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Cornell

[11] **3,861,771**

[45] **Jan. 21, 1975**

[54] **CABLE CONNECTOR WITH FIVE POINT GRIP AND NON-TWIST, NON-PULLOUT FUNCTION AND WITH RATCHET LATCH**

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[52] **U.S. Cl.** ..... **339/95 R,** 339/266 R, 339/274

[51] **Int. Cl.** **H01r 9/08**

[58] **Field of Search** 339/95, 266, 274

[56] **References Cited**

UNITED STATES PATENTS

3,138,422	6/1964	Lawlor	339/266 R
3,406,372	10/1968	Lawlor	339/95 R
3,801,952	4/1974	Lawlor	339/266 R

Primary Examiner—Joseph H. McGlynn

Attorney, Agent, or Firm—Hume, Clement, Brinks, Willian, Olds & Cook, Ltd.

[57] **ABSTRACT**

A device to anchor a cable end with a clamping type action, of the general type embodying male and female jaw members having respective tails for connection to another body; of a non-shearing type; characterized particularly by five points where pressure is applied to a cable, e.g., of a helically braided, stranded type; the fifth pressure point being in the form of a transverse ridge or equivalent projection which is spaced toward the butt end of the cable from a third pressure surface exerting pressure in the same direction as the ridge; a fourth pressure surface exerting pressure against the opposite side of the cable at a point intermediate the third and fifth pressure points, the fifth point ridge bending the cable end toward the opposed fourth pressure surface to improve the grip thereof and hence the pullout resistance of the connector. The ridge which constitutes the fifth pressure element, acting at a point where its indenting action cannot weaken the cable, may have sharp edges extending along its transverse length so as to embody the dual function of improved pull-out resistance and crossing the helically protruding stranded surface of the cable in a manner to resist untwisting movement of the cable which tends to occur under cable tension.

10 Claims, 9 Drawing Figures

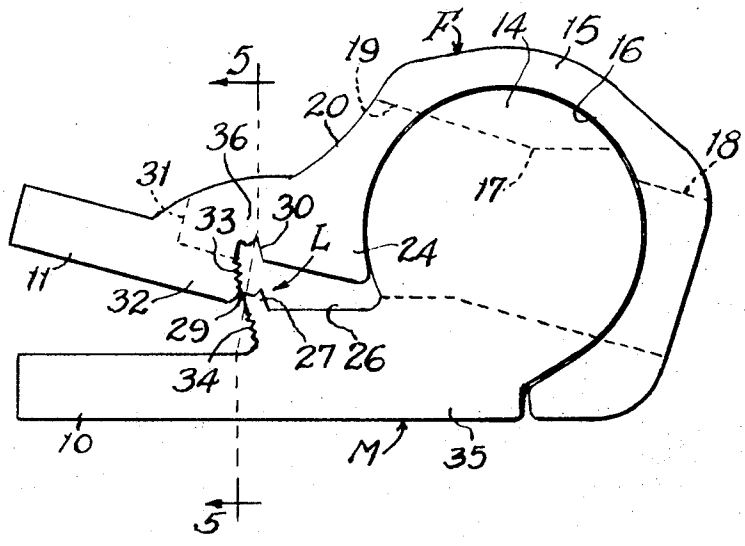
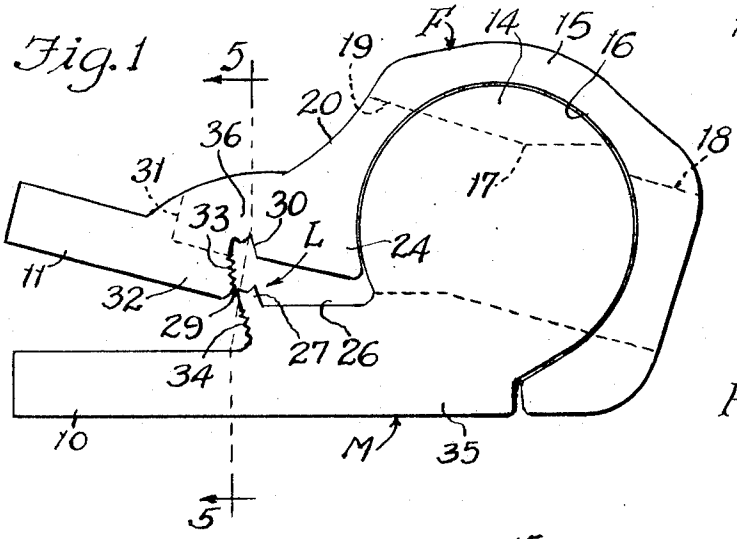


Fig. 1



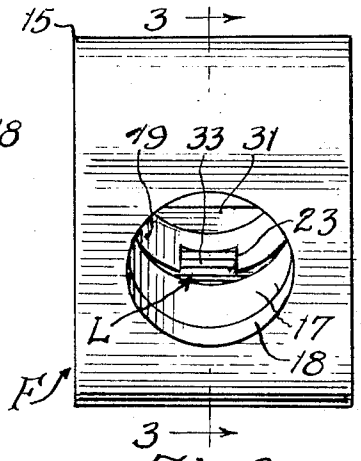
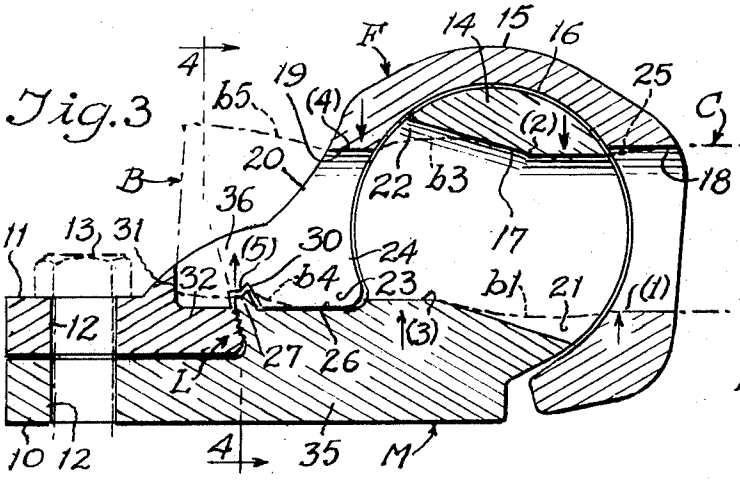


Fig. 2

Fig. 3



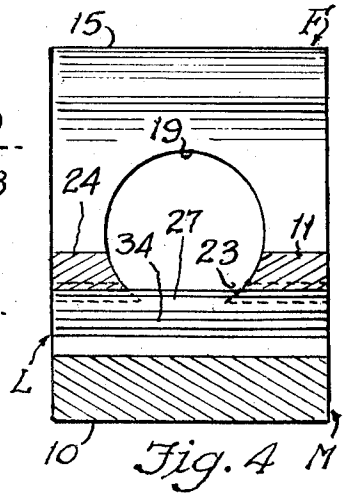


Fig. 4

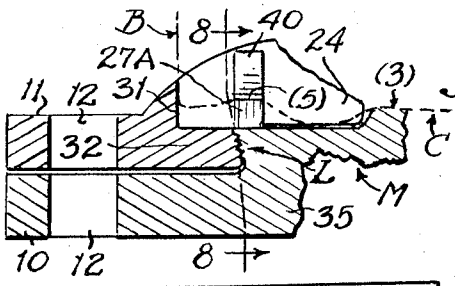
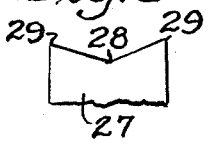


Fig. 7

Fig. 6



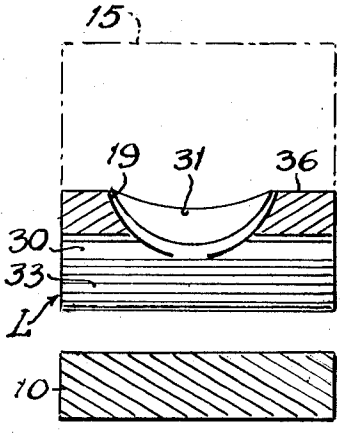


Fig. 5

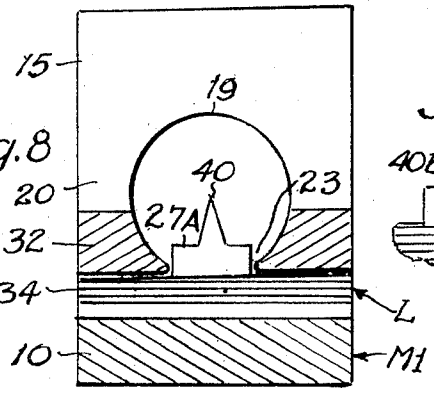
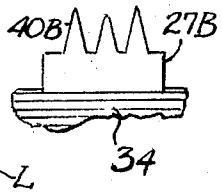


Fig. 8

Fig. 9



CABLE CONNECTOR WITH FIVE POINT GRIP AND NON-TWIST, NON-PULLOUT FUNCTION AND WITH RATCHET LATCH

In a modified form of the invention, the fifth pressure element, instead of being a transverse ridge with continuous or sharp edges, may have one or more pointed teeth which penetrate the cable with a combination of pullout resistance, anti-twist action, and improved electrical contact action.

BACKGROUND OF THE INVENTION

Cable clamps, including clamps of a non-shearing type, having jaws hingedly connected for movement between an open, cable-receiving position and a closed, cable-clamping position of their jaws, are known in the prior art, as disclosed in the following patents:

Schuck et al. U.S. Pat. No. 3,118,720 Electrical Connector

Lawlor U.S. Pat. No. 3,138,422 Electrical Connector with Wire-Gripping Means

Lawlor et al. U.S. Pat. No. 3,351,889 Electrical Connector etc.

Lawlor U.s. Pat. No. 3,406,372 Non-Shearing etc. Electrical Connector

Beaudion U.S. Pat. No. 3,437,979 Electrical Connector with Wire-Gripping Means

Lawlor U.S. Pat. No. 3,477,060 Electrical Connector of Integral Sheet Metal

Tracy U.S. Pat. No. 3,169,818 Electrical Conductor Clamp

Peterson U.S. Pat. No. 2,700,807 Guy Wire Clamp

Goetzelman U.S. Pat. No. 1,955,283 Ground Connector

Lanfear U.S. Pat. No. 2,680,145 Wire Connector

German Pat. No. 698,501

SUMMARY OF THE INVENTION

The present invention improves upon the clamps of the prior art in having a fifth pressure element providing markedly improved pullout resistance, acting at a point where it does not weaken the tension-loaded body of the cable. Such fifth pressure element may also function for anti-twist resistance. It may be a transverse ridge with sharp edges for indenting the cable, or it may be provided with one or more teeth arranged in a transverse relation to the cable axis. In the preferred form of the invention the fifth element is a ridge extending full width across its respective jaw member and entering a transverse notch in the opposed jaw member. The latter embodies a surface extending into a depression defined between the third and fifth pressure elements, allowing the fourth pressure element (on the opposite side of the cable) to deform the cable into such depression to provide improved pullout resistance.

The general object of the invention is to provide an improved cable clamp of the hinged jaw type having, in addition to four cable-engaging pressure areas of non-shearing character, a fifth pressure element such as to greatly improve the pullout resistance of the clamp.

Further objects are to provide such a clamp:

1. having cable-clamping means providing a twist-resistant function;
2. having latch means to hold the connector on the cable when partly closed, with just sufficient grip on the cable so that the cable and connector can be lifted and applied to an anchor element without risk of the connector dropping off the end of the cable while being manipulated to a position for attachment of the connector to another element; and
3. which can be fabricated entirely by extrusion operations with the exception of boring to provide diametrical cable-receiving bores.

Other objects will become apparent in the ensuing specifications and appended drawings, in which:

FIG. **1** is a side elevational view of my improved cable clamp, shown in the open, cable-receiving position;

FIG. **2** is an end view thereof;

FIG. **3** is a longitudinal sectional view thereof, taken on line **3—3** of FIG. **2**;

FIG. **4** is a cross-sectional view taken on line **4—4** of FIG. **3**;

FIG. **5** is a cross-sectional view taken on line **5—5** of FIG. **1**;

FIG. **6** is an enlarged detail of the gripping ridge;

FIG. **7** is a fragmentary longitudinal sectional view of a modified form of the invention;

FIG. **8** is a cross-sectional view of such modified form, taken as indicated by line **8—8** of FIG. **7**; and

FIG. **9** is a fragmentary detail of another modified form.

DESCRIPTION

Referring now to the drawing in detail and in particular to FIGS. **1–5** thereof, I have shown therein, as an example of one form in which the invention may be embodied, a cable clamp of the non-shearing, hinged male and female jaw type comprising, in general, male and female jaw members M and F respectively, having respective connector tails **10** and **11** each provided with a bolt or screw hole **12** through which a fastener element **13** may be inserted and anchored into a mounting body or to another clamp in end-to-end relation thereto. Male jaw M embodies, at its end opposite from tail **10,** a cylindrical head **14** generally tangent thereto. Female jaw F has at its corresponding end a generally C-shaped coupling sleeve **15** disposed largely on one side of the plane of its tail **11,** projecting therefrom in the same direction as male head **14,** whereby, with the cylindrical periphery of head **14** rotatably fitted within a mating cylindrical internal bearing wall **16** of sleeve **15,** the two jaws will be generally fitted to one another for hinging movement from an open, cable-receiving relation (FIG. **1**) to a closed, cable-clamping relation (FIG. **3**) in which tails **10, 11** can be brought together in substantially face-to-face contact. The invention also provides for positions of adjustment intermediate these open and closed positions, and for latching the jaws together by means of latch means indicated generally at L. Head **14** and sleeve **15** are provided with cable-receiving openings through which an end portion of a cable (indicated in phantom at C in FIGS. **3** and **7**) can be inserted when the clamp is in the open position of FIG. **1.** In male head **14** the opening **17** is of the X-shaped type shown in Lawlor U.s. Pat. No. 3,406,372, being of generally uniform width parallel to the hinge axis and broadened at each end in its medial plane normal to such axis. In female jaw F there are two diametrically-opposed openings, namely a circular opening **18** in the free end portion of sleeve **15**; and an opening **19** in a generally wedge-shaped junction portion **20** of sleeve **15** by means of which it is joined to its tail **11.**

Openings **17** and **18** are both developed by machining operations, e.g., boring, the only machining operations required for production of this preferred form of the invention. All other surfaces can be developed by extrusion through dies, being all parallel to the transverse (rotational) axis of the jaws. This is a distinct advantage in lowering cost of production. The opening **17** may be produced by boring (e.g., with a side-cutting boring bit) on two diametrical axes in the medial normal plane of head **14**, intersecting at an angle which may be in the range of 15°–20°, the essential factor being that in the enlarged ends of opening **17**, pockets **21** and **22** of sufficient depth to receive respective bowed portions *b*1 and *b*3 of cable C, will be defined between such enlarged ends and bearing wall **16**, as indicated in FIG. **3**, and the bowed portions in the pockets will contribute largely to the aggregate pullout resistance of the assembly in the closed clamp. Opening **19** is cylindrical for approximately three-fourths of its circumference, having an open bottom slot **23** (FIGS. **3** and **4**) in the heel portion **24** of junction **20**.

At this point it may be noted that four pressure surfaces (**1**), (**2**), (**3**) and (**4**) are provided, exerting pressures against the cable as indicated by the arrows in FIG. **3**. These four pressure surfaces are provided by opposite sides of the walls of openings **17** and **18**. Pressure surfaces (**2**) and (**3**) act to deform the cable into an S-configuration including the oppositely projecting bowed portions *b*1 and *b*3 respectively. Pressure surface (**1**) presses the entering portion of the cable against surface (**2**) and bends it slightly beyond the outer edge thereof, at **25**, at the same time tending to flatten the cable against surface (**2**) without any shearing action. Correspondingly, surface (**4**) presses the cable around the outer edge of surface (**3**) and downwardly, at *b*4 into a shallow depression **26** defined between said outer edge and a transverse ridge **27** projecting into opening **19** to provide the fifth pressure surfaces (**5**) where the butt end B of the cable is pushed upwardly (as viewed in FIG. **3**) bending the butt end B at *b*5 around said outer edge to further intensify the pullout resistance which has been amplified by the bending of the cable around the outer edge of surface (**3**) and into depression **26**, in which the cable is bowed reversely at *b*4 with reference to the bowed portion *b*3 projecting into pocket **22**. The intensification of pullout resistance at the end of the cable is obtained by reason of the fact that the butt end B is deformed upwardly from surface (**4**) as it emerges from the clamp, spreading upwardly and outwardly freely under the upward pressure of ridge **27**. Since this upward pressure is exerted well to the rear of opposed surface (**4**) well beyond the downward force at surface (**4**) the cable has ample opportunity to bend upwardly. The gripping surface of ridge **27** (FIG. **6**) is preferably defined by a V-notch **28** which intersects the two sides of the ridge to provide rather sharp gripping edges **29**, as shown in enlarged detail in this figure. The edges **29** provide improved grip on the end portion of the cable without any shearing action (since there is no directly opposed downwardly pressing edge associated with ridge **27** within the confines of female opening **19**). As ridge **27** bears against the cable strands they will flatten out against and be idented by the straight parallel edges **29**, thereby inhibiting any tendency toward twisting action of the cable which might facilitate slippage of the cable in the clamp under cable tension. At this point it may be noted that grip (**5**) acts upon the cable at a point where it can not be weakened by injury from the grip action, as would happen at other points farther from butt end B, where shearing action tends to occur in connectors of earlier design. Where shearing action, sharp edges, etc. tend to cause weakness at the points of grip, vibration due to electric current in the cable can cause failure at such points, especially where the cable is under high tension load. At the fifth pressure point, however, in the butt end of the cable, sharp edges and more upward thrust of the ridge or teeth providing the fifth grip can be utilized in a manner to substantially lessen the holding action required of the other grips, thereby reducing the risk of weakening the cable where its tension load is transferred to the connector.

Ridge **27** is received in laterally opposed slots **30** formed in junction member **20**, being fully exposed in opening **19** to accommodate its gripping action. Inwardly of slots **30** (toward the hinge axis) the two sides of junction heel **24**, separated by longitudinal slot **23**, may fit downwardly into depression **26** for maximum circumferential extent of sleeve bearing wall **16**. Endwardly from slots **30**, opening **19** is extended, as a bore with a solid bottom, to a stop shoulder **31** which serves to define a limit position of projection of cable C through the opening **19**. The solid bottom is defined by a downwardly offset web portion **32** of junction member **20**, formed as an inward continuation of female tail **11**.

Latch means L (FIGS. **1**, **3** and **5**) comprisees a plurality of fine parallel latch teeth **33** extending from side to side of the offset extremity of web **32**; and a corresponding series of fine transverse latch teeth **34** formed in an offset shoulder at the outer end of a relatively thick body portion **35** of male jaw M extending from its tail **10** and joining the tail to the male head **14** in tangent relation thereto. Depression **26** is formed in the body portion **35**. Latch teeth **33** and **34** are arranged in respective planes or surfaces of substantially segmental cylindrical form, substantially concentric with the hinge axis, and are so related to one another as to make interfering engagment as the two clamp jaws approach one another at the latching area, and to mate with one another in several positions of selected adjustment. It may be noted that junction member **20** of female jaw F, at respective sides of bore **19**, embodies side wall members in which slots **30** are formed so as to define thereabove a pair of relatively narrow web portions **36** of sufficient resiliency to allow a springing, yielding action such that the latch teeth **33**, **34** can be forced past one another in interfering relation to a selected position of adjustment or to the fully closed position.

Ratchet latch L functions to hold the connector attached to the cable when the connector is partly closed with just enough pressure to grip the cable so that the assembly can be manipulated (e.g., in reaching across other electrical equipment) without risk of the connector dropping off the end of the cable.

Instead of the ridge **27** extending the full width of the male jaw M as in FIGS. **1–5**, its ends may be machined off (FIGS. **7** and **8**) to provide a projection **27A** which may be sufficiently narrow to be received in bottom slot **23** of female jaw F, thus eliminating the need for slots **30** and making it possible to correspondingly reduce the thickness of junction **20** above latch L, and

also increasing the anti-twist action. Projection **27A** may also include a tooth **40** of wedge shape extending toward the center of bore **19** to a substantial height, such as to penetrate between strands of cable C to amplify the resistance to untwisting of a helically stranded cable under tension. The penetrating tooth **40** also functions to improve electrical conductivity between the connector and the cable by establishing contact with internal strands less affected by the corrosive action of air and moisture, and by a wedging action tending to crowd the strands against the respective side walls of bore **19**. Also, the chisel-edge point and lateral cornersedges of tooth **40** will tend to penetrate through and remove portions of the aluminum oxide coatings which tend to inhibit electrical contact among the strands and between the cable and connector. The tooth form of the invention aims to break such oxidation "seal" by contacting as many strands as possible (not merely the outer ones) and by the crowding, compressing action described.

FIG. **9** shows a further modification in which a plurality of cable-penetrating teeth **40B** project from the fifth pressure projection **27B** in an assembly which in other respects may be the same as that shown in FIGS. **7** and **8**.

I claim:

1. A cable clamp of the type comprising male and female jaws having respective mounting tails, said male jaw including a transverse cylindrical head having a generally diametrical cable-receiving opening with ends enlarged in a plane normal to its axis, said female jaw including a generally C-shaped coupling sleeve with a cylindrical internal bearing wall receiving said head for relative hinging movements of said jaws between open and closed positions, said coupling sleeve having first and second cable-receiving openings on opposite sides thereof substantially on a diameter of said male head and positioned to register with said head opening in the open position of the clamp so as to receive the end portion of a cable;

said coupling sleeve having, in said first and second sleeve openings, respective first and fourth pressure surfaces on opposite sides of the common axis of said sleeve openings and at diametrically opposite sides of said sleeve with respect to the hinge axis;

said male head having, at opposite ends of said head opening, respective second and third pressure surfaces diametrically opposed to said first and fourth pressure surfaces respectively across the common axis of said sleeve openings;

said male jaw, between said head and said tail thereof, having a transversely extending fifth pressure element projecting into the adjacent second sleeve opening when the clamp is closed, for bending the end portion of said cable toward and around said fourth pressure surface, to which said fifth pressure element is generally opposed but outside the outer extremity thereof.

2. A cable clamp as defined in claim **1**, wherein said fifth pressure element is in the form of a tooth dimensioned to enter an open slot in said sleeve at the bottom of said second opening and projecting radially inwardly so as to penetrate a stranded cable in said second opening.

3. A cable clamp as defined in claim **1**, wherein said fifth pressure element includes a transverse projection dimensioned to enter an open slot in said sleeve at the bottom of said second opening,

and a plurality of wedge-shaped teeth projecting radially inwardly from said projection so as to penetrate a stranded cable in said second opening.

4. A cable clamp as defined in claim **1**:

said male jaw having an intermediate body portion connecting its said tail to its said head;

said body portion being raised above said male jaw tail to provide an offset shoulder below and fifth pressure element;

and latch means comprising transverse, parallel teeth in said offset shoulder and at the forward end of the female jaw tail respectively, positioned to interengage to hold the jaws in selected intermediate positions between their open and closed positions.

5. A cable clamp as defined in claim **1**:

the enlargements of said head opening providing, in the closed positions of the jaws, first and second pockets adjacent said first and fourth pressure surfaces respectively to a depth such that said second and third pressures surfaces, in the closed clamp, may deform longitudinally adjacent portions of said cable into bowed protrusions into said first and second pockets for cable pullout resistance.

6. A cable as defined in claim **5**:

said male jaw having an intermediate body portion connecting its said tail to its said head;

said body portion having, adjacent the outer extremity of said third pressure surface, and disposed between the same and said fifth pressure element, a depression into which said fourth pressure surface is effective to deform a portion of the cable, adjacent the bowed protrusion in said second pocket, into a third bowed protrusion of reverse curvature relative to that in said second pocket.

7. A cable clamp as defined in claim **6**, wherein said fifth pressure element is effective to bend the end of said cable around and outwardly of said fourth pressure surface and in a direction opposite to that of the curvature of said third protrusion.

8. A cable clamp as defined in claim **1**, wherein said fifth pressure element is in the form of a ridge extending transversely of said male jaw.

9. A cable clamp as defined in claim **8**, wherein said ridge extends the full width of said male jaw;

said female jaw having, at respective sides of its adjacent second sleeve opening, notches positioned to receive the ends of said ridge.

10. A cable clamp as defined in claim **8**, wherein said ridge has a pair of marginal, cable-indenting edges defined on opposite sides of a longitudinal notch therein.

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