AN INTERLOCKING SYSTEM AND METHOD FOR CONNECTING AN AUTOMATION CONTROLLER AND A PROGRAMMABLE MODULE

BACKGROUND

[0001] The invention relates generally to industrial automation and control systems, such as those used in industrial and commercial settings. More particularly, embodiments of the present invention relate to techniques for interlocking programmable modules with automation controllers of such systems.

[0002] Industrial automation and control systems are used for controlling factory automation and the like. Such systems include various components, such as programmable logic controllers (PLCs), semiconductor power electronic circuits, power supplies, motor starters, relays, and so forth, that are utilized to monitor and control a process or system. Typically, the PLC examines a series of inputs reflecting the status of a controlled process and changes outputs affecting control of the controlled process.

[0003] In traditional automation and control systems, various components of the system are interconnected together as modules. Certain components cooperate with other components to expand functionality. For example, industrial automation controllers may provide for connection of additional input/output (I/O) modules to add input and output functionality to such controllers. Indeed, adding an I/O module may allow a particular controller to interface with a specific type of control equipment. In such systems, the components or modules are connected using interlocking systems that utilize numerous mechanical parts for locking the modules together. It is now recognized that the mechanical parts of such interlocking systems can be cumbersome, delicate, and expensive. Furthermore, it is now recognized that the complex nature of such systems typically creates inefficiencies during assembly of components. In addition, such systems may not remain connected in response to vibration, shock, or similar forces. Accordingly, it is now recognized that it is desirable to develop an interlocking system

for securing modules that provides a rigid connection between the modules while facilitating assembly.

BRIEF DESCRIPTION

[0004] In one aspect of the present invention~~embodiment~~, an interlocking system for connecting a programmable module and an automation controller of an industrial control and automation system is provided. The interlocking system includes a key comprising a shaft with a head on a first distal end of the shaft and a first attachment feature cantilevered from a second distal end of the shaft. The interlocking system also includes a first keyhole in a cover of the programmable module. The first keyhole is configured to enable the head to pass upwardly there through. The interlocking system also includes a second keyhole in a cover of the automation controller. The second keyhole is configured to enable the first attachment feature to slide downwardly there through such that axial rotation of the shaft causes the first attachment feature to become misaligned with the second keyhole and abut a lower surface of the cover of the automation controller such that disengagement of the key from the second keyhole is resisted. The interlocking system also includes a second attachment feature on a lower surface of the cover of the automation controller. The second attachment feature is configured to engage with the first attachment feature when the first attachment feature is rotated about an axis of the shaft and the engagement between the first and second attachment features maintains the first attachment feature in misalignment with the second keyhole.

[0005] In another aspect of the present invention~~embodiment~~, an industrial automation and control system is provided. The industrial automation and control system includes a plurality of monitoring and/or control modules configured to perform a monitoring and/or control function, and an interlocking system configured to connect adjacent monitoring and/or control modules. The interlocking system includes a key comprising a shaft with a head on a first distal end of the shaft and a first attachment feature cantilevered from a second distal end of the shaft, and a first keyhole in a first module. The first keyhole is configured to enable the head to pass upwardly there through. The interlocking system

also includes a second keyhole in a second module. The second keyhole is configured to enable the first attachment feature to slide downwardly there through such that axial rotation of the shaft causes the first attachment feature to become misaligned with the second keyhole and abut a lower surface of the second module such that disengagement of the key from the second keyhole is resisted. The interlocking system also includes a second attachment feature on a lower surface of the second module. The second attachment feature is configured to engage with the first attachment feature when the first attachment feature is rotated about an axis of the shaft and the engagement between the first and second attachment features maintains the first attachment feature in misalignment with the second keyhole.

[0006] In yet another aspect of the present invention~~embodiment~~, a method for connecting a programmable module to an automation controller is provided. The method includes passing a head of a key upwardly through a first keyhole in a cover of the programmable module. The head is located on a first distal end of a shaft of the key. The method also includes abutting a mating surface of the cover of the programmable module with a mating surface of a cover of an automation controller such that the first keyhole aligns with a second keyhole in the cover of the automation controller, passing a first attachment feature cantilevered from a second distal end of the shaft downwardly through the second keyhole, axially rotating the shaft to cause the first attachment feature to become misaligned with the second keyhole and abut a lower surface of the cover of the automation controller such that disengagement of the key from the second keyhole is resisted, wherein axially rotating the shaft causes coupling between a second attachment feature on a lower surface of the cover of the automation controller with the first attachment feature such that the coupling between the first and second attachment features maintains the first attachment feature in misalignment with the second keyhole.