This invention relates to a plug contactor of the type plugged into a receptacle to establish an electrical circuit path.

The contactor of the present invention is more particularly related to the type of device which is adapted to be latched within a receptacle such as the aperture of a plugboard against accidental displacement and to be locked therein against being pushed therefrom. A number of prior art devices have been developed for this general function having rather different operating features; examples being shown in U.S. Patents Nos. 3,134,633, 3,008,118, and 2,779,929. While devices described in these patents have been generally satisfactory in use, each has a requirement of relatively complicated assembly procedure and close tolerance parts.

It is an object of the invention to provide a contactor having a locking and latching mechanism which lends itself to ease of manufacture and assembly with relatively loose tolerance components.

It is a further object of the invention to provide a latching and locking contactor featuring a novel torsional spring action.

It is yet another object of the invention to provide an improved spring construction for accomplishing a latching function within a contactor or like device.

It is still another object to provide a one-piece locking and latching contactor or like device.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention, but are given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:
FIGURE 1 is a fragmentary longitudinal section of the contactor including the components of one embodiment of the invention in an assembled form;
FIGURE 2 is an end-on view partially sectioned showing the details of the contactor of FIGURE 1;
FIGURES 3a and 3b are respectively, end-on and perspective views of an alternative embodiment of the spring member for use in a contactor like that of FIGURE 1;
FIGURES 4a and 4b are respectively end-on and perspective views of a further embodiment of a spring member for use in a contactor of the type shown in FIGURE 1;
FIGURE 5 is a longitudinal section of the contactor of the invention showing a spring member similar to that of FIGURES 1–3 but of different material;
FIGURE 6 is a view of the spring member shown in FIGURE 5;
FIGURES 7a and 7b are end-on and perspective views, respectively, of an alternative spring construction similar to that of FIGURES 3a and 3b but of a different material;
FIGURES 8a and 8b are end-on and perspective views of a spring construction similar to that of FIGURES 4a and 4b but of a different material;
FIGURE 9 is a fragmentary longitudinal section of a one-piece embodiment of the contactor of the invention;
FIGURE 10 is a perspective of the spring of FIGURE 9; and
FIGURE 11 is a perspective of an alternative version of the spring employed in the contactor of FIGURE 9.

Turning now to FIGURE 1 the contactor 10 includes connecting a wire lead 12, a plastic insulating boot member 14 adapted to facilitate handling of the contactor and a forward barrel portion 20 adapted to fit within an aperture or receptacle and to carry a conductive path to the forward end thereof from the conductive strands of the core of lead 12. The contactor upon being plugged into an aperture or receptacle is used to engage a spring member connected to another lead and in standard fashion form a completed path for an electrical circuit. The barrel member 20 includes proximate the end thereof within boot 14, a ferrule portion 20a crimped or otherwise terminated to the conductive strands of lead 12 and integral therewith a portion 20b which tapers outwardly to a diameter larger than the diameter of the aperture or which the contactor is used. This serves to define a transverse face 20c leading to a portion of reduced diameter 20d which extends forwardly thereof and serves to support the contactor relative to the walls of the aperture or receptacle in which the device is used. At the forward end of 20d is an aperture struck in the side wall thereof, such aperture being shown as 20e. The aperture 20e is in length sufficient to permit a detent member to protrude therefrom and extends radially in the manner shown in FIGURE 2 about an arc of the surface of 20d for purposes to be described.

Forwardly of aperture 20e is a tapered transition portion 20f which leads to a nose portion 20g of substantially reduced diameter, such nose portion being terminated in a beveled or rounded end portion 20h. The nose portion 20g serves as the principal contact path for the contactor thus carrying signals from the strands of the core of lead 12 through the crimp or termination point within 20a along the barrel to the surface of 20g. 20g is normally engaged by a spring member in the receptacle or aperture of the device in which the contactor is used. The bevel 20h serves to prevent sharp edges from scratching or otherwise abrading gold or other plating employed on the opposing contact spring. Carried within barrel 20 is a spring member 22 having at one end a detent 22a which is curved in its forward axial sense and in a rearward axial sense to engage the edges of the aperture or receptacle in which the contactor is used and to cam there-
against to develop a radially inwardly directed force to operate the spring member. Preferably the outer surface of 22a is rounded radially as shown in FIGURE 2 to prevent sharp edges from damaging the receptacle in which the device is used by abrasion, scratching or chipping such. The detent 22a is supported and carried by an arm 22b which intersects the plane of 22a as indicated in FIGURE 2. The spring arm 22e extends in a generally a spring arm 22e. Within the arm 22b is a depression struck inwardly and indicated as 22c, which serves as a block to limit the inward travel of a nose member 24 wherein the arm 22e is in the outwardly extended position as shown in FIGURE 2. The spring arm 22e extends in a generally axial sense back along the contaminator barrel 20d and joins a mounting ring 22f which has an outer configuration such as to fit under spring pressure against the inner axial surface of barrel portion 20b and against the inner surface of the radial flange surface of 20c. This permits the spring member 22 to be inserted from the rear end of the barrel prior to the closure of the fowel portion 20a, the member 20b being closed or compressed to snap outwardly and be locked within the barrel thereby.

Positioned within nose portion 20g is a nose member 24 having a radially inwardly rounded end 24c and a head end 24d at the opposite end shown as 24b, which has been beveled and cammed surface 24c. The diameter of head 24b at its greatest excursion is such that in axial movement the member 24 will be blocked by 22e against being displaced down within barrel portion 20b. As indicated the dimension of the member 24 is such as to permit it to slide axially along and within 20g. A force applied to end 24a will operate to drive 24 inwardly such that the surface 24c will engage the arm 22b and particularly the depression 22c and cam 22d against to hold the arm outwardly, thus holding detent 22e outwardly and preventing the contaminator from being pushed out of the receptacle or plugboard aperture in which the device is used.

During the insertion or withdrawal of the contaminator from a receptacle, the outer surfaces of 22a operate against the edges, forward and rear, of the receptacle to be tampered inwardly, the inward movement being unrestricted by 24 which has axial clearance to be displaced forwardly if engaged by the surface of 22c.

The position of the arm 22b, detent 22a and spring 22e is such, relative to the central longitudinal axis of 20, as to provide a loading action which twists the arm 22e and drives such in a torsional manner. Spring 22e thus becomes a torsion spring being held against movement at the end opposite to 22b by the support 22f which cannot turn against the body of 20. At the contaminator is inserted or withdrawn into a receptacle then, the forces engaging the outer surface of 22a will operate to drive the spring inwardly and 22e will be loaded in a torsional fashion with the arm 22b twisting such spring as it moves to the position shown in dotted outline in FIGURE 2. The annular disposition and length of aperture 20e is such as to permit the rotation in a radial sense of 22a and 22b, with the result that 22a is driven downward within the outer surface of 20 to permit the contaminator to be freely withdrawn or inserted.

It is contemplated that the member 22 may be made of any suitable spring material, such as steel, or brass, beryllium copper, Phosphor bronze, stamped and formed to the configuration shown and hardened by drawing to a proper temper for the spring characteristics desired. The torsion rod principle is generally well-known in mechanics to supply a defined spring action of long life and reliability. The spring characteristics within a given material can be further regulated by an appropriate choice of the width and length of 22e.

In FIGURES 3a and 3b an alternative version of the spring member of the invention is shown to include a double detent feature and such may be used with a contaminator having a barrel 20 and a nose member 24 substantially identical to that shown in FIGURE 1; with only the addition of a further aperture such as 20e, located opposite to that shown in FIGURE 1 to accommodate the additional detent member. The spring member of the alternative embodiment is shown as 32 and includes an upper member having a detent 32a carried by an arm 32b having an inner depression 32c, all supported by torsion spring 32d which extends rearwardly to a mounting portion 32e. A upper member 32b is closely tolerated or slot 32f which serves to position 32b in contact with support portion 32e, which is in effect C-shaped, to be closed down in compression during insertion within the contaminator and further permits or assures a proper operation of the torsion arms without undue limitation from the spring arm support portion 32e. The lower and upper edges of the spring arms 32d and 32e bear against each other in use of the spring member of FIGURE 5 and the springs then tend to essentially line the contact between the two spring arms. In the spring relaxed state which is shown in FIGURE 3a, the diameter of the head of 24 is such as to engage and be blocked from rearward travel by the depressions 32c and 32d and head end 24d as shown in FIGURE 1.

A further alternative spring embodiment is shown in FIGURES 4a and 4b wherein a spring member 42 includes a first spring arm which is normally positioned on one side of the barrel of a connector body such as 20 to support a detent 42c carried by an arm 42b having a cone-shaped flared-in portion 42c and a spring member 42d. The spring member is formed previously with the detents 42a and 42b being driven inwardly during insertion to load springs in torsion. The portions 42c and 42d serve to engage 42c to provide a locking action.

Referring now to FIGURES 5-8b there is shown as part of the invention an alternative spring construction similar in use to the embodiments of FIGURES 1-3b, respectively, but drawn particularly to a spring version which employs wire rather than that of a stamping. In FIGURE 5 the features of 12, 14, 20 and 24 are substantially the same and a spring shown as 52 is secured therein as in FIGURE 1. Spring 52 includes a headed detent 52a carried by an arm 52b and a spring arm 52d carried by a mounting portion 52e, mounting itself a C-shaped spring. The detent 52a is preferably integrally formed on the wire by a standard heading technique and has the generally spherical configuration shown to define an outer curved surface to operate with respect to insertion and withdrawal in a fashion identical to that of detent 22a shown in FIGURE 6. The surface of 52b is as indicated in FIGURES 5 and 6, disposed to cooperate with the rear face of a nose member 24 to provide the locking feature. FIGURE 6 shows the movement of 52a and 52b to permit contaminator insertion and withdrawal.

FIGURES 7a and 7b show a version adapted for the use of a wire spring material wherein a spring construction 62 includes an upper detent 62a carried by a support 62b, a torsion spring arm 62d and a support spring 62e which supports a similar but oppositely oriented spring arm having a detent 62 and other similar portions. The external spring portions of spring arms 62d and 62f is a slightly relieved portion 62g, which permits the support 62 to itself operate in a spring fashion to be snapped within contaminator barrel 20, as is 52e in FIGURE 5. In operation the detents 62a and 62b are driven inwardly to load the spring arm 62d and 62f in torsion. A pushing force will, as in the above embodiment, slide the head of a nose member 24 inwardly to block the inward radial travel of detents 62a and 62b.

FIGURES 8a and 8b show yet a further version including a spring member construction 72 having a detent 72a.
supported by an arm 72b and a torsion spring 72d carried by a support 72e which, on the side opposite to 72f, supports a further spring arm 72d' having a detent 72a'. The detent supports 72b and 72b' are oppositely oriented and slightly curved, such that upon insertion or withdrawal of the contact the detents are driven inwardly to load the respective spring arms torsionally and upon said inward movement of 24 be locked to lock 72a and 72a' outwardly.

Turning now to a further aspect of the invention, FIGURES 9-11 show versions of a contactor employing a one-piece spring construction adapted to provide a latching and locking function. In FIGURE 9 the barrel 20 is identical to that described relative to FIGURE 1 to terminate a lead 12 in a boot 14. The spring member shown in FIGURES 9 and 10 as 82 includes a detent 82a supported by an arm 82b curved radially back along the interior of the barrel to join a spring arm 82f which is joined to a support 82e formed outwardly to rest in the recess within 24c. Support 82e curves around within the recess to a reduced portion 82f which forms a cord relative to the barrel interior and extends across to a position short of entering the barrel recess. There, portion 82f bends again to extend back forwardly along the barrel interior in a further portion 82g, which then bends to extend out through the contactor in a portion 122, suitably rounded as at 82i. The portion 82f forms a spring adapted for movement as indicated by the dotted lines to permit an axial travel of 82f, 82g upon forces being applied to 82i. The relaxed position of 82h is such as to permit an inward disposition of 82h radially to load torsion arm 82f and provide the contactor latching feature. The displaced position of 82h which loads 82f is such as to block the inward movement of 82a and provide the contactor locking feature.

The spring 82 is of the wire type previously described. FIGURE 11 shows a spring construction 92 adapted for stamping as described relative to the embodiments of FIGURES 1-3a. The detent 92a, support 92b, spring arm 92d, support 92e, portions 92f, 92g, 92h and 92i are for an identical function to that of the embodiment of FIGURES 9 and 10.

In both of the embodiments shown in FIGURES 10 and 11 the axial spring motion or ‘give’ is provided proximate the support. It is contemplated that by thinning and bowing a portion along 82g and 92g an alternative or additional axial spring motion can be provided.

In the foregoing embodiments the relative proportions of the contactor as shown in FIGURES 1, 5 and 9 are carried by other diameter of said barrel and whereas upward the said barrel being driven inwardly said support will load said member in torsion to provide a radial bias to said detent.

The contactor of claim 6 wherein said barrel includes a further portion on said center axis supporting a nose member which extends therefrom to receive forces applied to the end of the contactor, the said member being of a configuration to slide axially in said further portion and including a head adapted to engage said latch means to block inward movement of said detent to lock said contactor from being pushed from said receptacle.

A contactor for insertion within a receptacle, comprising a barrel of a configuration to slidingly fit with the receptacle, a latching means secured in said barrel including a detent extending through an aperture therein to a point of engagement with an edge of the receptacle, a torsion spring fixed at said rearward end against rotation and extending along said barrel toward said forward end and including a crank arm connecting block inward to said detent and operable to bias said detent outwardly through said aperture to latch said contactor within the receptacle against axial movement.

The contactor of claim 1 wherein there is included a further latching means secured in said barrel including a further detent extending through an aperture therein to a point of engagement with an edge of the receptacle, a further torsion spring fixed at one end against rotation and having a further portion spaced therefrom linked to said further detent to bias said detent outwardly whereby to latch said contactor within the receptacle against axial movement.

The contactor of claim 2 wherein the said torsion springs are spaced apart and said portions are oriented to effect a commonly directed loading of said springs as the said detents are driven inwardly.

The contactor of claim 2 wherein the said latching means are formed of one piece and include a common support having radial spring characteristics to fit into an enlarged bore of said barrel to hold said means against axial movement.

A contactor adapted for use within a receptacle, comprising a barrel with its center longitudinal axis extending in the sense of insertion or withdrawal of such contactor relative to said receptacle, a latching means secured in said barrel including a detent protruding upward an aperture in said barrel to engage receptacle edges and latch said contactor against axial displacement, a spring member extending along said barrel and fixed at one end, the other end being positioned apart from the longitudinal center axis and tied to a support carrying said detent, the said support being less in length than the said member of said barrel and whereby said detent being driven inwardly said support will load said member in torsion to provide a radial bias to said detent.

The contactor of claim 6 wherein said barrel includes a further portion on said center axis supporting a nose member which extends therefrom to receive forces applied to the end of the contactor, the said member being of a configuration to slide axially in said further portion and including a head adapted to engage said latch means to block inward movement of said detent to lock said contactor from being pushed from said receptacle.

A contactor for insertion within a receptacle, comprising a barrel of a configuration to slidingly fit with the receptacle, a latching means secured in said barrel including a detent extending through an aperture therein to a point of engagement with an edge of the receptacle, a torsion spring fixed at one end against rotation and extending along said barrel, said spring being free at the opposite end and having thereon a crank arm linked to said detent to bias said detent outwardly whereby to latch said contactor with the receptacle against axial movement, a locking means adapted for longitudinal movement to a point of engagement with said detent to block inward movement thereof to lock said contactor with the receptacle including spring means biasing said
locking means axially to a point of disengagement with said detent.

9. The contactor of claim 8 wherein said latching means and said locking means is of one piece.

10. A contactor adapted to be latched against withdrawal and locked against push-out of a receptacle including a barrel having a forward nose bored along the barrel longitudinal center axis, a latching and locking means including a spring member having a detent at one end driven by a torsion bar carrying a crank arm in turn carrying said detent with said torsion bar positioned to cause said detent arm to extend out of said barrel through an aperture therein to latch said contactor, a further spring member biasing a nose member formed on the other end of said means and forwardly to extend through said nose to receive axial forces and be driven thereby to a position to block said detent and lock said contactor.

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