April 10, 1956 E. L. KENT ET AL 2,741,670

KEY COUPLING APPARATUS

Filed May 26, 1951 2 Sheets-Sheet 1

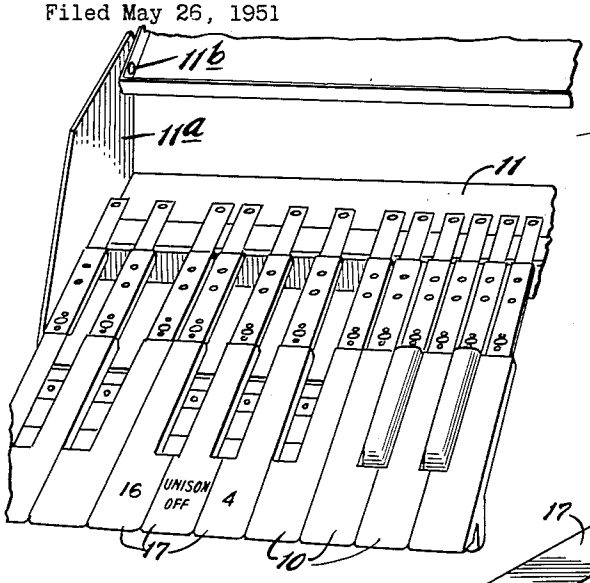



Fig. 1

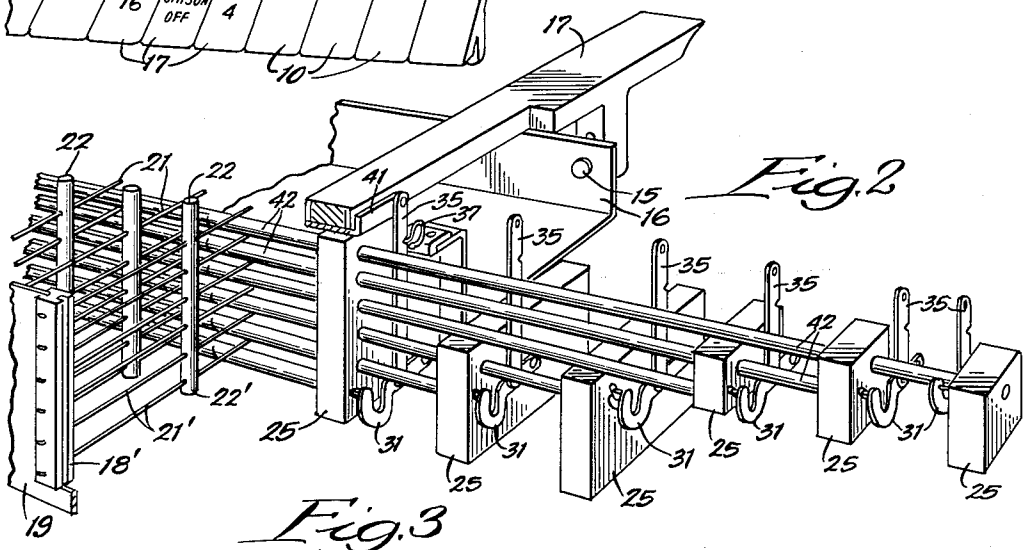
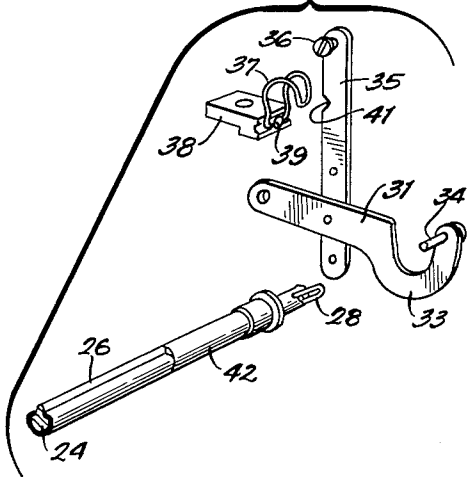



Fig. 2

Fig. 3




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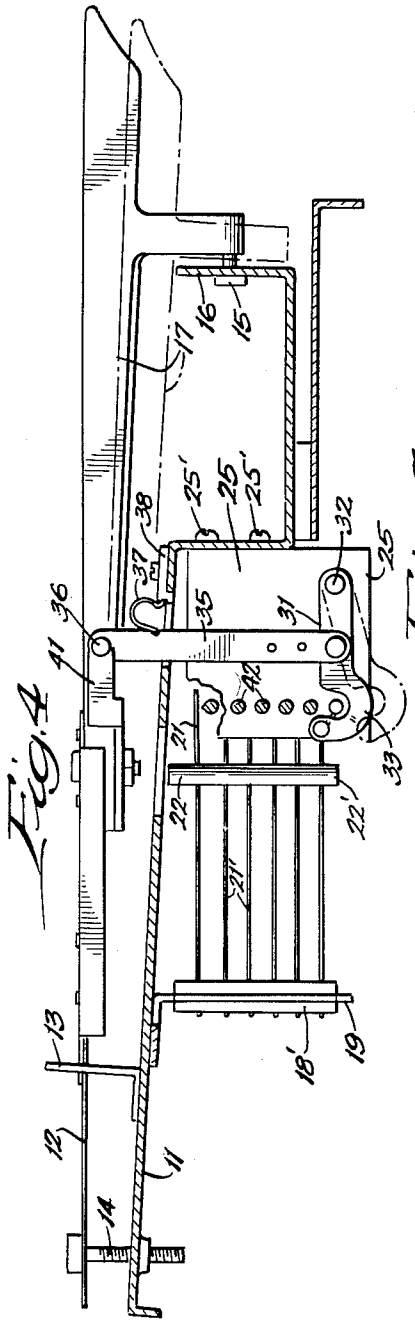


Fig. 4

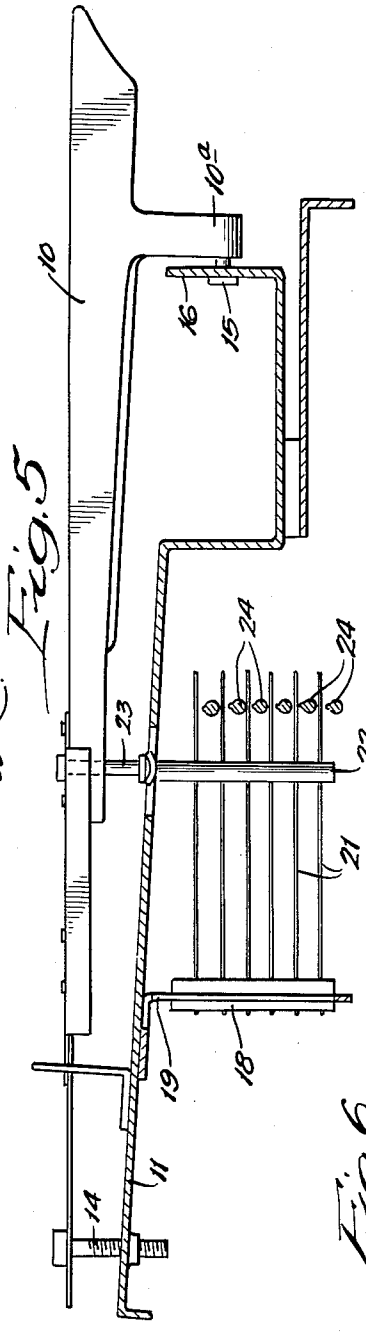


Fig. 5

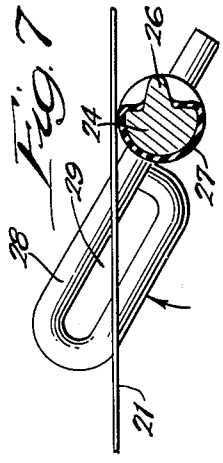


Fig. 7

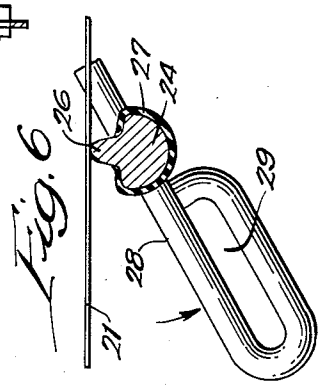


Fig. 6

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# KEY COUPLING APPARATUS

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Application May 26, 1951, Serial No. 228,462

10 Claims. (Cl. 200—1)

This invention relates to key coupling apparatus and more particularly to a coupling apparatus to be built into the keyboards of electric organs.

The provision of coupling switches in the keyboards of organs has heretofore been proposed. Such switches, constituting a coupling apparatus, have been relatively bulky and complicated and have involved complications in the wiring of the keyboard.

It is one of the objects of the present invention to provide a key coupling apparatus which is simple and inexpensive to manufacture, is small and compact, and provides a high degree of versatility of control.

Another object is to provide key coupling apparatus in which control of the coupling is effected by turning contact rods having contacting portions and insulating portions. According to one feature, the contact rods are constructed to insure good contact with flexible switch members and to provide uniform operation of the switch members under all conditions.

Still another object is to provide a key coupling apparatus in which the contact rods are turned by pivoted keys through a linkage including a toggle spring to insure full movement of the rods to either position.

According to one feature, the toggle spring is formed by a resilient loop acting on a link which connects the key to a lever for operating the contacted rod.

The above and other objects and features of the invention will be more readily apparent when viewed in connection with the accompanying drawings, in which:

Figure 1 is a partial perspective view of a keyboard embodying the invention;

Figure 2 is a partial perspective looking from the rear of the keyboard with parts omitted;

Figure 3 is a disassembled perspective view of the linkage for connecting the coupling keys to the contact rods;

Figure 4 is a transverse section showing a coupling key and its connecting linkage;

Figure 5 is a transverse section showing a playing key and

Figures 6 and 7 are enlarged partial sections of the contact rods.

The invention may be applied to a keyboard which includes a plurality of playing keys **10** pivoted at their rear ends on a supporting plate or key bed **11** which may extend completely across the keyboard or across a selected portion thereof. As best seen in Figure 5, the playing keys are provided with resilient spring extensions **12** which fit through narrow slots in an upright flange **13** to support the keys for pivotal movement. The projection **12** is adjustably tensioned by a screw **14** threaded into the key bed **11** by which the tension of the resilient extension **12** can be adjusted to adjust the return spring force acting on the key. At the forward end, each key has a downwardly projecting flange or skirt **10***a* formed with a vertical groove to fit over a guide pin **15** which is carried by a vertical flange **16** at the front of the frame to guide the key and limit movement thereof.



The keyboard also includes, preferably adjacent to one end thereof, a series of coupler keys **17** which are similarly mounted for pivotal movement as best shown in Figure 4. Any desired number of coupler keys may be provided depending upon the desired effect and the number of coupling combinations to be provided in a particular manual.

The key bed **11** is formed as shown to underlie the keys relatively closely and is imperforate except for the openings required for the operating mechanism as described hereinafter. The entire switch mechanism and the switches described hereinafter are mounted beneath the key bed where there is adequate space and where the mechanism is protected by the key bed against dust and dirt dropping between the keys. The key bed is preferably hinged on an axis adjacent to its rear edge so that the entire assembly can be swung back as a unit for access to the switches and coupling mechanism without requiring removal of any of the keys. This arrangement is illustrated in Figure 1 as applied to a double keyboard instrument. The lower key bed has enlarged end flanges **11***a* at its ends which are pivoted at **11***b* and the upper keyboard is also pivoted at its ends at **11***b*. Either or both of the keyboards can be swung back about the pivots from the playing position in which the lower keyboard is shown to the exposed position in which the upper key bed is partially shown. In the latter position easy access is had to the switches and other mechanism for easy assembly or repair.

Each playing key is adapted to operate a switch mechanism which, as shown, comprises a strip or block **18** formed of insulating material and grooved at its sides to fit into slots in a vertical flange **19** carried by the frame **11**. Each block **18** has rigidly embodied therein a series of flexible contact strips shown as wires **21** which extend outward from the block toward the front of the keyboard. The wires **21** preferably extend completely through the block for connection to cables or wires connecting the switches to the organ mechanism. The several wires of each switch assembly are connected for movement in unison by embedding them adjacent their free ends in a rod **22** preferably formed of molded insulating material. The wires are resiliently biased to an upper or straight position as shown in Figures 2 and 5 and are adapted to be moved downward to their contacting position by depression of the playing keys **10**. For this purpose, each playing key carries an adjustable abutment **23** adapted to engage the upper end of the corresponding pin **22** so that when the key is struck the pin will be moved downward to swing all of the wires downward.

The wires are adapted to engage contact rods **24** which extend along the keyboard and underlie the free ends of the respective wires. As shown in Figure 2, six contact rods are provided to provide six coupling combinations and the rods have circular end portions which fit rotatably in supporting blocks **25** formed of insulating material. The supporting blocks may be mounted on the frame **11** in any desired manner as by screws **25'** as shown in Figure 4 and serve as bearings for ends of the contact rods. It will be understood that the rods may be supported in similar bearings at desired points in their length so that they can be turned between operative and inoperative position as desired.

As best seen in Figures 6 and 7, each of the rods throughout the portion thereof which registers with the wires **21** is formed with a portion of arcuate section slightly greater than a semicircle which is covered with an insulating material **27**. A projecting strip **26** which is bare extends from the flat side of each rod and terminates substantially in a continuation of the arcuate portion thereof, as shown. When a rod is turned to the position shown in Figure 7, which is its inoperative position, the

corresponding wire 21 will engage the insulated surfaces thereof so that no circuit will be completed through the rod when a playing key is struck. However, when the rod is turned to its operative position, shown in Figure 6, the projection 26 will extend upward therefrom to be engaged by the corresponding wire 21 when a playing key is struck. This will complete a circuit through the switch wire and the rod to cause the selected note to be played. Since the projection 26 lies in a continuation of the arcuate surface, the action of the switch wires upon striking the key will be uniform under all conditions so that there is no danger of bending the wires and so that good contact with the rod is insured each time the key is struck. Because the projections 26 are relatively narrow, the wires will make good contact with them under relatively high unit pressure and the likelihood that dirt or foreign material might accumulate on the contacting surfaces is minimized.

To turn the rods, each rod carries at its end an arm projecting therefrom which may be in the form of a looped wire 28 fitted through a transverse bore in the rod and bent back on itself to form an elongated slot 29. Each of the rods is cut off closely adjacent to one face of one of the supporting blocks 25 and the arm 28 is secured to the end of the rod to lie closely adjacent to the supporting block so that the rods will be turned without any tendency to bend or deflect them. Each of the supporting blocks has an elongated lever 31 pivoted throughout on an axis 32 parallel to the rods. At its free end, each lever is offset or curved as indicated at 33 so that its free end portion will extend across the rod. A pin 34 is carried by the free end of each lever to fit slidably into the slot 29 in the corresponding arm 28. With this construction, the parts can be arranged very compactly as the lever 31 is swung between its two extreme positions. As indicated in full lines and dotted lines in Figure 4, the corresponding contact arm will be turned through substantially 90° between the positions shown in Figures 6 and 7.

Each lever 31 is adapted to be swung by a link 35 pivotally connected at its lower end to the central part of the lever and connected at its upper end through a pivot screw 36 to one of the coupler keys 17. When the coupler key is in its upper position the parts will occupy the position shown in Figure 4 with the contact rod turned to its inoperative position as shown in Figure 7. At this time, depression of a playing key will not complete any circuit through the rod and the corresponding note will not be played. When the coupling key is depressed to its dotted line position shown in Figure 4 the contact rod will be turned to its playing position shown in Figure 6 so that when a playing key is depressed a circuit will be completed and the selected note will be played.

To insure movement of the key and rod to the full limit of its travel in either direction, a toggle spring is provided acting on the link 35. The toggle spring as shown comprises a loop of resilient wire 37 which is pivotally connected at one end to a block 38 secured on the frame 11. The wire may be held in place in a groove in the end of the block 38 by a pin 39 so that the wire can pivot but can not accidentally fall out of the groove. At its opposite end, the resilient loop engages a notch 41 in the adjacent side of the link 35. This notch holds the end of the resilient loop in fixed position relative to the link, but enables the loop to pivot relative to the link. The notch and supporting block 38 are positioned relative to each other such that when the key is in its elevated position as shown in Figure 4, the line between the ends of the resilient loop will lie at an upward angle so that the loop will tend to urge the key upward to the maximum limit of its travel. This will insure that the lever 31 is swung upward to the maximum extent so that the contact rod will properly be positioned for no contact. When the key is depressed, the spring loop 37 will swing through center and will urge the key and lever 31 downward to the full limit of their travel, thereby to insure that the contact rod will be turned to its operative position and will be held in such position until the key is again raised.

According to one feature of the invention, the keys can easily be removed when desired without disturbing the remainder of the mechanism. The playing keys as shown in Figure 5 can easily be removed by removing the screws 14 and sliding the keys forward. To enable removal of the coupler keys, the pivot screws 36 at the upper ends of the links 35 fit into open ended notches in brackets 41 which are secured to the keys 17. The brackets lie on the sides of the links 35 opposite to the toggle springs 37 so that the springs will assist in holding the pins in the notches.

To remove a coupler key, its holding screw 14 is removed and the pin 36 on the corresponding link 35 is removed from the notch in the key bracket. The key can then be slid forward for removal in the same manner as the playing keys. The keys can be easily assembled initially or re-assembled by a reversal of the above described operations.

In connecting the keyboard the different contact rods may be wired to produce the desired coupling effects. As shown in Figure 1, one of the keys may be the unison key which will cause the manual to play at its normal or eight foot frequency. Others of the keys may be wired to cause the manual to play at different octave frequencies, such for example as sixteen feet, four feet, etc. To effect the desired coupling, it is necessary for the user only to strike the desired coupling key, which will cause the corresponding contact rod to be turned to its contacting position. Whenever the playing keys are depressed, circuits will be completed through the selected rod to cause the desired note to be played. To change the coupling, the user may flip up the previously depressed coupling key and depress the other desired key. Thus, by simple manipulation of the coupling keys, the desired coupling can be accomplished quickly and easily. It will be seen that the entire mechanism is extremely simple and compact so that it can be mounted easily in the confines of the usual keyboard and can easily be wired to produce the desired effects.

The circuits through the contact rods such as voltage supply circuits to key oscillators or control separate keying tubes are preferably individual circuits. For this purpose the contact rods, as shown in Figure 2, have circular uncoated portions 42 extending beyond the end supporting block 25. These portions are engaged by the wires 21' of a contact unit identical with the switch units described above. The wires 21' are embedded in a grooved block 18' which is supported in the flange 19 and are connected by a pin 22' which is pressed down at all times to hold the wires in engagement with the uncoated portions 42.

The wires 21' can be individually connected through individually adjustable potentiometers to a control voltage source so that when two or more couplers are made effective simultaneously, different tonal effects are produced. Thus when used with keying tubes or with oscillators whose frequency does not change with changes in keying voltage different amplitudes of the several different pitches can be mixed for changes in tone quality. When used with oscillators whose frequency does not change with changes in keying voltage different amplitudes of the several different pitches can be mixed for changes in tone quality. When used with oscillators whose pitch changes with variations in keying voltage the voltages to the different contact rods can be adjusted to produce pleasing celeste or choral effects.

While one embodiment of the invention has been shown and described in detail herein, it will be understood that this is illustrative only and is not to be taken as a defi-

nition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. Key coupling apparatus comprising a rotatable contact rod, a lever pivoted on an axis parallel to and spaced from the rod, an arm secured to the rod and projecting laterally therefrom, a pin and slot connection between the arm and the free end of the lever, a link connected to the lever, a pivotally mounted key lying generally parallel to the lever and connected to the link to move it longitudinally, and a toggle spring engaging the link to urge it to its full limit of movement in either direction.

2. Key coupling apparatus comprising a rotatable contact rod, a lever pivoted on an axis parallel to and spaced from the rod, an arm secured to the rod and projecting laterally therefrom, a pin and slot connection between the arm and the free end of the lever, a link connected to the lever, a pivotally mounted key lying generally parallel to the lever and connected to the link to move it longitudinally, and a resilient looped spring laterally curved and pivotally mounted at one end, the link having a notch in one side pivotally engaging the other end of the spring.

3. Key coupling apparatus comprising a rotatable contact rod, a lever pivoted on an axis parallel to and spaced from the rod and having an offset end to extend on the side of the rod opposite to the lever pivot, a slotted arm secured to the rod and projecting laterally therefrom, a pin on the offset end of the lever fitting slidably in the slot in the arm, a link connected to the central part of the lever, a pivoted key lying generally parallel to the lever and connected to the link to move it, and a toggle spring acting on the link to urge it to the full limit of its travel in either direction.

4. Key coupling apparatus comprising a movable contact rod, an operating member adjacent to the contact rod, means connecting the operating member to the rod to move the rod between operative and inoperative positions when the operating member is moved, a link pivoted at one end to the operating member, a pivotally mounted key, a bracket on the key to connect it to the link, the connection between the bracket and the link including a pin and a notch to receive the pin, one on the bracket and the other on the link and a toggle spring acting on the link and urging it toward the bracket to hold the pin in the notch.

5. Key coupling apparatus including in combination, a plurality of coupling rods extending substantially horizontally and positioned one above the other, each of said rods including a longitudinal insulating surface portion at a first angular position and a longitudinal conducting surface portion at a second angular position about said rod, a plurality of keys adapted to be depressed, a set of resilient conducting members associated with each key, said conducting members of each set being positioned one above the other and having portions individually positioned above said coupling rods, means interconnecting each key with said conducting members of the associated set for moving the same downward simultaneously into engagement with said rods when said key is depressed, actuating means connected to each rod for rotating the same, said actuating means having a first position in which the associated rod is positioned so that the insulating surface portion thereof is engaged by actuated conducting members, said actuating means being operable to a second position to turn the associated rod to a position so that said conducting surface portion thereof is engaged by actuated conducting members, and toggle means connected to said actuating means for urging the same toward said first and second positions.

6. Key coupling apparatus including in combination, a plurality of coupling rods extending substantially horizontally and positioned one above the other, each of said rods including an insulating surface portion and a conducting surface portion with both portions extending along the rods at substantially the same distance from the axis thereof and spaced peripherally from each other, a plurality of keys adapted to be depressed, a plurality of sets of contact strips with each set being associated with a key, said contact strips of each set being positioned one above the other and each strip having a portion positioned above one coupling rod, means interconnecting each key with said contact strips of the associated set for moving the same in unison downward into engagement with said coupling rods when the key is depressed, and actuating means connected to each rod for rotating the same, said actuating means having a first position in which the associated rod is positioned so that the insulating surface portion thereof is engaged by actuated contact strips, said actuating means operating to turn the associated rod to a position so that said conducting surface portion thereof is engaged by actuated contact strips, said actuating means including toggle means tending to hold said actuating means in the position in which it is operated.

7. Key coupling apparatus including in combination, a plurality of coupling rods extending substantially horizontally and positioned one above the other, each of said rods including an insulating surface portion and a conducting surface portion both extending along the rod and on different sides thereof, a plurality of pivotally mounted keys adapted to be depressed, a plurality of sets of contacts with each set being associated with a key, said contacts of each set being positioned one above the other and having portions individually positioned above said rods, means interconnecting each key with said contacts of the associated set for moving the same downward in unison into engagement with said rods when said key is depressed, actuating means connected to each rod for rotating the same, said actuating means having a position in which the associated rod is positioned so that the insulating surface portion thereof is engaged by actuated contacts, said actuating means operating to turn the associated rod to a position so that said conducting surface portion thereof is engaged by actuated contacts.

8. Key coupling apparatus including in combination, a plurality of coupling rods extending substantially horizontally and positioned one above the other, each of said rods including an insulating surface portion and a conducting surface portion both extending along the rod and on different sides thereof, a plurality of keys adapted to be depressed, a plurality of contact assemblies individually associated with said keys, each of said contact assemblies including a supporting block moulded of insulating material and a plurality of resilient contacts embedded in said block, said contacts of each assembly being positioned one above the other and having portions individually positioned above said rods, means interconnecting each key with said contacts of the associated assembly for moving the same downward in unison into engagement with said rods when said key is depressed, and actuating means associated with each rod for rotating the same, said actuating means having a first position in which the associated rod is positioned so that the insulating surface portion thereof is engaged by actuated contacts, said actuating means operating to turn the associated rod to a position so that said conducting surface portion thereof is engaged by actuated contacts.

9. Key coupling apparatus including in combination, a plurality of coupling rods extending substantially horizontally and positioned one above the other, each of said rods including an insulating surface portion and a conducting surface portion both extending along the rod and on different sides thereof, a plurality of keys adapted to be depressed, a plurality of contact assemblies individually associated with said keys, each of said contact assemblies including a supporting block moulded of insulating material, a plurality of resilient conducting wires embedded in said block, and a moulded insulating member spaced from said block and connected to said wires,

said wires of each assembly being positioned one above the other and having portions individually positioned above said rods, means interconnecting each key with said insulating member of the associated assembly for moving the same downward so that said wires engage said rods when said key is depressed, and actuating means associated with each rod for rotating the same, sad actuating means having a first position in which the associated rod is positioned so that the insulating surface portion thereof is engaged by actuated contacts, said actuating means operating to turn the associated rod to a position so that said conducting surface portion thereof is engaged by actuated contacts.

10. Key coupling apparatus including in combination, a plurality of coupling rods extending substantially horizontally and positioned one above the other, each of said rods including an insulating surface portion and a conducting surface portion both extending along the rod and on different sides thereof, a plurality of keys adapted to be depressed, a plurality of contact assemblies individually associated with said keys, each of said contact assemblies including a supporting block moulded of insulating material and a plurality of resilient contacts embedded in said block, said contacts of each assembly being positioned one above the other and having portions individually positioned above said rod, means interconnecting each key with said contacts of the associated assembly for moving the same downward in unison into engagement with said rods when said key is depressed, actuating means associated with each rod for rotating



the same, said actuating means having a first position in which the associated rod is positioned so that the insulating surface portion thereof is engaged by actuated contacts, said actuating means operating to turn the associated rod to a position so that said conducting surface portion thereof is engaged by actuated contacts, said supporting blocks having grooves in the sides thereof, and a slotted supporting plate for receiving said blocks of said plurality of contact assemblies with portions of said supporting plate extending in said grooves in said supporting blocks.

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