Jan. 12, 1965 L. V. WENCZEL 3,165,190

KEYBOARD COMPOSED OF THREE INTERRELATED BUT INDIVIDUALLY REPLACEABLE UNITS

Filed Jan. 23, 1962 4 Sheets-Sheet 1

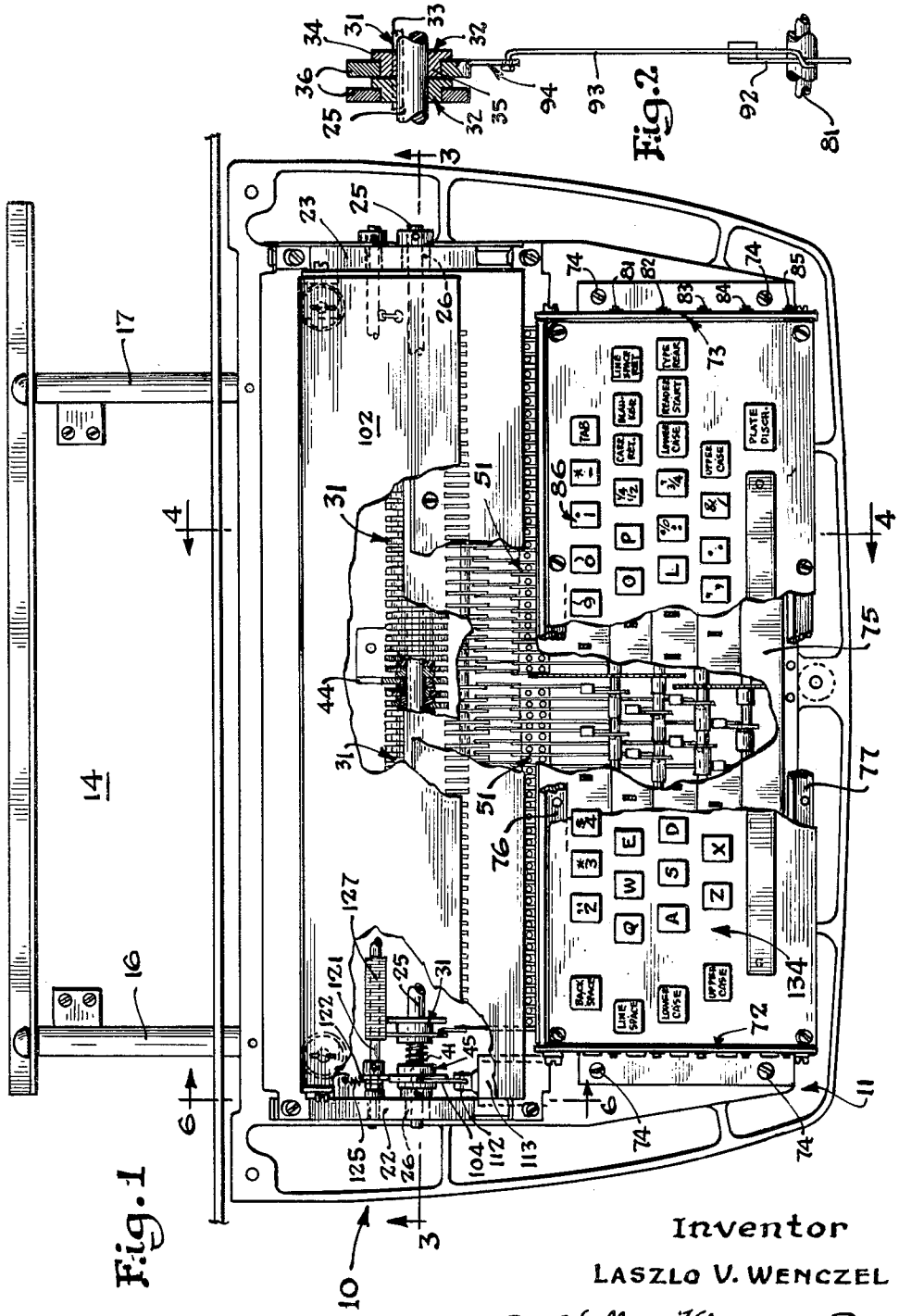


Fig. 1

Fig. 2

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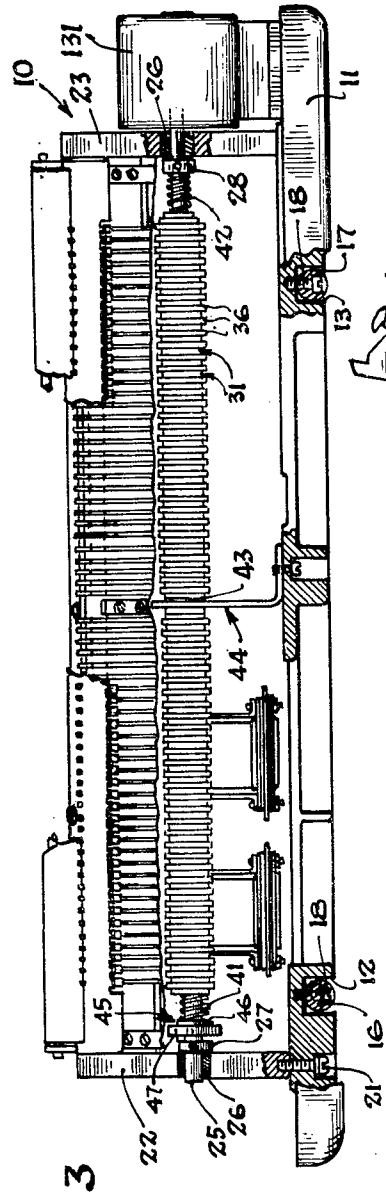


Fig. 3

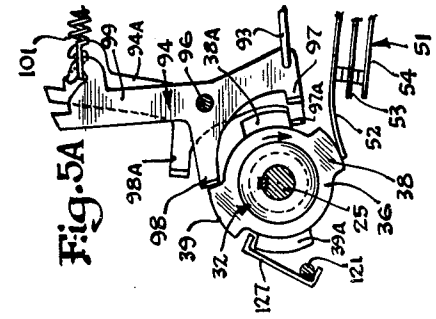


Fig. 5A

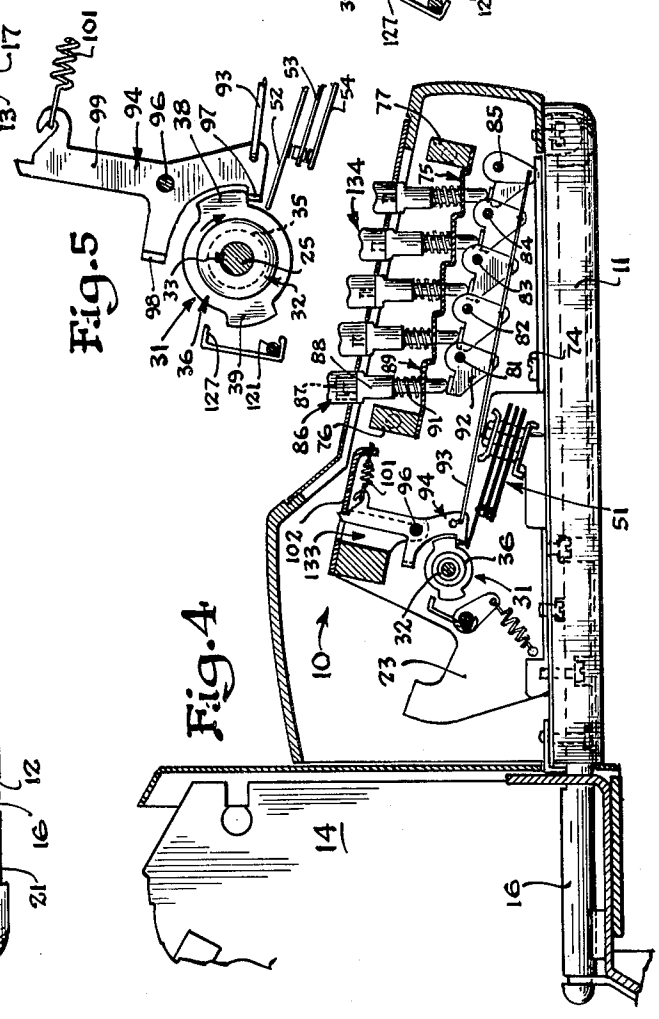


Fig. 5

Fig. 4

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Fig. 6

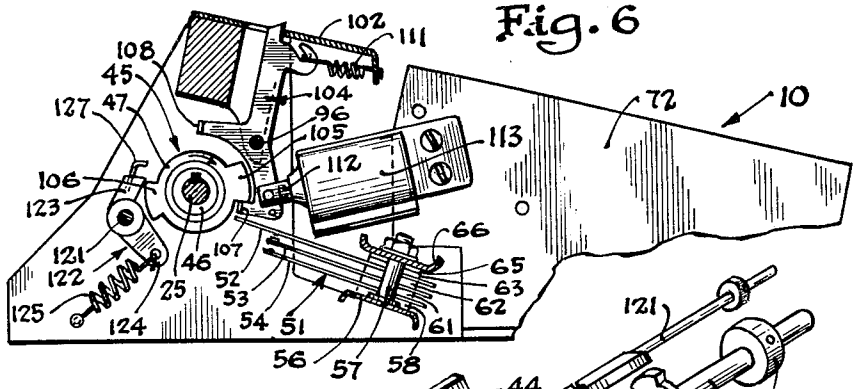


Fig. 7

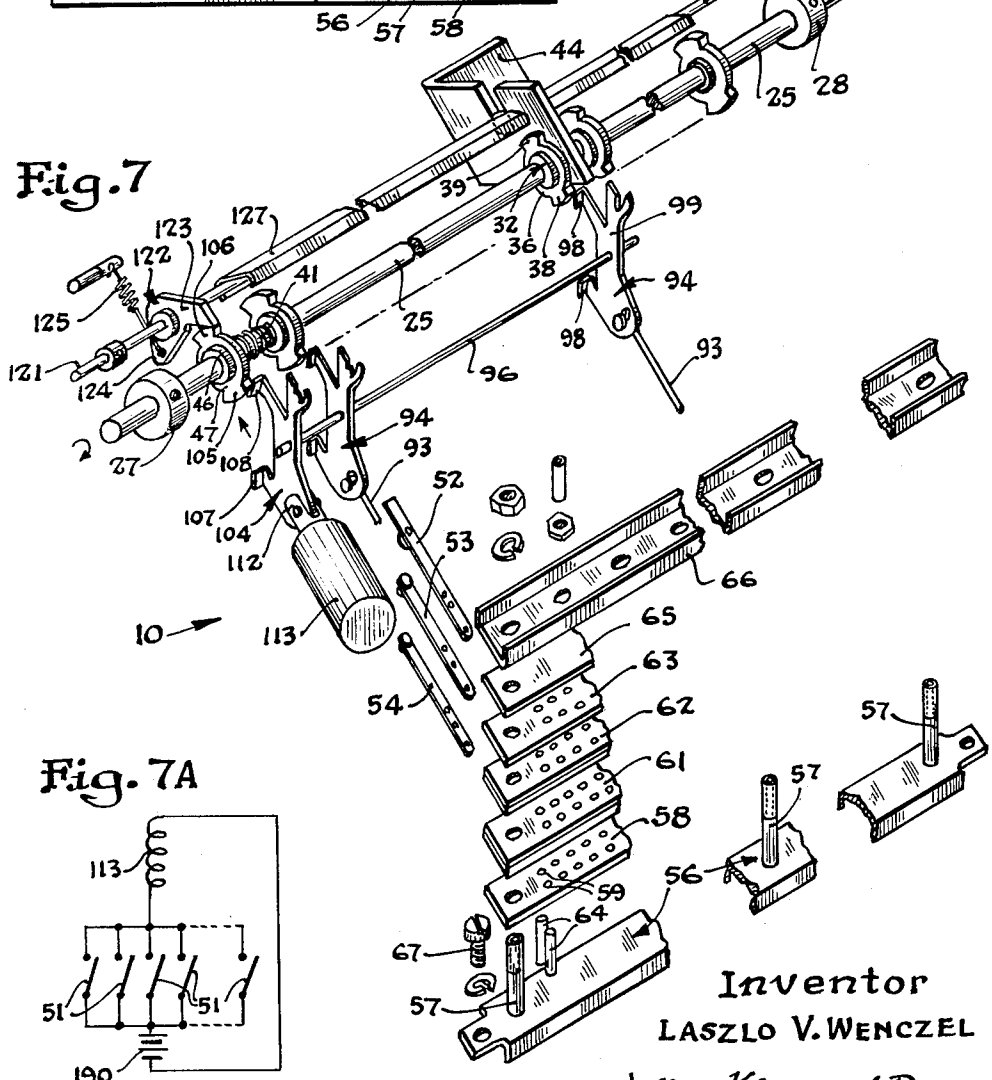


Fig. 7A

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Fig. 8

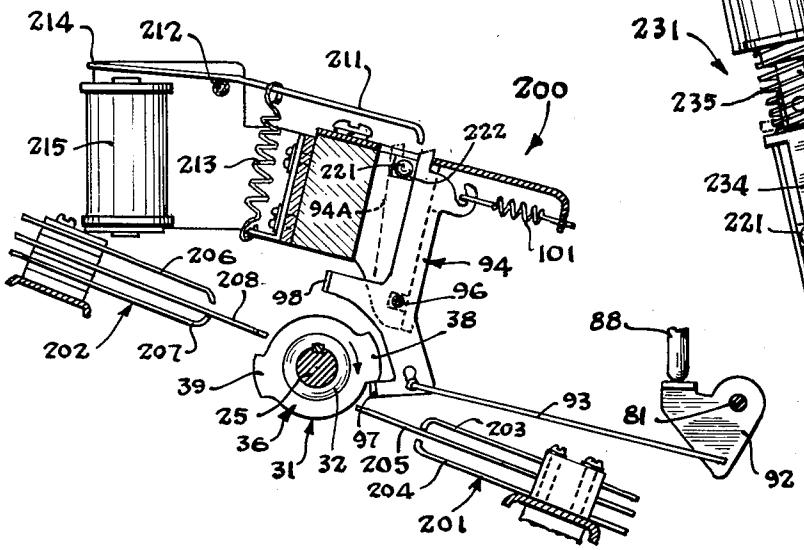


Fig. 10

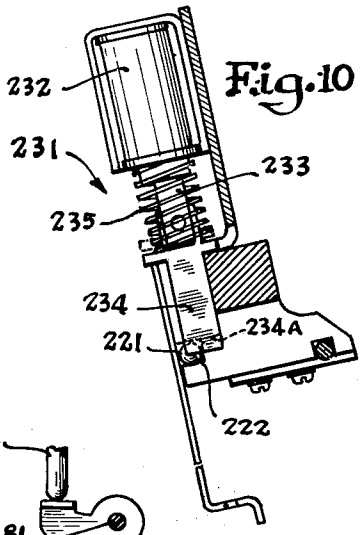


Fig. 9

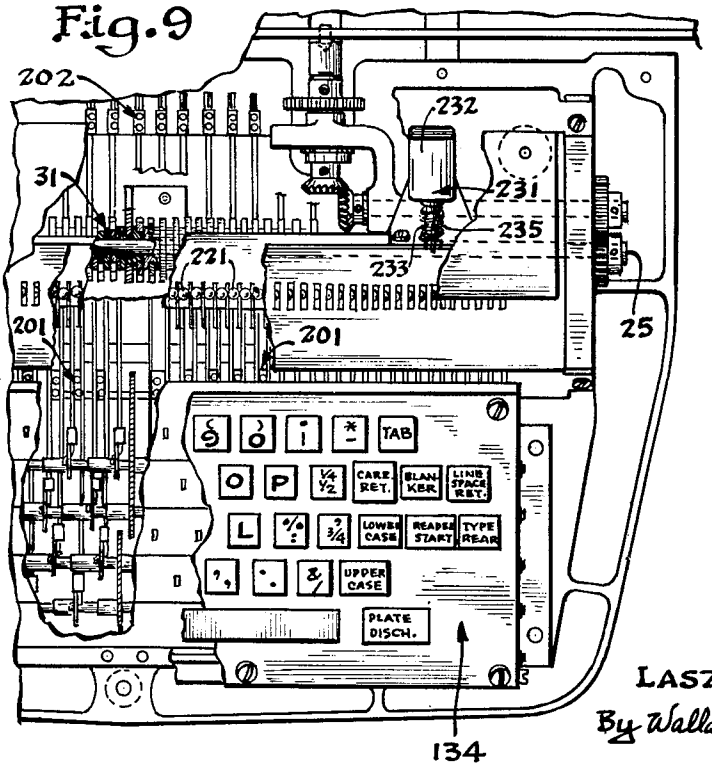
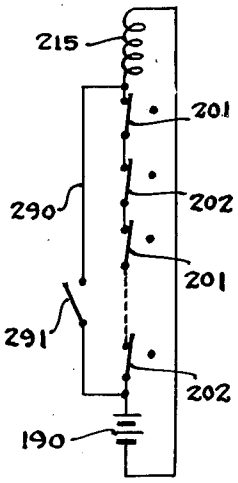


Fig. 11



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3,165,190

KEYBOARD COMPOSED OF THREE INTERRELATED BUT INDIVIDUALLY REPLACEABLE UNITS

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Filed Jan. 23, 1962, Ser. No. 168,123
11 Claims. (Cl. 197—19)

This invention relates to a new and improved electrically driven keyboard and more particularly to a keyboard apparatus suitable for use with a variety of different electrically actuated business machines.

There are a number of different kinds of business machines that may be controlled in their operation by electrical signals and in which it is necessary or desirable to provide for direct operator control by means of a keyboard mechainsm. Typical examples of business machines of this kind include keyboard-actuated automatic embossing machines, photocomposing machines, tape punches, computing devices, and others. Usually, the keyboard apparatus is specifically designed to meet the requirements of the business machine with which it is used. On the other hand, machines of this general kind have certain requirements in common, including particularly speed and accuracy of operation and freedom from frequent mechanical or electrical break-downs. The differences between the requirements of individual machines are usually concerned with the necessity of providing special keys for functions peculiar to a given machine.

In many business machines of this kind, there is no need for a mechanical connection between the keyboard and the machine itself. Rather, machine control is effected by opening, closing, or otherwise modifying individual electrical circuits in response to actuation of the keys of the keyboard by the machine operator. Consequently, effective control can be provided for a number of different kinds of machines, utilizing a single basic keyboard structure, if the keyboard itself can accommodate varying arrangements of keys to fit the functional requirements of the different machines.

It is a principal object of the invention, therefore, to provide a new and improved high-speed keyboard adapted for use with a variety of different business machines having varying requirements with respect to the number of functional keys in the keyboard.

A more particular object of the invention is to provide a control switch and actuating construction, for an electrically actuated keyboard, which is low in cost yet accurate in operation and which is also rugged and substantially maintenance-free. A feature of the invention which is of substantial value in achieving this object is the provision of switch actuating means capable of controlling a large number of individual control switches but driven from a single continuously driven shaft. Another important feature of the invention, in this regard, is a control switch assembly which locates all of the key-actuated switches of the keyboard in an assembly displaced from the operating keys and in a position readily accessible for cleaning and preventive maintenance.

Another object of the invention is to provide protection against overly rapid operation of two keys, in the use of an electrically actuated keyboard, without loss of the function controlled by the second of the two keys actuated.

An additional object of the invention is to provide for cyclic control of an electrically actuated keyboard, including particularly means for controlling the termination of a keyboard operating cycle in response to an electrical signal from the controlled machine indicative of completion of a machine operation.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

FIG. 1 is a plan view of a keyboard constructed in accordance with one embodiment of the present invention, with substantial portions of the upper part of the keyboard cut away to show the operating mechanisms thereof;

FIG. 2 is a detail view of a single key linkage in the keyboard;

FIG. 3 is a sectional elevation view taken approximately along line 3—3 in FIG. 1;

FIG. 4 is a sectional elevation view taken approximately as indicated by line 4—4 in FIG. 1;

FIG. 5 is a detail sectional view of a part of the keyboard apparatus, similar to a part of FIG. 4 but drawn to a larger scale;

FIG. 5A is a detail view similar to FIG. 5 with the apparatus in a different operating condition;

FIG. 6 is a detail sectional elevation view, similar to FIG. 4 but taken approximately along line 6—6 in FIG. 1;

FIG. 7 is an exploded perspective view of the principal operating components of the keyboard, exclusive of the keys;

FIG. 7A is a simplified schematic circuit diagram of a control device;

FIG. 8 is a detail elevation view, similar to FIG. 6, of another embodiment of the present invention;

FIG. 9 is a partial plan view of the keyboard mechanism of FIG. 8;

FIG. 10 is a detail sectional view taken approximately along line 10—10 in FIG. 9; and

FIG. 11 is a simplified schematic circuit diagram of a second control device.

A keyboard mechanism **10**, comprising the initial embodiment of the present invention, is illustrated in FIGS. 1–7. The keyboard **10** includes a base casting **11** having a pair of longitudinal channels **12** and **13**. The channels **12** and **13** are utilized to mount the keyboard **10** on the frame of a business machine **14** and particularly on a pair of cantilever support members **16** and **17**. Thus, as best shown in FIG. 3, the machine support members **16** and **17** are received in the longitudinal channels **12** and **13**, respectively, the base **11** being secured in predetermined position on the support members by suitable means such as a plurality of retaining screws **18**.

The frame of the keyboard **10** includes, in addition to the base member **11**, a pair of vertical frame members **22** and **23** which are mounted on the base by suitable means such as a plurality of mounting screws **21**. A main shaft **25** extends between the frame members **22** and **23**, being mounted in suitable bearings **26** in the vertical frame members. A pair of locating members **27** and **28** are mounted near the ends of the shaft **25**, intermediate the two vertical frame members, and are utilized to maintain the shaft **25** in aligned position, longitudinally of the shaft, between the frame members.

The main shaft **25** carries a large number of actuator devices **31** employed to actuate individual signalling de-

vices as explained more fully hereinafter. Each of the actuator devices 31, as shown specifically in FIGS. 2 and 5, comprises an inner drive disc 32 which is keyed or otherwise affixed to the shaft 25 by a suitable key member 33. The key member 33 may constitute a single member extending longitudinally of the shaft 25 and effective to secure all of the discs 32 on the shaft for rotational movement therewith. Each of the inner discs 32 is provided with a flange portion 34 and a recess portion 35. Each actuator device 31 further includes an annular actuating element 36 having an internal diameter smaller than the external diameter of the flange 34 on the associated driving disc 32. Preferably, the internal diameter of each annular actuator 36 is approximately equal to the external diameter of the portion 35 of the associated driving disc. Each of the annular actuating elements 36 is provided with a pair of diametrically opposed lugs 38 and 39, as shown in FIG. 5.

As shown in FIG. 3, and illustrated in detail in FIG. 2, the individual actuator devices 31 are disposed in longitudinal array along the shaft 25. A pair of springs 41 and 42 are utilized to hold the actuator devices 31 in compact relation to each other longitudinally of the shaft, each of the springs urging the actuator assemblies toward a stop member 43 fixedly mounted at the center of the shaft (FIG. 3). The stop member 43 may comprise a third bearing for the main shaft 25, supported in a bearing bracket 44.

The driving discs 32 and the actuator rings 36 of the actuator devices 31 may be fabricated from nylon or other suitable dimensionally stable plastic material. The material selected should permit achievement of a frictional driving connection between each of the internal driving discs 32 and the external actuator rings 36. On the other hand, the frictional connection between the inner and outer members of the actuator assembly 31, in each instance, should not be such as to cause the two elements to lock up with respect to each other, since these two elements must slip with respect to each other most of the time during operation of the keyboard 10. The self-lubricating qualities of nylon, and other plastic such as the fluoro-carbon plastics make these materials quite advantageous in construction of the individual actuator assemblies.

An additional actuator device 45 is located at the left-hand end of the shaft 25, as seen in FIGS. 1 and 3. The actuator device 45 is essentially similar in construction to each of the actuator devices 31, although it is utilized for a different purpose as described more fully hereinafter. Thus, the actuator device 45 includes an internal driving disc 46 and an external actuator 47 which correspond in construction and configuration to the members 32 and 36, respectively, of the actuator device 31 of FIGS. 2 and 5.

The keyboard 10 further includes a plurality of individual signalling devices equal in number to and individually associated with the actuators 31. In this embodiment of the invention, each of the signalling devices comprises a single pole switch as exemplified by the switch 51 (FIGS. 4 and 6). Each of the switches 51 includes an elongated upper contact arm 52 which projects into the path of movement of the actuator lugs or lobes on one of the actuator elements 36. The upper contact arm 52 in each of the switches 51 is of flexible construction and can be bent down to engage a second flexible contact arm 53 which, in turn, can be bent downwardly to engage a third or lower resilient contact arm 54. The contact arms 53 and 54 are shorter than the upper contact arm 52 and do not project into the path of the lugs on the associated actuator element. With reference to FIG. 6, it is seen that the upper arm 52 of each switch assembly 51 can be deflected by either lug on the associated actuator to close electrical contact between the individual elements of the switch.

It would be possible to construct the switch assemblies

51 as independent devices, but this presents substantial problems with respect to spacing between the switches. A preferred construction is best shown in FIGS. 6 and 7 and comprises a channel-shaped switch support member 56 having three vertically projecting support pins 57 affixed thereto. A first strip of insulator material 58 is mounted upon the support pins 57, the insulator strip being provided with suitable apertures for receiving the support pins. The insulator strip 58 is provided with a series of smaller apertures 59, there being two apertures 59 for each switch location. A second insulator strip 61 fits on the pins 57 above the strip 58, a third insulator strip 62 goes above the strip 61, and a fourth insulator strip 63 fits on the vertical support pins above the strip 62. Each of the insulator strips 61–63 is essentially similar in construction to the strip 58, and each is provided with a corresponding pair of apertures, similar to the apertures 59, at each switch location. Of course, the overall thickness of the insulator strips may vary, depending upon the installation requirements of the switches 51 and the spacing desired between the outboard ends of the resilient contact members 52–54.

Each of the spring contacts 52 fits between the insulator strips 62 and 63 in alignment with one pair of apertures in each of the insulator strips. Each contact member 53 is fitted between the strips 61 and 62, and each contact member 54 is located between the strips 58 and 61. Contact members are provided with apertures similar in size and configuration to the individual switch-position apertures in the insulator strips. The contact members 52–54 are held in aligned position relative to each other and relative to the insulator strips by means of insulator pins 64 which project upwardly through the individual apertures, at each switch location, in the insulator strips and through the corresponding apertures in the switch contact members. A steel pressure plate 65 is disposed above the switch insulator strip 63 and a channel-shaped upper support member 66 is disposed above the pressure plate 65. The entire assembly is held together by suitable retainer members such as the screws 67 which, in this instance, are threaded into tapped openings in the upper ends of the vertical support pins 57.

The mechanical linkages utilized to control the actuator devices 31 from a series of individual operator-actuated keys can best be understood by reference to FIGS. 1, 2 and 4. At the lower or front end of the keyboard 10, as illustrated in FIG. 1, a pair of vertical frame members 72 and 73 are mounted on the base 11 by suitable mounting means such as the screws 74. A transverse support frame comprising two transverse frame members 76 and 77 extends between the vertical frame members 72 and 73, and this support frame further includes a stepped transverse support member 75 as best illustrated in FIG. 4. In the keyboard 10, the transverse member 75 is provided with five levels to accommodate a five-row keyboard; a greater or lesser number of individual levels could be employed if desired to provide for a different number of rows of keys in the keyboard. The vertical frame members 72 and 73 also provide support for five individual transverse support rods or stationary shafts 81, 82, 83, 84 and 85, one for each row of keys in the keyboard.

The support member 75 in the keyboard 10 is utilized to support a plurality of individual keys. Since the operating linkages for the keys are essentially similar to each other, only one such linkage is described in detail. Thus, taking the key 86 in the first or upper row of the keyboard, it is seen that this key comprises an external cap member 87 mounted upon a vertically extending key element 88. The key element 88 projects through an aperture in the upper level 89 of the stepped support plate 75. A spring 91 is disposed in an encompassing relation to a portion of a key element 88 and normally maintains the key in the elevated or inactive position shown in FIG. 4. The lower end of the key member 88 is aligned with a bell crank 92 that is pivotally mounted upon the

stationary shaft 81 for the first row of keys. A connecting rod 93 is connected to the bell crank 92 (FIGS. 2 and 4) and this rod 93 is connected at its opposite end to a stop member 94 aligned with one of the actuator elements 36 in a given one of the actuator devices 31. As is evident from FIG. 4, when the key 86 is depressed against the bias afforded by the spring 91 it rotates the bell crank 92 in a counterclockwise direction about the support shaft 81. This rotational movement of the bell crank 92 is effective to move the connecting rod 93 to the right, as seen in FIG. 4 (downwardly as seen in FIG. 2). This movement of the rod 93 is utilized to control operation of the stop member 94 and, thereby, to control operation of the associated actuator element 36 as described in greater detail hereinafter.

As noted above, each of the key mechanisms for the keyboard is essentially similar to that described with respect to the key 86. Thus, for each key of the keyboard there is an associated bell crank, such as the crank 92, rotatably mounted on one of the stationary shafts 81–85. Moreover, each of the cranks is connected by one of the rods 93 to an individual stop element 94 that is employed to control an individual one of the actuating devices 31.

As shown in FIG. 5, the stop member 94 is pivotally mounted upon a shaft 96. The shaft 96 extends transversely of the keyboard between the vertical frame members 22 and 23. The stop member 94 includes a first stop element 97 and a second stop element 98. Ordinarily, the stop element 97 engages one of the lobes or lugs 38 and 39 on the actuator element 36 with which the stop member 94 is aligned. This is the position shown in FIG. 5. In this position, the stop element 98 of the stop member 94 is displaced from the actuator element 36 of the device 31, far enough to be clear of either of the lugs 38 and 39. The stop member includes an upwardly projecting arm 99; a biasing spring 101 is connected to the arm 99, the opposite end of the spring being connected to a fixed frame member 102 (see FIG. 4). The spring 101 is uitilized to bias the stop member 94 toward the position illustrated in FIG. 5, but permits rotational movement of the stop member from this position to the alternate position shown in FIG. 5A, as explained in detail hereinafter.

Each of the actuator devices 31 is aligned with an individual one of the stop members 94, as noted hereinabove. Consequently, there is no need to repeat a description of all of the stop elements and their relation to the actuator devices. Moreover, there is a similar stop element 104 that is associated with the actuator device 45 at the extreme left-hand end of the main shaft 25, as shown in FIGS. 6 and 7. The stop member 104 is also provided with two individual stop elements 107 and 108, corresponding to the stop elements 97 and 98, respectively, of the stop members associated with the other actuators. Moreover, the stop member 104 is provided with a biasing spring 111 that holds the stop member in the position shown in FIG. 6 but permits rotational movement of the stop member relative to the fixed support shaft 96. Thus, the stop element 107 is normally held in engagement with one of the lugs or lobes 105 and 106 on the actuator element 47 of the device 45.

The stop member 104 is not connected to any of the keys of the keyboard. Instead, the stop member 104 is mechanically connected to the armature 112 of a solenoid 113 that is mounted upon the vertical frame member 72. The solenoid 113 is utilized to control operation of the stop member 104 independently of the keys of the keyboard to afford protection against too-rapid actuation of the keys as explained more fully hereinafter.

A rock shaft 121 is incorporated in the keyboard 10; the rock shaft extends between and is journaled in suitable bearings mounted in the vertical frame members 22 and 23, as shown in FIG. 1. A crank member 122 is affixed to the shaft 121 at the left-hand end of the shaft as seen in FIG. 1. One end 123 of the crank 122 is normally engaged by one of the lobes 105, 106 of the actuator element 47 (FIG. 6). The other arm 124 of the crank

122 is connected to a spring 125 which urges the crank toward rotational movement in a clockwise direction. A bail 127 is affixed to the shaft 121; this bail extends across the keyboard mechanism in alignment with the actuator devices 31 (FIG. 1). However, when the crank 122 and the shaft 121 are held in their normal or initial rotational position, as shown in FIG. 6, the bail 127 is displaced from and is clear of the lugs or lobes on the actuator elements of the actuator assemblies 31, this relationship also being shown in FIG. 5.

For operation of the keyboard 10, it is necessary to provide some means for continuously rotating the main shaft 25. In FIG. 3, this means is generally indicated by the motor 131 connected to the outboard end of the shaft 25 that projects beyond the vertical support member 23. It is not essential that a separate drive motor be provided for the shaft 25, however. In those keyboard-controlled machines in which one or more motors or other drive sources are already available, the drive for the shaft 25 may be provided by a suitable power take-off from some other portion of the machine.

Thus, when the keyboard 10 is placed in operation, the motor 131 is energized to rotate the shaft 25. The speed of rotation of the shaft 25 is not critical, although it should be fast enough to provide the desired rapidity of operation of the keyboard. Typically, the rotational speed of the shaft 25 may be of the order of three hundred revolutions per minute. The rotational movement of the shaft, of course, causes all of the drive discs 32 of the actuator devices 31 to rotate at the same speed, since the drive discs are keyed or otherwise affixed to the shaft. The drive disc 46 of the individual actuator device 45 (FIGS. 6 and 7) is also rotated at the same speed as the main shaft.

When operation is started, all of the stop members 94 are in alignment in the position illustrated in FIG. 5. The stop element 97 of each stop member 94 engages one lobe 38 on the corresponding actuator ring 36. Engagement of the lobe 38 with the stop element 37 restrains rotational movement of the actuator 36, in each instance, with the result that the drive element 32 for the actuator ring must slip relative thereto. As long as these conditions are maintained, none of the signalling switches 51 are closed and there is no output signal from the keyboard. At the same time, the stop member 104 for the individual actuator device 45 is maintained in the position shown in FIG. 6, by the biasing spring 111. Accordingly, the stop element 107 of the stop member 104 engages one lobe 105 of the actuator 47 and prevents operation of this actuator.

Assuming that the operator now depresses the key 86 in the usual manner, pushing downwardly on the cap 87 of the key (FIG. 4), the key element 88 moves downwardly against the bias afforded by the spring 91, rotating the bell crank 92 in a counterclockwise direction. The rotational movement of the crank 92 moves the rod 93 to the right (FIGS. 4 and 5) and pivots the stop member 94 counterclockwise about the support rod or shaft 96. Depression of the key 86 through a predetermined distance causes a sufficient movement of the connecting rod 93 to pull the stop element 97 of the stop member 94 clear of the actuator lobe 38. As soon as this happens, the frictional connection between the driving disc 32 and the annular actuator 36 causes the latter to rotate in response to rotational movement of the shaft 25. In FIGS. 4 and 5, the direction of rotation of the shaft is clockwise. Thus, the actuator 36 rotates in a clockwise direction from the position of FIG. 5 toward that of FIG. 5A, bringing the lobe 38 into engagement with the contact arm 52 of the signalling device 51 and actuating the signalling device from its first or normal operating condition to a second or actuated condition. Moreover, the same pivotal movement of the stop member 94 that releases the stop element 97 from its original engagement with the lobe 38 of the actuator moves

the second stop element 98 into the path of the other lobe 39 of the actuator. Thus, as shown in FIG. 5A, the rotational movement of the actuator 36 is interrupted when the lug or lobe 39 engages the stop element 98, holding the actuator in a position in which it maintains the signalling device comprising the switch 51 in its second operating condition.

As long as the key 86 is held down, the actuator 36 is maintained in the position of FIG. 5A and holds the signalling switch 51 in its second operating condition. When the key is released, the spring 101 pivots the stop member 94 back in a clockwise direction toward the position of FIG. 5. As the spring 101 rotates the stop member, the stop element 98 is released from engagement with the actuator lobe 39 and the actuator is again released for movement in response to the frictional coupling with the drive disc 32 on the shaft 25. The annular actuator 36 accordingly rotates further in a clockwise direction until its movement is interrupted by engagement with the first stop element 97 of the stop member 94, which is now re-positioned in the path of the actuator lobe. Accordingly, upon completion of the keyboard operating cycle, the parts are again in the position illustrated in FIG. 5 except that the lobe 39 is now enegaged with the stop 97. Stated differently, the full operating cycle for the keyboard, with respect to a given function, entails a 180° rotation of one of the actuator rings 36.

The separate actuator device 45 does not control the operation of any of the signalling devices 51. Rather, and as noted above, it is utilized to prevent errors in operation of the keyboard which may result from the striking of two of the keys within a period of time shorter than a full operating cycle for the keyboard. This overly-rapid actuation of the keys may occur, for example, in the recording of letters or characters that are frequently used in a given combination. A typical instance is the recording of the characters "th" as in the word "the:"

To this end, the solenoid 113 may be connected in an electrical circuit which is effective to energize the solenoid each time any one of the signalling switches 51 is actuated to its closed condition. The particular form of circuit employed for this purpose is not critical. It may, for example, comprise a plurality of parallel energizing circuits directly connecting the solenoid to a suitable power supply 190, as shown in FIG. 7A. Another arrangement that could be used would entail a separate relay actuated upon the closing of any of the signalling switches 51.

As soon as the solenoid 113 is energized, it pulls the armature 112 to the right as seen in FIG. 6, pivoting the stop member 104 in a counterclockwise direction about the shaft 95. This releases the stop element 107 from engagement with the lobe 105 of the actuator element 47, permitting the actuator 47 to rotate in a clockwise direction in response to the frictional coupling with the drive disc 46. The rotational movement of the actuator 47 is interrupted by engagement of the lobe 106 with the stop element 108, after a rotation of about 120°. As the actuator 47 rotates, however, it clears the normal engagement of the lobe 106 with the crank 122. Consequently, the spring 125 pivots the crank 122 in a clockwise direction, rotating the shaft 121 and the bail 127 in the same direction toward the position shown in FIG. 5A. As can be seen in FIG. 5A, when this happens the bail or interlock member 127 is located in the path of movement of the lugs on the other signalling actuators, as represented by the element 39A in FIG. 5A.

Within the mechanism in the position shown in FIG. 5A, the striking of a second key by the keyboard operator, immediately after actuation of the first key, is still effective to release the actuator 36 associated with that key. The actuator can move only a short distance, however, before its movement is interrupted by the interlocking bail 127. Upon completion of the operating cycle initiated by the actuation of the first key, the solenoid 113 is de-energized, permitting the spring 111 to rotate the stop member 104 back in a clockwise direction to the position of FIG. 6. This releases the stop member 108 from engagement with the lobe of the annular actuator 47 and permits the actuator 47 to continue its clockwise rotation until again interrupted by engagement with the stop 107. This continued movement of the actuator causes it to again engage the crank 122, pivoting the crank against the bias of the spring 125 and back to the position of FIG. 6. The movement of the crank rotates the shaft 121 back to its original position, releasing the interlocking bail 127 from engagement with the lobe of the actuator associated with the second key depressed. Consequently, this second actuator is permitted to carry out its operating cycle, as described hereinabove in connection with the first key actuated.

It is thus seen that the actuator device 45, the solenoid 113, the stop member 104, and the assembly comprising the bell crank 122 and the interlocking member 127 afford a one-cycle memory which effectively "stores" the identity of the second key actuated and permits completion of its operating cycle after the operating cycle has been completed for the first key. In principle, this apparatus is self-monitoring because the signal which initiates operation of the first actuator is the same signal which causes restraint of operation of the second actuator until the operating cycle of the first actuator is completed. It should be noted that in normal rythmic use of the keyboard 10, the output speed of the keyboard exceeds the average input speed of the operator. Thus, the memory unit described hereinabove is required only for instances where the operator momentarily speeds up with respect to a combination of two keys, as noted above.

In the preferred arrangement illustrated in FIGS. 1 through 7, the keyboard 10 is constructed in a plurality of distinct though interconnected units. The first unit comprises the actuators 31 and the stop members 94, taken together with the main shaft 25. This unit of the machine also, in this embodiment, includes the one-cycle memory comprising the solenoid 113, the stop member 104, and the additional actuator device 45. The switching devices 51 comprise a second distinct unit of the keyboard and may be modified substantially without changing the first unit. Thus, instead of the switching devices 51 illustrated in connection with the keyboard 10, a corresponding plurality of single-pole double-throw switches may be utilized. Moreover, the leaf-spring switch structures that have been illustrated may be replaced by plunger-type devices or other signalling devices. Any such change has no effect upon the basic actuator assembly comprising the devices 31, as long as the signalling devices employed can be actuated from one operating condition to another by engagement with the lobes 38 and 39 of the actuators.

Another independent unit in the keyboard 10 comprises the assembly mounted in the frame 72–77, including the keys, the shafts 81–85, and the individual connecting linkages for the keys. Thus, it is seen that the entire key mechanism, up to the stop members 94, can be removed from the keyboard 10 by disengaging the individual connecting rods 93 from the stop members. The complete keyboard mechanism 134 can then be removed and replaced by a similarly constructed but different mechanism. In assembling a given keyboard, therefore, the construction of the actuators and associated stop members is not dependent upon the number of keys required in the keyboard mechanism to be used in association therewith. Instead, a keyboard having any given number of keys equal to or less than the total number of actuators available can be mounted in the keyboard 10 and, when the connecting rods 93 are connected to the stop members 94, the two units are completely and adequately inter-related. It is thus seen that the keyboard 10 comprises three independent but related modular units that may be combined to meet the requirements

of virtually any business machine that may be controlled by electrical signalling devices, so long as the total number of signalling devices and actuators is equal to or exceeds the required number of characters and functions for the business machine. A further advantage of the system, in addition to its flexibility, is that all of the signalling switches **51** are displaced from the operating keys of the keyboard in a single assembly that is readily accessible for cleaning and preventive maintenance.

FIGS. 8, 9 and 10 illustrate a keyboard **200** that in many respects is substantially similar to the keyboard **10** but which is modified in other respects. In connection with the keyboard **200**, it may be assumed that the basic key mechanism **134** of the keyboard **10** is utilized without changes. In addition, the continuously driven drive shaft **25** is the same as in the first embodiment, and the individual friction-driven actuator devices **31** also remain substantially unchanged. As before, the actuators **31** are controlled by individual stop members **94** each comprising the two individual stop elements **97** and **98** (FIG. 8).

In the keyboard **200**, the construction of the signalling devices is somewhat different from the signalling switches **51** in the keyboard **10**. Thus, the keyboard **200** includes a first series of signalling switches **201** which are located in approximately the same alignment as the switches **51** in the keyboard **10**. In this instance, however, the signalling switches **201** are aligned with alternate ones of the actuator devices **31**. This provides signalling devices for only fifty per cent of the actuator devices. The remaining actuator devices are associated with a second series of signalling switches **202** that are located diametrically opposite the devices **201**, relative to the axis of the shaft **25**. This arrangement permits the use of somewhat larger signalling switches and may be of substantial advantage where the signalling devices are required to carry relatively large currents.

Each of the signalling switches **201** is a single-pole double-throw device. Thus, each switch comprises a pair of fixed contact arms **203** and **204** which terminate short of the actuator **36** and its lobes **38** and **39**. A flexible resilient contact arm **205** projects between the arms **203** and **204** and into the path of movement of the actuator lobes **38** and **39**. This resilient contact arm **205** is normally engaged with the upper fixed contact **203** but can be moved into engagement with the lower fixed contact **204**. The switches **202** are of similar construction; each switch **202** includes fixed upper and lower contacts **206** and **207** between which a resilient flexible contact **208** projects. The movable contact **208** of each of the switches **202** is normally engaged with the lower fixed contact **207** but can be deflected to close an electrical circuit with the upper fixed contact **206**.

The keyboard **200** further includes a cycle-control device, comprising an elongated bail or lockout member **211** that is pivotally mounted upon a shaft or rod **212** that extends across the upper part of the keyboard. A spring **213** is connected to the bail **211** and urges the bail toward rotational movement in a clockwise direction about the axis of the shaft **212**. The left-hand portion **214** of the bail **211** comprises a magnetic member that is aligned with an electromagnet **215**. Ordinarily, the magnet **215** is energized, holding the left-hand portion **214** of the bail **211** down and maintaining the bail in the position shown in FIG. 8.

The base operation of the signalling devices **201** and **202** is accomplished, in the keyboard **200**, in much the same manner as in the case of the signalling devices **51** of the keyboard **10**. Thus, downward movement of the key element **88** pivots the bell crank **92** about the shaft **81**, pulling the connecting rod **93** to the right and pivoting the stop member **94** in a counterclockwise direction to the alternate position illustrated by the phantom outline **94A**. This movement of the stop member **94** releases the actuator **36** and the actuator is rotated in a clockwise direction by the frictional coupling to the drive disc **32**. The rotational movement of the actuator **36** is interrupted by engagement of the lobe **39** with the stop element **98** at a position where one of the signalling switches **201**, **202** is driven to its second operating position by the associated one of the actuator lobes **38** and **39**.

In this embodiment of the invention, the electromagnet **215** is connected in an operating circuit that is effective to de-energize the magnet as soon as any of the switches **201** and **202** is actuated to its second operating condition. For example, this can be accomplished by a series energizing circuit for the electromagnet that includes all of the upper contact pairs of the devices **201** and all of the lower contact pairs of the devices **202**, as schematically shown in FIG. 11, since these particular contact pairs are normally closed but are opened upon actuation of the signalling devices. When the electromagnet **215** is de-energized, the spring **213** pulls the interlock bail **211** downwardly and it engages the right-hand side of the particular stop member (FIG. 8) that has been actuated to its alternate position **94A**. At the same time, the bail engages the other side of each of the remaining stop members **94** and prevents actuation thereof. It is thus seen that all of the stop members are locked up, including both the one that has been moved to its second operating position **94A** and all of those that have not been so moved. Accordingly, the keyboard **200** remains in actuated position with respect to one signalling switch **201** or **202**.

To restore the keyboard mechanism **200** to its original operating condition and permit recording of another character, or performance of another function, the electromagnet **215** must again be energized to release the bail **211** from its interlock position. Of course, this must be accomplished after the key **88** is released. However, release of the key **88** does not automatically accomplish this purpose because the deenergization of the electromagnet **215** was accomplished through the operation of one of the switches **201**, **202**. A separate energizing circuit **290** (FIG. 11) can be provided for the magnet **215**, however, to energize the magnet **215** and release the bail **211**, permitting the mechanism to restore itself to the condition of FIG. 8. The circuit **290** includes a suitable relay or switch **291** actuated by the machine with which the keyboard is used. This makes its possible to control the duration of an output signal from the keyboard **200** in accordance with the requirements of any given business machine. That is, energization of the electromagnet **215** may be actuated by a suitable circuit from the business machine which the keyboard is associated so that the duration of the operating cycle of the keyboard is dependent upon the operation of the machine that it controls.

The keyboard **200** also includes a mechanical interlock or check mechanism for preventing simultaneous action of two or more keys. This mechanism comprises a plurality of individual balls **221** disposed in a channel **222** immediately ahead of the stop members **94**. The dimensions of the balls are selected to leave enough slack between balls in the channel **222** to permit the passage of one of the stop members **94** between the individual balls. However, there is not enough space in the channel to permit the movement of two stop members **94** between the balls. Consequently, if two keys are struck simultaneously, or if a second key is actuated before the bail **211** reaches its blocking position, the stop member controlled by the second key to be actuated cannot move through the ball channel **122** to the alternate position **94A**, being blocked by the balls in the channel.

The keyboard **200** further includes a separate device for locking out the keyboard to prevent utilization thereof. This device, illustrated in FIG. 10, may be employed to particular advantage in those applications in which the keyboard **200** controls a business machine that is also subject to control from an alternate source, such as a tape reader or the like. The lockout device **231** shown in FIG. 10 comprises a solenoid **232** having an armature **233** to which a blade-like stop member **234** is affixed.

The blade member 234 is movable between an initial position shown in solid lines in FIG. 10 and an alternate position indicated by the phantom outline 234A. A spring 235 is included in the device 231 and normally biases the armature 233 of the solenoid downwardly to hold the stop member 234 in its initial position.

In its initial position, the stop blade 234 projects down into the channel 222 between the balls 221. The blade 234 is approximately the same thickness as the individual stop members 94. Hence, as long as the solenoid 232 is maintained de-energized, the presence of the blade 234 in the ball channel 221 prevents effective actuation of any of the stop members 94. Of course, energization of the solenoid 232 raises the blade stop 234 against the bias of the spring 235 to the position 234A, in which it is clear of the ball channel. Thus, when the keyboard is to be used, the solenoid 232 is energized; when an alternate input is to be employed, the operating circuit for the solenoid 232 is held open. It will be understood that suitable interlocking circuit arrangements may be employed to prevent dual input from the keyboard and from some other input to the control business machine by controlling the energization of the solenoid 232.

In both of the foregoing embodiments, the actuators for the signalling devices are of two-lobed construction, an operating cycle for each actuator entailing rotation through 180°. Of course, single-lobe actuators could be used, though this would entail a time loss or a requirement for higher rotational speed of the shaft 25 to maintain a comparably short cycle time. Further, three-lobe or four-lobe actuators could be used, if desired, with a corresponding change in the angular distance entailed in each operating cycle. If three or more lobes are used on the actuators, or if the "normal" positions of adjacent actuators are angularly displaced relative to each other, the orientation of the signalling switches or other signalling devices can also be changed, permitting use of a larger number of different series of signalling devices.

Hence, while preferred embodiments of the invention have been described and illustrated, it is to be understood that they are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. A keyboard for an electrically operable business machine comprising:

a continuously rotated shaft;

a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;

a corresponding plurality of actuators each frictionally coupled to said shaft for movement between first and second operating orientations to actuate a given one of said signalling devices to its first and second operating conditions, respectively;

control means for individually selectively restraining each of said actuators in its respective first and second operating orientations, independently of the operating orientations of the remaining actuators, said control means comprising a corresponding plurality of stop members individually engageable with respective ones of said actuators;

and key-actuated means for individually moving each stop member into position to engage the associated actuator and hold it selectively in said first and second operating orientations aganist the frictional drive from said shaft.

2. A keyboard for an electrically operable business machine comprising:

a continuously rotated shaft;

a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;

a corresponding plurality of actuator devices each including a drive member affixed to said shaft for rotation therewith and an actuator member frictionally coupled to said drive member for movement between first and second operating orientations to actuate a given one of said signalling devices to its first and second operating conditions, respectively;

control means for individually selectively restraining each of said actuator members in its respective first and second operating orientations, independently of the operating orientations of the remaining actuators, said control means comprising a pair of stop elements for each actuator member;

and key-actuated means for individually moving each pair of stop elements alternately into position to engage the associated actuator member and hold it in a respective one of said first and second operating orientations against the frictional drive from the associated drive member.

3. A keyboard for an electrically operable business machine comprising:

a continuously rotated shaft;

a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;

a corresponding plurality of plastic actuator drive discs mounted on said shaft for rotation therewith, each of said discs having a peripheral flange and the flanges on adjacent discs defining a series of annular actuator-receiving recesses;

a corresponding plurality of annular plastic actuators disposed in said recesses and each frictionally coupled to one of said drive discs for movement between first and second operating orientations to actuate a given one of said signalling devices to its first and second operating conditions, respectively;

control means for individually selectively restraining each of said actuators in its respective first and second operating orientations, independently of the operating orientations of the remaining actuators, said control means comprising a pair of stop elements for each actuator;

and key-actuated means for moving the stop elements of each pair alternately into position to engage the associated actuator and hold it in a respective one of said first and second operating orientations against the frictional drive from the associated drive disc.

4. A keyboard for an electrically operable business machine comprising:

a continuously rotated shaft;

a plurality of signal switches, each including a movable switch element actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;

a corresponding plurality of actuators each frictionally coupled to said shaft for movement between first and second operating orientations to actuate a given one of said signalling devices to its first and second operating conditions, respectively, said actuators each being of annular configuration disposed in encompassing relation to said shaft and each including two actuator lobes engageable with the movable switch element of the associated signal switch;

control means for individually selectively restraining each of said actuators in its respective first and second operating orientations, independently of the operating orientations of the remaining actuators, said control means comprising a stop member for each actuator element, each stop member including two stop elements;

and key-actuated means for individually moving each

stop member to position the stop elements thereof alternately into position to engage the associated actuator and hold it in a respective one of said first and second operating orientations against the frictional drive from said shaft.

5. A keyboard for an electrically operable business machine comprising:
a continuously rotated shaft;
a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;
a corresponding plurality of actuators each frictionally coupled to said shaft for movement between first and second operating orientations to actuate a given one of said signalling devices to its first and second operating conditions, respectively;
control means for individually selectively restraining said actuators in their respective first and second operating orientations, said control means comprising a corresponding plurality of stop members each movable between first and second operating positions to engage and restrain the associated actuator in its first and second orientations, respectively;
key-actuated means for individually selectively moving said stop members between their respective operating positions;
an interlock member movable between a rest position displaced from said actuators and an interlock position in which said interlock member is engageable with all of said actuators to prevent movement of the actuators to their second operating orientation;
and electrically operated means for moving said interlock member to its interlock position whenever any one of said plurality of actuators is driven to its second operating orientation.

6. A keyboard for an electrically operable business machine comprising:
a continuously rotated shaft;
a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;
a corresponding plurality of actuators each frictionally coupled to said shaft for movement between first and second operating orientations to actuate a given one of said signalling devices to its first and second operating conditions, respectively;
control means for individually selectively restraining said actuators in their respective first and second operating orientations, said control means comprising a corresponding plurality of stop members each movable between first and second operating positions to engage and restrain the associated actuator in its first and second orientations, respectively;
key-actuated means for individually selectively moving said stop members between their respective operating positions;
an interlock member movable between a rest position displaced from said actuators and an interlock position in which said interlock member is engageable with all of said actuators to prevent movement of the actuators to their second operating orientation;
an electrically operated interlock actuating means for moving said interlock member to its interlock position whenever any one of said plurality of actuators is driven to its second operating orientation, said interlock actuating means comprising an additional actuator engageable with said interlock member, an additional stop member controlling said additional actuator, and a solenoid mechanically connected to said additional stop member and effectively electrically coupled to all of said signalling devices.

7. A keyboard for an electrically operable business machine comprising:
a continuously rotated shaft;
a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;
a corresponding plurality of actuators each including at least one actuator lobe and frictionally coupled to said shaft for movement between first and second operating orientations to engage said lobe with and actuate a given one of said signalling devices to its first and second operating conditions, respectively;
control means for individually selectively restraining said actuators in their respective first and second operating orientations, said control means comprising a corresponding plurality of stop members each movable between first and second operating positions to engage and restrain the associated actuator in its first and second orientations, respectively;
key-actuated means for individually selectively moving said stop members between their respective operating positions;
an interlock member movable between a rest position displaced from said lobes of said actuators and an interlock position in which said interlock member is disposed in the path of movement of the lobes of all of said actuators in position to engage said actuator lobes and prevent movement of the actuators after only a limited movement toward their second operating orientation;
and electrically operated means for moving said interlock position whenever any one of said plurality of actuators is driven to its second operating orientation.

8. A keyboard for an electrically operable business machine comprising:
a continuously rotated shaft;
a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;
a corresponding plurality of actuators each frictionally coupled to said shaft for movement between first and second operating orientations to actuate a given one of said signalling devices to its first and second operating conditions, respectively;
control means for individually selectively restraining said actuators in their respective first and second operating orientations, said control means comprising a corresponding plurality of stop members each movable between first and second operating positions to engage and restrain the associated actuator in its first and second orientations, respectively;
key-actuated means for individually selectively moving said stop members between their respective operating positions;
an interlock member movable between a rest position displaced from said actuators and an interlock position in which said interlock member is engageable with all of said actuators to prevent movement of the actuators to their second operating orientation;
and electrically operated interlock control means for moving said interlock member to its interlock position whenever any one of said plurality of actuators is driven to its second operating orientation, and for holding said interlock means in its interlock position, independently of operation of said key-actuated means, until released by means external of the keyboard.

9. A keyboard for an electrically operable business machine, including three interrelated modular units, comprising:
a signal unit comprising a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;
an actuator unit comprising a continuously rotated drive shaft, a plurality of actuators each frictionally coupled to said drive shaft for movement between

first and second operating orientations and each engageable with one of said signal devices to actuate a given one of said signalling devices between its first and second operating conditions, and control means for individually selectively restraining each of said actuators in its respective first and second operating orientations, independently of the operating orientations of the remaining actuators, said control means comprising a plurality of stop elements individually engageable with respective ones of said actuators;

and a keyboard unit including a plurality of keys individually connectable to respective ones of said stop elements to move each stop element, selectively, into position to engage the associated actuator and hold it in a respective one of said first and second operating orientations against the frictional drive from said shaft; each of said units being constructed as a separate, complete apparatus, replaceable in combination with the remaining units of the apparatus without change of the remaining units.

10. A keyboard for an electrically operable business machine, including three interrelated modular units, comprising:

a signal unit comprising a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;

an actuator unit comprising a pluraliy of actuators each movable between first and second operating orientations and each engageable with one of said signal devices to actuate a given one of said signalling devices between its first and second operating conditions, and control means comprising a plurality of control elements for individually selectively locating each of said actuators in its respective first and second operating orientations independently of the operating orientations of the remaining actuators;

and a keyboard unit including a plurality of keys individually connectable to respective ones of said control elements to actuate each control element independently of the others; each of said units being constructed as a separate, complete apparatus, replaceable in combination with the remaining units of the apparatus without change of the remaining units.

11. A keyboard for an electrically operable business machine, including three interrelated modular units, comprising:

a signal unit comprising a plurality of signal devices, each actuatable between first and second operating conditions, electrically connectable with said business machine to control operation thereof;

an actuator unit comprising a continuously rotated drive shaft, a plurality of actuators each frictionally coupled to said drive shaft for movement between first and second operating orientations and each engageable with one of said signal devices to actuate a given one of said signalling devices between its first and second operating conditions, control means for individually selectively restraining each of said actuators in its respective first and second operating orientations independently of the operating orientations of the remaining actuators said control means comprising a plurality of stop elements individually engageable with respective ones of said actuators, and interlock means restraining said actuators to prevent actuation of more than one signal device at a time;

and a keyboard unit including a plurality of keys individually connectable to respective ones of said stop elements to move each stop element, selectively, into position to engage the associated actuator and hold it in a respective one of said first and second operating orientations against the frictional drive from said shaft; each of said units being constructed as a separate, complete apparatus, replaceable in combination with the remaining units of the apparatus without change of the remaining units.

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