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Middleton, Jr.

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[54] **SAFETY INTERLOCK FOR POWER SWITCH OF INTERCONNECTED UNITS**

[75] Inventor: **Charles F. Middleton, Jr.**, Sudbury, Mass.

[73] Assignee: **Modicon Corporation**, Andover, Mass.

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[52] **U.S. Cl.** ..... **200/50 A**; 174/52 R; 312/320; 317/99

[51] **Int. Cl.**[2] **H01H 9/20**

[58] **Field of Search** ..... 200/50 A, 50 AA, 50 B, 200/51 R; 174/52 R, 53, 54, 58, 59, 65 R; 307/150; 317/99, 101 R, 101 CB, 112, 115, 117, 120; 339/58, 125 R; 206/328, 334; 312/215, 244, 288, 290, 300, 317–320

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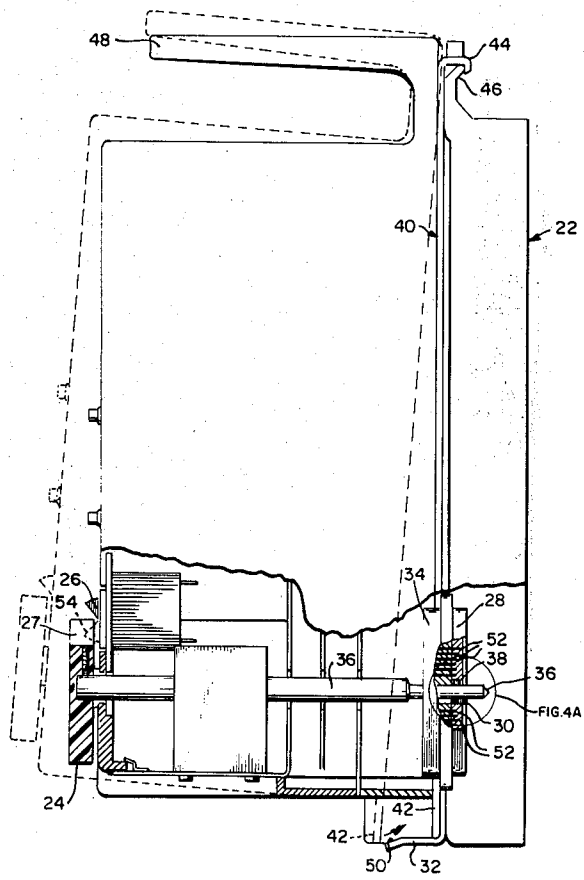
Primary Examiner—James R. Scott

Attorney, Agent, or Firm—Mattern, Ware and Davis

[57] **ABSTRACT**

A power-protect interlock system which assures interconnection of two units only when the power is off, prevents unwanted disconnection, and prevents unwanted operation of the units is provided by a control knob which operates a movable latch and allows a power switch to be activated only when the units have been interconnected. In the preferred embodiment, one unit incorporates a pin-receiving assembly, and the second unit, which incorporates the control knob, incorporates a pin connection assembly. Also, in the preferred embodiment, the first unit comprises a pivot plate along the top thereof and the second unit incorporates a hook member positioned for engagement with the pivot plate to support the weight of the second unit and allow easy interconnection of the units. Furthermore, the two units incorporate cooperating alignment members to assure precise accurate pin interconnection.

6 Claims, 7 Drawing Figures



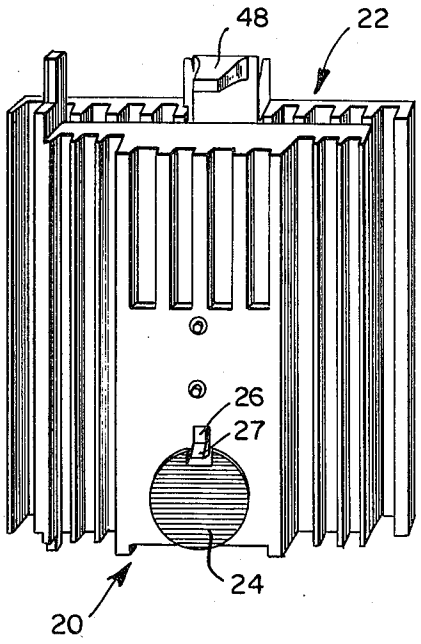


FIG. 1

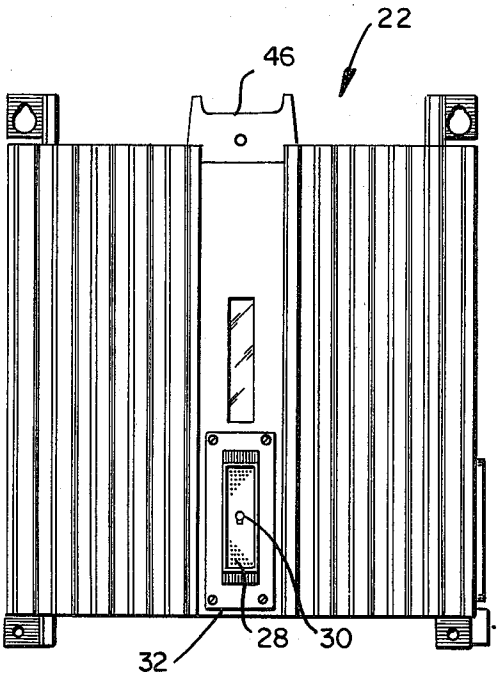


FIG. 2

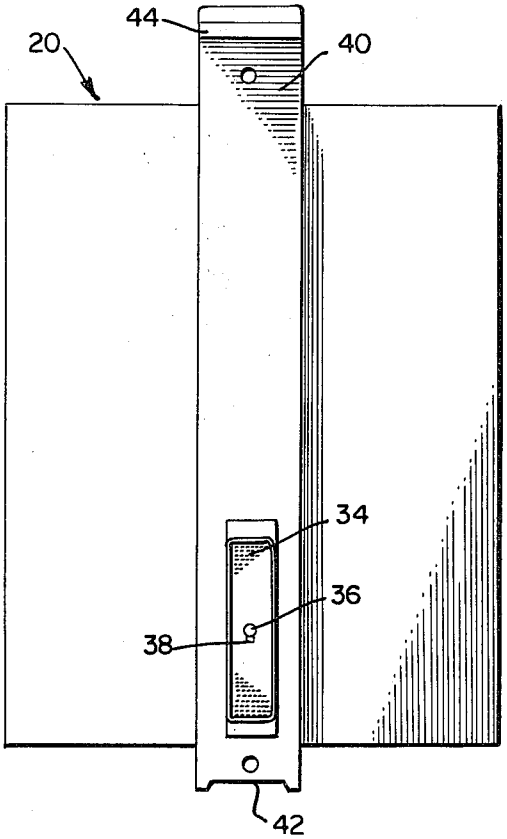


FIG. 3

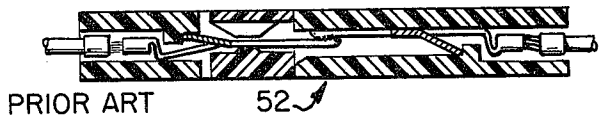


FIG. 6

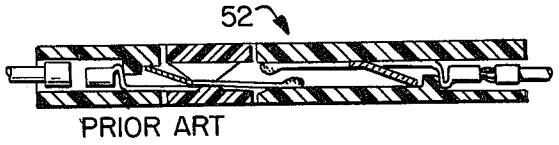


FIG. 5

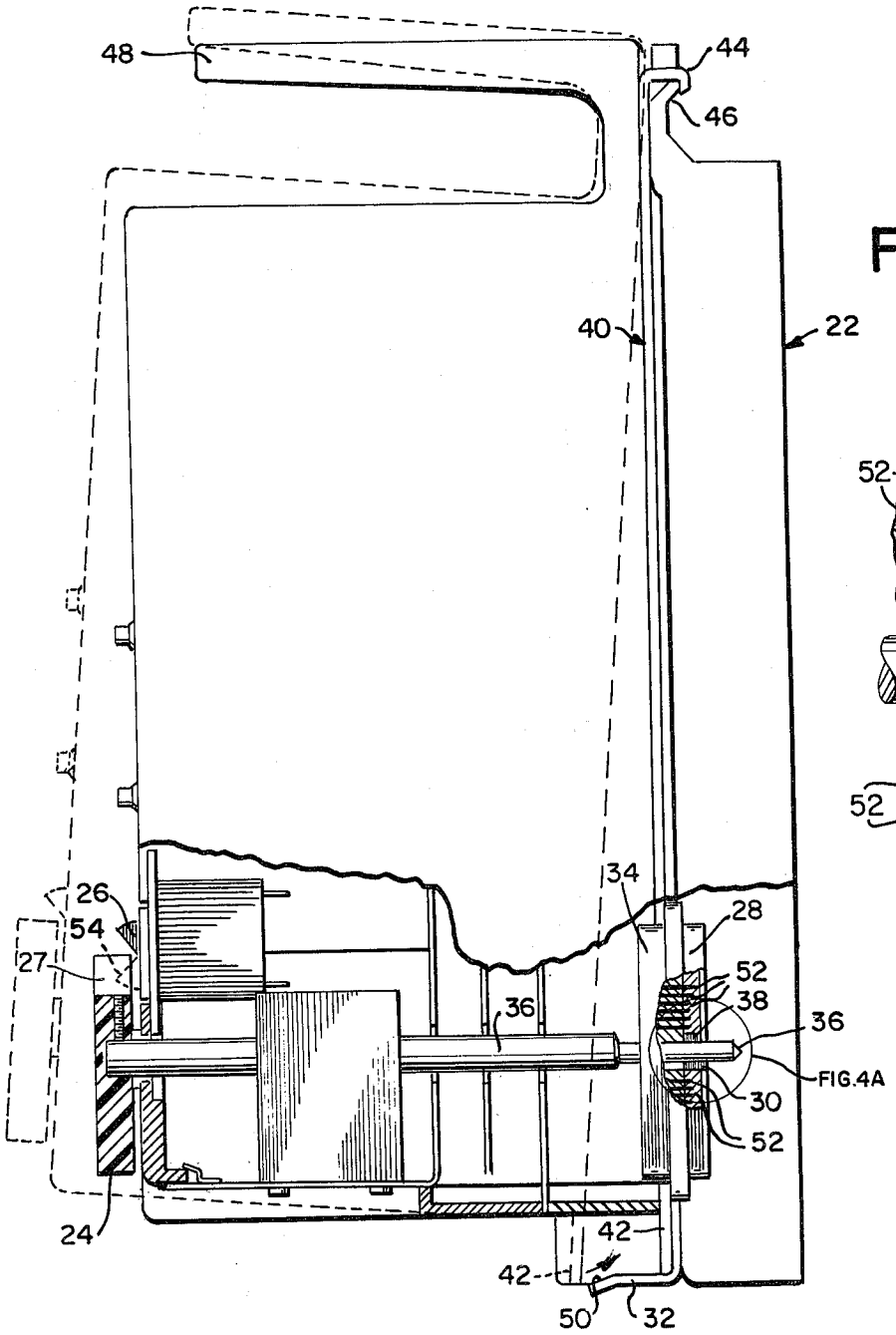
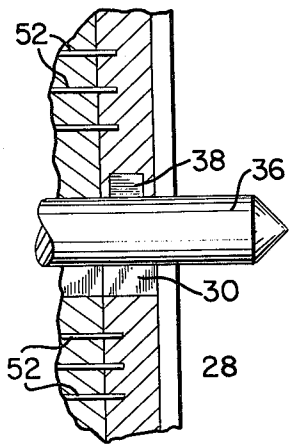


FIG. 4

FIG. 4A



SAFETY INTERLOCK FOR POWER SWITCH OF INTERCONNECTED UNITS

SUMMARY OF THE INVENTION

This invention relates to interlock systems, and more particularly to interlock systems which prevent unwanted electrical loading on connecting pins during their interconnection.

With the quickly emerging art in electronic systems, much use is being made of interconnection and quick disconnection of electronic units. In many well-known operations, such as machine controllers, for example, a power supply module may wish to be interconnected quickly and easily to a central processor, ready for operation. Furthermore, the power supply module may wish to be removed and a reprogramming module substituted therefor and interconnected with the central processor to insure the proper operation of the equipment. In these particular operations, and many similar well-known operations, the two units must be quickly and easily interconnectible on a repeated basis.

One of the problems which exist with interconnecting electronic units to each other on a repeated basis is the assurance of a positive electrical contact. As systems become more complicated, the number of interconnection pins is substantially increased. Each of these pins must provide a positive electrical contact, while also assuring that disconnection and repeated interconnections therewith can be made without a degradation of the electrical contact.

The major problem that exists in assuring such repeated operational utility is the prevention of electronic loading on the pin during the interconnection process. When any electronic loading is present on the pins, great risk of arcing across the pins and possible permanent interconnection between the pins is present. Furthermore, undesirable transient loads are applied to the units in a manner for which the unit may not have been designed.

Virtually all prior art units incorporate power switches which prevent electronic loading on the interconnection pins prior to installation and interconnection of the pin assemblies. However, the use of these power switches is left to the operator, who accidentally may have the unit in the ON position while attempting interconnection of the units.

Therefore, it is a principal object of this invention to provide an interlock system which assures that two units being interconnected cannot be connected while power is supplied thereto.

Another object of this invention is to provide the interlock system of the above character which prevents unwanted disconnection of the units, especially when the power is being supplied through the units.

Another object of this invention is to provide the interlock system of the above character which assures positive interconnection between the units.

Other and more specific objects will in part be obvious and will in part appear hereinafter.

The interlock system of this invention is particularly adapted for the interconnection of one unit to a second unit with complete assurance that power is not being supplied to the units when the interconnection is being achieved. One unit incorporates a pin-receiving assembly, while the second unit incorporates a pin-connection assembly adapted for interconnection with the pin-receiving assembly of the first unit. The second unit also incorporates a control knob which is positioned to prevent operation of the power switch unless the control knob is in the desired operative position with the two units securely interlocked.

In the preferred embodiment, the control knob is connected to a rotatable shaft which simultaneously provides a dual function, (1) to provide a positive latch with the first unit, and (2) to activate the interconnecting pins from a first open position to a second closed contacting position. By employing the interlock system of this invention, the control knob must be in one specific orientation in order to interconnect the two units, with this position assuring that the power switch is in the OFF position. Upon movement of the control knob to a second position, which simultaneously causes the rotatable shaft to perform its dual functions, the contact pins are interconnected and the units are securely locked together. In this second knob position, the power switch is freely operable and the power can now be turned on.

If interconnection of the second unit with the first unit were attempted with the control knob in its second position and the power switch turned ON, interconnection of the pins would not be accomplished since the shaft latch member could not be inserted into the cooperating latch-receiving member of the first unit. In this way, complete interconnection of the units with the power off is assured.

Although the preferred embodiment does incorporate both functions for the rotating shaft, it is obvious to one skilled in the art that either of these functions can be provided by the shaft while still allowing the objects of this invention to be carried out. Furthermore, it is possible, although less desirable, that neither of these functions can be provided by the shaft and merely the control knob with its cooperative effect on the power switch can be incorporated in order to prevent undesirable electrical loading on the pins during their interconnection.

In the preferred embodiment, the first unit, which is mounted to a supporting structure, also incorporates a pivot plate along its top surface, and the second unit incorporates a hook member positioned for pivoting interconnection with the pivot plate. In this embodiment, the first interconnection step is to engage the hook member of the first unit on the pivot plate of the second unit. This allows substantially all of the weight of the second unit to be supported by the first unit while also allowing the second unit to be freely pivotable about this contact point. This allows freedom of control for carefully installing and interconnecting the two units.

Furthermore, the units incorporate alignment-adjusting members along their bottom surfaces, which cooperatingly interact to precisely and accurately position the pin assemblies for proper interconnection.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

THE DRAWINGS

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of a power supply module interconnected with a central processor, incorporating the interlock system of this invention;

FIG. 2 is a front elevation view of the central processor of FIG. 1;

FIG. 3 is a rear elevation view of the power supply module of FIG. 1;

FIG. 4 is a side elevation view partially in cross section of the power supply module and central processor of FIG. 1, showing the details of the interlock system of this invention;

FIG. 4A is an enlarged cross-sectional view of the pin-connection assembly and the pin-receiving assembly of the interlock system of this invention;

FIG. 5 is a cross-sectional side view of one example of mating contacts in their open position; and

FIG. 6 is a cross-sectional side view of the contact of FIG. 5 shown in the closed position.

DETAILED DESCRIPTION

For exemplary purposes only, the interlock system of this invention will be described in its relationship to the interconnection and interlocking of a power supply module **20** to a central processor **22.** Power supply module **20** incorporates on its face a control knob **24** and a power switch **26.** As shown in FIG. **1,** control knob **24** incorporates a cut-out portion **27** which, when cooperatingly aligned with power switch **26,** allows the operation of switch **26.** As will be more fully described below, power switch **26** comprises a "rocker switch" which, when in the ON position, prevents the rotation of knob **24** and, when in the OFF position, allows control knob **24** to be freely rotated. Also, when switch **26** is in the OFF position and control knob **24** is rotated so that cut-out portion **27** is not aligned with switch **26,** switch **26** cannot be moved into the ON position.

As shown in FIG. **2,** central processor **22** incorporates a pin-receiving assembly **28.** In the preferred embodiment, pin-receiving assembly **28** is the female of the pin connector assembly, and also incorporates a latching slot **30.** Slot **30** is constructed to allow shaft **36** and latching plate **38** (FIG. **3**) to enter slot **30** only when knob **24** is in a position which requires switch **26** to be OFF. As will be more fully described below, when knob **24** is rotated into the position which allows power switch **26** to be moved to the ON position, latching plate **36** is securely engaged with slot **30.** Central processor **22** also incorporates a pivot plate **46** and an alignment-adjusting shelf **32,** which assures that power supply module **20** is in the proper aligned position for interconnection with receiving pin assembly **28.**

As shown in FIG. **3,** power supply module **20** incorporates an interconnecting male pin assembly **34** and a shaft **36.** Shaft **36** incorporates at its end a latching plate **38** radially extending therefrom, which cooperates and interlocks with slot **30** of central processor **22.** Power supply module **20** also incorporates a central plate **40,** which incorporates a hook member **44** near the top thereof, and an alignment fin **42** at its base. Alignment fin **42** is constructed to cooperatively engage with shelf **32** of central processor **22** to assure the proper alignment for the interconnection of pin assemblies **34** and **28.** For ease of handling, power supply module **20** incorporates a handle **48** which provides the maneuverability for module **20** that is desired.

In order for shelf **32** to be able to properly align and position power supply module **20** with the aid of alignment fin **42,** central processor **22** is adapted to be mounted on an existing support structure such as a wall, and power supply module **20** is interconnected therewith. The installation and interconnection of module **20** with central processor **22** can best be understood by referring to FIG. **4.**

In order to install and interconnect power supply module **20** with central processor **22,** power supply module **20** is held by handle **48** and hook member **44** is engaged with pivot plate **46** of central processor **22.** In this way, most of the weight of power supply module **20** is supported by central processor **22** and the surface upon which it is securely mounted. With the top of power supply module **20** securely engaged with central processor **22** and substantially all of the weight of module **20** supported thereby, power supply module **20** is easily advanced towards adjusting shelf **32** of central processor **22.**

Once power supply module **20** has been pivotably engaged with central processor **22,** with the fixed pivot point being located by the contact between hook member **44** and pivot plate **46,** power supply module **20** is easily advanced towards interconnection with central processor **22.** Alignment shelf **32** incorporates a downturned edge **50** which provides a ramp-like surface for precise adjustment fin **42.** In this manner, as alignment fin **42** contacts downturned surface **50** of shelf **32,** fin **42** engages surface **50** and advances up this ramp surface onto shelf **32** until seated in the final interconnecting position, as shown in FIG. **4.** In this way, by accurately positioning fin **42** on shelf **32,** precise and extremely accurate pin interconnections are assured.

Once power supply module **20** has been positioned in its desired exact location for interconnection with central processor **22,** knob **24** is rotated until the cut-out portion **27** is aligned with power switch **26.** As shown in FIG. **4,** central processor **22** incorporates a slot **30,** which accommodates both shaft **36** and its integrally attached latching plate **38.** When knob **24** is rotated, shaft **36** and plate **32** are also rotated and plate **32** is moved out of alignment with slot **30.** In this way, power supply module **20** is integrally locked with central processor **22,** assuring that unwanted removal or attempted removal of power supply module **20** from central processor **22** cannot be achieved.

Once power supply module **20** has been mounted to central processor **22** and pin assemblies **34** and **28** are in intimate contact with each other, power switch **26** can be moved from the OFF position shown in FIG. **4** with solid lines, to the ON position represented by phantom position **54.** In the preferred embodiment, switch **26** comprises a rocker switch which is cooperatively associated with cut-out portion **27** of knob **24.**

In the preferred embodiment, pins **52** of pin assemblies **28** and **34** comprise the type of interconnecting pins in which the contacts do not touch when the pins mate and are subsequently mated upon desired actuation. By using this type of contact pins, power supply module **20** can be properly positioned with central processor **22,** having contact pins **52** mating with each other without having the contact points of the pins touching until so desired.

The preferred pin assemblies are manufactured by I.T.T. Cannon Electric under their "Instamate DL" series of rectangular connectors. This type of connector is particularly applicable since it employs the rotation of a shaft to actuate the contacts from the non-touching

position shown in FIG. 5 to the touching position shown in FIG. 6.

Consequently, power supply module 20 can be properly positioned with pins 52 mating, but not in contact, until control knob 24 is rotated into the desired position with cut-out position 27 properly aligned with power switch 26. Since the rotation of control knob 24 not only assures the interlock of power supply module 20 with central processor 22, but also assures positive contact between mating pins 52, the installed unit is ready for operation and for having power switch 26 moved from the OFF position to the ON position.

By employing the interlock system of this invention, it is assured that any module connected to the central processor 22, such as power supply module 20 or a reprogrammable module having the similar configuration as module 20, but serving a different function, will be completely and accurately positioned and interconnected to central processor 22 without having any electrical power on contact pins 52 when mating contact is achieved.

A further power-prevent safety feature achieved by the interlock system of this invention is provided by the fact that in order to insert shaft 36 into recess 30 of central processor 22, shaft 36 must be oriented with latching plate 38 facing downwardly. In order to achieve this position, power switch 26 must be in the OFF position so that control knob 24 can be rotated into the proper position with latching plate 38 in the desired orientation. As a result, the elimination of power is assured when the mating of pins 52 is accomplished, since if plate 38 is in any other position the units will not be mateable. Then, by rotating knob 24 to the desired position with cut-out portion 27 properly aligned with power switch 26, causing the interlocking of module 20 with central processor 22 and the actuation of contact between the contact points of pins 52, the unit is ready for operation and the movement of switch 26 to the ON position.

In order to disconnect power supply module 20 from central processor 22, power switch 26 must be moved to the OFF position, shown by the solid lines in FIG. 4, and control knob 24 is then rotated to the position which will allow latching plate 38 to be aligned with slot 30 for disengagement of module 20 from central processor 22. In this way, the power-protect interlock system of this invention assures that disconnection of module 20 from central processor 22 will only be achieved when power is NOT supplied to pins 52.

By employing the power-protect interlock system of this invention, complete assurance is provided that two units will be interconnected and have pins mated and interconnected when power is not applied to the pins. Complete assurance is provided that power will be supplied only when desired. Similarly, disconnection of one unit from another cannot be achieved while power is on and supplied to the interconnecting pins.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A power-protect interlock system for interconnecting two units comprising:
   - A. a first unit incorporating
     - a) a pin-receiving assembly, and
     - b) a latch-receiving member; and
   - B. a second unit interconnectible with a power source and comprising
     - a) a pin-connection assembly positioned for interconnection with said pinreceiving assembly,
     - b) a movable latch positioned for locking interconnection with said latch-receiving member of said first unit,
     - c) a power switch having a power-on position and a power-off position, and
     - d) a knob
       1) incorporating latch connecting means for controlled movement of said movable latch,
       2) movable from a first latch open position to a second latch closed position, and
       3) positioned for cooperative interaction with said power switch to prevent movement of said power switch when said knob is in its first position and to prevent movement of said knob when said power switch is in its ON position; whereby said pin assemblies are exposed to power only when interconnected.

2. The power-protect interlock system defined in claim 1, wherein said first unit is further defined as being mountable to an existing support structure and incorporates a pivot plate, and said second unit is further defined as incorporating a hook member engageable with said pivot plate to support substantially the entire weight of said second unit and provide a pivot location for easy maneuverability of said second unit into engagement with said first unit.

3. The power-protect interlock system defined in claim 2, wherein said first unit is further defined as comprising an alignment shelf extending therefrom, and the second unit is further defined as comprising an alignment fin positioned for sliding engagement and cooperative association with said shelf to accurately position and precisely align said pin-connection assembly with said pin-receiving assembly.

4. The power-protect interlock system defined in claim 1, wherein said movable latch comprises a rotatable shaft incorporating a latching plate at one end thereof and said latch-receiving member of said first unit comprises a latching plate incorporating a slotted groove for entrance of said shaft and latching plate in only one orientation and locking engagement therewith when said latching plate is in any other orientation.

5. The power-protect interlock system defined in claim 1, wherein said power switch is a rocker switch and said knob incorporates a diametrically positioned cut-out portion cooperatively aligned with said rocker switch to allow manipulation thereof only when said cut-out portion is aligned therewith, whereby when said rocker switch is in the OFF position said knob is freely movable, and when said rocker switch is in the ON position said cut-out portion must be aligned with rocker switch and said knob is not movable.

6. The power-protect interlock system defined in claim 1, wherein said pin-connection assembly of said second unit is

1) engageable with said pin-receiving assembly of said first unit, and

2) responsive to movement of said knob to said second latch closed position for closing the contact points between said pin-connection assembly and said pin-receiving assembly.

* * * * *