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MECHANICAL INTERLOCKS FOR PLURAL ELECTRICAL APPARATUS

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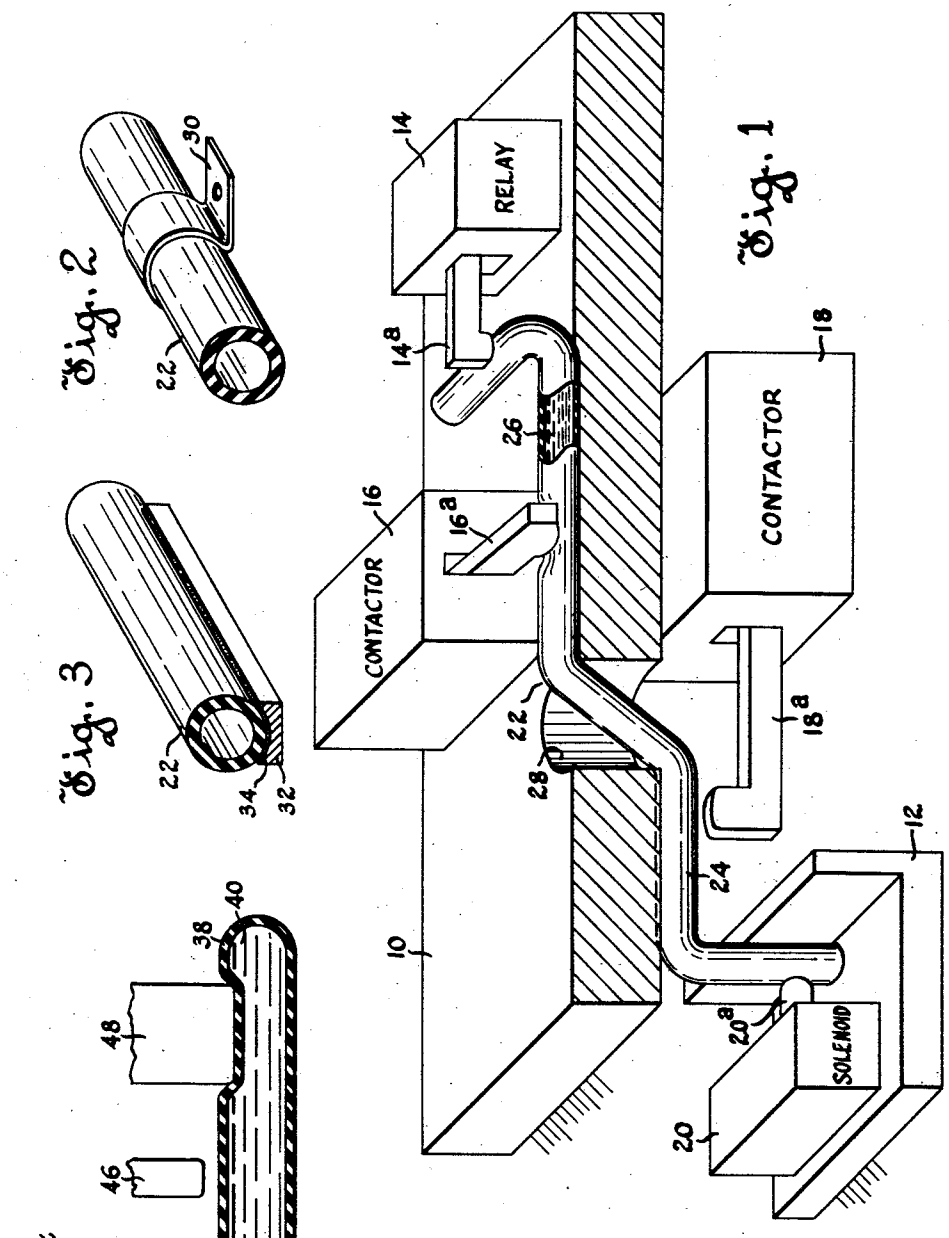


Fig. 1

Fig. 2

Fig. 3

Fig. 4

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MECHANICAL INTERLOCKS FOR PLURAL ELECTRICAL APPARATUS

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This invention relates to mechanical interlocks for plural electrical apparatus.

A primary object of the invention is to provide a reliable mechanical interlock for plural electrical apparatus which is simple to install and inexpensive to manufacture.

Other objects are to provide such an interlock which may be readily adapted for use with plural electrical apparatus of various sizes and types, and which imposes few limitations with respect to the relative placement and positioning of the apparatus interlocked as compared with the limitations of previously known interlocks.

Other objects and advantages of the invention will hereinafter appear.

The objects are attained by the provision of a hollow, sealed member having a flexible portion which is filled with a substantially incompressible liquid to a volume which is some predetermined amount less than the maximum volume of said hollow member when in its normal configuration. The material of which the hollow member is formed is selected so that the walls of the finished interlock may be easily depressed or deformed but may not be easily distended or ballooned to increase the volume of the hollow member beyond its maximum volumetric capacity when in its normal configuration. Such an interlock, when used with plural electrical apparatus each of which is provided with a suitable interlock mechanism, provides a very flexible and reliable interlock system. The interlock is positioned relative to such interlock mechanisms so that upon being actuated the mechanism depresses or deforms the interlock sufficiently to decrease the total volumetric capacity of the interlock, without distention thereof, to substantially the volume of the liquid contained therein.

Thus if any one of the interlock mechanisms is actuated to deform the interlock, the other interlock mechanisms are prevented from being actuated because further depression of the interlock would require distention or ballooning of the hollow interlock member.

While such member is preferably formed of a relatively inelastic material, such materials as rubber and elastomers perform satisfactorily since hollow bodies of such materials may be more readily deformed than distended.

The accompanying drawing illustrates one embodiment of the invention which will now be described. It is to be understood, however, that the embodiment selected for illustration is merely representative of the embodiments contemplated and which lie within the spirit and scope of the appended claims.

In the drawings, Figure 1 is a partially schematic, isometric view of an interlock system embodying the invention;

Figures 2 and 3 are enlarged, fragmentary, isometric views illustrating alternative means for mounting an interlock embodying the invention; and

Fig. 4 is a diagrammatic illustration, partly in elevation and partly in vertical section, of a modified form of the invention.

Referring to the drawing, the enumeral **10** designates a panel and **12** is a sub-panel mounted in a fixed relationship thereto. A relay **14** and a contactor **16** are mounted on one side, and a contactor **18** is mounted on the other side of panel **10**. A solenoid **20** is mounted on the sub-panel **12**. Relay **14**, contactors **16** and **18**, and solenoid **20** are provided with interlock mechanisms **14a**, **16a**, **18a** and **20a**, respectively.

An interlock **22** comprising a flexible, hollow, sealed, tubular member **24** containing a substantially incompressible body of liquid fill **26** extends along one surface of panel **10**, through opening **28** in panel **10**, along the other side of panel **10** and then to and along the surface of sub-panel **12**. The interlock is disposed in such manner that it is cooperatively engageable by the engaging face of each of the mechanisms **14a**, **16a**, **18a** and **20a**. It is secured to panel **10** and sub-panel **12** by any appropriate means such, for example, as by clamps **30**, one of which is shown in Fig. 2, or by a channel **32**, Fig. 3, attached to the panel, and to which the interlock is secured in any suitable manner, as by adhesive cement or the like as indicated at **34**.

Hollow member **24** will accommodate a given maximum volume of liquid **26** when in its normal configuration (i. e., that configuration it would assume without being distended or ballooned in any dimension). The actual volume of liquid **26** which is contained in member **24** is a predetermined amount less than such maximum volume. Air pressure external to member **24** will collapse the latter so that liquid **26** fills the same. If desired air or other compressible fluid may be permitted to occupy that portion of the hollow member not occupied by liquid **26**.

The relay **14**, contactors **16** and **18** and solenoid **20** are so positioned relatively to interlock **22**, and the strokes, lever arms and the areas of the engaging faces of the respective mechanism **14a**, **16a**, **18a** and **20a** are so proportioned that, in the embodiment illustrated, any one, but only one, of the mechanisms may be actuated at one time. For certain applications, less liquid fill may be used to permit more than one mechanism to be actuated at one time.

If preferred, the strokes, engaging forces and areas of the engaging faces of the several actuating members may be so proportioned and the volume of the liquid fill may be so proportioned relative to the volumetric capacity of the hollow member **24** that actuation of certain interlock mechanisms is effective to prevent actuation of certain other interlock mechanisms. One example is illustrated diagrammatically in Fig. 4, wherein a hollow member **38** containing a predetermined quantity of liquid **40** is adapted to be depressed by actuating mechanisms **42**, **44**, **46** and **48**. The reduction in the volumetric capacity of member **38** which is effected by actuation of mechanism **42** is equal to such reduction caused by actuation of mechanisms **44** or **46**, but is equal to only one-third of such reduction caused by actuation of member **48**. Thus actuation of mechanism **48** precludes actuation of mechanisms **42**, **44** and **46** or any of them. Actuation of one of the smaller mechanisms would not prevent actuation of one or both the other smaller mechanisms, but would prevent actuation of mechanism **48**.

The provision of other numbers of actuating mechanisms and/or actuating members of other relative sizes makes possible interlocking systems which would be difficult and costly to duplicate by mechanical interlocks heretofore known.

The interlock **22** may be pre-shaped to suit a given arrangement of the apparatus to be interlocked. However, the primary advantage of the invention is that the flexibility of the interlock permits the adaptation of standard forms of the interlock to various arrangements of appara-

tus. Thus as illustrated in Fig. 1, a length of straight tubing may be bent to lie in various planes, to extend to the opposite side of the panel, or even to extend to other panels. The apparatus interlocked may be placed and oriented according to other requirements than the necessity of interlocking.

Any kinks or the like which are formed in the interlocks in assembling the system would change the volumetric capacity of the interlock, and obviously would cause difficulty, such difficulties may be easily avoided by the use of preformed sections, such as metal elbows or the like, to replace portions of the flexible member, or by filling and sealing the interlock after it is installed. Or, alternatively, such difficulties, or difficulties caused by filling the hollow member with an improper volume of liquid, may be overcome by employing clamping means for adjusting the volumetric capacity of the member.

I claim:

1. In a mechanical interlock for plural electrical apparatus, in combination, a hollow sealed member having a flexible portion, said member containing a volume of substantially incompressible liquid, said volume being some predetermined amount less than the volumetric capacity of said hollow sealed member in its normal configuration, a plurality, exceeding two in number, of electrical devices each having an operating mechanism including an element individual thereto, each said element having an unoperated position in which said element is disengaged from said flexible portion and an operated position in which said element depresses said flexible portion to decrease said volumetric capacity of said hollow sealed member, and means for actuating one of said elements into its operated position wherein said liquid at said decreased capacity of said hollow sealed member locks at least one of said other elements in unoperated position.

2. An interlocking apparatus of the character set forth in claim 1, in which said hollow sealed member is of tubular form between the respective closed ends thereof.

3. In a mechanical interlock for plural electrical apparatus, in combination, a plurality, exceeding two in number, of electrical devices each having an interlock element operatively associated therewith, a sealed flexible tubular member normally engaged with said interlock elements, said tubular member containing a body of substantially incompressible liquid occupying a volume which is some predetermined amount less than the total normal configuration volumetric capacity of said tubular member, means for operating one of said interlock elements to depress a portion of said flexible tubular member to decrease its volumetric capacity, whereby said liquid is confined in said decreased capacity to prevent operation of at least one of said other elements.

4. In a mechanical interlock for plural electrical apparatus, in combination, a plurality, exceeding two in number, of electrically operated devices each having an interlock element operated jointly therewith, a sealed flexible tubular member cooperatively arranged with respect to each of said interlock elements, said sealed flexible member containing a body of substantially incompressible liquid occupying a volume which is a preselected amount less than the normal configuration volumetric capacity of said member, said sealed flexible tubular member being deformable without distention thereof, and means for operating one of said elements to depress a portion of said flexible tubular member to decrease its volumetric capacity, whereby said liquid is confined in said decreased capacity to prevent operation of one or more of the other of said elements.

5. In a mechanical interlock for plural electrical apparatus, in combination, a plurality, exceeding two in number, of electrically operated devices each having an interlock element operated jointly therewith, a sealed flexible tubular member cooperatively arranged with respect to each of said interlock elements, said sealed flexible tubular member containing a body of substantially incompressible liquid occupying a volume which is at least one times some predetermined amount less than the normal configuration capacity of said member, said sealed flexible member being deformable without distention thereof, and means for effecting operation of one or more of said elements to depress a portion or portions of said flexible tubular member to correspondingly decrease its volumetric capacity, whereby said liquid is confined in said decreased capacity to thereby prevent operation of one or more of the other of said elements.

6. In a mechanical interlock for plural electrical apparatus, in combination, a plurality of electrical devices, exceeding two in number, each having an interlock element operated jointly therewith, a sealed hollow flexible member positioned for engagement by one or more of said interlock elements either individually or jointly, and a body of liquid disposed within said hollow member, said interlock elements each being adapted upon a given operation thereof to effect depression of said hollow member to reduce the volumetric capacity of the latter, without distention thereof, some predetermined amount, said body of liquid having a volume substantially equal to the volumetric capacity of said hollow member, when in its normal configuration, less at least one times said predetermined amount, and means for actuating at least one of said elements into its operated position wherein said liquid at said decreased capacity of said sealed hollow flexible member effects locking of at least one of said other elements in unoperated position.

7. An interlocking apparatus like that defined in claim 6, wherein said sealed hollow flexible member is of tubular form between the respective closed ends thereof.

8. In a mechanical interlock for plural electrical apparatus, in combination, a plurality, exceeding two in number, of electrical devices each having an interlock element to be actuated thereby, a sealed hollow member having a flexible portion positioned for engagement by one or more of said interlock elements either individually or jointly, a body of liquid disposed within said hollow member, each interlock element acting automatically, upon energization of its associated electrical device selectively, to reduce the volumetric capacity of said hollow member, without distention thereof, at least one times some predetermined amount, and said body of liquid having a volume substantially equal to the volumetric capacity of said hollow member when in its normal configuration less at least two times said predetermined amount.

9. In a mechanical interlock for plural electrical apparatus, a hollow sealed member comprising a flexible portion and a single chamber containing a volume of substantially incompressible liquid, said volume being some predetermined amount less than the volumetric capacity of said hollow sealed member in its normal configuration, said hollow sealed member being deformable without distention thereof, and a plurality of electrical devices each having an operating mechanism including an element individual thereto, each said element having an unoperated position in which said element is disengaged from said flexible portion and an operated position in which said element depresses said flexible portion to decrease said volumetric capacity of said hollow sealed member, means for actuating a desired one of said elements into its operated position, the area of at least one of said elements being a multiple of the area of other of said elements so that when said one element is actuated into its operated position said liquid at the decreased capacity of said hollow sealed member locks said other elements in unoperated position, and when only one of said other elements is actuated into its operated position said liquid at the decreased capacity of said hollow sealed member locks only said multiple area element in unoperated position.

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