The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a tension type release coupler and more particularly to a coupler for automatically releasing a load suspended thereby upon deposition of the load. More specifically, the coupler of this invention has applications in subaqueous operations such, for example, as the deposition of mines or submarine measuring instruments on the ocean floor.

Previous devices of this character employed releasing pistols, explosively loaded weak links, and the pelican-trip hook devices. Such arrangements are complex, negative in action, destructive, and incur the extra expense of expended parts. Moreover, use of the explosive type is dangerous.

The present invention contemplates the provision of a novel coupler to release an object from a cable or other securing means used as a lifter or carrier. The coupler acts as a positive coupling until the object, suspended from it, is supported so as to relieve the tension on the device. When the tension is relieved, the device releases its hold to thereby free the cable. In this manner, if the coupler is used for subaqueous operations, the coupler attached to the cable is retrieved and no parts of the coupler are lost other than the load supporting tie-bar or shackles which is retained within the coupler during the lifting, carrying, and depositing operations.

An object of the invention is to provide a coupler which lockingly retains a load supporting shackle while under tension of the load and to automatically release the load shackle upon alleviation of the tension, as by deposition of the load.

Another object of the invention is the provision of an automatic release coupler in which spherical means lockingly retain a load supporting tie-bar while under tension of a load and to automatically release the load upon deposition thereof.

Another object is to provide an automatic release coupler for subaqueous operations in which no parts are expended upon discharge of the load.

A further object is to provide an automatic release coupler which is simple in construction, dependable in operation, and reusable indefinitely.

These and various other objects of the invention will become apparent to those skilled in the art from the following description which will be amplified, in order to facilitate a better understanding, by reference to the appended drawings, in which:

Fig. 1 is an isometric view, partly in section, of one embodiment of the invention adapted for use with a shackle type load support and showing the parts in load locking position in preparation for the load lifting operation;

Fig. 2 is a fragmentary isometric view, partly in section, of Fig. 1 rotated 90 degrees about its longitudinal axis;

Fig. 3 is a cross-sectional view taken along line 3-3 of Fig. 1 and shows the elements in load retaining position;

Fig. 4 is a fragmentary cross-sectional view taken along line 4-4 of Fig. 3;

Fig. 5 is the cross-sectional view of Fig. 3 showing the elements in open or load releasing position;

Fig. 6 is a cross-sectional view taken along line 6-6 of Fig. 7 of another embodiment of the invention adapted for use with an enlarged-end type of load support; and

Fig. 7 is a cross-section taken along line 7-7 of Fig. 6.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Figs. 1, 2, 3, 4 and 5, which illustrate a preferred embodiment of the invention, an automatic load-release coupler, denoted generally as 10, securely attached to an eye-bar 12 as by threads 14 and a cotter pin 15, the eye-bar being adapted to be secured to a lifting device or hoisting crane by means of a hook or cable passing through eye 13. The eye-bar 12 has an enlarged backing plate portion 16 defining a planar face 18 to limit the upward longitudinal movement of a cup-shaped member or housing portion, indicated generally as 20 and consisting of a cylindrical sleeve 22 having at one end a closure plate 24 with an axial bore circumferentially bounded by an annular longi
duval planar face 28, faces 18 and 28 abutting to limit the upward movement of cup 20 as is more clearly shown in Fig. 5.

The basic member of the coupler 10 is an elongated piece having a main cylindrical bifurcated body portion 30 with two forks 31 and 32 defining a notched, or longitudinal recess, 34 for receiving a load shackle or load supporting linkage 35, and a cylindrical, axially aligned shaft 36 extending from the other end of body portion 30 and being threadedly secured within enlarged portion 16. An annular flange 38, formed on body portion 30, serves as a bearing guide for the roots of sleeve 22 with the shaft 36 serving as a bearing guard for the bore of closure plate 24.

An expandible spring 40 is axially disposed over body 30 and seated on flange 38, the other end of spring 40 abutting against closure plate 24 whereby cup-shaped member 20 is urged in the upward position with faces 18 and 28 in abutment under no load conditions as shown in Fig. 5.

A pair of equidimensioned bores 42 and 44 are diametrically disposed on forks 31 and 32 respectively to receive balls 46 and 48 respectively, the balls having a diameter slightly less than the diameter of the bores 42 and 44 for crosswise or transverse movement in body portion 30.

A gradually decreasing internal perimeter portion 49, of sleeve 22, terminates in a uniform flange 50 which has an annular shoulder 51 formed therein. The section of portion 49 is to inwardly displace balls 46 and 48 when cup-shaped member 20 is in the spring constrained position and frictionally interlocks with the balls 46 and 48 under load supporting conditions by virtue of the radially exerted forces by balls 46 and 48 from shackle 35 as shown in Figs. 2 and 3. The shoulder 51 serves to prevent external emergence of balls 46 and 48 under no-load conditions as shown in Fig. 5. When the cup-shaped member 20 is in the spring constrained position, the internal face 53 of closure plate 24 is in substantial abutment with the rear face 55 of body portion 30 to thereby limit the longitudinal travel in the lower direction of cup-shaped member 20.

A key 58 has a locking shaft 59 which is adapted to be inserted in a bore 60 in cylindrical shaft 36 to main
tain the coupler in locking position until the lifting operation is commenced whereupon sleeve 22 is frictionally
interlocked by balls 46 and 48 to retain cup-shaped member 20 in the lower position at which time key 58 is removed.

The cross-section of notch 34 and the diameters of balls 46 and 48 are selected such that the balls cannot drop out of notch 34 when a load shackle is present in notch 34. Also, the strength of spring 40 is selected commensurate with the type of loads to be lifted and deposited.

In operation, the coupler 10 is normally in the position shown in Fig. 5 when being prepared to receive a load shackle. A load shackle is then inserted in notch 34, as shown by dotted shackle 35 in Fig. 5, and the cup-shaped member is pulled down to its lowest position to inwardly displace balls 46 and 48 whereby the cross-section of notch 34 is constricted, the coupler being maintained in this cocked position by insertion of key 58 in bore 60 as shown in Fig. 3. Upon application of a load force, as by lifting the load, the cup-shaped member 20 is retained in the lowest position by the frictional interlocking function of balls 46 and 48 with decreased peripheral portion 49, as aforedescribed, and key 58 is then removed. After the load is transported to its desired locale, it is deposited. During the deposition of the load, the load forces are alleviated sufficiently to enable the spring 40 to drive cup-shaped member 20 to its uppermost position, and the residual alleviated load forces act to outwardly displace balls 46 and 48 thereby to enable shackle 35 to drop out of notch 34. In this manner, an automatic load-release coupler is provided in which no parts are expended.

Referring now to Figs. 6 and 7, there is shown another embodiment suitable for a load tie-bar 70 having an enlarged end 72. This arrangement utilizes a coaxial bore entering the end of body portion 30' and extending part way therethrough so as to be circumferentially bounded by cylindrical walls 71 of body portion 30' to define a longitudinal recess 75. Four equally dimensioned balls 76, 78, 80 and 82, having coplanar axes are formed in the walls 74 for freely supporting balls 86, 88, 90, and 92, respectively, of equal diameters slightly less than the bores. The internal diameter of recess 75 and of bore 86, 88, 90 and 92 are so chosen that the balls cannot drop out by way of recess 75, external emergence of the balls being prevented by shoulder 51 as described with respect to Fig. 5. The operation of the embodiment of Figs. 6 and 7 is similar to the embodiment of Figs. 1 to 5. In lieu of four balls, any number of balls may be utilized in Figs. 6 and 7.

Although the dimensions in Figs. 6 and 7 are such as to prevent the balls from dropping out through recess 75, additional means, such as a resilient annular band 94 securely positioned to overlap the transverse bores, may be employed as a supplement in preventing the balls from dropping out by way of recess 75. The band 94, which may be metal or plastic, is of such resiliency as to yield in portions contiguous to the bores in response to inward displacement of the balls by flange 50 passing thereover as sleeve 22 rides upwardly upon deposition of the load.

To adapt the coupler for subaqueous operations, a pair of apertures 64 and 66 are formed in the side-walls of sleeve 22 to enable entry of water into the spring retaining chamber to thereby substantially equalize the internal and external water pressure on the coupler unit so that the expansive operation of spring 40 is not adversely affected by water pressure on the exterior surface of the coupler unit.

Obviously, many modifications and variations of the present invention are possible within the light of the above teachings. It is therefore to be understood, that within the scope of the teachings herein and the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A tension-locked, self-release, coupler comprising an elongated piece having a shaft portion adapted to be secured to a lifting device and a cylindrical body portion defining a recess between the forks of said bifurcated body portion for receiving a load-supporting linkage, each of said forks having a bore mutually diametrically disposed, a spherical element freely supported in each of said bores, a sleeve substantially coextensive with said body portion and mounted thereon for inward axidial movement towards the movement in one direction of said sleeve, the walls of said sleeve having a portion of reduced internal perimeter, said reduced portion contacting said spherical elements when the sleeve is in a substantially limited position in said one direction to thereby confine the distance between the elements whereby a load linkage is secured, said sleeve being longitudinally movable to a limited position in a direction opposite to said one direction, a shoulder of increased perimeter on said sleeve in registry with said spherical elements when said sleeve is in said limited opposite direction and effective to enable outward protrusion of said elements while simultaneously preventing outward emergence of said elements from their respective bores, the cross-section of said recess and the diameters of the spherical elements being such that the elements are unable to drop out of the bores by way of said recess, and an expansible spring supported at one end by said body portion and at the other end by said sleeve for driving said sleeve to said limited opposite position in the absence of a load force, the presence of a load force on a load linkage retained in said recess by the spherical elements when confined by said sleeve causing said elements to exert a radial force on said reduced portion that frictionally binds said sleeve and prevents movement thereof until the load force is alleviated during deposition of the load whereinupon said spring drives the sleeve to said limited opposite position, the residual alleviated load stresses forcing said spherical elements to move and protrude outwardly whereby the load linkage is automatically released.

2. The coupler of claim 1, wherein said sleeve is a cup-shaped member invertedly mounted over said body portion and having a bore in the base thereof for elidable movement on said shaft portion.

3. The coupler of claim 2, further including pressure equalizing means to adapt the coupler for subaqueous operations and comprising a plurality of ports in said sidewalls of said cup-shaped member to permit entry of water therewithin.

4. The coupler of claim 2, wherein said bores are of equal diameter and said spherical elements are of equal diameter but of a diameter less than the diameter of said bores, and further including annular flange on said body portion, said spring being supported between said flange and the base of said cup-shaped member, and manually operable means including a key insertable in a keyhole in said shaft portion for locking said cup-shaped member in the limited position in said one direction.

5. A tension-locked, self-releasing coupler comprising an elongated piece having a shaft portion adapted to be secured to a lifting device and a cylindrical body portion supported by said shaft portion at one end thereof and having a longitudinal recess entering through the other end thereof and extending part way in said body for receiving a load supporting linkage, plurality of bores in said body portion in transverse communication with said recess, a ball freely supported in each of said bores, an annular flange on said body portion, a cup-shaped member substantially coextensive with said body, an axial aperture in the base of said cup-shaped member, said cup-shaped member being mounted over said body por-
tion for longitudinally slidable movement on said flange and on said shaft portion by the walls thereof and by said aperture respectively, longitudinal movement in one direction of said cup-shaped member being limited by abutment of the base thereof with said one end of said body portion, the lip of said cup-shaped member having an annulus of decreased internal perimeter, the walls of said cup-shaped member having a concave annular portion adjacent said annulus, said concave portion contacting said balls when said cup-shaped member is in a substantially limited position in said one direction, an annular shoulder of increased internal perimeter formed on said annulus and in registry with said balls when said cup-shaped member is in said limited opposite direction, said annulus being effective to enable outward protrusion of said balls while simultaneously preventing external emergence of said balls from their respective bores, the cross section of said recess and the diameters of the balls being such that the balls are unable to drop out of the bores by way of said recess, and an expansible spring supported at one end by said annular flange with the other end thereof abutting the base of said cup-shaped member for driving said cup-shaped member to said limited opposite direction in the absence of a load force, the presence of a load force on a load linkage retained in said recess by said balls, when constrained by said cup-shaped member causing said balls to exert a radial force on said concave annular portion that frictionally binds said cup-shaped member and prevents movement thereof until the load force is alleviated during deposition of the load whereupon said spring drives the cup-shaped member to said limited opposite direction, the residual alleviated stresses forcing said balls to move and protrude outwardly whereby the load supporting linkage is automatically released.

6. The coupler of claim 5, wherein said recess is an axial cylindrical bore circumferentially bounded by the walls of said body portion and being adapted to receive a load supporting linkage of the tie-bar enlarged end type, all of said transverse bores being equidistantly disposed about said circumferentially bounding walls and having the axes thereof in a common plane, said transverse bores being of equal dimensions and said balls being of equal diameter but of a diameter less than said transverse bores.

7. The coupler of claim 5, wherein said recess is a longitudinal notch bounded by opposing walls formed integrally with said body portion and being adapted to receive a shackle type of load linkage, said transverse bores being diametrically disposed in said opposing walls, said transverse bores being of equal diameter and said balls being of equal diameter but of a diameter less than said transverse bores.

8. An automatic load-release coupler comprising an elongated piece having a shaft portion adapted to be secured to an extending cable and a body portion with a pair of forks extending therefrom to define a recess for receiving a load shackle, each of said forks having a bore of equal dimensions and mutually diametrically disposed, a ball freely supported in each of said bore, an annular flange on said body portion, a cup-shaped member substantially coextensive with said body portion and the forks and mounted thereover for slidable movement on said flange, said body portion limiting the movement in one direction of said cup-shaped member, the balls of said cup-shaped member having a portion of decreasing internal perimeter, said decreasing portion contacting said balls when the cup-shaped member is in a substantially limited position in said one direction to thereby compress the distance between the balls whereby a load shackle is retained in said recess, stop means associated with said shaft portion for limiting movement of said cup-shaped member in a direction opposite to said one direction, a shoulder on said cup-shaped member for preventing external emergence of said balls from their respective bores when said cup-shaped member is in said limited opposite direction, the space between said forks and the dimension of the balls being such that the balls are unable to drop out of the bores by way of said recess, and an expansible spring engaging said flange and the base of said cup-shaped member for driving said cup-shaped member to said limited opposite direction in the absence of a load force, the presence of a load force on a shackle in said recess when said cup-shaped member is in said limited one direction causing said balls to exert a radial force on said decreasing portion that frictionally binds said cup-shaped member and prevents movement thereof until the load force is reduced upon deposition of the load to thereby release said radial force and permit said spring to drive the cup-shaped member to said limited opposite direction whereby said load shackle is automatically released.

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