operated, said means comprising a key bar adapted at one end to rotate about a pivot point in response to operation of an associated key button, a steel ball pressed in a retaining hole in said key bar, a respective retaining clip for supporting each of said movable core members comprising two spring arms with aligned openings for mating with the opposite sides of the protruding faces of an associated ball, means for facilitating

mating of said fixed and movable core members comprising said openings and said ball diameter being dimensioned such that a predetermined space is established between said clip arms and the associated key bar for permitting a desired degree of angular displacement of said movable core member transverse of the plane of the key bar as the clip rotates around the protruding ball faces.

2. An arrangement according to claim 1 wherein said clip further comprises a retaining portion which supports the movable core member, means for further facilitating mating or fixed and movable core members comprising said retaining portion and the adjacent edge of the key bar being dimensioned such that a predetermined space is established between said retaining portion and the adjacent edge of the key bar for permitting a desired degree of angular displacement of said movable member in the plane of the key bar as the clip rotates around the protruding ball faces.

3. An arrangement according to claim 2 wherein interrogation and sense lines are threaded through said cores and respond to key operation to produce an output signal.

4. An arrangement according to claim 2 further comprising means to minimize damage to the core members in response to a force generated by vigorous key button operation comprising said retaining clip having the spring tension of said arms dimensioned to permit the spring clip openings to ride up the side faces of the ball from their normal aligned positions to cushion the shock due to key operation and to automatically return to the aligned position upon removal of the excess force.

5. An arrangement according to claim 4 comprising means for facilitating the replacement of the movable core member from the key bar comprising said spring clip having a spring tension which may be overcome by forcibly pulling the clip from the ball mounting or forcibly pushing a replacing clip and associated movable core member.

6. A magnetic keyboard comprising a plurality of individually operable keys, each key comprising a fixed U-shaped magnetizable core and an associated movable, flat bar magnetizable core, each of said associated cores having an air gap, means for closing the air gap when said key is operated comprising a key bar having a respective key button mounted near one end, means for supporting a respective movable core on key bar, means for moving said movable core into air gap closing position with respect to a respective U-core comprising means for moving said key bar about a pivot point at the other end thereof upon operation of an associated key button, said supporting means comprising a swivel joint permitting angular movement of said movable core in the plane of said key bar and angular movement in a plane transverse to the plane off said key bar, a drive line threading each of said cores, a drive pulse generator operatively connected to said drive line for generating electrical pulses so as to create a magnetic flux within each of said cores, and a plurality of sense lines threaded according to a predetermined code through said cores in a predetermined direction relative to the flow of current through said drive line.

7. An arrangement according to claim 6 wherein said supporting means also comprises arms providing spring restraining movement in a plane perpendicular to said two first-mentioned planes in response to overly vigorous key operation.

8. In a magnetizable core circuit keyboard having a controllable air gap for developing signals in response to operation of a key comprising a key bar, a movable, magnetizable core member for closing said air gap, a steel ball pressed in a retaining hole in said key bar, a spring clip supporting said movable core member comprising two spring arms with aligned openings for firmly gripping the opposite sides of the protruding surfaces of said ball under spring tension, said spring clip having sufficient spring compression in its arms to yieldably resist detachment or attachment of said assembly to said keybar without the application of force to overcome said spring compression, and movable core member assembly comprising said spring clip having the spring tension of its arms dimensioned so that forcible pulling or pushing permits detachment or attachment of said assembly to said key bar.

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,609,757 Dated September 28, 1971

Inventor(s) Corbin Dixon

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 11, cancel "or" and insert -- for --; line 49, after "operating" insert -- a --. Column 2, line 49, cancel "nd" and insert -- and --; line 52, cancel "operation" and insert -- operating --; line 74, cancel "surface" and insert -- surfaces --. Column 3, line 39, after "14" insert -- are shown riding high up on the surface of the ball 15. The spring clip 14 --. Column 4, line 11, cancel "or" and insert -- of --; line 24, cancel "he" and insert -- the --; line 43, after "on" insert -- said --; line 50, cancel "off" and insert -- of --; line 74, cancel the comma after "pression" and insert a period; line 74, cancel "and movable core member assembly comprising said"; line 75, cancel this line; line 76, cancel this line; line 77, cancel this line.

Signed and sealed this 1st day of August 1972.

(SEAL)  
Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

ROBERT GOTTSCHALK  
Commissioner of Patents