A manual keyboard unit having a number of regular manual keys of uniform "touch" or "feel" includes a commonly provided elongated manual input operator such as a space bar. The space bar is coupled to a motion equalizing or balancing assembly including a pair of supports coupled by a mechanism which imparts uniform movement to the elongated bar regardless of the point of manual actuation. A bias spring acting on the levers can balance the mass and friction of the equalizing assembly and the bar to give the space bar the desired "touch" or "feel."

26 Claims, 19 Drawing Figures
SPACE BAR ASSEMBLY

This invention relates to a manual keyboard unit and, more particularly, to a new and improved space bar operating assembly possessing a manual operating "touch" or "feel" consistent with the other manual keys in the keyboard.

Conventional keyboards and other manual data input units commonly include, in addition to a number of regular keys or key buttons, one or more elongated manual operators or keys such as the space bar. In these keyboards, particularly in electronic keyboard applications, it is desirable that all of the keys, both the regular keys and the elongated or large keys, possess the same "touch" or "feel" characteristics. In an electronic keyboard, the regular keys commonly comprise a key actuated switch having a frame-supported housing with a key button carried on the free end of the projecting key stem. The force resisting or overcome by the manual operation of the regular key is the resilient or magnetic key stem return bias. However, with the elongated or enlarged keys, such as a space bar, the mass of the bar and its supporting means is greater, and this, considered alone or when added to the return bias of a switch actuated thereby, tends to give the elongated bar or key a substantially different "feel" or "touch." Further, there is a tendency for elongated keys to "cock" and thus affect not only their "touch" but also the response of the switch operated thereby in dependence on the point of application of the manual operating force.

Accordingly, one object of the present invention is to provide a new and improved keyboard assembly with uniform "touch" and "feel" throughout its keys.

Another object is to provide a keyboard assembly including a new and improved elongated key or bar for the keyboard possessing operating characteristics consistent with the regular keys.

A further object is to provide a new and improved assembly of an elongated operator or key and an electric switch operated thereby.

A further object is to provide a new and improved space bar assembly with a motion equalizing assembly for controlling and guiding manually induced movement of the bar in which the mass and friction of the bar and equalizing assembly can be controlled, balanced, or compensated, and the net force involved in the "touch" or "feel" of the space key can be made the same as that of other keys in the keyboard unit.

In accordance with these and many other objects, an embodiment of the invention comprises a keyboard unit of the type including a number of electric switch units whose housings are mounted on a supporting frame and from which project the key stems on the free end of which is disposed a key actuating button. These switch units commonly include resilient or magnetic means for biasing the switch and its operating stem from an actuated to a normal or released position, and this biasing force is the force overcome by manual operation. Such keyboard units commonly include, for example, an elongated key such as a space bar which also controls the operation of an electric switch mounted on the supporting frame. In accordance with the present invention, the space bar is coupled to a motion equalizing mechanism carried on the supporting frame which insures easy reciprocating movement of the bar regardless of the point of application of pressure to the bar and maintains the bar during its reciprocating movement in a predetermined orientation with respect to the remaining keys or the supporting frame. This equalizing mechanism can include a biasing means which balances or compensates for the greater mass of the space bar and of the equalizing mechanism. Thus, the elongated space bar can be given the same "touch" or "feel" as the remaining keys in the keyboard unit.

Many other objects and advantages of the present invention will become apparent from considering the following detailed description in conjunction with the drawing in which:

FIG. 1 is a front elevational view in partial section of an improved space bar assembly embodying the present invention which is shown in its normal position; FIG. 2 is a sectional view taken along line 2--2 in FIG. 1; FIG. 3 is a sectional view taken along line 3--3 in FIG. 1; FIG. 4 is a sectional view taken along line 4--4 in FIG. 1; FIG. 5 is a sectional view similar to FIG. 1 and illustrates the keyboard assembly in an actuated condition; FIG. 6 is a front elevational view in partial section of an improved space bar assembly forming a second embodiment of the invention, the assembly being shown in its normal position; FIG. 7 is a sectional view taken along line 7--7 in FIG. 6; FIG. 8 is a sectional view taken along line 8--8 in FIG. 6; FIG. 9 is a sectional view taken along line 9--9 in FIG. 6; FIG. 10 is a sectional view taken along line 10--10 in FIG. 6; FIG. 11 is a sectional view similar to FIG. 6 illustrating the space bar assembly in an actuated position; FIG. 12 is a fragmentary front elevational view in partial section illustrating the space bar assembly in FIG. 6 with a different switch actuating assembly shown in normal position; FIG. 13 is a sectional view taken along line 13--13 in FIG. 12; FIG. 14 is a fragmentary sectional view illustrating the space bar assembly of FIG. 6 in its normal position and another embodiment of a switch and controlling assembly; FIG. 15 is a sectional view taken along line 15--15 in FIG. 14; FIG. 16 is a sectional view taken along line 16--16 in FIG. 14; FIG. 17 is a perspective view of another embodiment of a motion equalizing assembly; FIG. 18 is a perspective view of a further motion equalizing assembly; FIG. 19 is a fragmentary sectional view of a keyboard unit or control means with which the space bar assemblies can be used.

Referring now more specifically to FIG. 1 of the drawing, therein is illustrated an elongated key or space bar assembly which embodies the present invention and which is indicated generally as 10. The space bar assembly 10 forms a part of a keyboard unit or control means 11 (FIG. 19) having a supporting frame or struc-
The electric switches 14 can be of any suitable and well known construction and are mounted at spaced positions on the supporting frame 12 to be manually actuated by conventional means such as a button 14A mounted on a key stem extending from the switch unit 14. The force required to operate the regular switch unit 14 is that required to overcome the normally or commonly provided magnetic or resilient return bias which acts to restore the key stem to a normal position when manual pressure is removed.

In accordance with the present invention, the space bar assembly 10 provides the same operating characteristic, “touch” or “feel” as the regular key buttons 14A and thus provides a keyboard unit 11 of uniform operating characteristics. The space bar, operator, or operator member assembly 10 includes an elongated space bar 16 provided with a motion equalizing or guiding mechanism or assembly which is indicated generally as 18 and which is connected between the space bar 16 and the supporting structure 12. The mechanism 18 in the illustrated embodiment insures uniform reciprocating movement of the space bar 16 in a position or orientation generally parallel to the plane of the keyboard or its supporting frame 12 regardless of the point of application of manual force along the length of the space bar 16. In addition, the assembly 18 includes biasing means that compensate or balance the mass and friction of the space bar 16 and the mechanism 18. Accordingly, the net force acting on the space bar 16 or resisting actuation of this space bar 16 by the operator is nothing more than the return bias of the switch unit 14, which force is identical to that of the remaining keys in the keyboard assembly 11.

The construction of the electric switch or switch unit 14 can be of any suitable well known construction using contact springs or sealed reed contacts as shown in U.S. Pat. No. 3,462,719 or mercury-wetted contacts as shown in U.S. Pat. No. 3,497,837. In general, these switch units include, as with the switch unit 14 illustrated in FIG. 1, a housing 20 secured in an aperture 21 on the supporting frame 12 and having projecting from a wall thereof a pair of output terminals 22. Projecting from the upper end of the switch unit 14 is an operating shaft or key stem 24 normally biased to an upward or released position by a biasing means shown schematically as a compression spring 26 interposed between a fixed portion 20A of the housing 20 and a projection 24A on the key stem 24. In most of the keys in the keyboard assembly, a key button such as those shown in the above-identified United States patents is mounted on the upper end of the key stem 24 to permit manual actuation.

In the illustrated switch unit 14 which forms a part of the space bar assembly 10, a button 14A is not provided on the top of the key stem 24, and the upper edge of this key stem 24 abuts a resilient pad 28 secured to a block 16A projecting from the upper wall of the space bar 16 within the downwardly open cavity defined by an encircling skirt portion 16B of the space bar 16. When the space bar assembly 10 is in its normal position, the switch unit 14 is released. When the space bar 16 is manually depressed by the application of a manual force at any point along its length to the portion shown in FIG. 5, the key stem 24 is moved downwardly against the bias of the compression spring 26, and the switch unit 14 is operated to either connect or disconnect the terminals 22 in dependence on the normally open or normally closed character of the switch provided in the switch unit 14. When manual pressure is removed from the space bar 16, the assembly 10 is restored to the normal position shown in FIG. 1, essentially or primarily by virtue of the force of the biasing means or compression spring 26 provided in the switch unit 14.

The mechanism or assembly 18 provides means for guiding and directing movement of the space bar 16 relative to the supporting frame 12 when the space bar 16 is actuated, and, in the illustrated embodiment, so guides and controls movement of the space bar 16 that it remains in a position or orientation extending generally parallel to the upper surface of the supporting frame 12. A biasing means coupled to or associated with the mechanism 18 balances or compensates the mass of the space bar 16 and the mechanism 18 so that the “touch” or “feel” provided by actuation of the space bar 16 is the same as that obtained by operating one of the regular keys in the keyboard unit 11.

To couple the space bar 16 to the mechanism or assembly 18, this space bar 16 is provided with a pair of longitudinally spaced depending members 16C in each of which is provided an opening 33 in which is received the upper shouldered end of one of a pair of supports or supporting elements 34 and 36. The intermediate portions of the supporting elements 34 and 36 are slidably received within slots or guide means 38 (FIGS. 3 and 5) in a bight or top wall 40A of a generally U-shaped supporting frame 40 on which the mechanism or assembly 18 is mounted. The supporting frame 40 also includes a depending back wall 40B (FIG. 5) and a somewhat tapered front wall 40C. At its opposite ends, the lower edge of the back wall 40B is provided with a pair of forwardly extending flanges or tabs 40D (FIG. 3) having slots or guide means 42 in which are slidably received the lower ends of the supporting elements 34 and 36. The space bar 16, the mechanism or assembly 18, and the biasing means therefor form a complete subassembly carried solely on the frame 40 to permit these components to be mounted on the supporting frame 12 as an integral subassembly. To this end, the upper wall 40A of the frame 40 includes a pair of projecting tabs 40E (FIGS. 1 and 5) at its opposite ends which are secured by conventional fastening means 41 to the adjacent wall portions of the supporting frame 12 with the subassembly disposed in a corresponding opening 43 formed in the supporting frame 12.

The supporting elements 34 and 36 are guided within slots 38 and 42 which provide mounting means so that the space bar 16 is mounted for reciprocating rectilinear movement relative to both the subassembly frame 40 and the supporting frame or structure 12 of the keyboard unit 11. There is, however, the possibility that if the manual operating force is applied to either extremity of the space bar 16, one or the other of the supports or supporting elements 34 or 36 would attempt to move through a greater or lesser distance than the other of the supports 34, 36 with the result that the supports 34, 36 would bind against the adjacent wall surfaces of the top wall 40A or the flange 40D with the result that the space bar 16 would have to be forced to achieve adequate depression to operate the switch unit 14. This in turn could result in erratic operation or damage to the
switch unit 14 as well as frustrating the desire to have the operating "feel" of the space bar 16 the same as that of the other keys in the keyboard unit 11.

To prevent this and to insure movement of the space bar 16 in a parallel relation to the keyboard unit 11 or to the supporting structure 12 therefor, the mechanism 18 includes a pair of gear levers 44 and 46 which are pivotally mounted between the front and back walls 40B, 40C of the subassembly frame 40 in positions generally aligned with each other and disposed beneath the central portion of the space bar 16 by means of a pair of shafts or pivot pins 48 which are carried on the walls 40B, 40C and which pass through circular bossed portions 44A, 46A formed on the gear levers 44, 46 intermediate their ends (FIG. 2). The innermost ends of the gear levers 44 and 46 are provided with toothed or gear portions or segments 44B, 46B which mesh with each other. The outer free ends of the gear levers 44 and 46 are bifurcated to receive the supporting elements 34 and 36 so that a pin 50 extending between the bifurcations on the levers 44 and 46 is disposed within a slot 34A, 36A in the supporting elements 34 and 36. This pivotally couples the gear levers 44 and 46 to the supporting elements 34 and 36 for the space bar 16.

As set forth above, the mechanism 18 includes or there is coupled to this mechanism and the space bar 16 a biasing means which balances, neutralizes, or compensates for the mass of the space bar 16 and the mechanism 18 and the frictional forces thereof. In the illustrated embodiment, this biasing means includes a wire spring 54 (FIGS. 2, 4, 5) disposed between the back wall 40B and the gear levers 44 and 46. The wire spring 54 includes a central portion 54C connecting a pair of single convolution portions 54A received on and concentric with the bosses 44A and 46A on the gear levers 44 and 46. The free ends of the spring 54 are provided with offset portions 54B, each of which bears against a lower edge of one of the gear levers 44 and 46. Thus, the spring or biasing means 54 tends to pivot the gear lever 44 in a clockwise direction about its pivot pin 48 (FIG. 5) and to pivot the gear lever 46 in a counterclockwise direction about its pivot pin 48.

In many applications, the assembly 10 is mounted in the generally vertical or upright position shown in the drawing. This means that the weight or mass of the bar 16 and the coupled components of the mechanism 18 tend to move the bar 16 and coupled components downwardly. The biasing means or spring 54 is designed to balance or equalize the downwardly directed forces arising from the mass of the stated components by providing a corresponding upwardly directed force. A perfect dynamic compensation would leave the bias of the switch unit 14 as the net active force in the system. However, it will be appreciated that the deflection of the free ends of the spring 54 (FIGS. 1 and 5) will change somewhat the forces applied to the system by the spring 54, and the spring 54 is chosen to equalize, as much as possible, the forces arising from friction and mass. In one assembly 10 constructed in accordance with the present invention, the bar 16 and mechanism 18, in the absence of the switch unit 14, stabilize at a point between the normal position shown in FIG. 1 and the actuated position shown in FIG. 5. The design of the spring 54 could change with change in the mounting position of the assembly 10, i.e., a horizontal mounting, because the frictional and mass considerations could change.

Referring now more specifically to the operation of the space bar assembly 10, this assembly is normally in the normal position shown in FIG. 1 of the drawing. It is held in this position primarily by virtue of the biasing force of the compression spring 26 in the switch unit 14 acting on the space bar 16 and the connected mechanism 18 through the projection 16A, although a balancing force is applied to the system from the biasing means or spring 54. This normal position is determined by engagement of the lower surface of the flanges 40D by enlarged end portions 34B, 36B at the lower ends of the supporting elements 34, 36. A resilient washer 60 is disposed therebetween to cushion shocks.

Whenever a downwardly directed force is applied at any point along the space bar 16, usually by digital pressure, the space bar 16 and the supporting elements 34, 36 therefor begin to move downwardly against primarily the resilient bias of the compression spring 26 in the switch unit 14. As the supporting elements 34 and 36 move downwardly, the gear levers 44 and 46 are pivotted about the pivot pins 48 in counterclockwise and clockwise directions, respectively. If, for example, the force is supplied adjacent one or the other of the extremities of the elongated space bar 16 so that one or the other of the supports 34, 36 would tend to move downwardly more rapidly than the other, thus raising the possibility of binding, the gear connection between the toothed or gear portions 44B, 46B on the two gear levers 44, 46 positively interlocks the downward movement of the space bar supports 34, 36 so that they must move downwardly at the same speed. This avoids the possibility of binding these supports 34, 36 or skewing the position of the space bar 16. Since the space bar 16 moves down without skewing or cocking, the key stem 24 of the switching unit 14 is subjected to the expected rectilinear movement, and the action of the switch unit 14 is positive and proper. This also insures that the switch unit 14 is actuated with the same degree of depression of the key stem 24 as the other keys in the keyboard unit 11.

The downward movement of the space bar 16 controlled by the pivoting movement of the gear levers 44 and 46 is terminated in the displaced position shown in FIG. 5 by the engagement of the free ends of the gear levers 44 and 46 with a pair of resilient pads 62 which encircle the supporting elements 34 and 36 and which are interposed between the upper surfaces of the flanges 40D and the lower surfaces of the bifurcated ends of the gear levers 44 and 46. When manual pressure is removed from the space bar 16, this space bar 16 moves upwardly to the normal position shown in FIG. 1 and releases the actuated switch unit 14.

The force for moving the space bar 16 upwardly to its normal position is provided primarily or essentially by the biasing means or compression spring 26 in the electric switch unit 14. The gear levers 44 and 46 once again equalize the reciprocating movement of the supports 34 and 36 so that the space bar 16 moves upwardly, maintaining its desired orientation with respect to the remaining keyboard units. The biasing means 54, in compensating for friction and the mass of the bar 16 and the mechanism 18, insures that the primary power for moving these components is the bias of the switch unit 14. The upward movement is terminated when the resilient washers or elements 60 on the enlarged portions 34B, 36B of the bar supports 34, 36 engage the lower surfaces of the flanges 40D.
Accordingly, the space bar assembly 10 of the present invention provides means for insuring uniform predetermined movement of the space bar 16 during its actuating and release movements and thus insures predictable and proper actuation of the switch unit 14. The gear levers 44 and 46 prevent binding of the supports 34, 36, and the biasing means 54 in counterbalancing the mass and frictional force of the space bar 16 and the mechanism 18 insures that actuation of the space bar 16 at any point along its length provides the same operating "feel" and "touch" as the actuation of a regular key in the keyboard unit 11. The use of the space bar or elongated operator assembly 10 in keyboards of various constructions is facilitated by the present invention in which the bar 16, the equalizing mechanism 18, and the biasing means 54 are formed as an integral subassembly carried by the supporting frame 40 which can be inserted or mounted as a unit in keyboard constructions of various types.

Referring now more specifically to FIGS. 6-11 of the drawing, therein is illustrated a space bar assembly which is indicated generally as 70 and which embodies the present invention. The assembly 70 includes an elongated space bar operator, or operator member 72 similar to the space bar 16 and mounted on a supporting frame 74 for movement between normal and displaced positions under the control of a motion equalizing mechanism or assembly indicated generally as 76 to control the selective operation of a sealed switch 77. The assembly 70 is formed as a subassembly adapted to be mounted in the opening 43 in the supporting frame or base 12 and secured in position therein by suitable fasteners 41. To facilitate the low cost fabrication of the assembly 70, the space bar 72, the supporting structure or frame 74, and most of the components of the equalizing mechanism 76 can be formed as molded plastic parts.

To provide means for movably mounting the space bar 72 on the support 74, a pair of identical space bar supports or supporting elements 78 are provided having a generally cruciform cross section. The upper ends of the bar supports 78 are inserted into correspondingly formed openings or sockets 80 defined by two portions 72A projecting downwardly from the lower surface of the upper wall of the space bar 72 at points spaced from each other in its direction of elongation. The degree of insertion is limited by projections 78A (FIGS. 8 and 11) formed on the bar supports 78. To slidably mount the bar 72 on the supporting frame 74, the opposite ends of the frame 74 are provided with two closed portions 74A, generally at the ends of the top wall 74B, having generally cruciform shaped openings or guide means 82 (FIG. 10) therein in which are slidably received intermediate portions of the bar supports 78. An annular rubber gasket or damping member 83 is disposed on each of the bar supports 78 immediately beneath the projections 78A to cushion any impact between projections 78A on the bar supports 78 and the upper surface of the top wall 74B of the frame 74 when the space bar 72 is operated to its displaced position shown in FIG. 11.

The motion equalizing assembly 76 is connected between the bar supports 78 to insure uniform rectilinear sliding or reciprocating movement of the space bar 72 regardless of the point of application of operating force along its length. The assembly 76 includes a pair of identical and oppositely positioned levers 84 and 86 having hub portions 84A and 86A adjacent their inner or first ends which are disposed between a back wall 74C and a front wall 74D of the frame 74. A pair of shafts or pins 88 extending between the wall portions 74C and 74D and through the hub portions 84A and 86A pivotally mount the levers 84 and 86 on the frame 74 with toothed or segmental gear portions or segments 84B and 86B at their extreme inner ends in meshing engagement with each other.

To provide means for pivotally coupling the second or outer ends of the levers 84 and 86 to the space bar supports 78, the outer ends of these two levers 84, 86 are bifurcated to provide an opening 84C, 86C (FIGS. 7 and 11) in which is received a flat portion 78B of the bar supports 78 formed by interrupting two pairs of the ribs 78C or the cruciform section of the bar supports 78. This affords a pivotal connection between the levers 84, 86 and the bar supports 78.

To provide means for returning the assembly 76 and the space bar 72 to a normal position from a displaced position, a resilient biasing means is provided acting on both of the levers 84 and 86. This biasing means includes a plunger 90 (FIGS. 9 and 11) having an upper cylindrical portion 90A slidably mounted within a cylinder 92 formed by a cylindrical portion 74E extending downwardly from the bottom of the top wall 74B of the frame 74. A compression spring 94 is interposed between an enlarged lower head portion 90A on the piston 90 and the lower surface of the top wall 74B of the frame 74 surrounding the cylindrical projection 74E. The circular enlarged portion or head 90A on the plunger or piston 90 bears against the upper edges of the levers 84, 86 immediately above the gear segment portions 84B, 86B.

The compression spring 94 provides a bias sufficient to return the space bar assembly 70 to the normal position shown in FIG. 6 determined by engagement of the levers 84, 86 with the portion 74A of the frame 74. If desired, a resilient cushioning element can be interposed therebetween. Further and as set forth in detail above, the spring 94 can be so designed as to provide a resistance to movement of the space bar 72 corresponding to the force required to actuate other keys in the keyboard unit 11 so as to preserve a uniform "touch" throughout the keyboard unit 11.

To provide means for mounting the sealed contact or switch unit 77 on the frame 74 and to provide means for extending electrical connections thereto, a pair of electrically conductive terminals 96 and 98 are inserted in holes formed in or are molded into the frame 74 to lie immediately adjacent the back wall 74C with the upper ends projecting above the top surface of the top wall 74B of the frame 74. The electrically conductive terminals 77A of the sealed switch 77 are secured as by soldering or welding to the upper ends of the terminals 96 and 98. The lower ends of these terminals 96, 98 project below the space bar assembly 70 to facilitate making electrical connections thereto. When mounted in this position by the terminals 96 and 98, the sealed switch 77 extends in generally the same direction as the space bar 72 and is completely covered thereby.

To provide means for operating the sealed switch 77, a permanent magnet 100 (FIG. 9) is provided. This magnet 100 is carried in a holder 72B which is formed integral with the space bar 72 and which is located within a cavity defined by the depending edges or skirt 72D of the space bar 72. The holder 72B is secured to
the remainder of the bar 72 by a pair of spaced web portions 72C. The holder 72B and the permanent magnet 100 are offset from the vertical plane encompassing the switch 77 to permit the magnet 100 to be moved to a position adjacent one side of the switch 77. In a preferred embodiment, the magnet 100 is polarized in the direction of its axial elongation so as to provide the most efficient operating circuit for the magnetic elements of the switch 77, i.e., these elements are disposed in a generally parallel relation with the magnet 100 when the space bar 72 is depressed.

When the space bar assembly 70 is actuated, the manual depressing force is applied to the space bar 72 at any point along its length. As soon as either one of the bar supports 78 moves downwardly, it pivots the coupled lever 84, 86 in a counterclockwise or clockwise direction, respectively, about the shafts 88. Because of the coupling of the levers 84, 86 through the meshed gear segments 84B, 86B, any downward movement of one of the bar supports 78 results in a corresponding downward movement of the other bar support 78 so that the space bar 72 moves downwardly toward the frame 12, 74 maintained in a generally parallel relation thereto. Thus, any tendency for the space bar 72 and its supports 78 to bind or become “cocked” is positively prevented.

During the downward movement of the space bar 72, the plunger 90 is moved upwardly from the normal position shown in FIGS. 6 and 9 toward the position shown in FIG. 11 in which the spring 94 is fully compressed. The friction of the system coupled with the bias of the spring 94 can be arranged such that the “touch” of the space bar 72 is the same as other manually actuated keys in the keyboard assembly. As the space bar 72 approaches the operated or displaced position shown in FIG. 11, the permanent magnet 100 is moved immediately adjacent the side wall of the sealed switch 77, and the magnetic field from the permanent magnet 100 shifts the magnetic contact elements of the sealed switch unit 77 into engagement to complete a conductive circuit between the terminals 96 and 98 in the usual manner. Because of the fact that the assembly 76 maintains the space bar 72 in its desired relationship relative to the supporting frame 74 on which the switch 77 is mounted, the switch 77 will be operated uniformly on each stroke of the space bar 72 and with the expected operating characteristics.

When manual pressure is removed from the space bar 72, the compression spring 94 bearing on the piston or plunger 90 forces the ends of the levers 84 and 86 carrying the gear segments 84B, 86B downwardly to pivot the levers 84 and 86 in clockwise and counterclockwise directions, respectively. Through the pivotal connection of these levers 84, 86 to the bar supports 78, the bar supports 78 are moved upwardly to return the space bar 72 to the normal position shown in FIG. 6 and to remove the magnetic field of the permanent magnet 100 from proximity to the sealed switch 77 so that this switch 77 releases to interrupt the conductive circuit between the terminals 96 and 98.

Referring now more specifically to FIGS. 12 and 13 of the drawing, therein is illustrated a space bar assembly 110 providing another embodiment of the invention. The space bar assembly 110 is substantially identical to the space bar assembly 70 except for the location of and means for effecting operation of a sealed switch unit 112. In the space bar assembly 110, a pair of electrical terminals 114 and 116 are molded into or inserted into openings in the top wall 74B of the frame 74 immediately adjacent the front wall 74D to depend downwardly therefrom adjacent the lever 84. Two terminals 112A and 112B extending from opposite ends of the sealed switch unit 112 are secured as by soldering or welding to the electrically conductive terminals 114 and 116, respectively, in such a position that the switch capsule 112 normally is disposed in an inclined position beneath the lever 84 and at one side thereof. This position is also such that the sealed switch 112 is disposed adjacent the lever 84 when this lever 84 is moved to its actuated position.

To provide permanent magnet means for selectively controlling the operation of the switch 112, a permanent magnet 118 is secured by either friction fit or by an adhesive in an opening 119 formed intermediate the length of the lever 84. The permanent magnet 118 is so disposed within the opening 119 on the lever 84 that when the lever 84 is moved to its displaced position, the magnet 118 is disposed adjacent and extends substantially in a parallel relation to the inclined switch 112 as shown in dot-and-dash outline in FIG. 12.

When the space bar assembly 110 is operated by depression of the space bar 72 in the manner described above, the space bar supports 78 move downwardly and the levers 84 and 86 are pivoted in counterclockwise and clockwise directions, respectively. The lever 84 is moved to its extreme counterclockwise position determined by the engagement of the O-ring or resilient bumper 83 with the top wall 74B of the frame 74, the permanent magnet 118 is disposed parallel to and immediately contiguous the sealed switch 112 with the length of the permanent magnet 118 overlying the gap between the spaced magnetic and electrically conductive reeds of the switch 112. This moves these reeds into engagement and completes an electrical circuit between the terminals 114 and 116 through the switch 112.

When the space bar 72 is released, the compression spring 94 pivots the levers 84 and 86 in clockwise and counterclockwise directions, respectively, to restore the space bar 72 from the operated or displaced position shown in dot-and-dash outline to the normal position illustrated in FIG. 12. This moves the permanent magnet 118 away from the sealed switch 112 and permits this switch 112 to open. If desired, an additional reed switch and additional supporting terminals similar to the terminals 114 and 116 can be disposed adjacent the lever 86 or on the opposite side of the lever 84. An additional permanent magnet similar to the magnet 118 is provided for these levers 84, 86 to increase the number of contacts controlled by the actuation of the space bar 72.

FIGS. 14–16 illustrate a space bar assembly 120 which forms a further embodiment of the invention. The space bar assembly 120 is substantially identical to the space bar assembly 70 with the exception of the position of, the mounting for, and the means for operating a sealed switch 122. The sealed switch 122 is disposed within a supporting housing 124 which is secured to and depends from the lower surface of the upper wall 74B of the frame 74. The housing 124 is mounted spaced from and extending generally parallel to the adjacent one of the bar supports 78, and two terminals 122A and 122B for the switch 122 project below the
lower wall of the housing 124 (FIG. 16) to facilitate making electrical connections to the switch 122.

To provide means for controlling the selective operation of the switch 122, the space bar assembly 120 includes a permanent magnet 126 disposed within a carrier 128 having a lower circular portion 128A into which the lower end of a bar support 78 is received and secured thereto either frictionally or by the use of adhesive. The holder or carrier 128 also includes a generally cylindrical magnetic holding portion 128B secured to the portion 128A by an intervening web portion. The permanent magnet 126 is generally cylindrical in configuration, is axially polarized, and is inserted into the open top of the cylindrical holder portion 128B. The holder 128 has an opening or slot along the side adjacent the switch 122. The permanent magnet 126 extends in generally the same direction as the switch 122 and is normally disposed (FIG. 14) in a position spaced sufficiently above the gap between the reeds in the switch 122 that it is not effective to cause operation of the switch 122.

However, when the space bar 72 is depressed to move the bar supports 78 downwardly, the holder 128 carries the bar support 78 moves rectilinearly and downwardly so that the permanent magnet 126 overlaps the gap between the reeds in the switch 122 and applies a flux field sufficient to close these contacts, thereby completing an electrically conducting circuit between the switch terminals 122A and 122B. Because of the rectilinear movement of the space bar support 78 and thus the carrier 128 carried thereon, the permanent magnet 126 is disposed parallel to the sealed switch 122 and provides the most efficient magnetic circuit for effecting operation of the switch 122. When manual pressure is removed from the space bar 72, the compression spring 94 effects the above-described pivotal movement of the levers 84 and 86, and the bar supports 78 move upwardly so that the magnet 126 is no longer disposed in proximity to the gap between the magnetic reeds in the switch 122. This releases the switch 122.

FIG. 17 of the drawing illustrates a motion or movement equalizing linkage indicated generally as 130 which can be used in place of the illustrated mechanism 76 described above. To insure equalized or nonbinding movement of the space bar 72, the linkage or mechanism 130 includes a pair of levers 132 and 134 provided with hub portions 132A, 134A adjacent their inner or first ends through which extend pivotal mounting shafts 136 whose opposite free ends are adapted to be received within openings formed in the front and back walls 74D, 74C of the frame 74. The inner ends of the lever 132 and 134 are coupled for conjoint movement by providing a bifurcated portion 132B in the lever 132 into which fits or is received a tongue or projecting portion 134B formed on the lever 134. A resilient biasing means such as the plunger 90 and the compression spring 94 adapted to bear on the upper surface of the bifurcated portion 132B provides a return bias for the linkage 130.

The outer or second ends of the levers 132 and 134 are each provided with a tongue or projecting portion 132C, 134C which are received within generally circular openings formed in a pair of bar supports 138. The bar supports 138 are similar to the bar supports 78 and are provided with a cruciform section 138A at their upper ends to permit the bar supports 138 to be coupled to the space bar 72. The remaining portion of the bar supports 138 is generally rectangular or square in section and is adapted to be slidably received within a corresponding opening at the ends 74A of the frame 74 to slideably mount the bar supports 138 on the frame 74. The configuration of the opening formed in the end portion 74A of the frame 74 must be changed to one corresponding to that of the bar supports 138 to permit its installation. Alternatively, the cruciform section of the top portions 138A can be extended downwardly into proximity to the openings receiving the tongues 132C, 134C, and the linkage 130 can be directly mounted on the frame 74 shown and described above.

The operation of the linkage 130 is the same as that of the mechanism 76 described above. In response to depression of the space bar 72, the bar supports 138 are moved downwardly against the bias provided by the compression spring 94 so that the levers 132 and 134 are pivoted about the shafts 136 in counterclockwise and clockwise directions, respectively. The coupling of the levers 132, 134 by the portions 132B, 134B equalizes the movement of the bar supports 138 to insure nonbinding movement of the space bar 72 in a position maintained generally parallel to the frame 12. The various switch and switch controlling assemblies illustrated above in FIGS. 1, 6, 12, and 14 can be used in a space bar assembly using the linkage 130.

FIG. 13 illustrates a further embodiment of a linkage 140 useful in the space bar assembly to provide a motion equalizing mechanism or assembly. The linkage 140 includes an integral flexible bar effectively divided into a first pivotally mounted lever 142 and a second pivotally mounted lever 144 by a generally V-shaped notch 146 which provides a flexible and integrally formed pivotal connection indicated generally as 148 between the levers 142 and 144. Each of the levers 142, 144 includes a hub or bossed portion 142A, 144A through which extends a pivotal mounting shaft 149, the outer or opposite ends of which are received within openings formed in the front and back walls 74D, 74C in the frame 74. The shafts 149 can be molded integral with the levers 142, 144 or provided by separately inserted pins.

The linkage 140 also includes a pair of bar supports 150 of a rectangular section similar to the bar supports 138 and each provided with a cruciform top portion 150A for receiving and mounting the space bar 72. The intermediate portions of the bar supports 150 are slidably received within correspondingly formed openings in the end portions 74A of the frame 74. The bar supports 150 are integrally connected to the levers 142 and 144 by a section of reduced thickness 150B which provides a flexible, integral, pivotal connection between the bar supports 150 and the levers 142, 144. In the space bar assembly using the linkage 140, the switch and switch controlling arrangement can be of any of the types illustrated and described in detail above.

Further, although a separate biasing means such as the plunger 90 and the compression spring 94 can be provided bearing on the levers 142, 144 at the flexible joint indicated at 148, it is possible to construct a linkage 140 in which the deflection of the plastic material provides the return bias. More specifically, the plastic material forming the pivotal connections 148 and 150B can also be chosen to have a sufficient tendency to re-
When the linkage 140 is incorporated into a space bar assembly 70 and the space bar 72 is depressed, the supports 150 are moved downwardly. As soon as one of these supports 150 begins to move downwardly, the connected one of the levers 142, 144 is pivoted in a counterclockwise or clockwise direction, respectively, and is effective through the pivotal connection 148 to cause a corresponding movement of the other of the levers 142, 144. In this manner, both of the bar supports 150 are moved downwardly at the same rate to prevent binding of the space bar 72 during actuation. The downward movement of the space bar supports 150 is substantially rectilinear and is permitted even though these bar supports 150 are integrally connected to the levers 142, 144 because of the pivotal connections formed at 150B. When pressure is removed from the space bar 72, either the separate biasing means described above or the inherent tendency of the distorted plastic material in the areas 148 and 150B causes the levers 142 and 144 to be pivoted about the shafts 149 in clockwise and counterclockwise directions, respectively, to move the bar supports 150 upwardly to their normal position.

Although the present invention has been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments falling within the spirit and scope of the principles of this invention will be apparent to those skilled in the art. What is claimed and desired to be secured by Letters Patent of the United States is:

1. An elongated operator assembly for use with key input units comprising
   an elongated operator member movable in a given plane between normal and displaced positions,
   a supporting frame,
   means mounting the operator member on the frame for reciprocating and rectilinear movement in said plane,
   a mechanism including a pair of levers pivotally mounted on the frame for movement in said plane and underlying the operator member with each lever coupled to the operator member at a different spaced point, said levers being coupled together to control the path of movement of the operator member in said plane between said normal and displaced positions of the operator member,
   and biasing means coupled to the mechanism and providing a biasing force substantially balancing the weight of the operator member and mechanism.

2. A bar operator assembly for use in a keyboard assembly of the type using a number of individual manual key actuated switches having a given key return biasing force comprising
   an elongated bar having a mass and movable between normal and displaced positions,
   a supporting structure,
   a mechanism having a mass and carried on the supporting structure and coupled to the bar at points spaced from each other in the direction of elongation of the bar, said mechanism including a pair of supporting elements secured to the bar at said spaced points and slidably engaging the supporting structure for mounting the bar on the supporting structure for rectilinear reciprocating movement, said mechanism also including movement equalizing means underlying the bar and coupling the elements to each other to maintain said bar in a given orientation during movement between said normal and displaced positions of the bar,
   biasing means coupled between the supporting structure and the coupled mechanism and bar for balancing the mass and friction of the mechanism and the bar,
   and an electric switch means coupled to the bar for actuation thereby to an operated position, said electric switch means having a bias means for returning the electric switch means from the operated position of the electric switch means for and returning the coupled bar and mechanism to a normal position.

3. The bar operator assembly set forth in claim 2 including
   guide means for guiding the supporting elements for reciprocating movement,
   and in which the movement equalizing means includes a pair of levers pivotally mounted on the supporting structure intermediate their ends, pivotally coupled to the different ones of the supporting elements at one end, and having meshed toothed segments at their other ends.

4. The bar operator assembly set forth in claim 3 in which
   the biasing means is coupled to the pair of levers.

5. The bar operator assembly set forth in claim 2 in which
   the electric switch means includes an operator,
   and including means mounting the electric switch means with the operator for the electric switch means disposed to engage the elongated bar adjacent one end of the bar.

6. The bar operator assembly set forth in claim 5 including
   means mounting the mechanism generally beneath a center portion of the elongated bar.

7. The bar operator assembly set forth in claim 2 in which
   the coupled bar, mechanism, and biasing means form a single connected assembly,
   and means are provided for detachably mounting the assembly of the bar, mechanism, and biasing means on the supporting structure.

8. A bar operator assembly for use in a key input unit comprising
   an elongated bar movable in opposite directions between normal and displaced positions,
   a supporting structure,
   and a mechanism including a pair of levers each having first and second ends and each pivoted on the supporting structure intermediate their first and second ends, said mechanism having first coupling means coupling the first ends of the levers for con-joint movement, said mechanism also including second coupling means coupling the second ends of the levers to the elongated bar at points spaced from each other in the direction of elongation of the bar, the first and second coupling means in said mechanism effecting oppositely directed pivotal movement of the pair of levers as the elongated bar moves in either of said opposite directions between said normal and displaced positions of the elon-
gated bar to maintain a given orientation of the elongated bar during movement of the elongated bar between said normal and displaced positions of the elongated bar.

9. The bar operator assembly set forth in claim 8 in which the second coupling means includes bar supports coupled to the elongated bar at points spaced in the direction of elongation of the bar and mounted for reciprocating movement on the supporting structure, said second coupling means also including pivot means providing a pivotal connection between the second ends of the levers and the bar supports.

10. The bar operator assembly set forth in claim 9 in which the pivot means includes a flexible integral connection between the bar supports and levers.

11. The bar operator assembly set forth in claim 9 in which the pivot means includes cooperating projecting portions and recesses on the second ends of the levers and the bar supports.

12. The bar operator assembly set forth in claim 8 in which the first coupling means includes cooperating projections and recesses on the first ends of the levers.

13. The bar operator assembly set forth in claim 12 in which the cooperating projections and recesses include meshing gear segments on the first ends of both of the levers.

14. The bar operator assembly set forth in claim 12 in which the cooperating projections and recesses include a single projection on the first end of one of the levers and a single recess on the first end of the other lever.

15. The bar operator assembly set forth in claim 8 in which the first coupling means includes an integral, flexible connection between the first ends of the levers.

16. The bar operator assembly set forth in claim 8 in which resilient means acting on the levers adjacent the first ends of the levers.

17. The bar operator assembly set forth in claim 8 including switch means operated by movement of said elongated bar to the displaced position of the elongated bar.

18. A bar operator assembly for use in a key input unit comprising an elongated bar movable in opposite directions between normal and displaced positions, a supporting structure, a mechanism including a pair of levers each having first and second ends and pivoted on the supporting structure intermediate their first and second ends, said mechanism having first coupling means coupling the first ends of the levers for conjoint movement, said mechanism also including second coupling means coupling the second ends of the levers to the elongated bar at points spaced from each other in the direction of elongation of the bar, the first and second coupling means in said mechanism effecting oppositely directed pivotal movement of the pair of levers along paths of movement as the elongated bar moves in either of said opposite directions between said normal and displaced positions of the elongated bar to maintain a given orientation of the elongated bar during movement of the elongated bar between said normal and displaced positions of the elongated bar, a magnetically controlled switch, permanent magnet means for controlling the operation of the switch, and means mounting the switch and the permanent magnet means adjacent each other for movement relative to each other so that movement of the elongated bar controls operation of the switch.

19. The bar operator assembly set forth in claim 18 in which the switch is mounted in a fixed position on the supporting structure.

20. The bar operator assembly set forth in claim 19 in which the permanent magnet means is mounted on the elongated bar.

21. The bar operator assembly set forth in claim 20 in which the switch is mounted beneath the permanent magnet means in a position with the elongated bar overlying the switch.

22. The bar operator assembly set forth in claim 19 in which the permanent magnet means is mounted on one of the levers.

23. The bar operator assembly set forth in claim 22 including mounting means mounting the switch adjacent the path of movement of one of the levers carrying the permanent magnet means.

24. The bar operator assembly set forth in claim 23 in which the supporting structure includes an insulating portion, and the mounting means includes at least one electrically conductive terminal carried on the insulating portion and extending adjacent the path of movement of the lever carrying the permanent magnet means, the switch being connected to the terminal.

25. The bar operator assembly set forth in claim 19 in which the second coupling means includes a pair of bar supports connected to the bar at points spaced in the direction of elongation of the bar, and the permanent magnet means is mounted on one of the bar supports.

26. A bar operator assembly for use in a key input unit comprising a supporting structure, an elongated bar, a pair of supporting elements connected to spaced points on the elongated bar and slidably mounted on the supporting structure to mount the elongated bar on the supporting structure for reciprocating rectilinear movement, and a mechanism including a pair of levers pivotally mounted on the supporting structure underlying the elongated bar for equalizing movement of the elongated bar, said pair of levers extending in the direction of elongation of the bar and having spaced first and second ends, said levers having their first ends coupled together and their second ends individually coupled to different ones of the supporting elements.

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