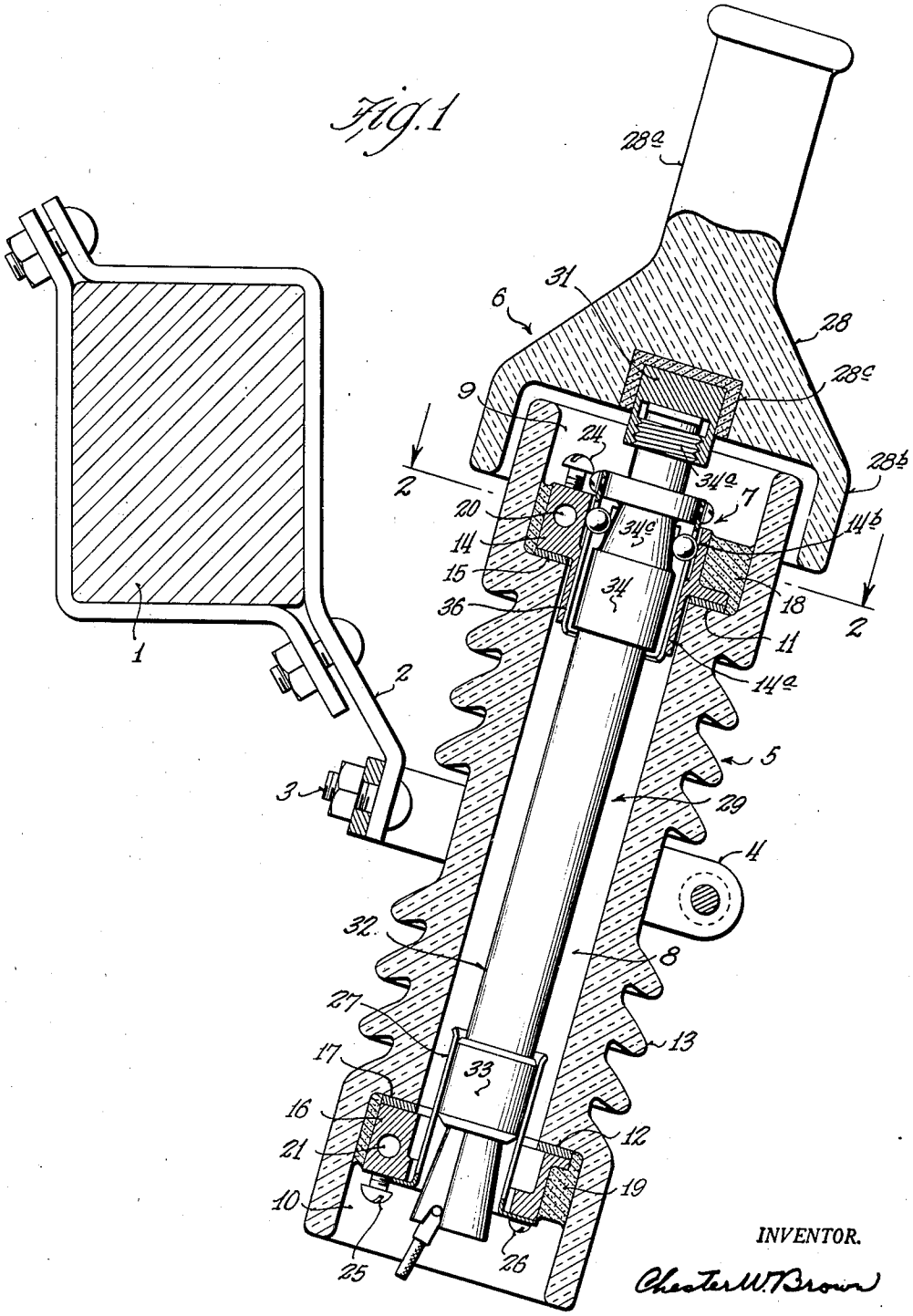
Jan. 8, 1946. C. W. BROWN 2,392,308

LOCK MECHANISM FOR ELECTRICAL EXPULSION DEVICES

Filed Nov. 21, 1942 2 Sheets-Sheet 1

Fig. 1



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LOCK MECHANISM FOR ELECTRICAL EXPULSION DEVICES

Filed Nov. 21, 1942 2 Sheets-Sheet 2

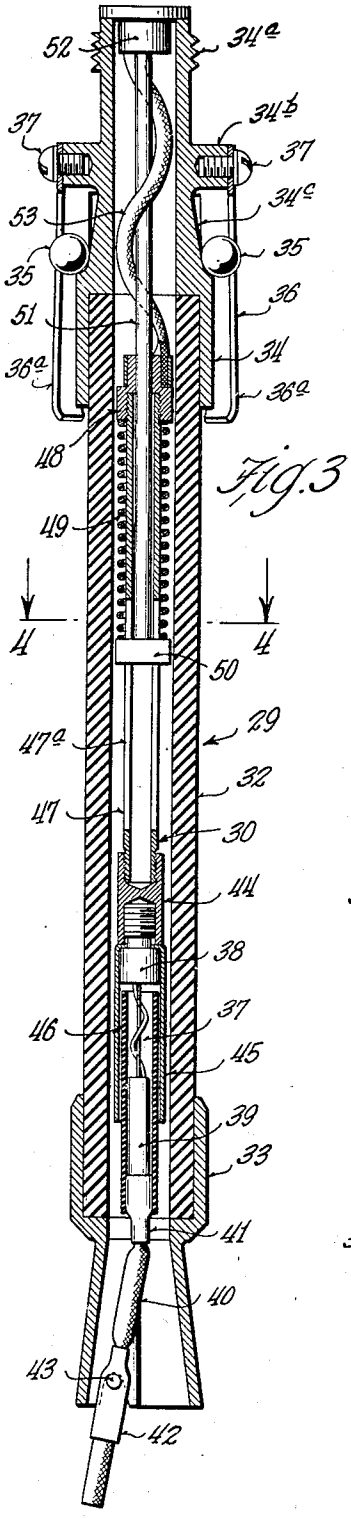


Fig. 3

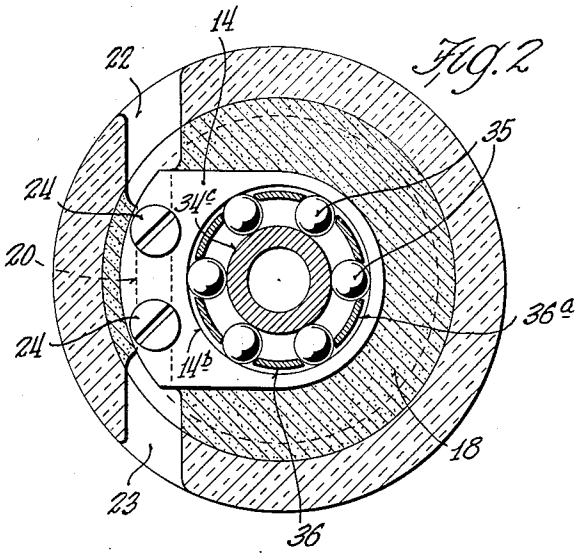


Fig. 2

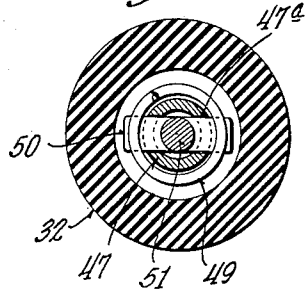


Fig. 4

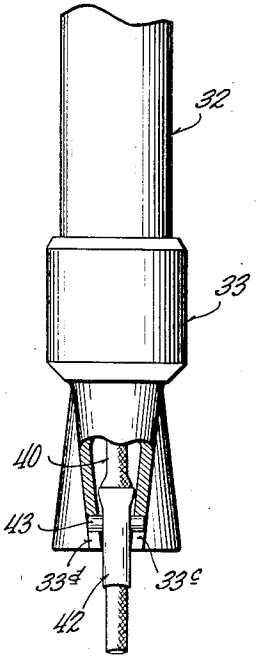


Fig. 5

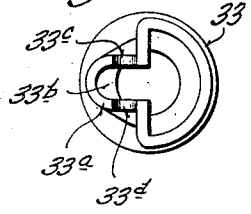


Fig. 6

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Patented Jan. 8, 1946

2,392,308

UNITED STATES PATENT OFFICE

2,392,308

LOCK MECHANISM FOR ELECTRICAL EXPULSION DEVICES

Chester W. Brown, Milwaukee, Wis., assignor to Line Material Company, Milwaukee, Wis., a corporation of Delaware

Application November 21, 1942, Serial No. 466,512

10 Claims. (Cl. 188—67)

This invention has to do with a mechanism designed more especially for use in conjunction with expulsion fuses and expulsion gaps of the bayonet type wherein the fuse unit or gap unit, as the case may be, is subjected to a considerable recoil force and must be secured against expulsion from the housing in which it normally is mounted—the recoil often being sufficient to expel the fuse unit or corresponding element with considerable violence, if it is not adequately secured.

Electrical protective devices of the character here dealt with are generally mounted near the ends of cross-arms where they can be reached by a lineman only with some considerable stretching; and for that reason it is important that the unit be capable of withdrawal from its housing with little difficulty, while at the same time it is even more essential that it be absolutely secure against expulsion when a violent blow-out occurs.

The primary object of the present invention is to provide a simple, rugged and inexpensive mechanism which will operate automatically and dependably to prevent expulsion of a fuse or gap unit in response to an explosive blow-out, and which at the same time renders the unit easily withdrawable manually.

The mechanism of the present invention is characterized, in its preferred embodiment, by the use of a plurality of steel or bronze balls which are forced into wedging engagement with the bore of a surrounding stationary member, in response to recoil force—actuation of the balls being accomplished by means of a tapered element forming a part of the withdrawable unit and which moves outwardly with the unit to a slight extent when an explosion occurs. Engagement of the balls with the bore of the stationary member immediately interrupts the outward movement of the unit, preventing expulsion thereof; but the unit can readily be withdrawn manually in response to a steadily applied pull (as distinguished from a violent yank) following or contemporaneously with a slight rotation which is effective to break the initial grip between the balls and the bore surface which they normally engage.

The subject matter of the present application is related to that of the copending application of William O. Schultz, Serial No. 467,121, filed November 27, 1942, entitled "Clutch and lock mechanism," and assigned to the same assignee.

While the drawings of the instant application are confined to the showing of a bayonet type expulsion fuse equipped with the mechanism of the present invention, those who are acquainted with the art of electrical protection will immediately apprehend that an expulsion gap could easily be substituted for the fuse link, and that it is immaterial to the operation of the subject mechanism whether the recoil force is due to the blowing of a fuse, the arcing of a gap, or some other cause.

In the drawings:

Fig. 1 is a vertical sectional view showing the preferred mechanism applied to a bayonet type expulsion fuse;

Fig. 2 is an enlarged cross-sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a longitudinal sectional view of the fuse cartridge and appurtenances forming a major portion of the fuse unit;

Fig. 4 is an enlarged sectional view taken along line 4—4 of Fig. 3;

Fig. 5 is an elevational view, partially in section, of the lower end of the fuse cartridge and illustrating the mode of attachment of the lower fuse-link terminal to the lower contact member on the cartridge.

Fig. 6 is a bottom plan view of the fuse cartridge shown in Fig. 3, with the fuse link removed.

Referring first to Fig. 1, it will be observed that the fuse structure is shown mounted on a cross-arm 1 by means of a clamp 2 which, in turn, is attached by a bolt 3 to a suitable band or strap 4 which embraces the mid-portion of the fuse housing in the usual manner.

The fuse structure shown is of the so-called bayonet type and its principal components are: a housing 5 and a fuse unit 6, which is withdrawable from the housing; and a lock mechanism 7 which constitutes the subject matter of the present invention.

Housing 5 is generally and preferably made of porcelain and is tubular in form, having a bore 8, enlarged at the two ends to form concentric recesses 9 and 10 and shoulders 11 and 12. The exterior of the housing is preferably formed with annular petticoats 13 which serve to increase the length of the leakage paths between terminals and between each line terminal and ground.

An upper terminal ring 14 is seated in recess 9, coaxially with bore 8, and spaced from shoulder 11 by a gasket 15. Similarly, a lower terminal ring 16 is seated in recess 10, coaxially with bore 8, and spaced from shoulder 12 by a gasket 17. Rings 14 and 16 are anchored in the housing by fillers 18 and 19 of cement or lead. Ring 14 is apertured transversely at 20 while ring 16 is simi-

larly apertured transversely at 21, in each case to receive terminals of a line in which the fuse is to be inserted. The housing is provided with transverse openings 22 and 23 registering with aperture 20 (see Fig. 2) and with additional similar openings (not shown) at its lower end registering with aperture 21. Binding screws 24 and 25 threaded respectively into rings 14 and 16 serve to firmly secure the line conductor terminals which enter apertures 20 and 21 through the aforementioned transverse openings in the housing. Rings 14 and 16 are spaced well apart lengthwise of the housing in order to obviate electrical flash-overs which might otherwise follow the blowing of a fuse; and the two rings are axially in alignment.

Secured to ring 16 by means of screws 26 is an inwardly and upwardly projecting socket-like tubular spring contact member 27 which is suitably split lengthwise through a portion of its length to afford lateral resiliency.

Upper ring 14 is bored at 14a to provide an internal contact surface, and is counterbored at 14b to provide a coaxial internal surface for engagement with the locking balls hereinafter described.

Fuse unit 6 includes a cap 28, generally of porcelain, and a cartridge 29 (see Fig. 3) which encloses a fuse-link 30. Cap 28 has a handle portion 28a and a diametrically enlarged skirt 28b which normally overlies the upper end of the housing and forms a closure to bar entry of rain and snow to the interior thereof.

Anchored to the cap, in a recess 28c formed therein, is a metal insert 31 having an internally threaded cavity for reception of the threaded upper end of the cartridge—the latter being detachable from the cap for the purpose of re-fusing the cartridge.

Cartridge 29 comprises an expulsion tube 32 which may be of horn fiber or, alternatively, some other suitable insulating material such as "Bakelite" lined with horn fiber or other material capable of evolving arc extinguishing gas or vapor when subjected to an arc—such materials being well known in the art. To the lower end of expulsion tube 32 is secured a tubular metal ferrule 33 which is designed for insertion into the socket-like tubular spring contact member 27 for effecting electrical connection therewith and thereby establishing a circuit between lower terminal ring 16 and the lower terminal of the fuse-link. Ferrule 33 preferably is downwardly flared at its lower end, as shown, in order to maintain a free passageway for discharge gases from the interior of the expulsion tube, notwithstanding a constriction along one side of said passageway which results from locally compressing the ferrule, as indicated at 33a in Fig. 6, to form a narrowed recess 33b for the reception of a fitting 42 attached to the fuse-link and referred to hereinafter in conjunction with the description of the fuse-link. Notches 33c and 33d are also formed in the locally compressed portion of the flare for the reception of a pin 43 which serves to anchor the lower end of the fuse-link and establish electrical contact between the fuse-link and ferrule 33.

To the upper end of expulsion cartridge 32 is secured a tubular metal ferrule 34 which is externally threaded at 34a for engagement with the internal thread of metal insert 31. Ferrule 34 has an external integral flange 34b, below which is turned a frustro-conically tapered external surface 34c of acute angularity and designed to function as a wedge for forcing steel or bronze balls 35 laterally into engagement with the bore surface 14b. Six such balls are shown in Fig. 2 spaced equally around the frustro-conical portion 34c and held in place by means of a tubular retainer 36 which is secured at its upper end to flange 34b, by means of screws 37. Retainer 36 is slotted longitudinally to form a plurality of depending resilient contact fingers 36a which pressingly engage bore surface 14a when the fuse unit is in place as exhibited in Fig. 1. Thus a firm electrical connection is established between upper terminal ring 14 and ferrule 34. The longitudinal slots which separate adjacent contact fingers 36a are wide enough to permit balls 35 to project through the retainer as shown, but are of substantially less width than the diametrical dimension of the balls, whereby to prevent the balls escaping from the retainer. The slots are widened for a short distance below the balls to permit insertion of the latter during assembly, but preferably are narrowed below said widened portion in order to obtain a maximum of contact area. The apertures in the retainer through which the balls project individually are proportioned to permit a limited movement of the balls axially of the fuse unit, wherefore the balls are susceptible of movement toward the small end of the taper into positions wherein they cannot be actuated by the frustro-conical portion into pressing engagement with bore 14b.

The balls are normally wedged lightly between bore surface 14b and frustro-conical surface 34c, and an abruptly applied force tending to withdraw the fuse unit from the housing will cause the balls to press forcibly against the bore surface, due to the wedging action of the frustro-cone, and the resultant greatly increased friction between balls and bore surface will serve to oppose and overcome the aforementioned force. The greater the force tending to expel the fuse unit, the greater will be the gripping action of the balls; and thus the reaction opposing expulsion of the fuse-unit is always equal to the expellant force, provided the angularity of the wedge is sufficiently acute. But a force applied gradually to the fuse unit in a direction to withdraw the same will not cause the balls to grippingly engage the bore surface, provided the fuse unit is rotated slightly as the withdrawing force is applied, and provided the angularity of the wedge is not excessively acute. I have found that an included angle of about twenty-four degrees is satisfactory. That is to say, an angle of twelve degrees on each side relatively to the longitudinal axis. Rotation of the fuse unit is not an invariable condition precedent to withdrawal thereof, but more often than not it is necessary in order to break the normally slight grip of the cone on the balls. Once this is broken by rotating the fuse unit, the latter is easily withdrawable in response to a steady pull applied gradually, but not in response to an abruptly applied force.

Fuse-link 30 is a self-contained replaceable unit comprising a fusible section 37 consisting of a fuse wire and a strain wire in parallel and designed to rupture in response to a fault current in excess of a predetermined limit. The upper end of the fusible section is connected to a threaded terminal member 38 while the lower end is connected to a terminal 39 which, in turn, is connected to a flexible conductive leader 40 through the medium of a tubular sleeve 41. There is attached to the flexible leader a conductive fit-

ting 42 having a transverse pin 43 projecting from opposite sides thereof, as shown in Fig. 5, and designed to seat in notches 33c and 33d respectively for the purpose of anchoring the lower end of the fuse-link and establishing electrical connection thereof with ferrule 33 and thence with the lower terminal ring 16 and the line wire connected therewith.

Terminal member 38 is connected to a metal coupling sleeve 44 with which it operates conjointly to grip an inwardly extending flange at the upper end of a depending metal tube 45 which telescopically encircles the fusible section as well as a fiber tube 46 which is secured at its lower end to tubular sleeve 41. Fiber sleeve 46 functions as a gas-evolving medium for extinguishing the arc when the fuse blows, provided the arc is of relatively small intensity. Otherwise extinguishment of the arc is dependent, at least in part, upon the gas-evolving properties of expulsion tube 32 or of gas-evolving material otherwise suitably situated within the expulsion tube, such as a liner of horn fiber, not shown.

In threaded engagement with the upper end of coupling sleeve 44 is an elongate tubular conductor member 47, extending axially of the expulsion tube and terminating in a cap 48 which forms an upper abutment for a coil spring 49, the lower end of which abuts a cross-head member 50 which is secured to the lower terminus of a rod 51 which is slidably journaled in cap 48 and terminates at its upper end in a contact button 52. Interconnecting the latter and cap 48 is a flexible conductor 53. This serves to maintain a conductive path through the fuse-link without relying upon uncertain contact between rod 51 and the bore of cap 48 or upon contact between cross-head 50 and tube 47. The latter is slotted through, diametrically and longitudinally, at 47a to accommodate cross-head 50 and said cross-head is movable in the slot lengthwise of tube 47.

Spring 49 is normally compressed. That is to say, when the fuse-link is installed in the expulsion cartridge, as shown. And said spring continuously applies tension to the strain wire of the fusible section by exerting an upward force on tube 47. If and when the fuse blows, tube 47 together with coupling member 44, terminal member 38, and metal tube 45 are abruptly moved upwardly by the spring—thereby stretching the arc which forms at the point of rupture, thus helping to extinguish the arc. If the blowout is due to a short circuit and is, therefore, accompanied by a heavy follow current the intense resulting arc will cause an instantaneous evolution of gas in such volume as to give rise to a more or less violent explosion within the expulsion tube. The gaseous product of the explosion is directed downwardly and out through ferrule 33—since there is no other discharge passageway—and the force of reaction is directed toward expelling the fuse unit from the housing. The fuse unit could be thrown a considerable distance, and violently, if no adequate means were provided for restraining it; but the locking device of this invention comes into play instantly and effectively prevents expulsion of the fuse unit.

To withdraw the fuse-unit manually it generally is necessary to rotate it slightly before or simultaneously with the application of axially directed force.

When inserting the fuse unit into the housing the locking balls are ineffective to interfere.

The invention of William O. Schultz described in the above-identified Schultz application provides means which are operative to avoid the necessity of rotating the fuse unit before withdrawal; but the present invention antedates that of Schultz and is of somewhat simpler construction.

What is claimed is:

1. Mechanism wherein a first member has an opening and a second member extends axially through said opening and is movable axially relatively to said first member in opposite directions alternately, one of said members having a portion which is tapered axially adjacently to the other member, and a plurality of locking elements spaced circumferentially around said second member and interposed between said members, said locking elements being movable radially of said second member and arranged to be acted upon by said tapered portion and normally co-operative with said tapered portion, when acted upon thereby, to obstruct axial movement of said second member relatively to said first member in one only of said directions, and a retainer for said locking elements, said retainer being interposed between said members and fixedly secured to and carried by that one of said members having the aforementioned tapered portion, said retainer having apertures individual to said locking elements and through which said locking elements extend to bridge said members, said locking elements being movable in said apertures axially of said members toward the small end of said tapered portion into positions wherein they are not actuable by said tapered portion to effect the aforesaid obstruction, said locking elements being rollable circumferentially to some degree about said second member.

2. Mechanism wherein a first member has an opening and a second member extends axially through said opening and is movable axially relatively to said first member in opposite directions alternately, one of said members having a portion which is conically tapered axially adjacently to the other member and concentrically therewith, and a plurality of balls spaced circumferentially around said second member in contacting relation to said tapered portion and interposed between said members, said balls being movable radially of said second member and arranged to be acted upon by said tapered portion and normally co-operative with said tapered portion, when so acted upon, to effect a locking interengagement between said members whereby to obstruct axial movement of said second member relatively to said first member in one only of said directions, and a retainer for said balls encircling said second member and fixedly secured to and carried by one of said members and interposed between said members, said retainer having apertures individual to said balls and through which said balls extend to bridge said members, said apertures being sufficiently elongate axially of said second member to permit movement of said balls toward the small end of said taper into positions wherein they are not actuable by said tapered portion to effect the aforesaid obtsruction.

3. Mechanism wherein a first member has a bore and a second member extends axially through said bore and is movable axially of said bore relatively to said first member in opposite directions alternately, said second member having a portion within said bore which is conically tapered axially of said bore and concentrically

with said bore, a tubular retainer fixedly secured to and carried by said second member and encircling said tapered portion, and a plurality of balls within said retainer and spaced circumferentially around said tapered portion and movable by said tapered portion into pressing engagement with the bore of said first member in response to axial movement of said second member relatively to said first member in one only of said directions, said balls, in co-operation with said tapered portion, being effective to obstruct continued movement of said second member in said one direction, relatively to said first member, when in pressing engagement with said bore, said retainer having a plurality of apertures individual to said balls and through which said balls project to engage said bore, said apertures being proportioned to prevent escape of said balls from said retainer while permitting movement of said balls toward the small end of said tapered portion into positions wherein they are not actuable by said tapered portion to effect pressing engagement with said bore.

4. Mechanism wherein a first member has a bore and a second member extends axially through said bore and is movable axially of said bore relatively to said first member in opposite directions alternately, said second member having a portion within said bore which is conically tapered axially of said bore and concentrically with said bore, a tubular retainer carried by said second member and encircling said tapered portion and frictionally contacting said bore, said retainer being slotted lengthwise and thus rendered radially resilient, and a plurality of balls within said retainer and spaced circumferentially around said tapered portion and movable by said tapered portion into pressing engagement with the bore of said first member in response to axial movement of said second member relatively to said first member in one only of said directions, said balls, in co-operation with said tapered portion, being effective to obstruct continued movement of said second member in said one direction, relatively to said first member, when in pressing engagement with said bore, said retainer having a plurality of apertures individual to said balls and through which said balls project to engage said bore, said apertures being proportioned to prevent escape of said balls from said retainer while permitting movement of said balls toward the small end of said tapered portion into positions wherein they are not actuable by said tapered portion to effect pressing engagement with said bore.

5. Mechanism wherein a first member has a bore and a second member extends axially through said bore and is movable axially of said bore relatively to said first member in opposite directions alternately, said second member having a portion within said bore which is conically tapered axially of said bore and concentrically with said bore, a tubular retainer carried by said second member and encircling said tapered portion, said retainer being extended axially and slotted to form a plurality of axially extending resilient contact fingers which frictionally engage said bore, and a plurality of balls within said retainer and spaced circumferentially around said tapered portion and movable by said tapered portion into pressing engagement with the bore of said first member in response to axial movement of said second member relatively to said first member in one only of said directions, said balls, in co-operation with said tapered portion, being effective to obstruct continued movement of said second member in said one direction, relatively to said first member, when in pressing engagement with said bore, said retainer having a plurality of apertures individual to said balls and through which said balls project to engage said bore, said apertures being proportioned to prevent escape of said balls from said retainer while permitting movement of said balls toward the small end of said tapered portion into positions wherein they are not actuable by said tapered portion to effect pressing engagement with said bore.

6. In a device of the class described, the combination with a sleeve having a tubular contact portion of substantially uniform internal diameter throughout its length, of a closure member projecting into said sleeve and having a tapered portion within said tubular contact portion, locking means including a ball disposed between said portions, said sleeve and closure member being relatively rotatable, and retaining means on said member retaining said ball adjacent said tapered portion, said retaining means being secured to said tapered portion and affording movement of said ball in a direction longitudinally of said member, whereby movement of said member through said sleeve in one direction is unimpeded and movement in the other direction is impeded except upon rotation of said member relative to said sleeve.

7. In a device of the class described, the combination with a pair of telescopically related contact members, one of which presents a cone-like surface to a cylindrical surface on the other, locking means interposed between said surfaces for simultaneous contact therewith and including an element movable in a direction lengthwise relative to the axes of said members and in a direction rotatively about the said axes, and retainer means for said element affording said lengthwise movement and serving as an actuator for causing rotational movement of said element, said retainer means being secured to and carried by said cone-like surface.

8. In a device of the class described, the combination with a pair of telescopically and rotatively related contact members, one of which presents a cone-like surface to a cylindrical surface on the other, locking means including an element interposed between said surfaces and movable lengthwise and circumferentially of said members, and retainer means affording said lengthwise movement and simultaneously holding said element against movement relative to said retainer means in said circumferential movement, said retainer means being secured to and carried by said cone-like surface.

9. In a device of the character described, the combination with a sleeve-like member having a tubular contact surface, of a movable member extending into and through said sleeve-like member and having a cone-like surface surrounded by said contact surface, a retainer interposed between said members and surrounding said cone-like surface, said retainer being fixedly secured to said movable member and in part resiliently expansible into frictional contact with said tubular contact surface, said retainer being slotted longitudinally between said surfaces, and a ball-like locking element in said slot disposed between said surfaces, said slot affording limited radial and longitudinal movement of said locking element relative to said movable member, the circumferential dimension of the slot being such as

to retain said locking element on said movable member.

10. In a device of the character described, the combination of first and second telescopically related members, said first member including a cylindrical contact surface and said second member including a cone-like surface concentrically related to and adjacent said contact surface, a retainer fixedly secured to said second member and interposed between said surfaces, said retainer including resilient contact fingers frictionally engaging said contact surfaces and having a longitudinally slotted portion between said surfaces, and a ball-like locking element in said slot and between said surfaces, said slot affording radial and longitudinal movement of said element.

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