

March 24, 1964

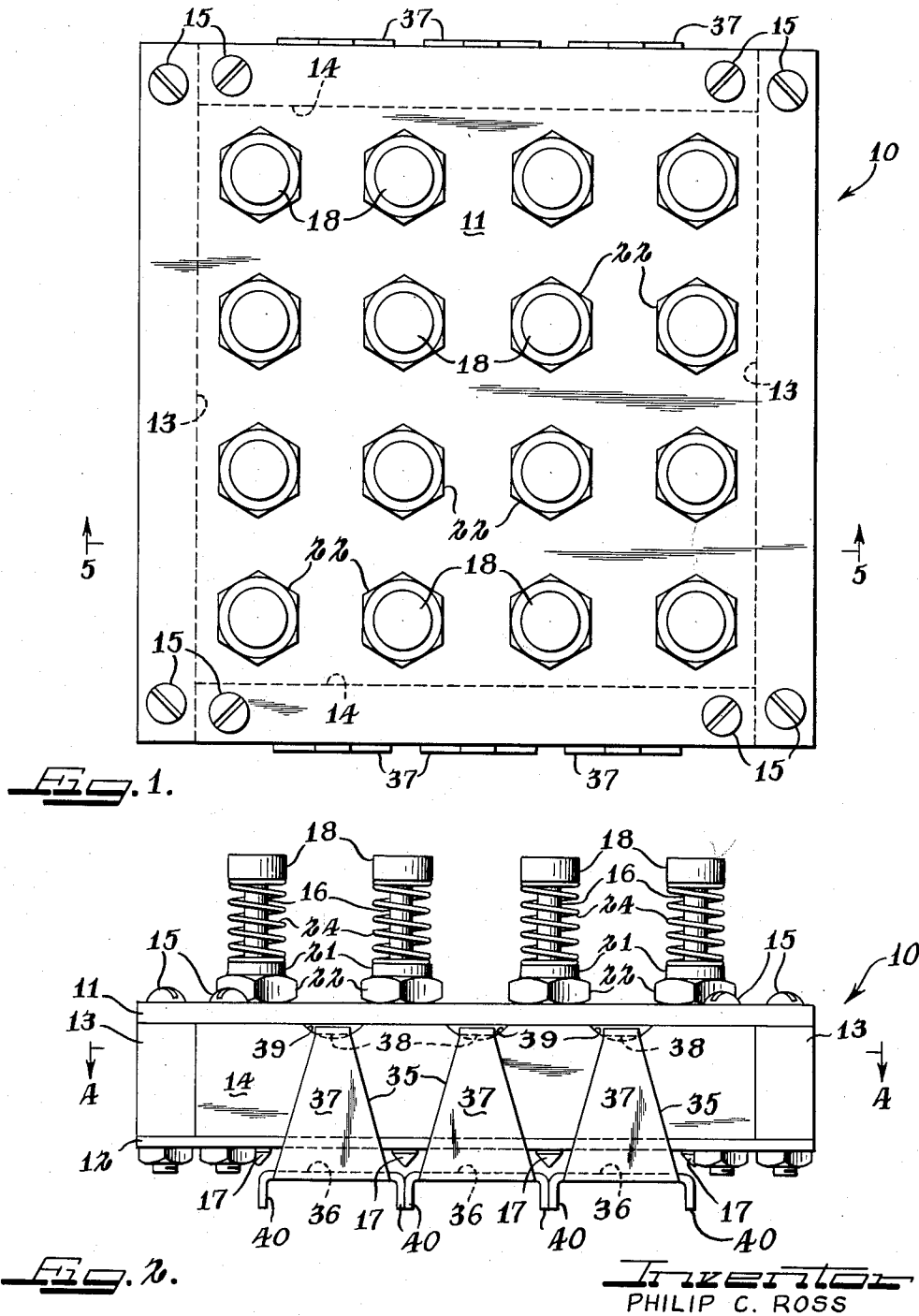
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3,125,895

SWITCH INTERLOCK AND LOCKOUT UNIT

Filed Jan. 15, 1962

4 Sheets-Sheet 1



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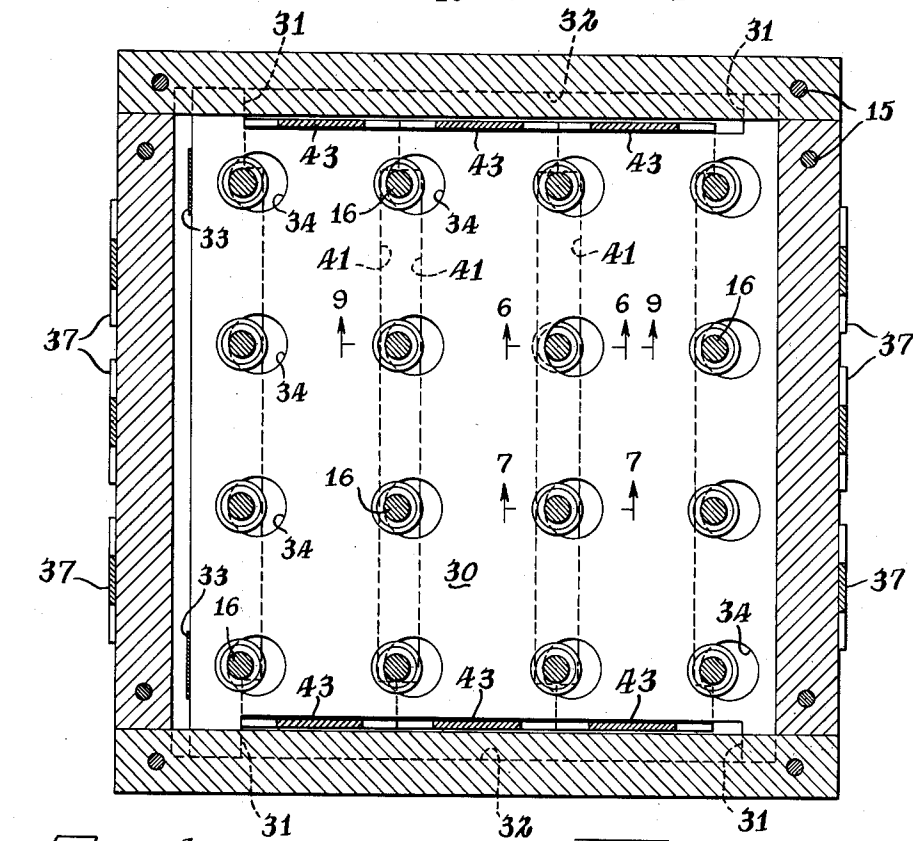
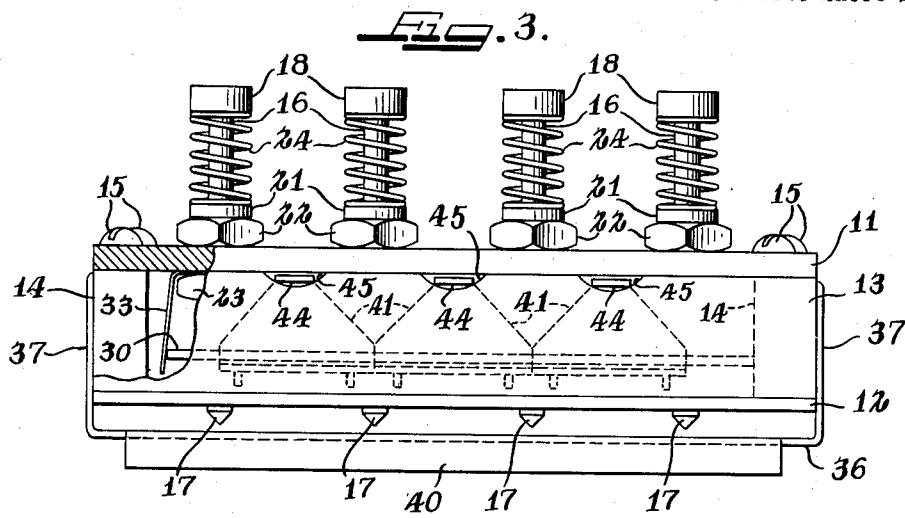
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4 Sheets-Sheet 2



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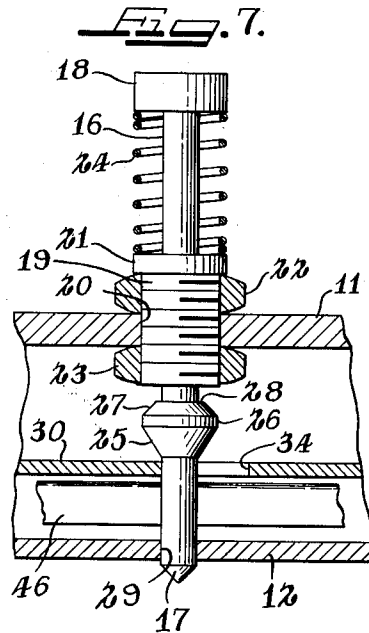
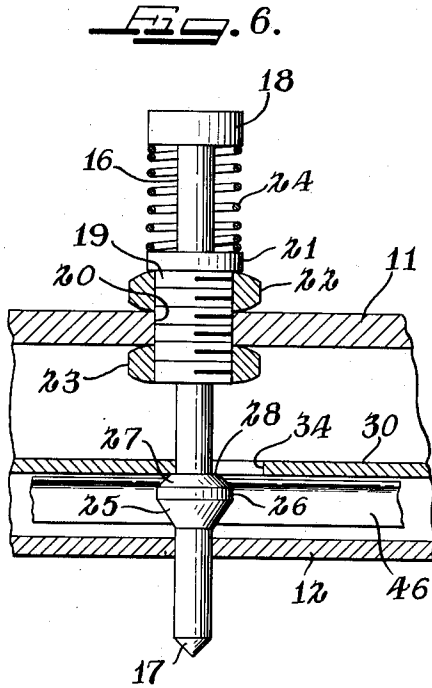
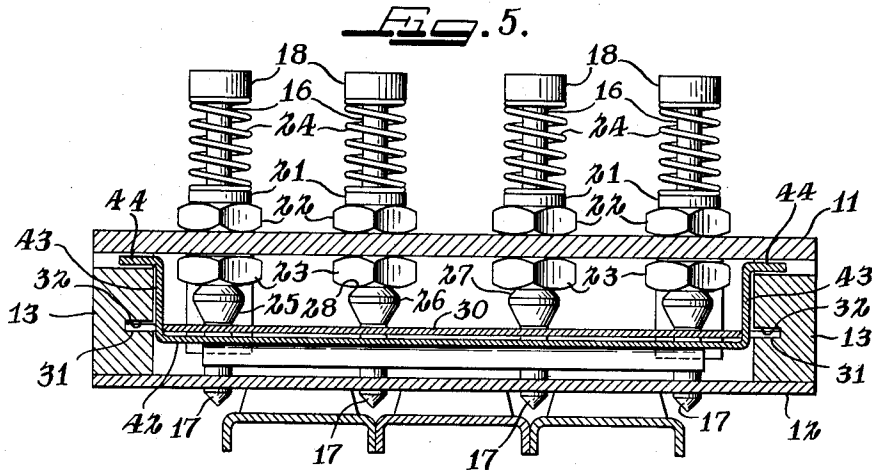
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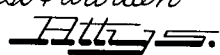
SWITCH INTERLOCK AND LOCKOUT UNIT

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SWITCH INTERLOCK AND LOCKOUT UNIT

Filed Jan. 15, 1962

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Fig. 8.

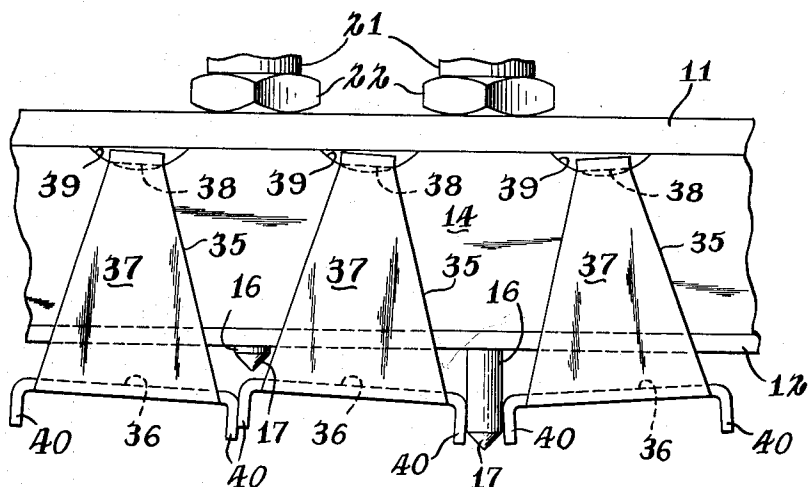
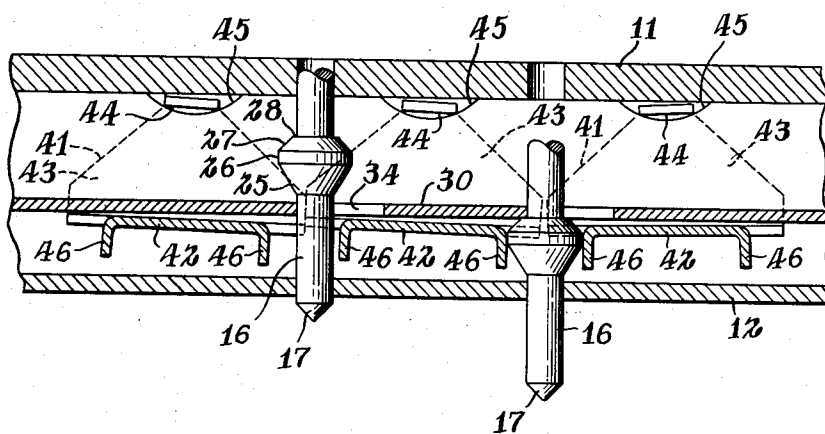


Fig. 9.



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SWITCH INTERLOCK AND LOCKOUT UNIT
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Filed Jan. 15, 1962, Ser. No. 166,071
8 Claims. (Cl. 74—483)

This invention relates to a protective device for use with multiple switch controlled electrical circuits, the device functioning to protect against improper use of said circuits by mechanically providing for interlocking of the switches and preferably additionally providing for locking out and preventing simultaneous multiple switch operation.

Electronic apparatus such as computers, program controllers, etc., include multiple and complex circuitry subject to controlled automatic operation and variable interrelational coupling by a multiple switch keyboard. Operation of such machines are rather complex and detailed and successful operation requires the use of trained and skilled personnel. However, in order to protect the delicate instrumentation and to further assure proper operational use of the same, it is important to provide built-in safety devices which will prevent improper inadvertent switch operation. For this purpose various forms of keyboard switch interlock mechanisms have been proposed and used. Basically, such mechanisms function to mechanically prevent improper multiple switch actuation thus protecting the delicate apparatus from damage and also at least substantially guarding against improper operation of the computer or the like.

It is an object of the present invention to provide a new and improved switch interlock unit which is capable of efficiently functioning and mechanically preventing inadvertent multiple switch actuation while further providing new and improved positive means for maintaining closed single switch operation.

A further object is to provide a new and improved switch interlock and lockout unit including mechanical refinements providing additional unique safeguards against inadvertent multiple switch actuation thus assuring complete protection of highly complex and delicate instruments.

Still another object is to provide a new and improved lockout means for use with multiple electrical switching assemblies in an interlock unit, the lockout means providing a substantially improved margin of safety in preventing multiple switch actuation in the event of partial mechanical failure occurring in the basic interlock mechanism.

Still a further object is to provide a new and improved switch interlock and/or lockout unit which is of relatively uncomplicated design and compact arrangement, the lockout means being of the unique nature for special cooperative functioning with suitable interlock means, the unit further preferably including specially arranged and designed interlock and lockout means capable of new and improved functioning.

Other objects not specifically set forth will become apparent following a detailed description of the invention made in conjunction with the accompanying drawings wherein:

FIG. 1 is a top plan view of the interlock and lockout unit of the invention;

FIG. 2 is an end elevation of the unit of FIG. 1;

FIG. 3 is a fragmentary side elevation of the unit;

FIG. 4 is a sectional plan view taken generally along line 4—4 in FIG. 2;

FIG. 5 is a transverse section taken generally along line 5—5 in FIG. 1;

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FIG. 6 is an enlarged fragmentary section taken generally along line 6—6 of FIG. 4;

FIG. 7 is a view similar to FIG. 6 taken generally along line 7—7 in FIG. 4;

FIG. 8 is an enlarged fragmentary end elevation of the unit illustrating operational functioning of one portion of the lockout means thereof; and

FIG. 9 is an enlarged fragmentary section taken generally along line 9—9 in FIG. 4 illustrating operational functioning of another portion of the lockout means of the unit.

Referring to FIGS. 1—3, the switch interlock and lockout unit 10 of the invention generally includes a top plate 11 and bottom plate 12 suitably attached to bar-like side plates 13 and end plates 14 by fasteners 15. A plurality of push rods 16 project upwardly above the top plate 11 and extend downwardly through the unit as viewed with beveled or cone shaped bottom ends 17 projecting slightly below the bottom plate 12. Referring particularly to FIGS. 6 and 7, each push rod includes an enlarged top disk 18 adapted for mechanical engagement with the operating part of a switch (not shown) which upon actuation functions to depress the push rod downwardly through the unit 10 as viewed. Each push rod 16 extends through an externally threaded bushing 19 received in an aperture 20 in the top plate 11. The top end of the bushing 19 is formed with an enlarged annular shoulder 21 below which is received a clamping nut 22 which cooperates with another clamping nut 23 received interiorly of the unit on the opposite side of the top plate 11. The clamping nuts 22 and 23 are threadedly received on the bushing 19 and clamp the same in the aperture 20 of the top plate 11. A return coil spring 24 is trapped between the opposed surfaces of the enlarged top portion 21 of the bushing 19 and the top disk 18 of the push rod 16. The spring 24 functions to normally hold the push rod 16 in retracted position relative to the unit 10 as shown in FIG. 7.

Within the unit 10, the push rod 16 is formed with an enlarged camming means preferably including a lowermost relatively long inverted frusto-conical camming surface 25 terminating in juncture with the outer cylindrical surface of the lower portion of the push rod 16 extending between the camming surface 25 and the conical tip 17. The camming surface 25 terminates upwardly as viewed in a flat band-like cylindrical surface portion 26 which is relatively short with respect to its axial length. The flat outer surface 26 constitutes the diametral extent of the enlarged circumferential camming means portion and preferably parallels the longitudinal axis of the push rod 16. An uppermost relatively short and reverse frusto-conical camming surface 27 joins the flat surface 26 and extends upwardly inwardly toward the main push rod stem portion while terminating short thereof in an annular radial shoulder 28. As shown in FIG. 7, the shoulder 28 abuts the lowermost end of the bushing 19 to limit the extent to which the push rod 16 is urged upwardly by the return spring 24. The lowermost end portion of the push rod 16 including the conical tip 17 thereof extends through a suitable aperture 29 formed in the bottom plate 12.

FIGS. 3—5 illustrate the mounting of a flat, relatively thin interlock plate 30 in the interior of the unit 10 transversely therethrough between the side and end plates 13 and 14. The interlock plate 30 is of a width less than the distance between the side plates 13 as best shown in FIGS. 3 and 4 to provide a space between an edge thereof and the left-hand side plate 13 as viewed. The corners of the interlock plate 30 are provided with projecting ear portions 31 (FIGS. 4 and 5) which extend into continuous slots 32 formed in the inner surfaces of the end plates 14 and open inwardly of the unit 10. The

length of the interlock plate 30 as measured between the end walls 14 of the unit is appreciably less than the distance between the inner surfaces of the end plates 14 thus permitting the interlock plate 30 to reciprocally slide transversely within the unit 10. A pair of generally inverted L-shaped return springs 33 are suitably attached to adjacent push rod assemblies and include downwardly directed leaf spring portions engaging the left-hand edge of the interlock plate 30 as viewed in FIGS. 3 and 4 to constantly urge the plate toward the right into engagement with the push rods or opposite side plate 13.

The interlock plate 30 includes a plurality of apertures or openings 34 aligned with the push rods 16 with the lower ends of the push rods 16 extending there-through. In this respect, the return spring 33 may function to hold the interlock plate 30 in engagement with the lower end portions of the push rods 16 as shown in FIGS. 4 and 7. Operational functioning of the interlock plate 30 in conjunction with the camming means of the push rods 16 is best shown in FIGS. 6 and 7. FIG. 7 illustrates initial undeformed positioning of a push rod 16 prior to actuation of a switch unit (not shown) aligned for operation therewith. FIG. 6 illustrates another push rod 16 which has been depressed as a result of actuation of a switch unit (not shown) aligned for mechanical coaction therewith. Operation of a single switch from a keyboard of a computer or the like, which keyboard contains a bank of switches each of which is aligned with a push rod 16, results in the depression of the push rod 16 associated with the actuated switch.

The push rod 16 as shown in FIG. 6 moves downwardly against the action of the spring 24 sliding in the internal bore of the bushing 19 and the relatively long camming surface 25 operates against the adjacent edge of the opening 34 in the interlock plate 30 with the result that the plate 30 is moved to the left as viewed against the action of the return springs 33. Continued downward movement of the push rod 16 eventually results in sliding engagement between the flat surface 26 of the camming means and the edge portion of the interlock plate opening 34 at which point the interlock plate has moved to its greatest extent against the return springs 33. The contacting edge portion of the interlock plate opening 34 then rides along the short reverse camming surface 27 during which the interlock plate moves back toward the right as viewed. Finally, the interlock plate 30 moves back to its original position with the bottom surface thereof adjacent the contacting edge portion of the opening 34 engaging the radial shoulder 28 of the push rod 16 to hold the push rod in depressed position. In this manner the push rod 16 is locked downwardly in the unit 10 and the switch unit actuating the same is closed with attached circuits operating.

With the push rod 16 of FIG. 6 being locked downwardly as described, any of the other push rods 16, such as the one shown in FIG. 7, cannot be moved downwardly into locked position by actuation of the switch unit associated therewith without releasing the first push rod 16 of FIG. 6. Thus actuation of the switch unit associated with the push rod 16 of FIG. 7 will result in a camming of the interlock plate 30 to the left as viewed in the manner described above during which operation the edge portion of the opening 34 engaging the radial shoulder 28 of the push rod 16 of FIG. 6 will correspondingly be released and, upon complete and adequate depression of the push rod 16 of FIG. 7, the push rod 16 of FIG. 6 will be completely released to return to its initial inoperative position by reason of the action of the return spring 24 thereof. Upon release of the push rod 16 of FIG. 6, the switch associated therewith will be automatically opened and the circuit connections caused thereby will be broken thus eliminating the possibility of inadvertently improperly closing multiple circuits in the computer or the like.

With the arrangement described, only one switch and

corresponding push rod can be activated at any one time, all of the remaining switches and push rods being completely and automatically deactivated. The rather elaborate camming arrangement described provides for precise controlled movement of the interlock plate 30 in such a manner that single switch actuation must be positive and complete before circuits are made or broken. In other words, the arrangement of the camming surfaces prevents the making and breaking of different circuits with only a slight depression of a second push rod. It will be appreciated that positive and sustained force must be applied against the switch button of the switch unit operating the push rod 16 of FIG. 7 to cause complete travel of the contacting edge portion of the interlock plate opening 34 along the camming surface 25 before the push rod 16 of FIG. 6 is fully released. If the operating force applied against the switch unit of the push rod 16 of FIG. 7 is inadequate to move the push rod downwardly to an extent that the flat camming surface 26 is engaged, upon the release of such force the interlock plate 30 will automatically ride along the short camming surface 27 of the push rod 16 of FIG. 6 back into engagement with the radial shoulder 28 thereof to return the push rod into its fully locked position.

As a further precaution against inadvertent double switch operation and in the event that an actuated push rod 16 should not properly return to its inactivated position, it is preferred that the unit 10 is supplied with at least one series of specially designed and uniquely arranged lockout means forming a part of the invention. Referring first to FIGS. 1-3, an outer bottom series of lockout means forms a part of the unit. The lockout means includes a plurality of pivotally mounted plates 35 each of which is formed with a downwardly opening channel shaped bottom plate portion 36 extending longitudinally of the unit 10 below the bottom plate 12 in paralleling side-by-side relation. Opposite ends of each portion 36 is formed with upwardly directed mounting ears 37 which are tapered upwardly and terminate in inwardly directed mounting flanges 38. The flanges 38 are relatively narrow and are received in upwardly opening arcuate grooves 39 formed along the top edge of each end plate 14 in spaced relation. The flanges 38 and grooves 39 are dimensioned to provide for limited pivoting of each lockout plate 35. It will be noted that a clearance is provided between the top surfaces of the mounting flanges 38 and the adjacent edge portions of the top plate 11 which close off the grooves 39. The longitudinal bottom plate portions 36 include depending side flange portions 40 which in the position of rest of the lockout plates 35 are in engagement with one another as shown in FIG. 2.

FIG. 8 illustrates operational use of the lockout plates 35. Downward operative movement of a single push rod 16 results in the receiving of the lowermost end of the push rod including the conical tip 17 between a pair of lockout plates, the conical tip 17 providing for ready sliding of the push rod between the depending flange portions 40 of adjacent plates. With a push rod 16 depressed as shown in the right hand portion of FIG. 8, all of the lockout plates 35 are pivoted away from the depressed push rod 16 and, by reason of the mounting of these plates for limited pivotal movement, all of the plates are pivoted to at least substantially their fullest extent and adjacent plates are placed in rather substantial tight engagement. In this manner the plates associated with the remaining push rods function to become relatively rigid lockout means whereby the remaining push rods cannot be readily depressed without the first depressed push rod being released and withdrawn from between the lockout plates. The arrangement is such that the left-hand push rod, as viewed in FIG. 8, is completely out of alignment with the contacting edges of the adjacent lockout plates 35 and attempted downward depression of the push rod, if not accompanied by an adequate release of the

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right-hand push rod as viewed, merely results in solid abutment between the conical tip 17 and a rigid surface of the underlying lockout plate.

It should also be noted that the particular camming means described above are especially useful in conjunction with the use of the unique lockout plates of the invention. Downward depression of a second push rod causes at least some translation of the interlock plate 30 thus permitting at least limited upward movement of the initially depressed push rod, such as the push rod 16 of FIG. 6. The relative positioning of the various elements including the lockout plates and the dimensioning of the inclined camming surfaces of the push rods are such that slight withdrawal of the initially depressed push rod results in corresponding sufficient withdrawal of the conical tip 17 thereof from between the lockout plates 35 to permit some pivoting of the lockout plates back toward their position of rest to begin to receive the conical tip 17 of the second push rod which is undergoing actuation. Once the flat surface 26 of the camming means of the push rod 16 of FIG. 6 engages the edge portion of the interlock plate opening 34, the conical tip 17 thereof is substantially withdrawn from between the lockout plates 35 and the conical tip 17 of the second push rod being depressed is at least partially received between its associated lockout plates 35. However, if for any reason, the push rod 16 of FIG. 6 should not continue to return to its inoperative position, such as in the event that the return spring 24 thereof fails or the push rod becomes stuck in its bushing 19, the second push rod cannot be completely depressed to an adequate extent that the switch unit associated therewith is closed. This is made possible by the special operation and positioning of the lockout plates 35 bearing in mind that the conical tip 17 and the adjacent lower end portion of the push rod must be fully received between the lockout plates 35 before the push rod is adequately depressed for locking by the interlock plate 30. Thus, if the push rod 16 of FIG. 6 fails to return to a position adequately to open the switch associated therewith, the second push rod undergoing depression will be stopped by a bottom wedging action set up by the lockout plates 35 which have not been permitted to return to their complete position of rest and are at least still slightly tilted.

Preferably, a second series of lockout plates are mounted internally of the unit 10 directly below the interlock plate 30 and extending at right angles to the first series of lockout plates. As best shown in FIGS. 3, 5 and 9, a plurality of lockout plates 41 extend between the end plates 14 and include downwardly opening channel shaped bottom plate portions 42 extending below the interlock plate 30 and formed with opposite end mounting ears 43 of generally inverted V contour and terminating in mounting flanges 44 which are received in upwardly opening arcuate grooves 45 formed in the top surfaces of the end plates 14 and closed off by the top plate 11. The lockout plates 41 are arranged in side-by-side relation but are spaced to a greater extent from one another than the lockout plates 35 previously described. The plates 41 are arranged to receive therebetween the enlarged circumferential camming portions of the push rods 16. The bottom plate portions 42 of the lockout plates 41 are preferably formed with depending flanges 46 to present smoothly operating engaging surfaces for the camming means of the push rods.

FIG. 9 best illustrates operational use of the lockout plates 41. The right-hand depressed push rod 16 has its circumferentially enlarged camming portion between adjacent edges of cooperating lockout plates 41 with these plates being pivoted away from the push rod with the result that the remaining plates are also pivoted out of alignment with their corresponding push rods and a tight wedging action exists. The left-hand push rod 16 of FIG. 9 upon actuation must release the depressed push rod 16 sufficiently to permit adequate pivoting of the lock-

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out plates 41 toward their position of rest to receive portions of the camming means of increasing width. In the same manner as previously described in connection with the use of the lockout plates 35, the lockout plates 41 will move toward their position of rest during release of the initially depressed push rod and while doing so will cooperatively receive increasing portions of the camming means of the second push rod which is being depressed. The combined series of lockout plates 35 and 41 form a matrix by being arranged at right angles to one another, this matrix cooperatively functioning with the push rods to require adequate retraction of an initially actuated push rods to require adequate retraction of an initially actuated push rod to an extent that the switch unit associated therewith is open prior to closing of the second switch unit undergoing actuation.

It will be appreciated that any number of push rods and associated switch units may be used in accordance with the teachings of the present invention. The unit is capable of efficient functioning and is not unduly complicated in design. The unit may be readily fabricated and assembled with the individual parts thereof cooperating in a new and unique manner. The lockout means function as swinging gates and by reason of this action as well as by reason of interlock and lockout plate design and arrangement, efficient operation accompanied by low frictional drag is possible. The pendulum-type swinging action of the lockout plates 35 and 41 provided by reason of the pivotal overhead mounting thereof (as distinguished from pivotal attachment at points below the level of plate operation) provides for improved efficiency and ease of operation. Additionally, the entire unit is more compact.

Obviously certain modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. A combination interlock and lockout unit for use with multiple electrical switching assemblies, said unit comprising a housing, a plurality of push rods mounted in said housing for reciprocal movement through said housing, an interlock plate transversely of said housing, spaced openings formed in said plate and in alignment with said push rods, means mounting said interlock plate for limited transverse movement in said housing, plate camming means forming a part of each push rod and aligned for engagement with an edge portion of a plate opening to move said plate, said camming means including an inclined plane surface portion and a radial shoulder portion, spring return means engaging said push rods to urge the same away from said plate, the camming means of one of said push rods upon actuation thereof towards said plate engaging an edge portion of one of said plate openings to move said plate and pass through said opening, the radial shoulder portion engaging the opposite face of said plate to hold said push rod in locked position, and lockout means in the form of a series of plates pivotally mounted in said unit in side-by-side relation along the opposite side of said interlock plate with adjacent edges overlying said openings, said lockout plates being spaced relative to one another to be pivoted to their fullest extent and to be placed in relatively tight engagement with one another upon the insertion of a portion of said push rod between a pair of said lockout plates when said push rod is actuated through said opening.

2. The combination of claim 1 wherein said lockout means comprises two series of lockout plates extending at right angles to one another in overlying relation, a first series arranged to cooperate with a portion of said camming means of one of said push rods and a second series arranged to cooperate with the innermost end of one of said push rods.

3. A combination interlock and lockout unit for use

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with multiple electrical switching assemblies, said unit comprising a housing, a plurality of push rods mounted in said housing for reciprocal movement through said housing, an interlock plate transversely of said housing, spaced openings formed in said plate and in alignment with said push rods, means mounting said interlock plate for limited transverse movement in said housing, plate camming means forming a part of each push rod and located intermediate the ends thereof and aligned for engagement with an edge portion of a plate opening to move said plate, said camming means being in the form of an enlarged circumferential portion presenting a relatively long frusto-conical camming surface joining a flat outer surface which in turn joins a reverse relatively short frusto-conical camming surface which terminates in a radial shoulder, spring return means engaging said push rods to urge the same away from said plate, the camming means of one of said push rods upon actuation thereof toward said plate engaging an edge portion of one of said plate openings to move said plate and pass through said opening, the radial shoulder engaging the opposite face of said plate to hold said push rod in locked position, and lockout means in the form of a series of plates pivotally mounted in said unit in side-by-side relation along the opposite side of said interlock plate with adjacent edges overlying said openings, said lockout plates being spaced relative to one another to be pivoted to their fullest extent and to be placed in relatively tight engagement with one another upon the insertion of a portion of said push rod between a pair of said lockout plates when said push rod is actuated through said opening.

4. The combination of claim 3 wherein said lockout means comprises two series of lockout plates extending at right angles to one another in overlying relation, a first series arranged to cooperate with a portion of said camming means of a push rod and a second series arranged to cooperate with the innermost end of the push rod.

5. The combination of claim 3 wherein said lockout means comprises two series of lockout plates extending at right angles to one another in overlying relation, a first

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series arranged to cooperate with a portion of said camming means of a push rod and a second series arranged to cooperate with the innermost end of the push rod, said lockout plates each including opposite end upwardly projecting mounting means pivotally supported by side and end wall portions of said housing.

6. In an interlock unit for use with multiple electrical switching assemblies, said unit having a plurality of reciprocating push rods arranged to engage interlock means which are designed to hold a selected one of said push rods in depressed position and release the same upon adequate depression of another push rod, the provision of lockout means cooperating with said interlock means to prevent depression of another push rod in the event of inadequate retraction of said selected push rod, said interlock means being in the form of a series of pivotally mounted plates arranged in side-by-side relation to receive a portion of said selected push rod therebetween, said plates being spaced relative to one another to be pivoted to their fullest extent and to be placed in relatively tight engagement with one another upon the insertion of said selected push rod between a pair of said plates.

7. The interlock unit of claim 6 wherein said lockout means comprises two series of lockout plates extending at right angles to one another in overlying relation to cooperate with separate portions of a push rod.

8. The interlock unit of claim 6 wherein said lockout means comprises two series of lockout plates extending at right angles to one another in overlying relation to cooperate with separate portions of a push rod, said lockout plates each including opposite end upwardly projecting mounting means pivotally supported by side and end wall portions of said unit and providing for pendulum-type pivoting of said plates.

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