FIG. 1

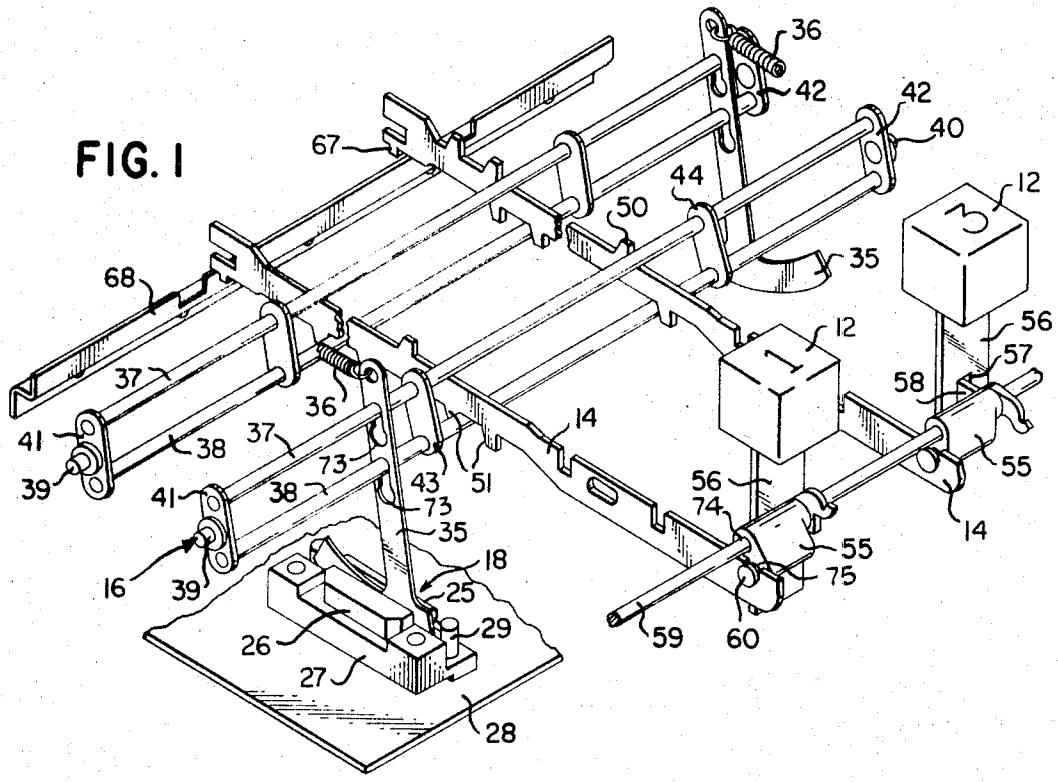
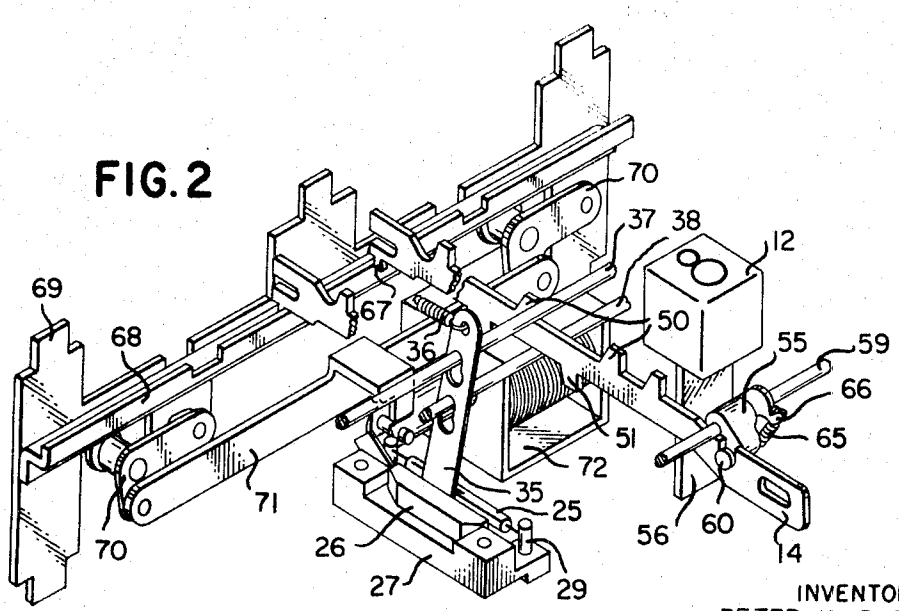


FIG. 2



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SELF-INTERLOCKING KEYBOARD

BACKGROUND OF THE INVENTION

In the area of keyboard design, efforts have been made, as one advantageous feature therein, to prevent the simultaneous depression of two or more keys by use of slides or balls positioned to respond to key-operated mechanism. It will be recalled that simultaneous depression of two keys on a typewriter usually results in jamming the type bars against one another and requires manual separation of the bars before proceeding with the work. Of course, the slide or ball type of interlock has been quite common in business machines wherein depression of any one key causes a connected member to cam between adjacent elements and thus move them apart so that a separate key-connected member could not be forced between other like elements along a line thereof. Such interlocking mechanisms, commonly known as being of the "entering type", generally exhibit an interactive disadvantage wherein by reason of pressure upon a non-depressed key, a depressed key tends to be locked, thereby likewise tending to inhibit release of the depressed key. In this respect, the entering type of interlock may have a tendency to restrict the operating speed capability and additionally have a higher noise level because of the relative closeness of parts and of the materials used. It is by reason of such complaints that improved designs are being sought to gain advantages over the prior-art keyboards.

U.S. Pat. No. 2,383,260, issued Aug. 21, 1945, on the application of John Joseph Kittel, discloses one example of prior art interlock mechanism for preventing operative depression of more than one key lever at the same time. The key lever blocking device is a pivoted line lock plate engageable by the heel of an abutment on the key lever, the plate being rocked rearwardly to be disposed directly under the toes of other key lever abutments.

U.S. Pat. No. 2,835,369, issued May 20, 1958, on the application of Charles Schroder, shows and describes another key interlock, including key levers engaging adjacent rockers which are journaled on a common pivot rod, each rocker having lugs projecting right and left, and also overlapping edges engageable by the lugs, so that, on depression of any one key, oppositely-located rockers prevent operation of other keys.

A further example of the prior art is disclosed in U.S. Pat. No. 3,189,153, issued June 15, 1965, on the application of Cecil P. Barnard and Donald H. Heiser, wherein an encoding keyboard has indicia means in the form of bails movable to one of two stable positions and cooperating with coding means actuated by the keys. The interlocking means comprises a plurality of disks disposed to move by insertion of a code bar therebetween, so that only one bar can be operated at any one time.

Each of these prior art examples utilizes interlocking means of the entering type, and all suffer from the stated disadvantages of high noise level and slow response upon key release.

SUMMARY OF THE INVENTION

The present invention relates to keyboards and more particularly to a keyboard utilizing a series of glass-enclosed reed-contact switches for making and breaking an encoding circuit, the keyboard having interlocking structure which is self-operating upon depression of a key without added mechanism of any sort beyond that required to obtain the coded output, such structure being capable of efficient operation with the contact switches. The coded output information derived from depression of the keys is obtained through the normally opened reed switches which are closed, or biased to an "on" condition, by a proximally located fixed magnet. For each of the switch assemblies, there is provided an interposer of ferrous material and supported from a pair of spaced shafts operable in rotary fashion about a common center, the interposer being actuated by key-driven mechanism to move into and out of the space between the switch and its magnet to open and close the switch. Presence of the interposer within a majority of the space between the switch and the magnet causes sufficient lines of force of the magnetic field to be shunted away from the reed switch, so that the contacts open. In normal operation of the keyboard, each switch is held open, or "off", by means of its respective interposer being spring-biased into the space between the magnet and the switch, and actuation of a key will remove, by means of later-described mechanism, the appropriate interposers to cause their corresponding switches to close, whereby an electrical binary output, unique to that key, is generated.

Control of each interposer is provided by transverse bail assemblies within the keyboard frame behind the keystem area and above the switch-magnet area. Each bail assembly comprises the pair of shafts disposed about a center of rotation, and mounted on and suspended from each shaft pair is the interposer, which is laterally positioned, so as to align with a respective switch-magnet assembly, there being a plurality of interposer-shaft pair assemblies for actuation of each of the magnetic reed switches. Interspersed and arranged among the several bail assemblies and running perpendicular to and between each shaft pair are toothed racks, one per keyboard key. One tooth of each rack is arranged to bear upon either the upper or the lower shaft of each bail assembly, so as to provide, upon movement of the rack, positioning of each bail and interposer to either the switch "on" or the switch "off" position. At its keystem end, each rack is connected to a bellcrank, which in turn is driven by depression of the key. With such arrangement, depression of a key transfers motion, through the bellcrank and toward the front of the keyboard, of the particular rack associated with the key, so that the rack teeth cause actuation of the bails and the interposers to condition the reed switches to the output code selected, by means of the appropriate rack teeth locations for that particular key. The electrical binary coded output comprises six binary bits derived for each key by the arrangement of the teeth on the associated rack.

A complete key-to-key mechanical interlock is generated within and is an inherent by-product of the instant encoding mechanism in the above-described rack-bail mechanism by virtue of the facts that (*a*) teeth are provided on each rack so that each and every bail-interposer assembly is positively actuated toward the appropriate reed switch "on" or "off" condition for a given key and (*b*) no two keys derive thereby the same electrical output code, so that, as any two keys are depressed, they will be in mechanical conflict as to the "on" or "off" positioning of at least one bail, and the complete depression of either key or both keys is

the output code selected, by means of the appropriate rack teeth **50, 51** locations, for that key **12.**

A complete key-to-key mechanical interlock is provided within the above-described rack-bail mechanism by reason that (*a*) teeth **50, 51** are provided on each rack **14** so that each bail-interposer assembly is positively positioned with respect to the appropriate reed switch "on" or "off" condition for a given key **12** and that (*b*) no two keys **12** derive thereby the same output code, because, as any two keys **12** are depressed at the same time, they will conflict as to the "on" or "off" positioning of at least one bail, and the complete depression of either key **12** or both keys **12** is blocked. The nature of the particular construction and the interlocking action is that of a "non-entering" type of interlock whereby, with one key **12** held depressed, pressure on another key **12** tends to restore the first-mentioned key **12** rather than tending to lock down the first-mentioned key **12.** In the illustration of this action, and referring to FIG. **1,** the "1" key **12** is shown in a depressed position, with its rack **14** actuated toward the front of the keyboard, and the "3" key **12** is shown in an undepressed position, with its rack **14** in the home position. The interlocking of the parts is realized by means of a lower tooth **51** of the "1" key rack **14** being in the rear of and engaged with the bail lower shaft **38** thereby holding the bail assembly **16** in "off" position and an upper tooth **50** of the "3" key rack **14** being in the rear of and engaged with the bail upper shaft **37.** This latter condition will normally prevent the depression of the "3" key **12.** If greater pressure is exerted on the "3" key **12** rather than on the "1" key **12,** the bail assembly **16** will be rotated in a clockwise direction thus returning the "1" key **12** to its home position by means of shaft **38** acting on tooth **51.** Likewise, teeth **50** and **51** on the remaining racks **14** are positioned and engaged with the associated bail assemblies **16** to prevent depression of any other key **12** at the same time. Understandably, if sufficient pressure is exerted on a different key **12,** it would tend to restore the depressed key **12** in the manner described above.

Associated with the key-to-key or self-interlocking mechanism is a lock-up feature as shown in FIG. **2,** the concept and arrangement being employed during machine operation. With the "8" key **12** depressed against the action of a rack restore spring **65** connected between a frame member (not shown) and a finger **66** of the bellcrank **55,** a tooth **50** on the rack **14** engages with the upper shaft **37** of the bail assembly **16** as the rack **14** is being moved to the right, or to the forward part of the keyboard. Each of the racks **14** has a finger portion **67** projecting downwardly at the rear thereof for engaging a blade portion **68** of a lockout slide assembly **69** slidably mounted within the framework of the machine (not shown) and movable up and down by means of bellcrank assemblies **70,** which assemblies **70** are actuated through a drive arm **71** connected to a lockout solenoid **72.** When any one key **12** is depressed, its rack **14** moves to the front of the associated keyboard, and the finger portion **67** moves in front of the blade portion **68,** after which the solenoid **72** is energized to raise the lockout slide assembly **69** and thus trap the portions **67** of all other racks **14** to prevent operation of any other key **12** on the key-board. With the lock-up mechanism actuated, the "8" key rack **14** is locked by reason of the lockout blade portion **68** being in the "up" position, which receives the finger portions **67** of all other racks **14,** and, in effect, all other keys are locked out. The lockout solenoid **72** has a spring return for moving the slide assembly **69** downwardly and for releasing all the finger portions **67.**

The geometry of the mechanism of the instant invention provides additional advantages over prior-art keyboards. For instance, a characteristic of the glass-enclosed reed switch **25,** which is of primary importance to the design of any mechanism using it, is the "differential" of the switch **25.** The "differential" of a switch is defined as the difference between the level of actuating force or influence required to activate the switch and the level of reduced actuating force or influence at which the switch is deactivated. In a mechanism which uses permanent magnets **26** for the actuation of glass-enclosed reed switches **25,** as in the instant invention, the above-mentioned "differential" resolves to a distance of physical movement of the magnet **26** with respect to the reed switch **25** or of an interposer **35** with respect to the reed-magnet assembly. In known prior-art keyboards that use reed switching devices for generation of output signals, the total magnet or interposer movement, with respect to the reed switch or reed-magnet assembly, has been equal to or less than the total movement of the actuating key. In the instant invention, the total interposer movement with respect to the reed-magnet assembly is nearly four times the total movement of the actuating key.

Additionally, the extent of the reed switch differential as regards its proportion of total key travel in prior art devices has been from 25 to 60 percent of the key travel, depending upon the exact reed-actuating technique employed. A direct result of so large a porportion of key travel in the differential range to total key travel is the need for precise, critical, and expensive adjustment procedures during manufacturing processes to avoid improper code emissions from the keyboard. Contrariwise, due to the large interposer travel relative to key travel of the instant invention, the proportion of key travel in the differential range with respect to total key travel is maintained hereby at less than 15 percent of total key travel.

It is thus seen that herein shown and described is a keyboard having interlock mechanism of a "non-entering", or "self-interlocking", type which has advantages and features that incorporate optimum human factors of design, that minimize moving mass and the inertial effects thereof, and that reduce or minimize noise levels. While only one embodiment has been disclosed for the construction of the self-interlocking keyboard, certain variations on the above may occur to those skilled in the art, so it is comtemplated that all such variations having these features are within the scope of the invention.

What is claimed is:

1. A keyboard comprising a

plurality of data keys, a

plurality of code rack members each movable to an actuated position in response to the movement of a corresponding data key, a

plurality of code bail assemblies, each assembly comprising a pair of spaced apart connected shafts symmetrically disposed about a center of rotation and transversely mounted adjacent said rack members and each bail assembly being rotatable between a first and a second control position,

switch means responsive to the respective control position of each of said bail assemblies for generating data signals indicative of the data key moved, said switch means including a contact unit, a magnet and an interposing member downwardly supported from said shafts and swingable in an arc between said contact unit and said magnet for actuating said contact unit,

means normally urging each of said bail assemblies to said first control position, and

abutment means mounted on the upper and lower sides of said rack members for engaging said spaced shafts upon movement of said rack member to an actuated position, said abutment means positioned to rotate at least one of said bail assemblies to said second control position whereby the disposition of said one bail assembly in said second control position will prevent depression of two data keys simultaneously.

2. An interlock mechanism for a keyboard having a plurality of data keys, and racks movable in response to operation of the keys, the interlock comprising

a plurality of rotatably mounted bail assemblies positioned adjacent to and extending in a direction transverse to the movement of the racks, each of said bail assemblies including a first shaft disposed over said racks and a second shaft spaced from and connected to said first shaft and disposed under said racks,

means engaging said bail assemblies for normally urging the bail assemblies to a home position, and

actuating means including abutment teeth mounted on the upper and lower sides of said racks and positioned to engage said first and second shafts upon movement of the rack in response to the operation of the keys, said actuating means teeth spaced along said racks and positioned to rotate selected bail assemblies to an actuated position against the action of said urging means whereby the bail assemblies in said actuated position will prevent depression of two data keys simultaneously.

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United States Patent [19]

Hunt et al.

[11] **3,750,797**

[45] **Aug. 7, 1973**

[54] **CARRIER POSITIONING AND TABULATION APPARATUS**

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[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[22] Filed: **Dec. 28, 1970**

[21] Appl. No.: **101,703**

[52] **U.S. Cl.** **197/176**, 197/179

[51] **Int. Cl.** **B41j 25/18**

[58] **Field of Search** ..... 197/16, 82, 84 R, 197/84 A, 84 B, 90, 176, 177, 178, 179, 187

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[57] **ABSTRACT**

A carrier positioning and tabulation apparatus including a carrier, a leadscrew for controlling carrier advancement, an emitter wheel associated with the leadscrew having emitter spokes and a home emitter spoke, a stop device associated with the leadscrew for stopping rotation of the leadscrew and advancement of the carrier, and a pin wheel rotatable synchronously with advancement of the carrier and having settable pins for indicating the approach of a tabulation position which is defined by a signal generated upon the sensing of the home emitter spoke.

5 Claims, 2 Drawing Figures