May 11, 1965 R. H. KIELY 3,183,315

PUSH BUTTON SWITCH WITH DETENT ARRANGEMENT

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Fig. 1.

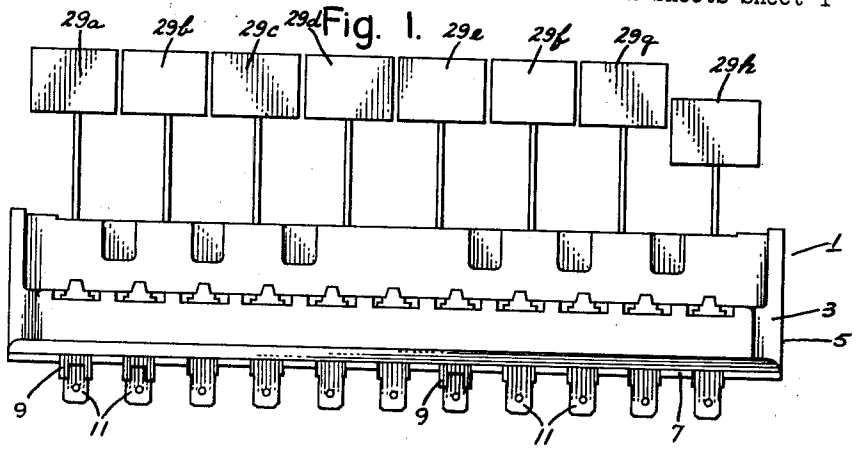


Fig. 2.

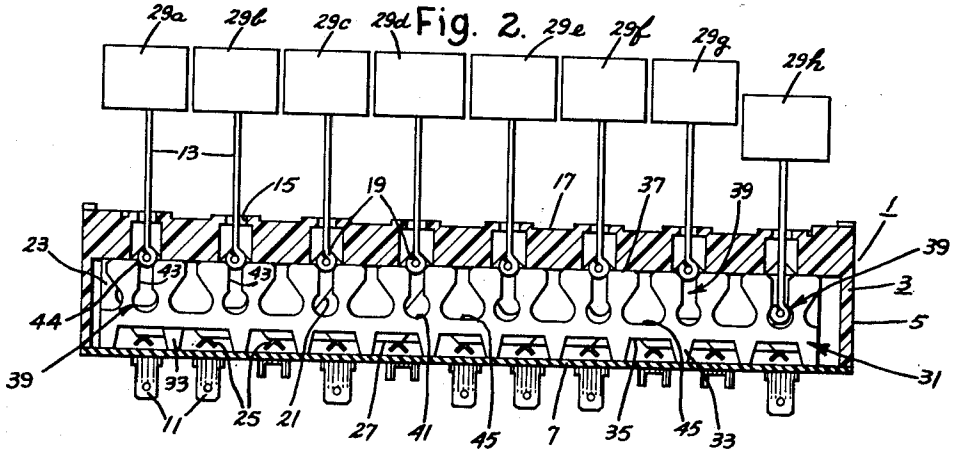


Fig. 3.

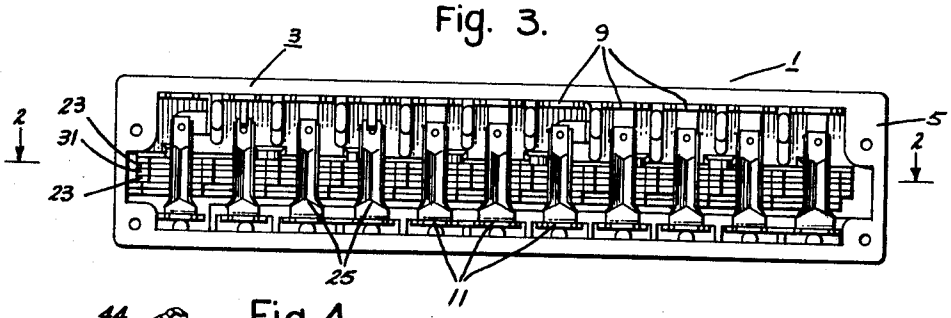
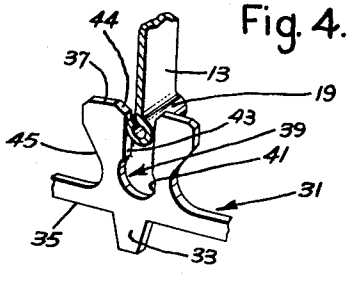


Fig. 4.



Inventor:
Richard H. Kiely

by Thomas A. Briody

His Attorney

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Fig.5.

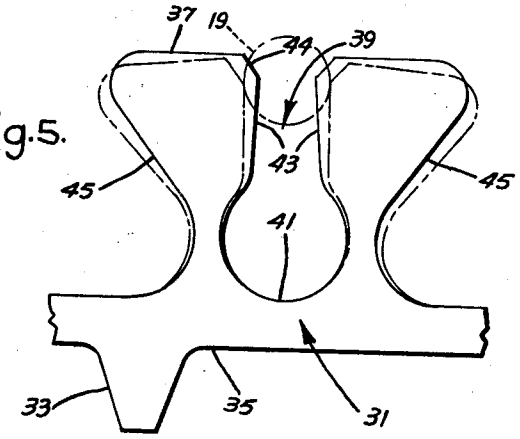
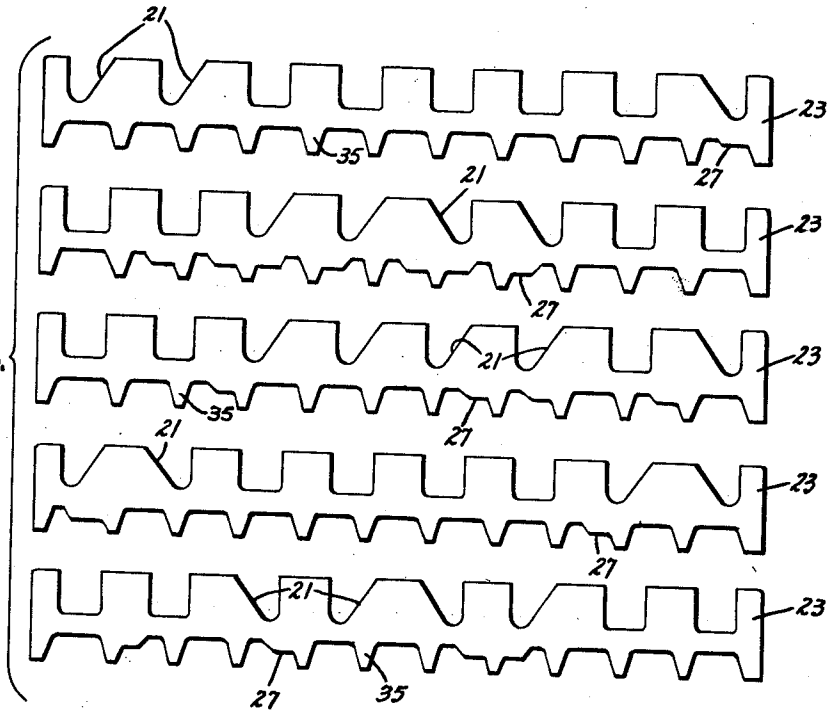


Fig.6.



Inventor:
Richard H. Kiely,
by Thomas A. Brody
Attorney.

United States Patent Office 3,183,315 Patented May 11, 1965

3,183,315
PUSH BUTTON SWITCH WITH DETENT ARRANGEMENT

Richard H. Kiely, Huntington, Conn., assignor to General Electric Company, a corporation of New York

Filed Dec. 8, 1961, Ser. No. 157,994
8 Claims. (Cl. 200—5)

This invention relates to a pushbutton switch and particularly a multiple pushbutton switch having a series of manually controlled actuating members which may be depressed to control the operation of several circuits operating through the switch.

Multiple pushbutton switches have been used in great numbers as appliance switches for electric ranges, washing machines, and room air conditioners, etc. To enhance the ruggedness of these switches and to efficiently operate them over a long period of years, various types of prior art structures have been utilized to precisely position the actuating members. Such structures are quite commonly referred to as "detents" since they tend to restrain or hold the actuating members in their different positions. The prior art detent structures of the type referred to have proven to be relatively complex for the over-all switch and also somewhat expensive. It has, therefore, been found desirable to provide a new and improved detent structure for a multiple pushbutton switch, which structure is extremely simple, efficient in operation, and low in cost.

An important object of this invention is to provide a pushbutton switch with a novel and efficient means for precisely positioning the reciprocating actuating members thereof.

Another object of this invention is to provide an improved multiple pushbutton switch which includes a plurality of reciprocating actuating members and a single part cooperable with each and every one of these members for controlling the movement and positioning thereof.

A further object of this invention is to provide a novel detenting arrangement for a pushbutton switch, which arrangement is simplified in structure, readily manufacturable, and low in cost.

In carrying out my invention, in one form thereof, I apply it to a multiple pushbutton switch with movable sliders. Each slider has a series of inclined working surfaces that are acted upon by pushrods, and cam surfaces for engaging movable contact supporting arms of the switch. Each pushrod has a cylindrically configured actuating section formed at its inner end. Depression of one of the pushrods causes the actuating section thereof to coact with certain inclined surfaces of one or more of the sliders for moving certain sliders and returning the previously depressed pushrod back to its outermost position. At the same time, the cam surfaces of the sliders act upon certain predetermined movable contacts of the switch to move them toward or away from their associated fixed contacts and thus either open or close circuits of the switch. By my invention, a thin flat element of elastic material or the like is arranged in the switch so that it is relatively immovable. This flat element has a series of detenting apertures formed therein.

Each of these detenting apertures includes a pair of adjacent spaced apart edges which engage the cylindrically configured actuating section of an associated pushrod to hold the pushrod in its outer position against accidental displacement. When a pushrod is in its depressed position, the pair of edges of its associated detent aperture engage the actuating section of the pushrod to restrain the pushrod in that position. Each pair of edges also coacts with the pushrod actuating section to control the reciprocating movement of the associated pushrod between its outer and depressed positions. With such an arrangement, a single flat element is thus utilized to simply and efficiently control the positioning and reciprocating movement of all of the pushrods of a multiple pushbutton switch.

Further aspects of my invention will become apparent hereinafter, and the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which I regard as my invention. The invention, as to organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description when taken in conjunction with the accompanying drawing in which:

FIG. 1 is a front elevational view of a multiple pushbutton switch embodying my invention;

FIG. 2 is a front cross-sectional view similar to FIG. 1, but taken generally along the line 2—2 of FIG. 3;

FIG. 3 is a bottom view of the switch of FIG. 1 with the cover plate removed;

FIG. 4 is a fragmentary perspective view showing the cylindrical actuating section of a pushrod cooperating with the detent element;

FIG. 5 is an enlarged fragmentary elevation view of the detent aperture of my novel detent element; and

FIG. 6 is a view showing the configuration of the movable sliders of my improved switch.

Referring in detail to the drawing, and in particular to FIGS. 1–3, there is shown a multiple pushbutton switch 1 wherein my invention has been advantageously employed. The switch housing 3 comprises hollow base 5 and relatively thin cover plate 7, both of which are formed of suitable insulating material and cooperate to provide a compact supporting structure for the operating mechanism of the switch. Cover plate 7 is securely attached to base 5 by terminals 9 and 11 of the fixed and movable contacts. These terminals are arranged in oppositely disposed rows (FIG. 3) and extend outwardly through base 5 and cover plate 7 (as shown in FIG. 1), being attached thereto in the well-known manner to hold the terminals in place and secure the cover and base together.

To actuate switch 1, pushrods 13 extend downwardly through apertures 15 of top wall 17 of base 5, into the hollow portion thereof (FIG. 2). These pushrods have cylindrically configured actuating portions 19 (FIG. 2) which cooperate with various inclined upper working edges 21 of elongated sliders 23. (See also FIG. 6). Sliders 23 are disposed in parallel relationship in the well-known manner, and reciprocate longitudinally, to actuate movable contact supporting arms 25. The lower edge of each slider, as shown in FIGS. 2 and 6, has

one or more cam surfaces 27 formed thereon. Cam surfaces 27 are for alternately engaging certain movable contact arms 25 to effect the opening and closing of predetermined switches in certain operating positions of the sliders. The inclined working surfaces 21 of the upper edges of the sliders 23 are so arranged on the different sliders that the number of pushbuttons which can be depressed at one time is limited. Thus, for example, in the illustrated switch, one or more, but not all of the pushrods 13 may be fully depressed at any one time. As is thus well known in the art, the depression of one of the pushrods 13 causes the longitudinal movement of one or more of sliders 23. Movement of certain of the sliders returns previously depressed pushrods to their outermost positions and also actuates certain contacts of the switch by engagement of cam surfaces 27 of the sliders with the movable contact supporting arms 25.

To provide a convenient means for manually depressing pushrods 13 of my switch, pushbuttons 29*a*–29*h* are mounted to the outer ends of the pushrods. (See FIGS. 1 and 2.) Each of the pushrods 13 is thus fastened to one of the manually operable pushbuttons 29*a*–29*h* and is reciprocably movable therewith to operate one or more switches.

Turning now to an important aspect of my invention, which is the provision of a novel and improved means for precisely controlling the positioning and reciprocating movement of the pushrods 13, as shown in FIG. 2, it will be noted that an elongated element 31 is positioned within the switch housing 3. For the illustrated embodiment of my invention, element 31 is stamped from a thin sheet of resilient material such as nylon phenolic .031 inch thick and has a flat planar configuration generally resemblant to sliders 23. However, element 31 differs from the sliders 23 in that it does not in essence slide, but is rather relatively stationary with respect to the base 5. Nevertheless, preferably the element 31 is capable of a very slight floating movement within base 5, being positioned therein by the placement of cylindrical portions 19 of the pushrods 13, as shown in FIG. 2. The element 31 also has supporting feet 33 on its lower edge 35 as do the sliders 23, so that cover plate 7 will support element 31 in place within base 5 and the element 31 will not interfere with the supporting arms 25 of the movable contacts.

In the upper edge 37 of element 31 (as shown in FIG. 2), there is formed a series of detenting apertures or slots 39, one of which is disposed underneath the cylindrical actuating section 19 of each pushrod 13. Each of the slots 39, resembles an inverted keyhole, comprising (as shown best in FIG. 5) a rounded innermost end 41, and a pair of opposed edges 43. The edges 43 gradually converge from rounded end 41 toward upper edge 37 and then flare outwardly in divergent fashion to form a mouth 44 opening into upper edge 37.

Between each pair of adjacent detenting slots 39 there is formed a cutout section 45. In the particular illustrated element 31, the cutout sections 45 have the general configuration of an urn-shaped vessel with a bulbous body portion and a relatively narrow neck opening into edge 37. The purpose of the cutout sections 45 shall become apparent hereinafter.

For an explanation of the operation of the improved pushrod controlling arrangement of my invention, attention is now directed to FIG. 2. Each of the pushrods 13 is normally disposed in its outermost or undepressed position. When a pushrod such as, for example, the pushrod of pushbutton 29*a* shown in FIG. 2, is in its outermost position, the cylindrically configured actuating portion 19 of that pushrod nests into engagement with the outwardly divergent edges of mouth 44 of detent slot 39. The outwardly divergent edges of mouth 44 thus tangentially engage the curvature of cylindrical actuating portion 19 and hold pushbutton 29*a* and its associated pushrod 13 upwardly in a level position.

When one of the pushbuttons, such as, for example, pushbutton 29*h* is depressed from its normal outermost position, as shown in FIG. 4, the cylindrical portion 19 of its associated pushrod engages the opposed edges 43 and flexes these edges outwardly and away from each other so that they gradually part and allow the cylindrical portion 19 to approach rounded end 41 of slot 39. As the cylindrical portion 19 of the depressed pushrod is moving downwardly toward rounded end 41 of slot 39, the material of element 31 disposed around the rounded end 41 resiliently flexes as suggested by the dotted lines in FIG. 5, allowing the edges 43 to impart the desired frictional resistance to the movement of the pushrod. In viewing FIG. 5, it will be noted that the edges 43 are in substantially uniform parallelism during the movement of pushrod portion 19 between its outer and depressed positions. The frictional resistance imparted by edges 43 to portion 19 during movement of the pushrod between its two positions, is therefore substantially steady. When the pushbutton 29*h* has reached its depressed or innermost position, as shown in FIG. 2, it is retained there due to the resilient flexure of the innermost ends of edges 43 to their original position.

With pushbutton 29*h* in its depressed position as shown in FIG. 2, upon subsequent depression of certain of the other pushbuttons, a working surface 21 of one of the sliders 23 cams cylindrical portion 19 of the pushbutton 29*h* upwardly through detent slot 39 to the outermost position for pushbutton 29*h*. As portion 19 of the depressed pushrod is moved outwardly to its outermost position, it again engages edges 43 of slot 39 and resiliently parts these edges to control the movement of the pushrod.

When multiple pushbutton switches of the type illustrated herein are in use, some of the pushrods usually do more work than others in acting upon the sliders 23 and actuating the switch contacts. Thus, for example, the depression of one pushrod may cam several sliders 23 from one longitudinal position to another, whereas the depression of another pushrod may cam only a single slider 23 from one longitudinal position to another. The present invention affords a simplified means for controlling each of the pushrods in accordance with the amount of work it does in the switch. More particularly, the width or gap size between each pair of edges 43 of the different slots 39 may be varied in accordance with the work done by each pushrod to provide a substantially uniform force requirement for moving each of the pushrods from its outer position to its depressed position. Thus, for example, where the work to be performed by certain pushrods is relatively heavy, the gap size of the associated detent apertures 39 may be of such a dimension as to provide a relatively light detent action. On the other hand, where the work to be performed by other pushrods is relatively light, the gap size of the associated detent aperture 39 may be dimensioned to provide a relatively heavy detent action. It will thus be seen that the improved detenting element of my invention may be readily constructed so that it simply and efficiently imparts a substantially uniform action to the various pushrods, irrespective of the work which these pushrods do in the switch.

As a further advantage which may be obtained by utilizing the pushrod controlling element 31 of the present invention, attention is directed to FIGS. 1 and 3. When used in conjunction with the sliders 23, the element 31 may be sandwiched between some of these sliders. Since element 31 is relatively immovable with respect to the sliders 23, it thus serves as a barrier to prevent the sliding movement of sliders 23 on one of its sides from affecting the sliding movement of sliders 23 on its other side.

It will now be understood that my new and improved pushbutton switch as herein illustrated provides a simple and efficient means for economically controlling the positioning and movement of the switch actuating members. It should be realized that certain aspects of my

invention may be incorporated efficiently and beneficially in other various types of pushbutton switches.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I therefore aim in the following claims to cover all such equivalent variations as fall within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a multiple pushbutton switch having a housing and a plurality of pushrods mounted on said housing for reciprocating movement between outer and inner positions, contact means including a plurality of movable contacts operable by selective movement of said pushrods between said positions, a cylindrical section on the inner end of each of said pushrods, and a thin planar element disposed in said housing beneath said pushrods for controlling said pushrods by coaction with the cylindrical section of each pushrod, said element having a series of detent apertures disposed to receive the cylindrical sections of the pushrods, each of said apertures including a pair of opposed edges, the edges of each pair being arranged for movement in opposite directions within the plane of said element to resiliently grip the cylindrical section of an associated pushrod during movement thereof between said positions and to restrain said pushrod in its inner and outer positions, thereby to control the movement and positioning of said pushrods.

2. In a multiple pushbutton switch having a housing and a plurality of pushrods mounted on said housing for reciprocating movement between outer and inner positions, a plurality of longitudinally elongated sliders disposed in side-by-side relationship within said housing and having inclined working surfaces formed thereon, said pushrods being engageable with said working surfaces of said sliders for selective movement of certain of said sliders in predetermined directions, contact means including a plurality of movable contacts operated by the longitudinal motion of certain of said sliders, a cylindrical section on the inner end of each of said pushrods, and a thin planar element disposed in said housing beneath said pushrods in side-by-side relationship with said sliders for controlling said pushrods by coaction with the cylindrical section of each pushrod, said element having a series of detent apertures disposed to receive the cylindrical sections of the pushrods, each of said apertures including a pair of opposed edges, the edges of each pair being arranged for movement in opposite directions within the plane of said element to resiliently grip the cylindrical section of an associated pushrod during movement thereof between said positions and to restrain said pushrod in its inner and outer positions, thereby to control the movement and positioning of said pushrods.

3. In a pushbutton switch having a housing and at least one pushrod mounted on said housing for reciprocating movement between first and second positions, a thin planar element disposed in said housing for controlling said pushrod, a section of said pushrod engageable with said element, said element having at least one edge engaged with said section of the pushrod, said edge resiliently engaging said section of the pushrod and said edge being moved thereby in the plane of said element upon reciprocation of said pushrod to restrain the reciprocating movement of said pushrod.

4. In a multiple pushbutton switch having a housing and a plurality of pushrods mounted on said housing for reciprocating movement between first and second positions, contact means including a plurality of movable contacts operable by selective movement of said pushrods between said positions, and a thin substantially planar element disposed in said housing for controlling said pushrods, said planar element extending longitudinally

in alignment with said pushrods, and said element including a plurality of pairs of opposed edges, each pair of said edges being arranged in cooperable association with one of said pushrods, the edges of each pair being arranged for movement in opposite directions and resiliently gripping the associated pushrod during movement thereof between said positions thereby to control the reciprocating movement of said pushrod.

5. In a multiple pushbutton switch having a housing and a plurality of pushrods mounted on said housing for reciprocating movement between outer and inner positions, a plurality of longitudinally elongated sliders disposed in side-by-side relationship within said housing and having inclined working surfaces formed thereon, said pushrods being engageable with said working surfaces of said sliders for selective movement of certain of said sliders in predetermined directions, contact means including a plurality of movable contacts operated by the longitudinal motion of certain of said sliders, a cylindrical section on the inner end of each of said pushrods, and a thin planar element disposed in said base in side-by-side relationship with said sliders for controlling said pushrods by coaction with the cylindrical section of each pushrod, said element having a series of detent apertures disposed in association with the cylindrical sections of the pushrods, a recess formed in said element between each adjacent pair of said detent apertures, each of said apertures including a pair of opposed edges, the edges of each pair being arranged for movement in opposite directions within the plane of said element to resiliently grip the cylindrical section of an associated pushrod during movement thereof between said positions and to restrain said pushrod in its inner and outer positions, thereby to control the movement and positioning of said pushrods.

6. The switch of claim 5 wherein each detent aperture includes a rounded inner end in which the cylindrical section of an associated pushrod is restrained when it is in its inner position and a flared mouth section in which the cylindrical section of said pushrod is restrained when it is in its outer position.

7. In a pushbutton switch having a housing and a plurality of actuators mounted on said housing for reciprocating movement between outer and inner positions, a plurality of longitudinally elongated sliders disposed in side by side relation within said housing and having inclined working surfaces formed thereon, said actuators being engageable with said working surfaces of said sliders for selective movement of certain of said sliders in predetermined directions, contact means including a plurality of movable contacts operated by the longitudinal movement of said sliders, and a detent element disposed in said housing in alignment with said actuators, said element being of thin elongated construction and having a longitudinal edge and a plurality of uniformly configured apertures opening into said longitudinal edge, each of said apertures comprising a pair of opposed edges disposed in generally transverse relationship to the longitudinal edge of said element, said opposed edges being normally converged toward each other from their inner ends in the direction of the longitudinal edge, and arranged for movement in opposite directions within the plane of the element upon movement of an associated actuator between its positions, said opposed edges being in substantial parallelism during movement of the associated actuator between its positions and resiliently gripping said actuator thereby to control the movement of said actuator.

8. In a multiple pushbutton switch having a housing and a plurality of pushrods mounted on said housing for reciprocating movement between outer and inner positions, contact means including a plurality of movable contacts operable by selective movement of said pushrods between said positions, a control section formed on each of said pushrods and an elongated detent element

disposed in said housing in alignment with said pushrods for controlling said pushrods by coaction with the control section of each pushrod, said detent element having a series of detent apertures disposed to receive the control section of the pushrods, each of said apertures including a pair of opposed edges, the edges of each pair being arranged for movement in opposite directions to resiliently grip the control section of an associated pushrod during movement thereof between said positions and to restrain said pushrod in its inner and outer positions, thereby to control the movement and positioning of the pushrods.

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BERNARD A. GILHEANY, *Primary Examiner.*