Feb. 11, 1941. E. C. MATTHEWS ET AL 2,231,365

SWITCHING DEVICE

Filed May 10, 1933 2 Sheets-Sheet 1

FIG. 1

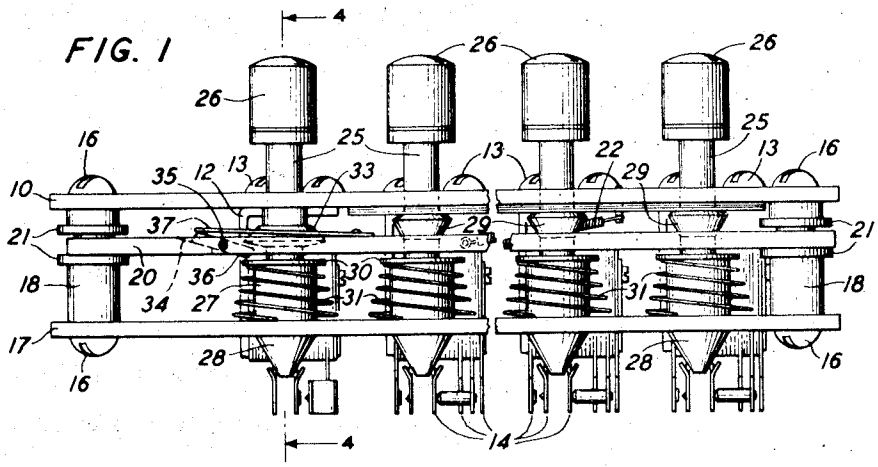


FIG. 2

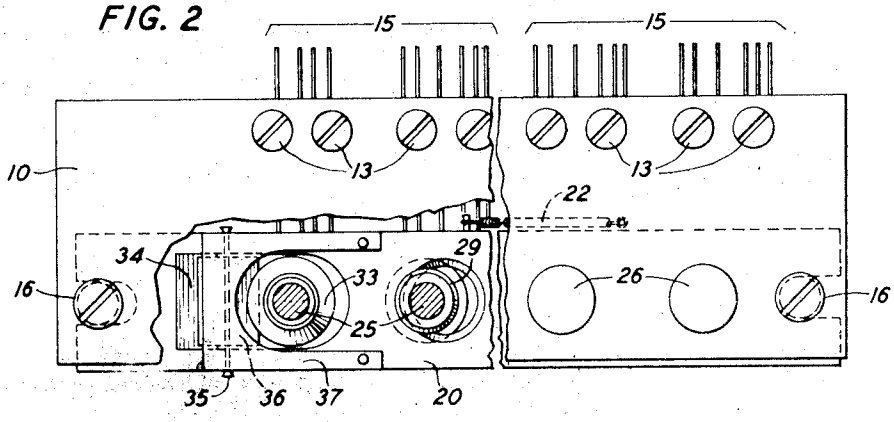


FIG. 3

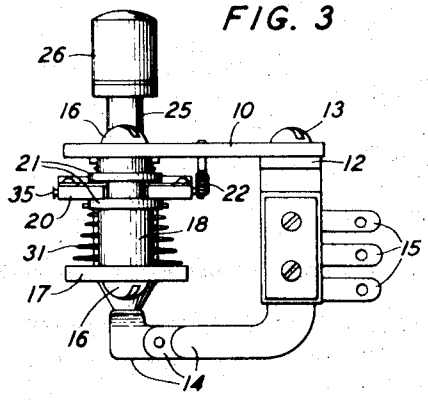
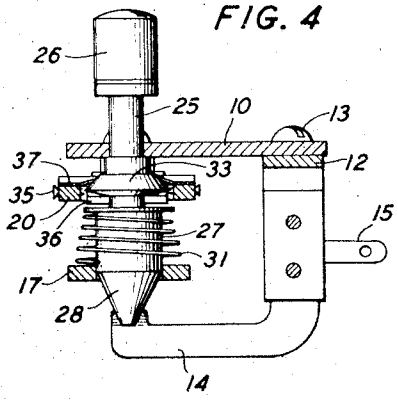


FIG. 4



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SWITCHING DEVICE

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FIG. 5

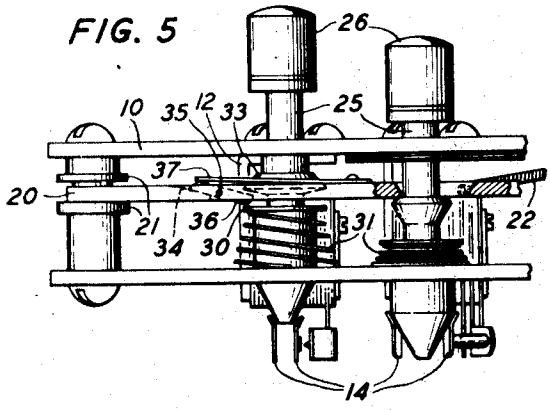


FIG. 6

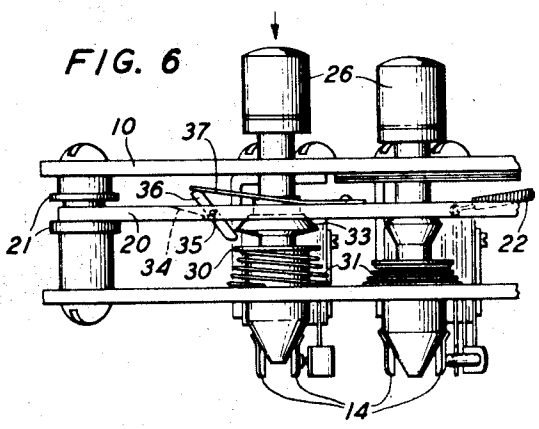


FIG. 7

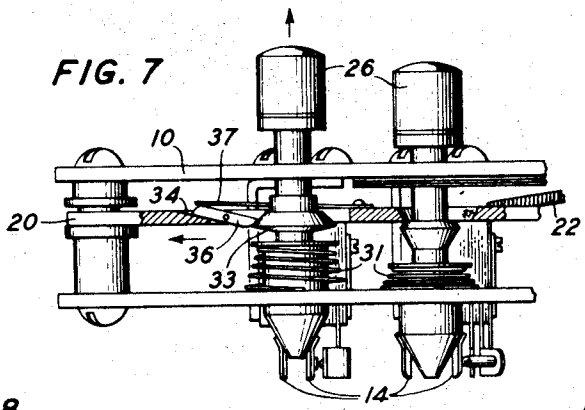


FIG. 8

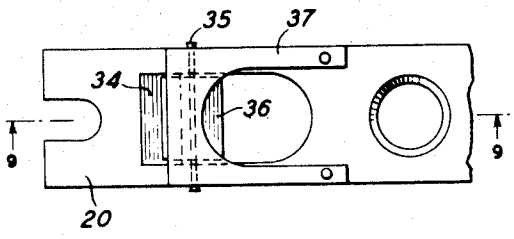


FIG. 10

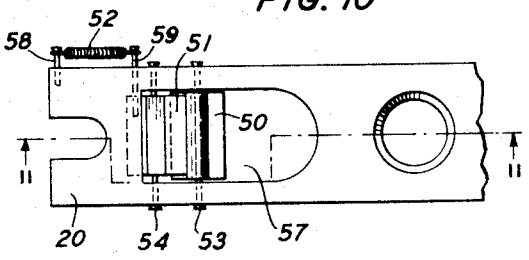


FIG. 9

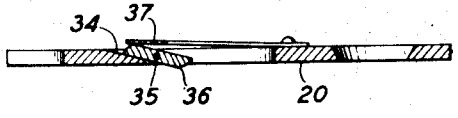
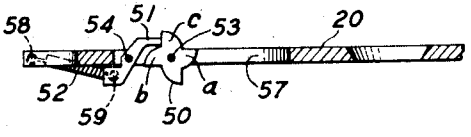


FIG. 11



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Patented Feb. 11, 1941 2,231,365

UNITED STATES PATENT OFFICE

2,231,365

SWITCHING DEVICE

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Application May 10, 1938, Serial No. 207,056

6 Claims. (Cl. 200—5)

This invention relates to switching apparatus and more particularly to mechanically locking keys of the type used at telephone subscribers' stations.

Key structures of the type to which the present invention is particularly applicable are frequently characterized as mechanically locking plunger type keys in that the depression of a button-capped plunger rod causes a locking plate to move longitudinally against the action of a restoring spring until the top of a cone carried by the plunger passes below the lower surface of the locking plate after which the latter returns to its initial position and holds the plunger in its depressed position. The longitudinal movement of the locking plate due to the subsequent operation of another plunger disengages the plunger previously depressed, allowing it to return to its normal position. Structures of this nature which are employed for switching purposes at subscribers' stations are equipped also with a non-locking key which usually serves as a "hold" key, that is, it is actuated to hold a telephone line while some other switching function is performed by the subscriber. Heretofore, the actuation of a "hold" key or button caused the release of any previously actuated plunger during its downward travel so that the switching operation effected by the release of the previously actuated plunger took place immediately after the switching operation performed by the "hold button. Recently developed subscribers' station wiring plans require an appreciably longer time interval between the operation of the contacts controlled by the "hold" button and the release of any previously operated line button.

It is therefore the object of this invention to delay the release of a mechanically locked contact controlling plunger for a relatively long period of time after the contacts controlled by the releasing medium have been actuated.

This object is attained in accordance with a feature of the invention by causing the non-locking key plunger to trip the plunger latching mechanism on its return movement rather than on its downward stroke as has heretofore been the custom.

The invention will be readily understood from the following detailed description made with reference to the accompanying drawings in which:

Fig. 1 is a front elevation of a key structure embodying the features of the invention;

Fig. 2 is a top plan view of the structure shown in Fig. 1 with part of the mounting plate broken away to expose certain structural details;

Fig. 3 is an end view of the structure shown in Fig. 1;

Fig. 4 is a section taken along the line 4—4 of Fig. 1 and looking in the direction of the arrows;

Fig. 5 is a view illustrating a line plunger in locked position;

Fig. 6 is a view illustrating the condition which prevails when the "hold" plunger is partially depressed.

Fig. 7 is a view illustrating the condition which prevails after the "hold" plunger has been fully depressed and has completed a part of its return movement;

Fig. 8 is a top plan view of the mechanism which functions to introduce the desired time interval in the operation of the key;

Fig. 9 is a section taken along the line 9—9 of Fig. 8 looking in the direction of the arrows, and

Figs. 10 and 11 are views, corresponding to Figs. 8 and 9, respectively, disclosing a modification of the invention.

A mounting plate 10 of metal or other suitable material has secured to the under surface thereof equally spaced L-shaped brackets 12. Each bracket 12, secured to the mounting plate 10 by means of screws 13 carries a spring pile-up consisting of L-shaped spring elements 14 and insulating separators. The spring elements 14 are provided with integral tabs 15 by virtue of which circuit connections to the key may be made.

Below the mounting plate 10 and secured thereto by means of screws 16 is a second metal plate 17. The spacing between the two plates 10 and 17 is effected by the sleeve-like members 18 which are tapped at either end to accommodate the screws 16. A slidable latch plate 20 is slotted at each end and is adapted to travel between circular skirt-like projections on the sleeve-like members 18. The portion of each member 18 between the integral extensions 21 is reduced in section to allow the slotted ends of the latch plate 20 to move freely. A restoring spring 22 has one end secured to the stationary mounting plate 10 and the other end to the slidable latch plate 20.

The key structure illustrated consists of a plurality of locking plungers and a single non-locking plunger. Each plunger comprises a shank portion 25 on one end of which is secured, in any suitable manner, an insulating button

or cap 26 and to the other end of which is secured an insulating cap 27 having its end tapered as at 28. The tapered or cone-shaped end of the insulating member engages the flared ends of the two longest contact springs when the plunger is actuated to move these springs into engagement with other springs of the spring pile-up. Substantially midway of the ends there is integrally formed on each of the locking plunger shanks a plunger locking cone 29. The plates 10, 20 and 17 are provided with circular apertures through which the assembled plunger extends. The apertures in the stationary plates 10 and 17 are in alignment whereas the apertures in the latching plate 20 are, normally, slightly out of line with the apertures in the stationary plates Each of the plungers is provided with a metal collar 30 against which the insulating cap 27 is forced when placed on the plunger shank. A coil spring 31 encircles the upper portion of the cap or cone 27 and is confined between the projecting portion of the collar 30 and the upper surface of plate 17 so as to be compressed when the associated plunger is depressed.

The shank portion of the non-locking plunger, shown to the left of Fig. 1, is also provided with an integral cone-shaped projection 33 whose taper is inverted with respect to that of the locking cones 29.

The aperture in the latching plate 20 through which the non-locking plunger passes is extended to the left (Figs. 1 and 2) to provide a rectangular section, the extreme left limiting edge being chamfered as shown at 34. A shaft 35 extends across the rectangular section of the latching plate aperture and is freely supported in bearings effected by a perforation in each of the opposite sides of the latching plate. Rotatably mounted on the shaft 35 is a pawl 36. A substantially U-shaped resilient spring 37 is riveted to the latch-plate 20 in such a manner that the cross-bar of the "U" rests against one edge of the pawl 36 as clearly shown in Figs. 1, 5, 6, 7 and 9.

The key structure just described operates in the following manner: When a button 26 of a locking plunger 25 is actuated or depressed, the metal cone 29, which forms part of the plunger rod associated with that button causes the locking plate 20 to move longitudinally against the action of spring 22 until the top of the cone 29 passes below the lower surface of the locking plate, after which the latter, under the influence of spring 22 returns to its initial position and holds the plunger in its depressed position. The longitudinal movement or displacement of the locking or latch plate 20 results from the camming action of the cone 29 on the periphery of the apertures in the plate. The longitudinal movement of the locking plate 20 due to the subsequent operation of another locking plunger releases the plunger previously depressed, allowing it to return to its normal position under the action of coil spring 31. The last plunger depressed is locked in its actuated position in the manner already described. It will be observed at this time that the release of any locked plunger is effected during the downward travel of the subsequently actuated locking plunger.

In the case of the "hold" key shown to the extreme left of Figs. 1, 2, 5, 6, and 7, any locked plunger is released on the return movement of the "hold" plunger as will now be described.

Fig. 5 illustrates a locking plunger locked in its actuated position and the non-locking plunger in its normal position. In this position of the non-locking plunger, or "hold" key, the lower right edge of the pawl 36 is in its normal position. As shown in Figs. 1 and 5 the pawl 36, in its normal position, is inclined at such an angle that its inner end extends between the collar 30 and the lower surface of the cone 33 with suitable clearances between the pawl and these members. That portion of the shank 25 immediately above the cone 33 is larger in diameter than the remaining portion so that the collar effected thereby serves as a stop to limit the upward movement of the plunger under the influence of spring 31.

In Fig. 6 the non-locking plunger is shown partially depressed. As the plunger starts its downward movement, the upper right-hand edge of the pawl 36 is engaged by the under surface of the cone 33 and as the plunger continues its downward travel the pawl 36 is rotated on the shaft 35 against the restraining influence of the U-shaped spring 37. As the plunger continues its downward travel, the pawl 36 is cleared by the cone 33 just prior to the time when the plunger reaches the limit of its downward stroke so that the pawl, under the influence of spring 37 is returned to its normal position. The inner end of pawl 36 is then located above the cone 33 and, as illustrated in Fig. 7 which shows the non-locking plunger partially returned to normal under the influence of coil spring 31, the tapered surface of the cone produces a camming action on the pawl 36 which is now restrained from rotating counter-clockwise by the latch plate surface 34. The pawl 36 and therefore, the latch plate 20 experiences a thrust to the left. As the non-locking plunger continues its return movement under the action of its coil spring 31 the latch plate 20 is displaced longitudinally to such an extent that the locked plunger, previously depressed, is now released and returns to normal under the action of its coil spring 31. As this occurs, that is, as the latch plate moves a sufficient distance to permit the release of the locked plunger, the cone 33 rides off the pawl 36 and the upward travel of the plunger is arrested by the engagement of the collar on shank 25 with the under surface of the mounting plate 10.

It is apparent from the foregoing description that the latching plate 20 experiences no longitudinal thrust when the non-locking plunger is depressed and it is not until some time after the plunger has reached its lowermost position and has started its return movement that the latching plate is displaced longitudinally to release any of the plungers which have been previously actuated and locked in their actuated positions. The contact springs controlled by the non-locking plunger are accordingly actuated and remain actuated for a short interval before those controlled by the non-locking plunger are returned to normal.

In the modification of the invention shown in Figs. 10 and 11 a ratchet wheel or star wheel 50 is rotated on the down stroke of the "hold" plunger and is held against rotation on the return stroke of the plunger by means of the dog or stop 51 so that the latch plate 20 is moved longitudinally on the return stroke of the plunger. The star wheel 50 is free to rotate on the shaft 54 which bridges the aperture 57 and is housed in the edges of the plate 20 which define the width of the aperture. The stop 51 is similarly mounted on the shaft 53. A coil spring 52 has one end secured to the latch plate 20 at 58 and the other end to the stop 51 at 59.

When a "hold" button is depressed, the lower surface of the cone **33** engages the flat surface of the tooth *a* causing the star wheel or ratchet **50** to rotate in a clockwise direction, viewing Fig. 11. During the rotation of the star wheel the free end of the stop **51** rides over the curved surface of the tooth *b* until it rides off and, under the influence of the spring **52**, is brought into engagement with the straight portion of the tooth *b*. By this time the cone **33** has also completed its travel over the straight portion of the tooth *a* and is situated below the level of the plate **20**. Upon release of the "hold" button the tapered surface of the cone **33** engages the curved surface of the tooth *c* of the star wheel **50** and tends to rotate the star wheel in a counter-clockwise direction. The star wheel **50**, however, is held against rotation by the pawl **51** so that, as the plunger returns to normal under the action of its associated coil spring **31**, the star wheel experiences a lateral thrust due to the camming action of the cone **33**. The latch plate accordingly is moved longitudinally to effect the release of any previously operated locking plunger. After the cone **33** rides off the curved surface of the tooth *c* the latch plate is returned to its normal position under the action of spring **22**.

What is claimed is:

1. In a switching device, a depressible contact operating plunger, latching means for locking said plunger in its depressed position, a second plunger and means for actuating said latching plate to release said first plunger, said means comprising a pawl pivotally mounted on said latching plate and a camming device associated with said second plunger, said pawl being rotated in one direction under the influence of said camming device during the downward stroke of said second plunger and moved longitudinally with said latching plate under the influence of said camming device during the return stroke of said second plunger.

2. In a switching device, a depressible contact operating plunger, a latching plate for locking said plunger in its depressed position, a pawl pivotally mounted on said latching plate and rotatable in one direction from its normal position, a second depressible contact operating plunger having a camming element which engages and rotates said pawl during the downward travel of said second plunger and means effective when said second plunger reaches its depressed position for returning said pawl to its normal position, in which position it is acted upon by the camming surface of said camming element during the return movement of said second plunger to cause said latch plate to operate and release said first plunger.

3. In a switching device, a plurality of contact operating plungers, means for locking said plungers in their operated positions comprising an apertured latching plate which is displaced longitudinally during the downward passage of said plungers through their respective latch plate apertures by a camming element associated with each of said plungers and restored to normal position by a restoring spring when the camming element is depressed beyond the level of the latching plate, a non-locking plunger having a camming element associated therewith and means for permitting the camming element of said non-locking plunger to pass freely through its corresponding aperture in said latching plate when said non-locking plunger is depressed, said means comprising a pawl pivotally mounted in the corresponding aperture of said latching plate and operatively associated with the camming element of said non-locking plunger.

4. In a switching device, a depressible contact operating plunger, a latching plate for locking said plunger in its depressed position, a second plunger and means for actuating said latching plate to release said first plunger, said means comprising a ratchet and dog combination carried by said latching plate and a camming device associated with said second plunger, said ratchet being free to rotate in one direction under the influence of said camming device during the downward movement of said second plunger and which is held by said dog against rotation in the opposite direction and cooperates with said camming device during the return movement of said second plunger in causing the operation of said latching plate to release said first plunger.

5. A key switching unit including a depressible contact operating plunger, a second depressible contact operating plunger, a slidable latch plate having apertures through which each of said plungers may be depressed to a contact operating position, means integrally associated with said first plunger and cooperating with the edge of its respective latch plate aperture for causing said latch plate to be moved in a predetermined direction when the plunger is depressed, and other means for permitting the depression of said second plunger through its respective latch plate aperture without moving said latch plate, said means cooperating with said second plunger during its return movement to cause said latch plate to move in the predetermined direction.

6. In a switching device, a depressible contact operating plunger, a latching plate for locking said plunger in its depressed position, a second plunger and means for actuating said latching plate to release said first plunger, said means comprising a member pivotally mounted on said latching plate and a camming device associated with said second plunger, said pivotally mounted member being rotated in one direction under the influence of said camming device during the downward stroke of said second plunger and moved longitudinally with said latching plate under the influence of said camming device during the return stroke of said second plunger.

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