March 5, 1963 M. L. CLEVETT 3,080,024

GROUND ANCHOR

Filed Oct. 16, 1958 2 Sheets-Sheet 1

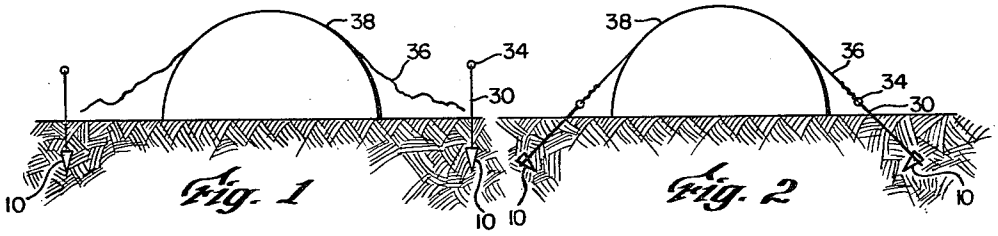


Fig. 1 Fig. 2

Fig. 3

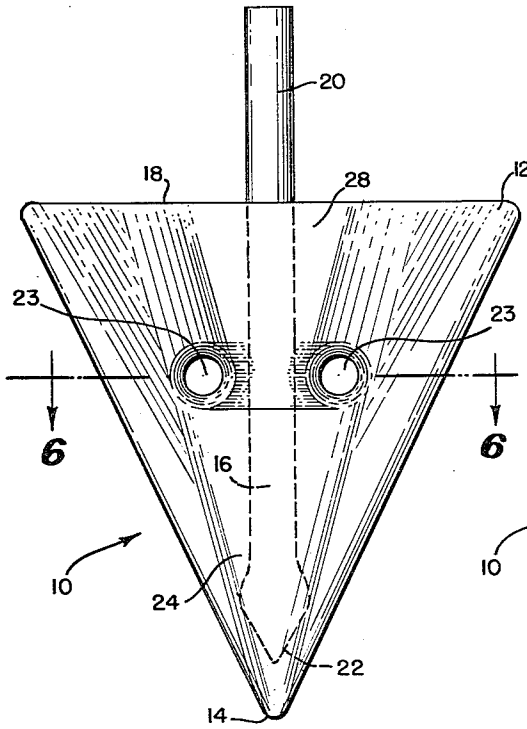


Fig. 4

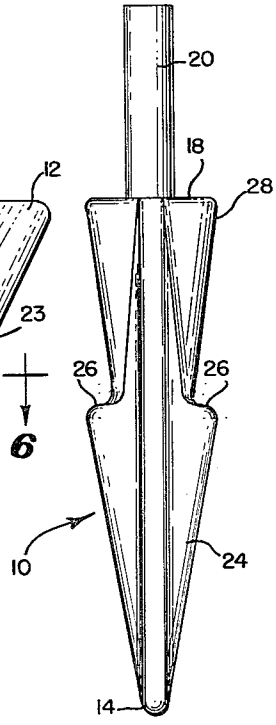
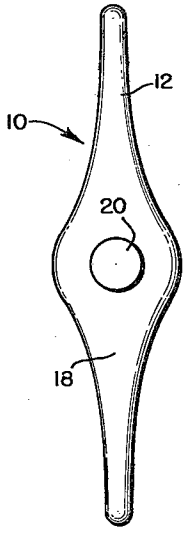


Fig. 5



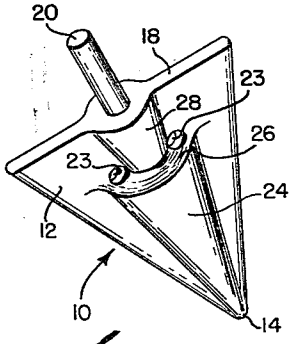


Fig. 7

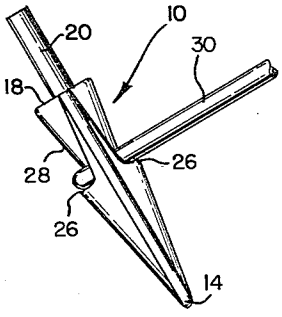
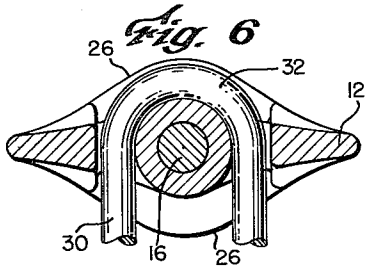


Fig. 8

Fig. 6



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GROUND ANCHOR

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Fig. 9

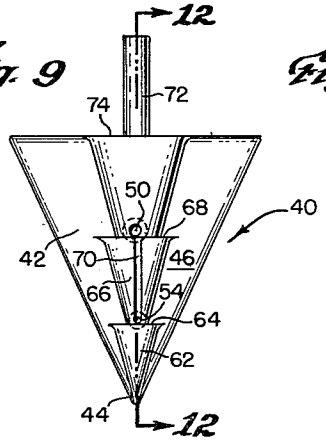


Fig. 10

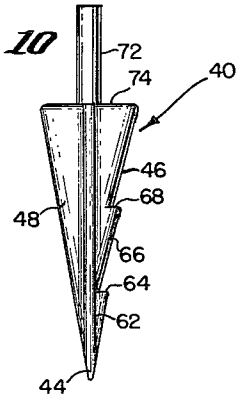


Fig. 11

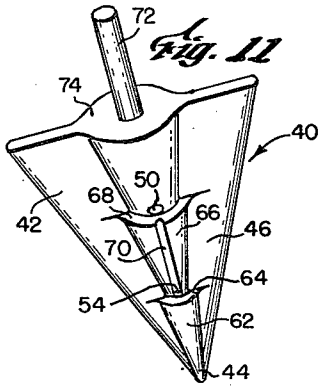


Fig. 12

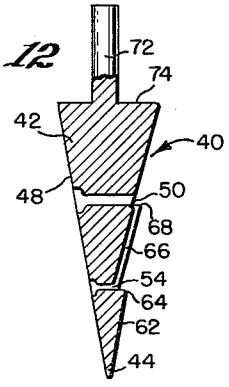


Fig. 13

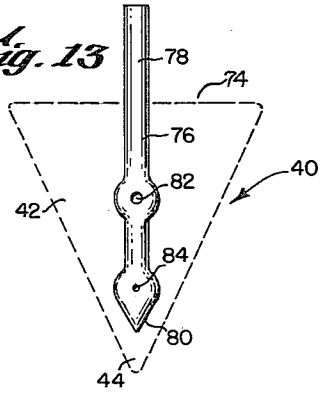


Fig. 14

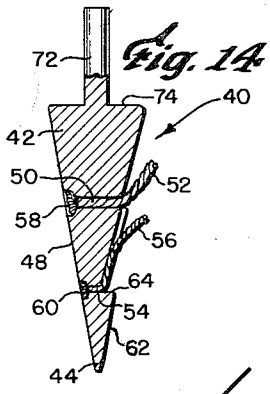


Fig. 15

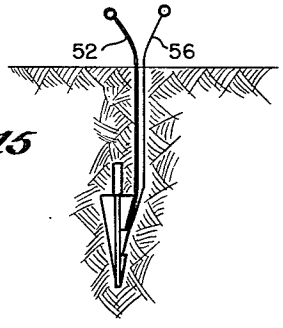


Fig. 16

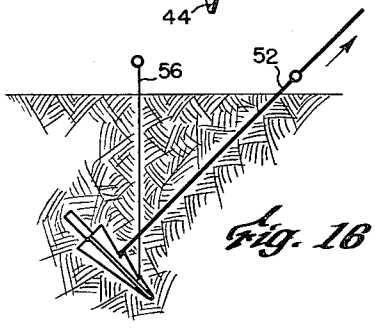
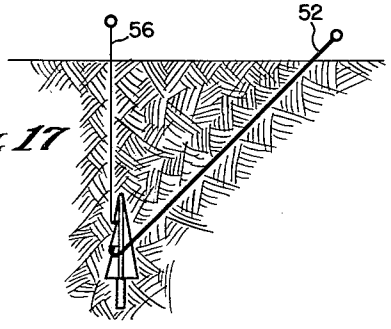


Fig. 17



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United States Patent Office

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3,080,024

GROUND ANCHOR

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Filed Oct. 16, 1958, Ser. No. 767,743
7 Claims. (Cl. 189—90)

This invention relates to an improvement for ground anchors of the type described in my previous Patent No. 2,712,864 issued on July 12, 1955.

It is an object of my invention to provide a ground anchor device which can be used effectively in very hard ground without chafing the attached cable or crushing the anchor, and is yet light and portable. Another object of my invention is to provide a device which can be easily retrieved, if necessary. Still other objects of my invention are to provide a ground anchor which can be easily and relatively inexpensively fabricated, can be transported without special protective packing and can be air dropped or parachuted without harm.

In the accomplishment of these and other objects of my invention I provide a device shaped generally like an isosceles triangle or arrowhead, having an indented wedge-like profile, with apertures at the indent through which a connecting cable is looped. An internal, steel reinforcing rod or shank similar to a short arrow shaft, starts near the apex of the triangle and emerges at about the center of the edge opposite the aforesaid apex. The anchor device can be cast or forged around the shank, or the shank may be pressed into a casting. A driving pipe engages the protruding portion of the shank in telescoping relation and as force is applied to the pipe the anchor is driven into the ground along with its connecting cable, chain or rod. When the desired depth is reached the pipe is pulled out and a guying cable is then attached to the connecting cable and put under tension. This tension will readily upset the anchor in the earth pulling the broad face of the anchor perpendicular to the cable which it thereby secures.

One feature of my invention is the use of a steel shank which helps to reinforce the driving tip of the anchor. Further, the use of the steel shank around which the driving pipe is fitted eliminates the shearing which sometimes occurs in light metal ground anchors when a driving lug, integrally cast or forged with the anchor plate, is used.

Another feature of my invention is the use of a built up rib on both faces of the anchor roughly co-axial with the steel reinforcing shank. This rib becomes gradually thicker and broader away from the tip and terminates abruptly to form a shoulder on each anchor face just below the cable apertures. This feature serves two important functions. First, the shoulders formed by the conical ribs protect the connecting cable from abrasion by hard ground during the insertion process. Second, the rib adds substance to the anchor where it is needed during insertion, near the tip or apex.

Still another feature of my invention resides in a second truncated conical rib, the narrow end of which begins between the two cable openings just above the shoulder forming the base of the conical rib already mentioned, and which expands toward the edge of the triangle opposite the apex, terminating flush with the said edge. The resulting enlarged, generally circular cross section between the cable openings widens the loop of the connecting cable and thereby reduces cable deformation and possible failure. Furthermore, the integrally formed tapering rib above the holes urges the cable emerging on the side opposite the loop to lie in a wide curve rather than bending

upward at a sharp angle, thus further minimizing cable deformation.

Further features and objects of the invention will become apparent from the following description of a preferred embodiment wherein:

FIGURE 1 is a side elevation, partly diagrammatic, of an air-inflated shelter to be lashed to the ground by guy lines, showing a pair of the ground anchors embodying the invention driven into the ground prior to having their connecting cables fastened to the ends of the guy lines.

FIGURE 2 is a similar view of the shelter lashed to the ground by the guy lines with the ends of the guy secured to the connecting cables of the ground anchors and the anchors disposed in planes substantially at right angles to the guy line.

FIGURE 3 is a face elevation of the ground anchor.

FIGURE 4 is a side elevation of the ground anchor.

FIGURE 5 is a top elevation of the ground anchor.

FIGURE 6 is a horizontal cross section on line 6—6 of FIGURE 3.

FIGURE 7 is a perspective view of the anchor, and

FIGURE 8 is an edge elveation of the ground anchor and connecting cable showing relative positions of the same when the connecting cable is under tension.

FIGURES 9, 10, 11, 12, 13, 14, 15, 16, and 17, show a variation of the ground anchor designed to facilitate retrieval.

FIGURE 9 is a face elevation of the ground anchor.

FIGURE 10 is a side elevation of the ground anchor.

FIGURE 11 is a perspective view of the ground anchor showing the ribbed face.

FIGURE 12 is a horizontal cross section on line 12—12 of FIGURE 9.

FIGURE 13 is a phantom view of the ground anchor with an added reinforcing shank.

FIGURE 14 is a view similar to that in FIGURE 12 but with the connecting cable and the retrieving cable inserted in the anchor.

FIGURE 15 is a digrammatic representation showing the ground anchor, with connecting cable and retrieving cable attached, inserted into the ground.

FIGURE 16 is a diagrammatic representation of the inserted ground anchor and cables in which the connecting cable is attached to a guying cable under tension, and the ground anchor is in a position normal to the line of tension.

FIGURE 17 is a diagrammatic representation of the ground anchor, relieved from tension on its connecting cable, being pulled up by its retrieving cable.

In the drawings the numeral 10 designates generally a ground anchor embodying my invention which may be cast or forged from aluminum, magnesium, iron, steel, plastic, or other suitable materials. The anchor 10 comprises a body portion or plate 12 which is substantially flat and has substantially the shape of an isosceles triangle or arrowhead with an apex 14 of the triangle adapted to penetrate into the ground. For many applications the plate 12 may be approximately ⅛ inch thick, and the altitude of the triangle may be of the order of four inches. These dimensions may be varied as desired, of course, and it is not intended to restrict the invention to any particular dimensions.

An internal steel reinforcing shank 16 extends from just above the apex 14 along the altitude of the triangular plate 12 and protrudes a few inches beyond an edge 18 opposite the apex 14 forming a driving shaft 20. The shaft 20 is adapted to enter the bore of a driving tube or pipe which is used to drive the anchor into the ground; the shank 16 is reduced as indicated at 22 to permit it to fit into the apex 14 and give added reinforcement when

the anchor 10 is driven into hard ground. In order to assure easy flow of molten material around the shank 16 during the casting process the tip may be also somewhat flattened or tapered as is best seen in FIGURE 3.

The plate 12 is provided with cable apertures 23 on either side of the steel shank 16. These apertures 23 are normal to the face of the anchor plate 12 and are located near the centroid thereof.

Co-axial with the steel reinforcing shank 16 is an integral conical enlargement or rib 24 which begins near the apex 14 of the plate 12, where the rib has substantially the same thickness as the plate, becomes thicker and broader toward the center of the anchor 10 and terminates in vertical shoulders 26 just below the two cable apertures 23. In an anchor with an altitude of approximately four inches these shoulders extend about five-sixteenths of an inch beyond either face of the anchor plate 12 near the cable apertures 23.

If the shoulders 26 are thought of as the base of a cone the point of which coincides with the apex 14, another cone, somewhat truncated, has its narrow end at that base, the shoulders 26, between the two apertures 23 and becomes broader and thicker as it approaches the edge 18, thus forming a second rib 28. The end of this rib 28, in effect the base of the aforesaid truncated cone, is flat and flush with the edge 18 of the triangular plate 12. At the edge 18 the conical rib 28 is substantially wider than the thickness of the plate 12 as is most clearly shown in FIGURES 5 and 7.

The apertures 23 receive a connecting cable 30 which forms a loop 32 about one side of the truncated conical rib 28. The loop 32 rests on a shoulder 26 formed by the base of the rib 24. As will be seen in FIGURE 6 the height of the shoulder 26 above the apertures 23 is selected to be greater than the diameter of the connecting cable 30 so that the shoulder 26 protects the cable loop 32 from the highly abrasive action of hard or frozen ground on the cable during the installation process.

Furthermore, the diameter of the circular cross section of the rib 28 between the two apertures 23 is selected to prevent the connecting cable 30 from being bent too sharply at its loop 32, which if permitted might cause the wire to fail under tension. On the other face of the anchor 10 from the loop 32, the emerging cables are urged outward by the expanding rib 28 thereby minimizing any tendency of the wire to bend too sharply at the loop.

It will be noted that the connecting wire 30 is looped through the anchor 10 near the centroid of the triangular plate 12. This arrangement permits the ground anchor to automatically orient itself at substantially right angles to the line of pull upon the guy line, as will be further described hereinafter.

The connecting cable 30 carries a suitable guy line attaching eye 34 to which a guy cable 36 is ultimately attached. This connecting cable may be of any length between the anchor 10 and the eye 34, for instance two or three feet depending upon the application and depth of penetration contemplated.

FIGURE 1 and FIGURE 2 show the use of my improved ground anchor for lashing down an inflatable shelter 38. Two anchors 10 are driven into the ground on opposite sides of the shelter. This is accomplished by slipping one end of a suitable pipe over the protruding shank 20 and applying a series of sharp forceful blows, either by hammer or pneumatic tools, to the other end of the pipe in a generally vertical fashion or at any desired angle. Preferably the outside diameter of the pipe used as a driving tool should be a shade less than the diameter of the conical rib 28 at edge 18 against which the pipe abuts during insertion. Too small a pipe does not effectively transmit the applied force and if it is larger than the rib it will be too large for the path cleared by the anchor.

The anchor may be driven to any desired depth, depending upon the relative hardness of the soil, the length of the pipe employed as a driving tool, the length of the connecting cable, and the amount of tension expected from the application.

When the anchors 10 have been driven to a desired depth, the upper end of the connecting cable 30 will extend above the surface of the ground. This is then connected through the eye 34 to the guying cable 36 which is tightened until the desired degree of tension is achieved. When the connecting cable is placed under tension as illustrated in FIGURE 2 the anchors 10 will automatically change their positions in the ground and orient themselves in planes substantially at right angles to the lines of the pull of the guying cable 36. This occurs because the connecting cable 30 is looped through each anchor at the centroid of the triangular plate 12. As the tension in the cables 36 and 30 gradually increases the anchors 10 will shift from the nearly vertical positions shown in FIGURE 1 to the inclined positions of FIGURE 2 in which the anchors are shown at right angles to the line of the cables. In this position the anchors 10 offer maximum holding power because the entire triangular areas of the flat plates 12 are now resisting extraction from the ground.

Unlike many conventional anchors this device displaces relatively little soil as the anchor penetrates the ground. As a result the soil around the anchor remains well packed and undisturbed. The embedded anchor will therefore be firmly held and thus offer additional resistance to extraction.

An embodiment of the improved ground anchor particularly designed to facilitate retrieving is illustrated in FIGURES 9, 10, 11, 12, 13, 14, 15, 16 and 17.

The shape of this retrievable ground anchor designated generally by the number 40 is much like the ground anchor 10 previously described. The body portion is formed by a susbtantially flat triangular plate 42 having an apex 44 adapted for penetration into the ground. In profile, however, as can be seen in FIGURE 10 my retrievable ground anchor 40 has a double sawtooth configuration on one face 46 whereas the other face 48 remains flat. An aperture 50 at the centroid of the plate 42 receives a connecting cable 52. A second smaller aperture 54 considerably closer to the apex 44 of the plate 42 is adapted to receive a retrieving cable 56 which can be somewhat smaller than the connecting cable.

It will be noted in FIGURES 12 and 14 that both apertures 50 and 54 are wider at the flat face 48 than at the sawtooth face 46 of the plate 42. Both the connecting cable 52 and the retrieving cable 56 are inserted into their respective apertures 50 and 54. The cable ends 58 and 60 emerging at the flat face 48 are swaged thus increasing their diameters just enough to permit the swaged ends to seat within the widened openings of the apertures 50 and 54 but not to pull through the narrow necks of the said apertures.

This construction permits the swaged ends 58 and 60 to be seated completely within the anchor's body thus reducing abrasion on the cable ends during the insertion process. The seating of the swaged ends within the widened openings of the apertures 50 and 54 also leaves the flat face 48 of the anchor plate 42 unobstructed, further facilitating insertion into the ground. The swaging is a very simple means of attaching the cables 52 and 56 to the anchor 40 which can be accomplished if necessary in the field by handsized swaging pliers, without the need for heavy, bulky equipment.

The sawtooth profile 46 of the ground anchor 40 is formed by two half-conical ribs on one face of the anchor. The first integrally formed rounded rib 62 is pointed toward the apex 44 of the plate 42 and terminates in a shoulder 64 just below the retrieving cable aperture 54. A second integrally formed rounded rib 66 starts at a point just above the retrieving cable aperture 54 and broadens toward the connecting cable aperture 50 just below which it terminates in a second shoulder 68.

In some applications when the first shoulder 64 is smaller than the second shoulder 68 a groove 70 runs lengthwise along the second rib 66 as can be seen in FIGURE 9 and FIGURE 11. This groove 70 receives the retrieving cable during the insertion of the anchor 40 into the ground and thereby protects it.

A short cylindrical extension or lug 72 may be integrally formed centrally upon the edge 74 opposite the apex 44. The lug 72 is adapted to enter the bore of a driving pipe for insertion of the anchor 40 into the ground as is hereinafter described.

Although my retrievable ground anchor will generally be used in unfrozen ground, in some applications the additional strength given by an internal steel reinforcing shank may be desired. As shown in FIGURE 13 for those applications the lug 72 is omitted and instead an internal steel reinforcing shank 76 around which the anchor 40 is forged or cast, extends from the apex 44 along the altitude of the triangular plate 42 and protrudes beyond the edge 74 to form a short driving shaft 78. The shank 76 is reduced as indicated at its tip 80 to permit it to fit further into the apex 44. In order to assure easy flow of molten material around the shank during casting the tip 80 may be somewhat flattened or tapered. At a point corresponding with the centroid of the anchor plate 42 the shank 76 is flattened and pierced to form an eye 82 which is slightly larger than and concentric with the connecting cable aperture 50. A second eye 84 slightly larger than and concentric with the retrieving cable aperture 54 is formed in a flattened portion of the shank somewhat near the tip 80.

The installation process is identical with that already described. A driving tool such as a pipe is engaged at the upstanding plug 72 (or driving shaft 78) and the anchor driven into the ground. The same care taken in allowing for a sufficient length of connecting cable 52 to protrude above the ground must, of course, be taken with the retrieving cable 56. When the connecting cable 52 is attached to a guying cable and tension applied, the anchor 40 is pulled to a plane normal to the line of the tensioned cables and thus offers maximum resistance to extraction.

The end of the retrieving cable remains free above the earth until removal of the anchor 40 is desired. Tension is then removed from the connecting cable 52 and applied instead to the retrieving cable 56. Since the retrieving cable 56 is attached to the ground anchor 40 at a point quite near its apex 44, tension on the retrieving cable 56 upsets the anchor in the ground so that the apex 44 points upward and the anchor is readily pulled to the surface in this position.

Certain minor variations of this preferred embodiment will be apparent to those skilled in the art, and therefore it is not my intention to confine the invention to the precise forms herein shown, but rather to limit it in terms of the appended claims.

Having thus described and disclosed a preferred embodiment of my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A ground anchor comprising; a plate having a corner formed into a pointed apex; reinforcing means extending through said plate internally thereof from near said apex in a direction substantially in the plane of said plate, a conical rib coaxial with said reinforcing means extending from near said apex and outwardly from a margin of said plate opposite to said apex, means forming a path for a cable along one face of said plate through said plate substantially at the centroid thereof, and around said reinforcing means, means including an enlarged shoulder on said plate for preventing chafing said cable when said anchor is driven into hard ground with said cable in position around said reinforcing means, and said reinforcing means forming a driving lug for said anchor in the portion thereof where said reinforcing means extends outwardly therefrom.

2. A ground anchor comprising a plate having a corner terminating in an apex; a rib on said plate extending from said apex toward and terminating substantially at the centroid of said plate to form a shoulder on said plate, a steel rod extending internally through said plate generally in the plane thereof from near said apex coaxial with said rib and thence outwardly through a margin of said plate opposite to said apex, walls in said plate forming cable receiving openings in said plate substantially at the centroid thereof and on the side of said shoulder away from said apex, and means on said plate for guiding a cable from said openings to said margin in a path the height of which from the central plane of said plate is less than the maximum height of said shoulder from said plane plus the thickness of said cable.

3. A ground anchor comprising; a relatively thin and generally flat plate tapered to form a point; a steel shank extending internally of said plate from near said point through the margin opposite thereto, a portion of said shank extending beyond the said margin adapted to receive a driving tool, said plate having walls forming apertures in its central region on opposite sides of said internal steel shank, first and second tapered ribs formed integrally with the surfaces of said plate along the axis of said shank, said first rib beginning near said point and terminating in shoulders short of said apertures, said shoulders being higher than the thickness of a loop and standing ends of a cable passing through said apertures, said second rib beginning near the shoulders formed by said first rib and terminating flush with said edge opposite said point whereby said cable lying away from said loop is spread by said second rib.

4. A ground anchor comprising; a relatively thin and generally flat triangular body portion; a steel shank internal thereof extending from near an apex of said triangular body through the midpoint of the margin opposite said apex to form a short shaft for a driving tool, cable receiving apertures in said body portion located substantially at the centroid of said body portion on opposite sides of said shank, a conically tapered rib formed integrally with the body portion extending along the axis of the said shank broadening from the said apex and terminating in raised shoulders near the said apertures, each of said shoulders having a height above said plate greater than the diameter of a cable inserted in said apertures, and a truncated conically tapered rib coaxial with the axis of said shank originating from the above said shoulders and extending flush to the said margin opposite, the end of the said rib adjacent to said margin forming a flat face to be engaged by a driving tool.

5. A ground anchor device comprising; a relatively thin and generally flat triangular plate; a reinforcing steel shank internal of said plate extending from an apex of said triangle through said plate and emerging from a margin of said plate opposite said apex, said shank extending outwardly of said margin and adapted to receive means for driving the anchor into ground, a pair of transversely arranged cable receiving apertures near the centroid of said plate on opposite sides of said internal steel shank, a first rib integral with said plate extending from said apex forming rounded portions on and extending along opposite faces of said plate substantially coaxial with said steel shank and terminating abruptly in shoulders before reaching said transverse apertures, said shoulders extending above the combined thickness of said plate at said apertures and the thickness of cable looped therethrough, and a second rib formed integrally with the plate and extending therealong coaxial with said shank from a point adjacent said openings expanding outwardly and terminating at said margin causing a cable in said apertures to spread away from its loop.

6. A ground anchor comprising; a substantially triangular flat metal plate with a steel reinforcing shank internal thereof; the end of said shank near an apex of said triangle having a somewhat reduced dimension, said

steel shank coincident with an altitude of said triangle and extending through a margin of said plate opposite said apex, cable receiving apertures piercing said flat plate at the substantial centroid of said triangle on each side of said internal steel shank, first and second conical ribs, said first rib being formed integrally with both faces of said flat plate the point of said cone extending from said apex, with the base of said cone terminating in a shoulder on each face below said apertures, the thickness of the anchor at said shoulders being greater than twice the diameter of a cable passing through said apertures plus the thickness of said plate between said apertures, said second rib being frustoconical, formed integrally with both faces of said plate, extending from a point near the said apertures and terminating flush with said edge opposite said apex, whereby a cable looped through said aperture will spread outwardly from said loop beyond the edges of said second rib.

7. A ground anchor comprising; a plate having a corner formed into a pointed apex; a conical rib extending from said apex of said plate and outwardly from a margin of said plate opposite said apex; reinforcing means positioned within said conical rib, a portion of said reinforcing means positioned to extend beyond said margin and adapted to receive means for driving said anchor into the ground; means for connecting a cable to said plate at the substantial centroid thereof in such a way that said reinforcing means bears the tension of said cable when said anchor is in the ground and said cable is pulled; means for preventing chafing of a cable connected to said plate during driving of said anchor into unbroken ground; said reinforcing means comprising a steel shaft; and connecting means comprising walls forming cable receiving apertures transversely arranged on opposite sides of said shaft whereby the tension of a cable looped through said apertures is taken by said shaft.

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