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LOCKING ELECTRICAL CONNECTOR

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Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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LOCKING ELECTRICAL CONNECTOR
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ABSTRACT OF THE DISCLOSURE
A rotatable electrical connector cap having supplementary locking means in the form of a retractable locking pin normally extendable outwardly from the face of the connector to and having retracting means in the form of a reciprocable annular sleeve encircling the connector cap, which may be manually grasped to retract the locking pin, to rotate the connector cap and to draw it axially from the mating connector body.

BACKGROUND OF THE INVENTION
This invention relates to a locking electrical connector and, more particularly, to a connector of the type wherein a separable connector cap is rotatable relative to a receptacle or a connector body and in which supplementary locking means are provided to prevent reverse rotation and uncoupling of the connector.

Rotatably locking separable electrical connectors are well known in the art. In a connector of this type, the end face of the usual receptacle or connector body defines a plurality of arcuate slots which are arranged about a common center and communicate with internally formed chambers enclosing the female contacts. The separable cap portion of the connector carries a plurality of axially extending L-shaped blades which are also positioned about a common center. To mate the cap and receptacle, the blades are inserted into the corresponding arcuate slots and into the female contacts. The cap is then rotated in a clockwise direction, the blades remaining within the female contacts and the circumferentially extending portions of the L-shaped blades become misaligned with the slots and extend behind the face of the receptacle. It is then impossible to separate the cap from the receptacle by a direct axial pull. To separate the two members the cap must be rotated counterclockwise relative to the receptacle body to realign the blades and slots before withdrawal.

Although rotatably locking electrical connectors are widely and successfully used throughout the electrical industry, it would be desirable to provide a connector having an even more positive locking means. This is particularly true where the connectors are used in certain industrial applications where they may be subjected to considerable vibration. It is possible under such circumstances for the cap to be vibrated counterclockwise relatively to the receptacle so that they become unlocked from one another.

In the copending application of Harvey Hubbell, Ser. No. 515,596, filed Dec. 22, 1965, now U.S. Patent 3,393,395 assigned to the same assignee as the instant application, there are illustrated several embodiments of locking mechanisms which may be incorporated in a locking electrical connector. These embodiments each comprise a connector cap having a spring biased retractable latch pin arranged to move a reciprocable locking aperture defined in a connector body after the connector components have been rotated relative to one another.

SUMMARY OF THE INVENTION
It is the primary object of this invention to provide a rotatable locking electrical connector cap having supplementary locking means and which may be used with standard receptacles and connector bodies.

Another object of this invention is to provide a rotatably locking electrical connector cap and receptacle having a latch pin and latch pin retracting means in the form of an annular sleeve which may be grasped when handling the cap. A further object is to provide a connector cap of the type described which is neat in appearance, and is inexpensive to manufacture.

To accomplish these objects, in one form we have provided a rotatably locking electrical connector cap with retractable locking means normally extending beyond the face of the cap positioned to enter a slot in a standard mating connector component upon rotation of the connector cap, and reciprocable annular retracting means encircling the connector cap and secured thereto for manually grasping the connector cap, retracting the locking means, rotating the connector cap and removing the connector cap from the mating connector component.

BRIEF DESCRIPTION OF THE DRAWING
Other objects and further details of that which we believe to be novel and our invention will be clear from the following description and claims taken with the accompanying drawings, wherein:

FIG. 1 is a side elevational view of an electrical connector cap and a standard receptacle shown in a separated condition;

FIG. 2 is a partial sectional view taken substantially along the line 2—2 of FIG. 1 showing the latch pin retracting means;

FIG. 3 is a front elevational view of the receptacle shown with the blades of the connector cap inserted into the slots thereof prior to being rotated, the latch pin bearing on the planar end wall of the receptacle;,

FIG. 4 is a front elevational view of the receptacle similar to that of FIG. 3, showing the blades of the connector cap in their rotated position with the latch pin disposed in the grounding slot of the receptacle;

FIG. 5 is a sectional view taken substantially along line 5—5 of FIG. 2 with the connector cap and receptacle in the same relationship as shown in FIG. 4; and

FIG. 6 is a sectional view similar to that of FIG. 5 showing the annular sleeve having been retracted to draw the latch pin from the receptacle slot.

DESCRIPTION OF THE PREFERRED EMBODIMENT
With particular reference to the drawing, there is illustrated a standard receptacle 10 having a mounting strap 12 for securement to a usual wall box. It should be understood that, although a receptacle has been shown, a standard connector body may be substituted therefor throughout this description. The receptacle body is made of a suitable plastic insulating material and includes a planar face 14 defining a plurality of slots 16 therein, each describing an arc segment of a common circle. The slots communicate with usual internal chambers which house suitable female contacts in a known manner. Binding head terminal screws 18 (only two of which are shown in FIG. 1) electrically connected to the female contacts are arranged to receive electrical current carrying wires from a power source. As the internal construction of the receptacle is conventional, it is not illustrated nor is it discussed in great detail.

In FIG. 1, our unique electrical connector cap 20 is shown separated from the receptacle 10 and aligned therewith. The embodiment of our connector cap, as herein disclosed, shows a cap having four contact blades 22, these being two line blades, a neutral blade and a grounding blade. Each blade has one of its ends embedded in the insulating material of the connector cap, while the
opposite end extends from the body and has the usual circumferentially extending overhanging portions 24 for locking the connector cap 20 in the receptacle in a known manner. The grounding blade 22G extending farthest from the planar face 26 of the connector cap, so that it may engage the female grounding contact of the receptacle before the other blades, thereby protecting the system, includes a radially inwardly extending keying portion 28. The body of the connector cap comprises a front insulation portion 30, a central insulation portion 32, a rear insulation portion 34 and a protective metal shell 36, the rear insulation portion and the metal shell being secured to the remaining portions by means of elongated securing screws 38. Blades 22 pass through the front insulation portion, being embedded in the central insulation portion wherein they are secured to usual contact terminals in a wiring area (not shown) defined between the central and rear insulation portions 32 and 34. The wiring area accepts the bare ends of a load cable 40 which engage the blade contact terminals. The load cable 40 passes through the metal shell 36 and rear insulation portion 34, being held in place and strain relieved by a cable clamp 42.

The front insulation portion 30 comprises an annular disc having a central axial opening 44, a radially outwardly extending flange 46 located at one end which is coextensive with its planar face 26, circumferentially spaced radially inwardly extending keyways 48 forming a splined cylindrical wall and a long narrow cavity 50 located between two of the keyways. A post 52 extending from one face of the central insulation portion 32, passes into the central axial opening 44 and is headed at 54 to secure the front insulation portion to the central insulation portion. It should be understood that the two portions 30 and 32 may be secured together in any other desired manner.

An annular sleeve 56 made of a suitable plastic insulating material is carried by and encircles the major portion of the connector cap 20, being axially movable relative thereto. The sleeve is formed with a double cylindrical wall including an interior wall 58 and an exterior outwardly flared wall 60 which define a circumferential channel 62 therebetween to receive the cylindrical side wall of the metal shell 36. Interior wall 58 lies adjacent the cylindrical outer surface of the insulation portions 30, 32 and 34. Extending radially inwardly from the interior wall at one end thereof are plural circumferentially spaced key portions 64 and a single tongue 66. The exterior flared wall 60 is formed with a knurled surface 68 to aid in grasping the connector cap. When the annular sleeve 56 is located upon the connector cap 20 the key portions 64 and the tongue 66 enter the keyways 48 and the long narrow cavity 50, respectively.

A bushing 70 made of a low friction plastic material may be positioned through the end wall of the front insulation portion over the narrow cavity 50 and is axially aligned with an opening 72 defined in the tongue 66. Latch pin 74 having a head 76 at one end passes through both the opening 72 and the bushing 70. A compression spring 78, disposed in a recessed seat 80 defined in the central insulation portion 32, bears against the head 76 to bias the latch pin 74 leftwardly (as viewed in FIGS. 5 and 6) urging it to protrude beyond the planar face 26 of the connector cap 20. The compression spring 78, located off center relative to the connector cap, adequately serves to bias the annular sleeve 56 leftwardly as shown in FIGS. 1 and 5. Cocking and binding of the annular sleeve are prevented because the keying portions 64 ride upon the splined front insulation portion. It should be apparent that the compression spring performs two functions: (1) it biases the annular sleeve 56 leftwardly; and (2) it biases the latch pin 74 leftwardly to allow it to move independently of the annular sleeve.

When in use, our unique connector cap 20 is handled in a manner similar to the usual rotate-to-lock connector caps. It is necessary first to align the blades 22 with the slots 16 of a standard receptacle 10 as illustrated in FIG. 1. It should be noted that the latch pin 74 protrudes from the planar face 26 of the connector cap. Then the blades 22 are inserted into the slots 16 until the planar face 26 is contiguous with the planar face 14 wherein the latch pin 74 is caused to be displaced into the connector cap with its end bearing against the planar face 14 of the receptacle 10 (see FIG. 3). The connector cap may be secured to the receptacle in the usual manner by rotation thereof. When the connector cap has been fully rotated, the latch pin 74 is aligned with the end of the grasping slot 16C and is urged into the area vacated by the rotated grounding blade 22G (see FIGS. 4 and 5). This effect a positive locking of the connector cap with the receptacle since the latch pin 74 prevents counter-rotation of the connector cap. When effecting coupling as described above, the annular sleeve 56 is grasped and is rotated in a manner similar to the handling of the usual connector cap, the keys 64 in the keyways 48 effectively transmitting the rotational force from the sleeve to the cap.

In order to disconnect the connector cap 20 and the receptacle 10, it is necessary to draw back the annular sleeve 56 to withdraw the latch pin 74 from through the slots formed in a mating connector device, said blades being of a size to be relatively rotatable in the slots; retracting sleeve means at least partially enclosing said insulating body and reciprocally axially movable relative thereto; interlocking means for substantially preventing rotation of said sleeve means relative to said insulating body; and retractable locking means normally extending beyond the face of the cap and positioned to enter one of said slots upon rotation of said connector cap, said locking means engaging said sleeve means for axial movement therewith.

2. The connector cap defined in claim 1 wherein said locking means comprises a pin reciprocably mounted in said body with one end captured therein and being biased outwardly of said body.

3. The connector cap defined in claim 1 wherein said sleeve means has a knurled, substantially cylindrical outer surface for assisting in manually grasping said connector cap.

4. The connector cap defined in claim 1 wherein said interlocking means includes plural circumferentially spaced axially extending keyways formed in said body and plural mating circumferentially spaced axially extending key portions formed on said sleeve means.
5. The connector cap defined in claim 4 wherein a spring biases said sleeve means toward the face of the cap.

6. The connector cap defined in claim 4 wherein said locking means comprises a pin reciprocably mounted in said body with one end captured therein and a spring seated in said body to bias said pin outwardly of said body and said sleeve means toward the face of the cap.

7. A rotatable electrical connector cap comprising: an insulating body; a plurality of elongated contact blades secured in said body for selective insertion into and through the slots formed in a mating connector device, said blades being of a size to be relatively rotatable in the slots; retracting means at least partially enclosing said insulating body and reciprocably axially movably relative thereto; interlocking means including an axially and radially inwardly extending recess formed in said body, and a mating radially inwardly extending tongue formed on said retracting means positioned to enter said recess for substantially preventing rotation of said retracting means relative to said insulating body; and retractable locking means normally extending beyond the face of the cap and positioned to enter one of said slots upon rotation of said connector cap, said locking means engaging said retracting means for axial movement therewith.

8. The connector cap defined in claim 7 wherein said locking means comprises: a pin reciprocably mounted relative to said body and said tongue and carried by said tongue; and a spring seated in said body biasing said pin outwardly of said body.

9. A rotatable electrical connector cap comprising: an insulating body; a plurality of elongated contact blades secured in said body for selective insertion into and through the slots formed in a mating connector device, said blades being of a size to be relatively rotatable in the slots; a cup-shaped protective shell having a planar end wall and a cylindrical skirt secured to the insulating body; retracting means at least partially enclosing said insulating body and reciprocably axially movably relative thereto and including a sleeve defining a circumferential channel at one end positioned to receive said cylindrical skirt; interlocking means for substantially preventing rotation of said retracting means relative to said insulating body; and retractable locking means normally extending beyond the face of the cap and positioned to enter one of said slots upon rotation of said connector cap, said locking means engaging said retracting means for axial movement therewith.

10. A rotatable electrical connector cap comprising: an insulating body; a plurality of elongated contact blades secured in said body for selective insertion into and through the slots formed in a mating connector device, said blades being of a size to be relatively rotatable in the slots; retracting means including a spring biased sleeve at least partially enclosing said insulating body and reciprocably axially movably relative thereto and having a knurled, substantially cylindrical outer surface for assisting in manual grasping of the connector cap; interlocking means for substantially preventing rotation of said retracting means relative to said insulating body including plural circumferentially spaced axially extending keyways and an axially and radially inwardly extending recess formed in said body, and plural mating circumferentially spaced axially extending key portions and a radially inwardly extending tongue formed on the inner surface of said sleeve; a pin normally extending beyond the face of the cap and reciprocably mounted relative to said body and said tongue and carried by said tongue for axial movement therewith and positioned to enter one of said slots upon rotation of said connector cap; and a spring seated in said body to bias said pin outwardly of said body and said sleeve toward the face of the connector cap.

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