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INTERLOCK STRUCTURE FOR TWO MANUALLY OPERATED TOGGLE SWITCHES

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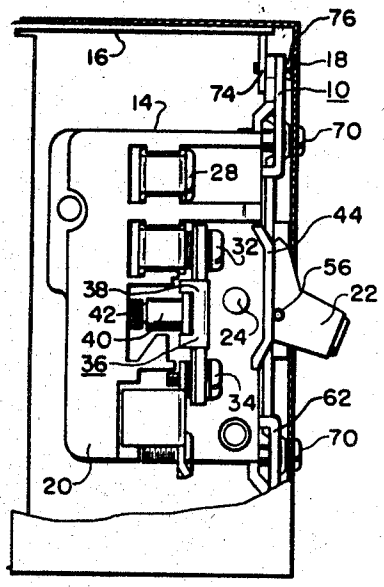

FIG. 3

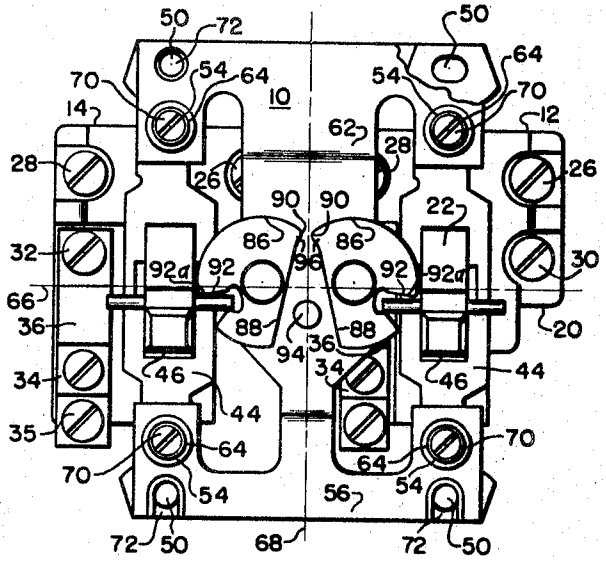

FIG. 1

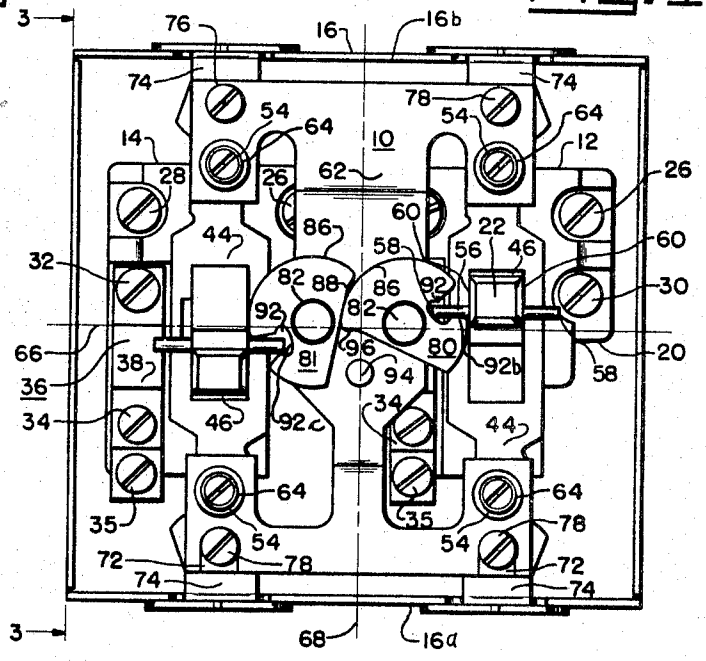

FIG. 2

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INTERLOCK STRUCTURE FOR TWO MANUALLY OPERATED TOGGLE SWITCHES

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ABSTRACT OF THE DISCLOSURE

An inexpensive interlock structure having a minimum number of parts arranged to prevent concomitant operation of the handles of a pair of manually operated overload type switches to circuit closing positions and the movement of the handle of one of the switches when the other switch is tripped in response to an overload current. The switches each have a pin extending from the switch operating handle and the interlock structure has a mounting plate arranged to position the switches on a support so the pin on each switch handle extends into a notch in one of a pair of identical disc-like members that are rotated on the mounting plate. Each of the members has surfaces arranged so that a rotative movement of one of the members by one of the handles will cause a surface on the said one member to move into a position interfering with the rotative movement of the other member of the pair and prevent movement of the handle of the other switch.

This invention relates to mechanical interlocks and more particularly, to an inexpensive interlock structure having a minimum number of parts arranged to position a pair of manually operated switches relative to each other and prevent the closing of one of the switches when the other is in a closed condition.

While not limited thereto, the invention is especially suited for use in connection wtih the type of electrical switch illustrated in application Ser. No. 540,406, filed Apr. 5, 1966, which I, as the inventor Jordan F. Puetz, assigned to the assignee of the present invention.

It is an object of the present invention to provide a durable, simple, and inexpensive mechanical interlock structure having a mounting plate arranged to position a pair of manually operated switches so a pair of disc-like members, carried on the plate to be rotated by the handles of the switches, will operate to prevent closing of one of the switches when the other is in a closed condition.

Another object is to provide a mechanical interlock to prevent concomitant closing of two identical manually operated switches wherein each of the switches has a pin extending from a side wall of an operating handle along an axis spaced and parallel to the axis about which the handle rotates between two positions for opening and closing a set of contacts of the switch and to provide the interlock with a mounting plate that positions the switches on a support so the axis of both handles extend along a common axis and spaces the switches from each other so the pins on the handles are received in notches in a pair of identical disc-like members that are rotatably mounted on the mounting plate in the space between the switch handles and have cooperating interfering surfaces to prevent movement of the handle of one of the switches to a circuit closing position when the other of said pair of switches is in a circuit closing position.

A further object is to provide a mechanical interlock to prevent concomitant closing of two identical manually operated overload responsive type switches each having a pin extending from a side wall of an operating handle along an axis spaced and parallel to the axis about which the handle rotates between two positions for opening and closing a set of contacts of the switch and to provide the interlock with a mounting plate that positions the switches on a support so the axis of both handles extend along a common axis and spaces the switches from each other so the pins on the handles are received in notches in a pair of identical disc-like members that are rotatably mounted on the mounting plate in the space between the switch handles and each have cooperating interfering circular and flat surfaces which engage each other to prevent movement of the handle of one of the switches to a circuit closing position when the other of said pair of switches is in a circuit closing position and to prevent the movement of the handle of one of the switches to a circuit closing position when the other of said pair of switches is in a tripped condition in response to an excess current flow.

An additional object is to provide a mechanical interlock to prevent concomitant closing of two identical manually operated switches wherein each of the switches has a pin extending from a side wall of an operating handle along an axis that is spaced and parallel to the axis about which the handle is rotatable between two positions for opening and closing a set of contacts of the switch and to provide the interlock with a mounting plate that is arranged to properly position the switches on a support so the axis of both handles extend along a common axis and to space the switches from each other so the pins on the handles are received in notches in a pair of identical disc-like members that are rotatably mounted on the mounting plate in the space between the switch handles and each have cooperating interfering curved and substantially flat peripheral edges which engage each other to prevent movement of the handle of one of the switches to a circuit closing position when the other of said pair of switches is in a circuit closing position and to provide a stop between the disc-like members to limit rotation of the members to prevent improper installation of the interlock on the switches.

Further objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating certain preferred embodiments in which:

FIG. 1 is a front plan view of a mechanical interlock according to the present invention as used with a pair of identical manually operated switches.

FIG. 2 shows the mechanical interlock and the switches in FIG. 1 positioned within a cavity of a supporting outlet box with one of the switches in a circuit closing condition.

FIG. 3 is a side elevational view taken along line 3—3 in FIG. 2 with a portion of a cover plate and the outlet box for the switches broken away.

Referring to the drawings, the numeral **10** designates a mechanical interlock structure. The structure **10** is particularly suited to prevent concomitant operation of a pair of manually operable switches **12** and **14** when the switches **12** and **14** are positioned by a support **16**, shown as an electric outlet box, and covered by a cover plate **18**. The switches **12** and **14** preferably are of the type disclosed in my application for patent Ser. No. 540,406, filed Apr. 5, 1966 and as the switches **12** and **14** are identical, only the switch **12** will be described, it being understood that the designations applied to the components of the switch **12** are applicable to corresponding components of the switch **14**. The switch **12** has a molded insulating housing **20** enclosing cooperating contacts, not shown, which are actuated in response to movements of a rotatable operating handle **22** from a circuit opening or OFF position when the handle **22** is positioned as in FIG. 1 to a circuit closing or ON position when the handle **22** is rotated about a pivot **24** to the position shown in FIG. 2. The housing **20** provides a support for wire connecting terminals **26**, **28**, **30**, **32** and **34**. The

switch 12 is constructed to complete a circuit between the terminals 26 and 28 and a circuit between the terminals 30 and 32 when the handle 22 is moved from the OFF position shown in FIG. 1 to the ON position shown in FIG. 2. The switch 12 additionally includes a melting alloy type overload unit 36 connected between the terminals 32 and 34. The unit 36 is of a well known type and includes a terminal 35 and a heating element 38 which in response to an excess current flow between the terminals 32 and 34 causes liquification of a normally solidified solder alloy within a sleeve 40 permitting rotation of a ratchet wheel 42 from a normally fixed position. When the wheel 42 is free to rotate, a suitable mechanism, not shown, within the housing 20 causes an interruption of the circuits between the terminals 26–28 and 30–32 as the movable contacts, not shown, within the switch housing move independently of the handle 22 to a circuit opening position while the handle 22 remains in the ON position shown in FIG. 2. The handle 22 moves with a snap toggle spring action as it is manually moved through a dead center between the OFF and the ON positions. When the switch 12 is subjected to an excess current flow the switch contacts open and the handle 22 remains in the ON position. After the solder within the sleeve 40 solidifies the control of the switch contacts is restored by moving the handle from the ON position to a reset position. When the switch 12 is reset, the handle 22 is initially moved by a manual force from the ON position toward the OFF position past the dead center point of the switch toggle mechanism. When the dead center point is passed, the switch toggle mechanism will cause the handle to move with a snap action to a tripped position located intermediate the ON and the OFF positions.

The switch 12 has a mounting strap 44 to which the housing 20 is secured with the strap 44 having an elongated central opening 46 through which the handle 22 extends. Additionally, the strap 44 has oval shaped openings 50 adjacent each of its opposite ends and threaded openings 54 positioned between the opening 46 and the openings 50. Extending along an axis parallel and spaced from the axis of the pivot 24 in the handle 22 is a pin 56. The pin 56 is secured in the handle 22 to present free ends 58 extending externally of the opposite side walls 60 of the handle 22 and is arranged so as to engage a top surface of the mounting strap 44 when the handle 22 is positioned as in FIG. 1 or 2 and to move through an arcuate path of travel as the handle is rotated about the axis through the pivot 24 between the positions in FIGS. 1 and 2.

The interlocking mechanism 10 includes a mounting plate 62 having openings 64 aligned with each of the openings 54 in the switches 12 and 14 for positioning the switches 12 and 14 adjacent each other so the pivot axis of the handles 22 of the switches 12 and 14 are aligned in a common axis indicated by numeral 66 in FIGS. 1 and 2. The openings 64 are further located in the plate 62 so the handles 22 of the switches 12 and 14 will move in planes parallel and spaced equidistantly a predetermined distance on opposite sides of a vertical centerline designated by the numeral 68 in FIGS. 1 and 2 when screws 70 are passed through the openings 64 and threaded into the openings 54. The plate 62 additionally has four openings 72 located to be aligned with the openings 50 in the switches 12 and 14. The openings 50 and 72 are located to be aligned with the threaded openings in ears 74 extending from opposite end walls 16*a* and 16*b* of the support 16. Thus the assembly consisting of the interlock mechanism 10 and the switches 12 and 14 may be secured to the support 16 by four screws 76 which are passed through the openings 72 in the mounting plate 62 and the openings 50 in the switches 12 and 14 into the threaded openings in the ears 74.

The interlock mechanism 10 additionally includes a pair of identical interlocking members 80 and 81 that are disc-like in shape and mounted to rotate on the mounting plate 12 by pivot pins 82. The pivot pins 82 have a rivet-like shape with a shank extending through suitable openings in the members 80 and 81 and with a head portion engaging a flat front surface of the members 80 and 81 to maintain the members 80 and 81 in position on the plate 62. The pins 82 are located adjacent the centerline 66 equidistantly on opposite sides of the centerline 68 as shown in FIGS. 1 and 2.

Each of the members 80 and 81 has a curved peripheral surface 86 having a cylindrical shape defined by a radius through the center of the pins 82. The members 80 and 81 additionally have a substantially linear peripheral surface 88, a tip 90, and notches 92 located and shaped to operate, as will be later described. If desired, a stop 94, formed as a raised portion on the mounting plate 62 on the vertical centerline 68 between the members 80 and 81, may also be included to limit rotation of the members 80 and 81.

Prior to assembly of the interlock structure 10 and the switches 12 and 14, the stop 94 limits rotation of the members 80 and 81 on the mounting plate 62 to prevent an improper assembly of the switches 12 or 14 and the interlock structure 10. As described, the members 80 and 81 are freely rotatable on the plate 62 and when the members 80 and 81 are properly positioned on the plate 62, the linear surfaces 88 of the members 80 and 81 will confront each other and the curved surfaces 86 will face in opposite directions. If the stop 94 is absent, either of the members 80 or 81 will be free to rotate 180°, prior to the assembly with the switches 12 and 14, to a position wherein the linear surface 88 of one of the members, e.g., member 80, will face the switch 14. When the member 80 is thus positioned, the free end 58 on the pin 56 will be free to move, during the rotation of the handle 22 of the switch 12, without engaging the member 80 and thus defeat the operation of the interlock structure.

The assembly of the switches 12 and 14 and the interlocking structure in the outlet box 16 and the positioning of the cover 18 is accomplished as follows: the switches 12 and 14 are initially connected to suitable electric conductors, not shown, present in the outlet box 16. For example, a pair of leads from a common source may be connected to the terminals 26 and 30 of both switches 12 and 14 and a pair of leads from a load, not shown, may be connected to the terminals 28 and 35 of the switch 12 and a second load, not shown, may be connected to the terminals 28 and 35 of the switch 14. Thus when the switches 12 and 14 are operated to a circuit closing position the loads will be energized.

After the switches are thus wired, a pair of the screws 76 are loosely threaded through the oval shaped openings 50 in the switches 12 and 14 into the threaded openings in the ears 74 located along the bottom wall 16*a* of the box shown in FIG. 2. Thus the switches 12 and 14 are loosely positioned in the outlet box 16. The interlock structure 10 is then positioned on the switches 12 and 14. As shown, the openings 72 at the lower edge of the plate 62 are formed as notches. This arrangement will permit the notches at the lower edge of the plate 62 to be moved behind the heads of the screws 76 to movably position the interlock structure 10 on the switches 12 and 14. The members 80 and 81 are then rotated so the notches 92 are aligned to receive the free ends 58 of the pins 56 extending from the switches 12 and 14. When the free ends 58 of both switches 12 and 14 are received in the notches 92 of both members 80 and 81, the four screws 70 are loosely threaded through the four openings 64 in the plate 62 into the threaded openings 54 in the switches 12 and 14 to position the interlock structure 10 on the switches 12 and 14 as previously described. When the interlock structure 10 and the switches 12 and 14 are thus positioned on the box 16, a pair of screws 76 are then passed through the openings 72 in the interlock plate 62 and the openings 50 in the switches 12 and 14 and tightened in the threaded openings in the ears 74 at the top edge 16*b* of the box 16 and when the pair of screws 76 at the bottom edge 16*a* are tightened, the

switches 12 and 14 with the interlock structure 10 properly positioned thereon will be mounted in the box 16. The cover 18 may be secured to the box 16 by removing the four screws 70 which were previously loosely threaded into the openings 54 to maintain the relative positions of the interlock structure 10 and the switches 12 and 14 during assembly with the box 16 and reinserting the screws 70 through suitable openings in the cover 18 and tightening the screws 70 in the openings 54 to secure the cover 18 to the switches 12 and 14.

The interlock structure 10 will prevent concomitant operation of the switches 12 and 14 to circuit closing positions when the interlock structure 10 and the switches 12 and 14 are mounted in the box 16 as described, or when the switches 12 and 14 and the interlock structure 10 are detached from the box 16 and the cover 18 and merely held assembled by the screws 70. When the switches 12 and 14 and the interlock structure 10 are properly assembled, the free ends 58 of the pins 56 extending toward the centerline 68 will be positioned in the notches 92 in members 80 and 81. The notches 92 each are located in the members 80 and 81 so the tips 90 on the members 80 and 81 will be on opposite sides of the centerline 68 and a top wall 92*a* of each of the notches 92 will be juxtaposed and parallel to the side walls of the pins 56, when one of the switches 12 or 14 is actuated, e.g., switch 12 in FIG. 2, by rotating its handle 22 from the first position shown in FIG. 1, to the position shown in FIG. 2. The movement of the handle 22 from the first position known in FIG. 1, wherein the contacts of the switch 12 are in a circuit opening condition, to the second position shown in FIG. 2, wherein the contacts of the switch 12 are in a circuit closing condition, as transmitted through the pin 56, causes a counterclockwise rotation of the member 80 about the pin 82 to the position shown in FIG. 2. When the member 80 is positioned as in FIG. 2, the curved surface 86 on the member 80 will be positioned to be engaged by the surface 88 on the member 81 to interfere with a clockwise rotation of the member 81, as would result if an attempt were made to move the handle 22 of the switch 14 from the position shown in FIG. 1 to the position shown in FIG. 2. The notches 92 in the members 80 and 81 are arranged so that when the member 80 and the handle 22 of the switch 12 are positioned as in FIG. 2, a wall portion 92*b* of the notch 92 will be juxtaposed and parallel to the side walls of the pin 56 so as to present a maximum bearing surface when the handle 22 of the switch 12 is rotated from the position shown in FIG. 2 to the position in FIG. 1.

As shown, the tips 90 on the members 80 and 81 are formed by a junction between the curved surfaces 86 and a curved surface 96 extending from the linear surface 88. The curvature of the surfaces 96 is an inverse of the curvature of the surfaces 86 on the members 80 and 81 so the tips 90 are located as close as permissible on opposite sides of the centerline 68 when the members 80 and 81 are positioned as in FIG. 1 so the interlocking function between the members 80 and 81 will occur upon minimal movement of the handles 22 of the switches 12 and 14.

As shown, the roots of the notches 92 are enlarged as indicated by the numeral 92*c* to provide clearance for the extreme free ends 58 of the pins 56 during movements of the switch handles 22 and the members 80 and 81, as described.

In view of the foregoing description it is apparent that movement of the handle 22 of the switch 14 from the position shown in FIG. 1 to the position illustrated by the position of the handle 22 of the switch 12 in FIG. 2 while the handle 22 of the switch 12 is positioned as in FIG. 1, will cause the member 81 to rotate in a clockwise direction to a position wherein the surface 86 on the member 81 will interfere with movement of the surface 88 on the member 80 and prevent movement of the handle 22 of the switch 12 to the position shown in FIG. 2. Additionally, as the pins 56 are arranged to extend externally from opposite side walls 60 of the handles 22 of both switches 12 and 14, it is apparent the positions of the switches 12 and 14 may be reversed on the interlock structure 10 without loss of the interlocking function provided by the interlock structure 10.

If either of the switches 12 or 14, e.g., the handle 22 of the switch 12, is in an ON position and the switch 12 is subjected to excess current, the contacts within the switch 12 will move to a circuit opening position while the handle 22 remains in the ON position. Normal operation of the handle 22 of the switch 12 from the ON position toward the OFF position, when the switch 12 has been tripped in response to an excess current, would cause the handle to move with a snap action to a tripped position that is located intermediate the dead-center position of the handle 22 and the full OFF position. The switch 12 is reset for operation by manually moving the handle 22 from the tripped position to the full OFF position. Thus as the tripped position of the handles 22 of the switches 12 and 14 are intermediate the full ON and the full OFF positions, the interlock structure 10 will prevent actuation of one of the switches 12 or 14 when the handle 22 of the other switch is in a tripped position.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art.

What is claimed is:

1. A mechanical interlock for use with and adapted to prevent concomitant closing of two identical manually operated switches, each of said switches having an operating handle rotatable about a pivot axis for actuating a set of switch contacts from a circuit opening to a circuit closing position when the handle is rotated from a first position to a second position about the pivot axis and a pin extending from a side wall of the handle along an axis parallel and spaced from the pivot axis to provide a free end on the pin that is movable along a defined path as the handle is moved between the first and the second positions, said interlock comprising in combination: a mounting plate having openings therein for positioning the two switches adjacent each other so the pivot axes of the switches are aligned in a common axis and the free ends of the pins on the adjacent switches are spaced a predetermined distance from each other to move in parallel paths when the switches and mounting plate are secured to a support, and a pair of identical disc-like members each having a notched portion, a curved surface and a straight surface on the peripheral edges thereof, each of said members being individually rotatably mounted on the mounting plate and equidistantly spaced on opposite sides of a centerline that is centered between the handles of the adjacent switches to have its notched portion receiving a portion including the free end of the pin on one of the switches for being rotated by the pin as the handle of the said one switch is moved from the first to the second position and its curved surface arranged to move into an interfering position with the straight surface on the member that has a notched portion receiving the pin on the switch other than said one switch for preventing movement of the handle of the said other switch from the first to the second position when the handle of the said one switch is in the second position.

2. The combination as recited in claim 1 wherein the notched portion on the member receiving the pin on the said one switch faces in a direction opposite the direction faced by the notched portion which receives the pin on the said other switch and including a stop centered on the centerline for preventing rotation of the members to position wherein the notches on both members face in the same direction.

3. The combination as recited in claim 1 wherein each of the switches is of the overload responsive type and the

handle of either one of the switches is rotatable to a third position that is intermediate the first and second positions when said one switch is tripped in response to an overload current condition and the curved and the straight surfaces on the members are shaped so that when the handle of the said one switch is in the third position the handle of the switch other than the said one switch is prevented from movement from the first position to the second position.

4. The interlock structure in claim 1 wherein the mounting plate is provided with a set of spaced openings each alignable with an opening in the switch and a threaded opening in the support for positioning the mounting plate and switches on the support and the mounting plate is provided with an additional set of openings each aligned with a threaded opening in the switches for securing a cover plate for the switches.

5. The combination as recited in claim 1 wherein a pair of spaced pins mounted on the mounting plate provide a means for rotatably mounting the members.

6. The combination as recited in claim 5 wherein the notches in each member have opposite side wall portions extending in a plane through the center of the pin on which the member is mounted.

7. The combination as recited in claim 1 wherein the pins extend from opposite parallel side walls of the handles of the switches whereby the switches may be interchangeably mounted on the support.

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