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Johnson et al.

[11] **3,709,464**

[45] **Jan. 9, 1973**

[54] DEVICE FOR IMBEDDING AND REMOVING ELONGATED MEMBERS

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[52] **U.S. Cl.** ..... **254/29 R**

[51] **Int. Cl.** **E21b 19/00**

[58] **Field of Search** 254/29–31

[56] **References Cited**

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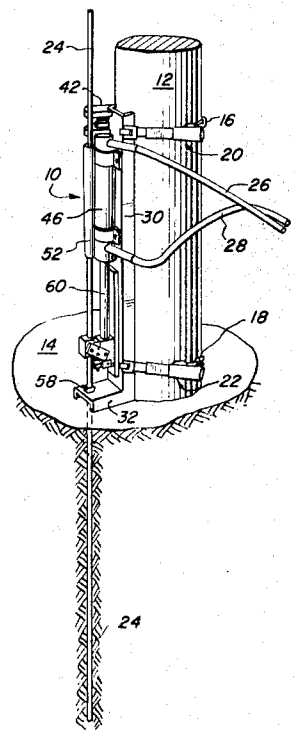
[57] **ABSTRACT**

This device for driving or forcing elongated members such as electrical ground rods into a penetrable solid such as the subsoil comprises a supporting frame which is releasably anchored in relation to the penetrable solid, the frame having mounted thereon a reciprocating driving means such as a double-acting hydraulic cylinder. The driving means reciprocates gripping jaws linked thereto. The linkage is such that the gripping jaws engage and grip the elongated member upon movement in one direction and release it in the opposite direction. Means are provided for readily adapting the device for reversal of the direction of the gripping and release movements.

2 Claims, 9 Drawing Figures



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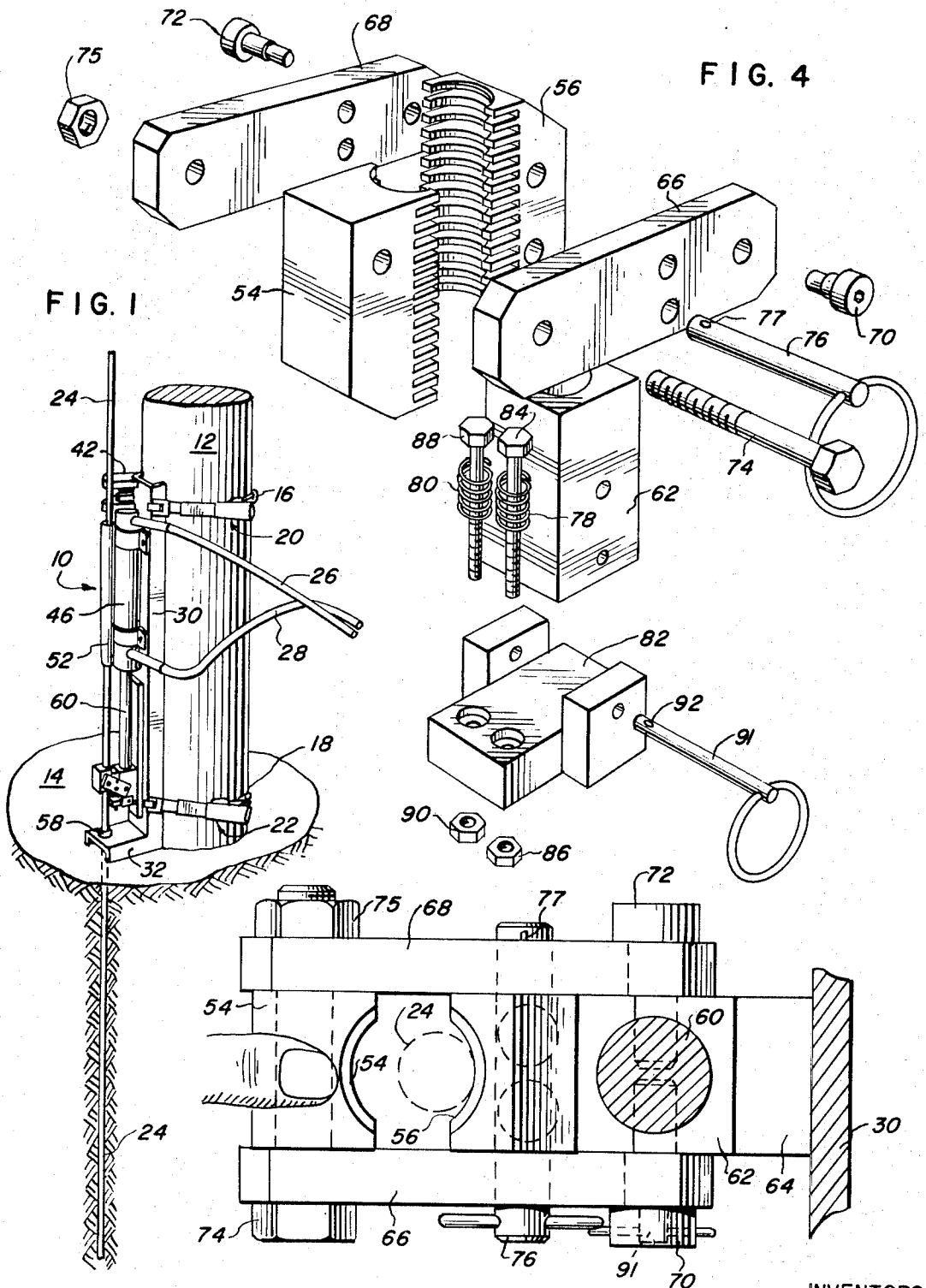

FIG. 1

FIG. 4

FIG. 5

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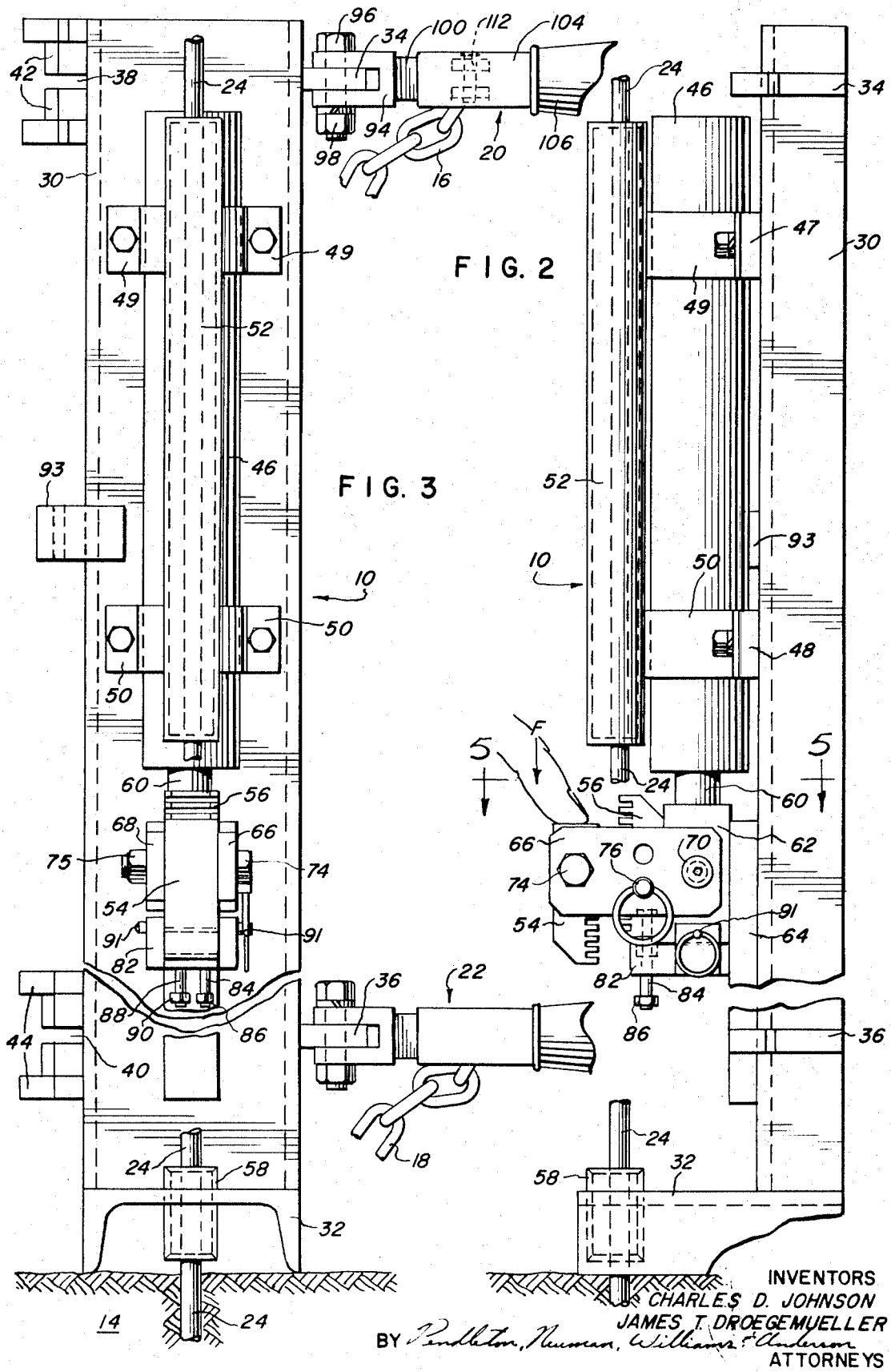

FIG. 2

FIG. 3

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FIG. 6

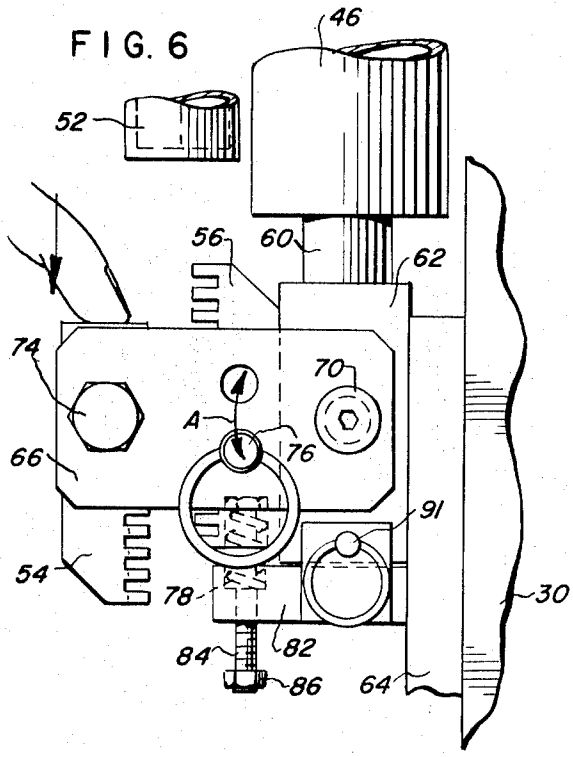


FIG. 7

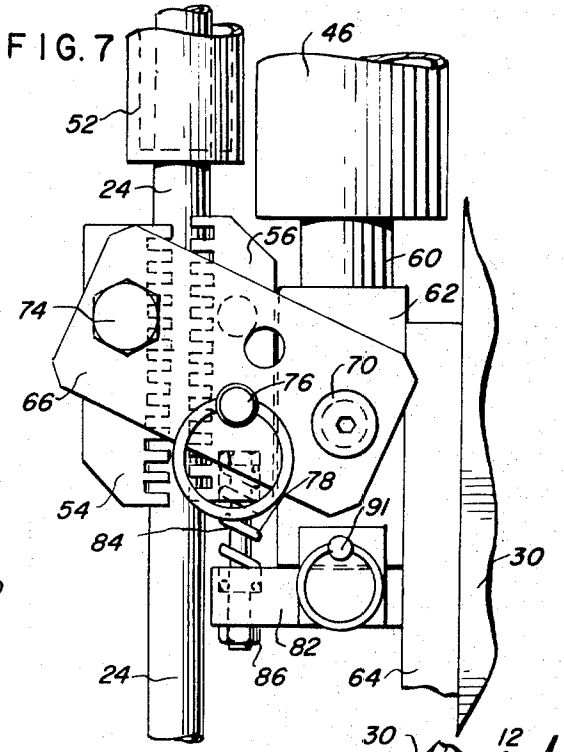


FIG. 8

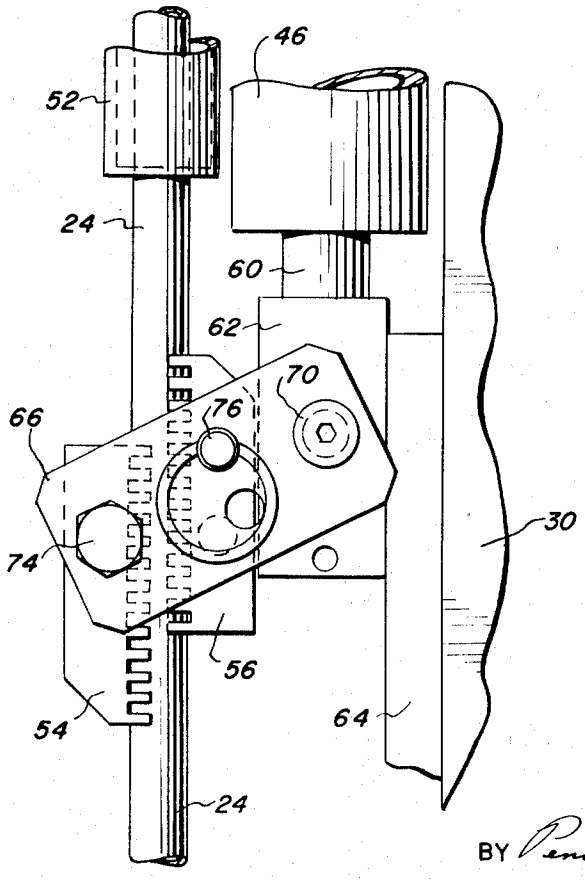
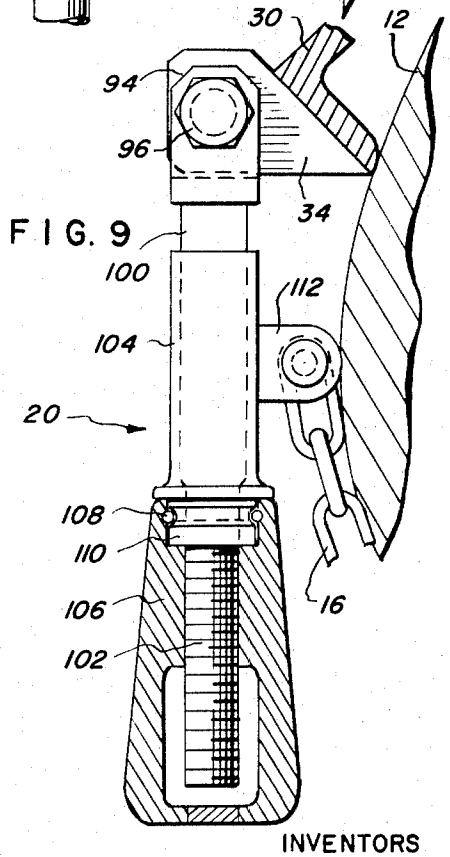


FIG. 9



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DEVICE FOR IMBEDDING AND REMOVING ELONGATED MEMBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a power-actuated device for imbedding elongated members such as electrical ground rods into penetrable solids or substrates such as the surrounding soil or subsoil. More particularly, it relates to a versatile, low cost, power-actuated, impact-free rod driver which requires but a single operator and is capable of driving or removing rods of any desired length with a minimum of physical damage.

While the present invention will be described with particular reference to an embodiment designed specifically for imbedding electrical ground rods in soil, it should be understood that the invention is not limited thereto. It can also be adapted for driving or imbedding any elongated member including fence posts and sign posts in various penetrable solids, as those skilled in the art will recognize in the light of the present disclosure.

2. Description of the Prior Art

Various techniques are employed for installing electrical ground rods, e.g., copper-coated steel rods, at substations and the like, ranging all the way from manually pounding the rod into the ground with a hammer or lightweight sledge to the use of various power-actuated devices for such purposes. Hand driving is time-consuming, inconvenient, and difficult to accomplish, particularly in the case of ground rods of extreme length, e.g., multi-section rods which may go down as much as 30 to 100 feet or more to reach and penetrate the strata of better conducting soils. The pounding may also damage the rod, and the whipping and bending of the rod as it is progressively hammered enlarges the hole, thereby decreasing contact area and interfering with the desired electrical grounding. These problems and the attendant high cost has led to the development of devices for rendering the manual technique more convenient or otherwise mechanizing the operation.

One crude approach is to apply a driving head to the rod at an intermediate point whereby the rod is gripped for convenient manual driving. A specific embodiment employed for post driving is illustrated, for example, in U.S. Pat. No. 2,330,360. The tediousness and inefficiencies associated with such hand-driven devices are manifest, as outlined above. In addition, in the case of extremely long posts or rods, the driving head must be repeatedly and manually removed and moved along the rod for an additional "bite," as insertion proceeds.

The mechanization of the operation has included rod grippers which are pounded by air hammers or the like, the grippers being progressively moved along the rod by means of quick release handles and the like. Illustrative of such devices is the rod driver of U.S. Pat. No. 3,034,588. Such device is cumbersome, and, as a practical matter, requires two people to operate, one to hold and operate the air hammer or other impact means and the other to progressively position the rod gripper along the rod as it is progressively inserted. In addition, the device relies upon substantially sharp teeth to achieve the requisite grip on the rod; resulting in excessive physical damage, marring of any surface coating and the like. Moreover, while the device is intended for both rod driving and rod removal, the rod removal technique requires removal and reversal of the device on the rod and is otherwise awkward and inconvenient. It is also sometimes inoperative when only a small portion of the rod protrudes above the ground, leaving insufficient space for application of the air hammer.

Still other techniques include the erection of stands or guide rigs so that the rod can be pounded from the top using various power-actuated hammers, including air hammers, electrical hammers and self-contained gasoline powered hammers. Such alternatives are cumbersome, time-consuming and expensive. Such equipment is also very heavy and difficult to maneuver and requires more than one man to operate. In many instances it can not be readily adapted for rod removal purposes. Adjustments must be made to accommodate rods or couplings of different diameters and lengths. In addition, such techniques require special adapters to prevent damage to the rod, particularly at the top, as the result of the impact forces. As aforementioned, the high impact forces also may cause excessive whipping or bending of the rod and undesired hole enlargement.

OBJECTS OF THE INVENTION

It is therefore a general object of the present invention to cope with these and other problems associated with prior art devices. It is another general object to provide a power-actuated, impact-free device for imbedding elongated members in penetrable solids, which device can be readily adapted for removal purposes also.

It is a more specific object to provide a fast-acting, rod driving and rod removal device which can be efficiently operated by a single operator. It is another specific object to provide a power-actuated rod driving and rod removal device which may be powered by conventional hydraulic systems. It is still another specific object to provide a power-actuated driving and removal device wherein the insertion and removal forces are substantially uniformly and smoothly applied without impact forces and without excessive hole enlargement.

It is still another specific object to provide a smooth-acting rod driver wherein the insertion forces are applied adjacent the penetrable body with a minimum of rod whipping or bending. It is a still further object to provide a rod driving device wherein the driving forces enhance the gripping forces, whereby the greater the driving force the greater the gripping action. It is a still further object to provide a rod driving and removal device which does not excessively mar the surface or otherwise damage the rod. It is a still further object to provide a rod driving and removal device which can accommodate rods of varying or different diameters and lengths without complicated adjustment.

These and other objects of the present invention will become apparent as the detailed description thereof proceeds.

SUMMARY OF THE INVENTION

These objects are achieved in a particular embodiment by a driver comprising a supporting frame which is releasably anchored to an adjacent, substantially immovable, structure. The frame supports a reciprocating drive means such as a double-acting hydraulic cylinder

which carries a jaw support head at the end of the reciprocating piston rod. The jaw support head has spaced parallel arms pivotally mounted and extending outwardly therefrom so as to straddle the elongated member to be imbedded.

Outer and inner gripping jaws are pivotally mounted at spaced intervals on the parallel arms. As will become apparent from the drawings hereinafter, the linkage of the gripping jaws and parallel arms is such that the jaws grip the rod when the driving means moves in one direction and releases the rod on the return stroke. The linkage is also readily adjustable whereby the gripping and release action may be reversed without physically removing and reversing the device. Thus, the rod may be pushed or pulled in either direction, as desired, the two modes of operation being referred to hereinafter as the insertion mode and the removal mode, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more clearly understood from the following detailed description of a specific embodiment, read in conjunction with the accompanying drawings, wherein:

FIG. **1** is a perspective view of the device of the present invention anchored to a utility pole and in the process of inserting an electrical ground rod;

FIG. **2** is a fragmentary side elevation view of the device on an enlarged scale with the rod gripping jaws in the insertion mode but manually depressed to the open position;

FIG. **3** is a fragmentary front elevation view with the rod gripping jaws in the same position as in FIG. **2**;

FIG. **4** is an exploded perspective view on a further enlarged scale of the rod gripping jaws and associated linkage;

FIG. **5** is an enlarged fragmentary section view on the line **5**—**5** of FIG. **2**;

FIG. **6** is a fragmentary side elevation view on a scale somewhat larger than FIG. **2** and, as in FIG. **2**, showing the rod gripping jaws in the insertion mode and depressed to the open position;

FIG. **7** is a fragmentary side elevation view similar to FIG. **6** but showing the rod gripping jaws closed on a ground rod preparatory to rod insertion;

FIG. **8** is similar to FIGS. **6** and **7** but depicting the gripping jaws in the rod removal mode; and

FIG. **9** is an enlarged fragmentary plan view in partial section showing the adjustable handle means for anchoring the device to a utility pole or the like.

It should be understood that graphic symbols are employed in the drawings and that the drawings are not necessarily to scale. It should also be understood that details shown in some figures may be omitted in other figures for simplicity and to facilitate illustration of still other details. Thus the drawings may depart in certain respects from actual appearances when visually observed. It should also be understood, of course, that the invention is not necessarily limited to the particular embodiment illustrated.

DETAILED DESCRIPTION OF THE DRAWINGS, INCLUDING PREFERRED EMBODIMENT

Referring to FIG. **1**, apparatus **10** of the present invention is releasably anchored to utility pole **12** adjacent the ground **14** by means of chain loops **16** and **18**, which are tightened by chain tighteners **20** and **22**, respectively. Apparatus **10** is thus disposed in its insertion mode to force ground rod **24** to the desired depth in ground **14**. While ground rod **24** is depicted as a single rod, it may in fact be a multi-sectioned rod having threaded ends which are coupled together by means well known to those skilled in the art.

Apparatus **10** in the present exemplar is hydraulically actuated by means of hydraulic fluid, e.g., compressed air, hydraulic oil, or the like, introduced and returned to a source (not shown) by means of hydraulic lines **26** and **28**. One of the advantages of the present invention is that it may be hooked up to already existing hydraulic systems, thus avoiding the expense of specially designed systems.

Referring to FIGS. **2** and **3**, apparatus **10** comprises upright frame or stand **30** which is supported on the ground by horizontal portion **32** which is welded and otherwise secured thereto. Frame **30** is held against the anchoring structure, such as utility pole **12** (FIG. **1**), by the aforementioned chain loops **16** and **18**. One end of each of these chains is linked or pinned to chain tighteners **20** and **22**, respectively, the chain tighteners in turn being pivotally mounted on side brackets **34** and **36**, respectively, of stand **30**. A remote link of each of the chains is inserted into slots **38** and **40** formed between the upper and lower portions of side brackets **42** and **44**, respectively. The chains are tightened by chain tighteners **20** and **22** as described in greater detail hereinafter in connection with FIG. **9**. Since chains **16** and **18** may be of any selected length, it is apparent that the apparatus may be secured to anchoring structures of almost any girth.

Double-acting hydraulic cylinder **46**, having pads **47** and **48** welded thereto, is immovably secured to frame **30** by the indicated bolts which pass through corresponding apertures in pads **47** and **48** and frame **30**. These bolts also pass through aligned apertures in brackets **49** and **50**, which support upper hollow cylindrical rod guide **52**, and thereby similarly secure the latter to frame **30**. Guide **52** is disposed above and in general alignment with the outer and inner jaws **54** and **56** of the gripping mechanism. Guide **52** is also aligned with the lower hollow cylindrical rod guide **58**, which is mounted on and through the horizontal portion **32** of stand **30**, adjacent the ground line.

The piston rod **60** of hydraulic cylinder **46** is reciprocated by conventional hydraulic circuitry (not shown) whereby rod **60** is reciprocally extended and retracted in vertical orientation when the apparatus is operated. Secured to the end of rod **60** is jaw support head **62**, which is in sliding engagement with stationary vertical backing bar **64** on stand **30**.

As shown in FIGS. **2**–**5**, lateral linkage plates **66** and **68** are pivotally mounted adjacent the sides of support head **62** by means of stripper bolts **70** and **72**, respectively, which are threaded into the threaded apertures of the support head. While a separate support head at the end of cylinder rod **60** is employed in this exemplar, it should be understood that the support head could be omitted and the structures modified so that the linkage plates could be pivotally secured to the rod itself. Such alternative is considered an equivalent of the structure depicted and claimed hereinafter.

Linkage plates **66** and **68** pivotally support outer and inner jaws **54** and **56** by means of bolt and nut combination **74** and **75** and removable pin **76**, respectively. Removable pin **76** is held in position by means of detent means **77** adjacent the entering end thereof. As will become apparent hereinafter, in the insertion mode removable pin **76** is inserted in the lower intermediate apertures of linkage plates **66** and **68** and the aligned lower aperture of inner jaw **56**. In the removal mode it is inserted in the upper intermediate apertures of linkage plates **66** and **68** and the aligned upper aperture of inner jaw **56**.

As viewed in FIGS. **6** and **7**, which depict the insertion mode, outer and inner jaws **54** and **56** and linkage plates **66** and **68** are biased in a clockwise direction by means of compressed springs **78** and **80**. The end-adjacent portions of springs **78** and **80** are housed in side-by-side cylindrical recesses in the lower surface of inner jaw **56** and aligned cylindrical recesses in the upper surface of bracket **82**.

Springs **78** and **80** are retained by means of bolt and nut combinations **84** and **86** and **88** and **90**, respectively, the elongated shanks of which slidingly pass through concentric cylindrical apertures in the recesses of bracket **82**. Bracket **82** is removably secured to support head **62** by means of removable pin **91**, which passes through aligned apertures in the upstanding arms of bracket **82** and the lower portion of support head **62**. Removable pin **91** is retained in its inserted position by detent means **92** (FIG. **4**). As will become apparent hereinafter, bracket **82** is removed to convert the device from its insertion mode to the removal mode.

As shown in FIGS. **2**, **3**, **5** and **6**, wherein the jaw linkage is counterbiased in a counterclockwise direction by finger pressure resulting in force F, jaws **54** and **56** are widely spaced so as to receive rods or couplings of various diameters. When counter-biasing is removed, the jaws close, as shown in FIG. **7**, so as to incipiently grip rod **24**. The arc of movement of the inner jaw between the open and closed positions in the insertion mode is indicated in FIG. **6** by arc A. It will be noted that the inner jaw initially moves away from and then back towards support head **62** as the jaws close.

When piston rod **60** is extended downwardly, the linkage is such that jaws **54** and **56** tightly grip the rod and smoothly force it downwardly without jolting impact. The greater the required insertion forces, the greater the gripping action. As piston rod **60** reaches the end of its downward travel and commences the return stroke, the linkage is such that the jaws release rod **24** and slidingly return along the rod to the upper position for another grip on a higher portion of rod **24** preparatory to the next insertion stroke. This operation is repeated until the rod is inserted to the depth desired.

The removal mode of the present invention is illustrated in FIG. **8**. In this mode, pin **91** is removed, as aforementioned, so as to release bracket **82** with springs **78** and **80** and retainer bolt and nut combinations **84–86** and **88–90**. To minimize the chances of misplacing or losing bracket **82** and associated parts when removed, it may be pinned by means of pin **91** to the retainer bracket **93** on the side of stand **30** (FIG. **3**).

Also, as aforementioned, in the removal mode pin **76** is removed from the lower intermediate apertures in linkage plates **66** and **68**. The upper intermediate apertures are then aligned with the upper aperture on inner jaw **56**, and the pin reinserted in the aligned apertures.

Thus, in the removal mode, the pivotal axis of inner jaw **56** is now above, instead of below, a plane through the pivotal axes of linkage plates **66** and **68** and outer jaw **54**. The relationship of these parallel axes determines the direction of movement of the rod. In the insertion mode, the pivotal axis of inner jaw **56** is below a plane through the pivotal axes of linkage plates **66** and **68** and outer jaw **54**. In the removal mode it is above. In other words, the pivotal axis of the inner jaw is disposed, in relation to the other axes, in the direction of desired movement.

In the removal mode of FIG. **8**, the gripping jaws **54** and **56** are gravitationally biased in a counterclockwise direction whereby they incipiently grip rod **24**. When piston rod **60** is retracted upwardly, the linkage is such that jaws **54** and **56** grip rod **24** and pull it upwardly. At the end of the upward stroke, jaws **54** and **56** release their grip on rod **24** and slide downwardly on the rod as piston rod **60** is again extended. On the next upward stroke, the gripping action is repeated. The operation is continued until the rod is completely removed or removed to the extent desired.

In an illustrative specific embodiment, the piston of cylinder **46** has an effective area of about three square inches in the downward direction and the hydraulic system is capable of supplying hydraulic oil up to about 2,000 psi. Thus, a force of as much as three tons is available at the gripping jaws for rod insertion. The effective piston area on the upstroke is less, but this presents no difficulty because requisite rod removal forces are usually substantially less than rod insertion forces.

The operation of chain tightener **20** (and identical chain tightener **22**) is illustrated in FIG. **9**. U-shaped bracket **94** is pivotally bolted to bracket **34** of stand **30** by bolt and nut combination **96** and **98** (FIG. **3**). Square-shaped shaft **100** with threaded cylindrical extremity **102** extends from bracket **94** and telescopes within hollow square shaft **104** having rotatable fluted handle **106** with mating threaded interior. Conventional ball bearings **108** and thrust bearing **110** permit fluted handle **106** to be rotated under load and to move shaft **104** with chain connector bracket **112** relative to shaft **100** and thus stand **30**.

When anchoring the device to a utility pole or the like, stand **30** is placed against the pole as illustrated in FIG. **1** and fluted handle **106** is rotated so that shaft **100** extends substantially from shaft **104**. Chain **16** is looped around the pole and a link (the closest link possible) inserted in slot **38** (FIG. **3**). Fluted handle is then rotated to tighten chain **16** to the desired extent, thereby anchoring the device. Chain tightener **22** is similarly utilized to tighten chain **18**.

From the above description and drawings, it is apparent that the objects of the present invention have been achieved. While only certain embodiments have been described or illustrated, many alternative modifications and equivalents will be apparent from the above description to those skilled in the art. These and other alternatives and equivalents are considered within the spirit and scope of the present invention and coverage thereof is intended by the claims of any patents based on this application and any continuations

or divisions thereof, even though not necessarily encompassed by the strict verbiage thereof.

Having described the invention, what is claimed is:

1. A device for imbedding elongated members in, or removing the same from, a penetrable solid, said device comprising in combination:

a. a supporting frame;

b. means for releasably anchoring the frame in substantially fixed relation to the penetrable solid;

c. reciprocating driving means mounted on said frame;

d. jaw support means disposed to be reciprocated by said reciprocating driving means;

e. spaced, parallel arms pivotally mounted on said jaw support means and extending outwardly therefrom and disposed to receive the elongated member therebetween;

f. an outer gripping jaw pivotally supported by and between said parallel arms adjacent the outer extremities and having an inner gripping surface disposed upon reciprocation to grip the elongated member; and

g. an inner gripping jaw pivotally supported by and between said parallel arms in inwardly spaced relationship from said outer jaw whereby the elongated member may be disposed therebetween, said inner gripping jaw having a frictional gripping surface on the outer surface thereof disposed upon reciprocation to grip the elongated member in opposed relationship to the outer gripping jaw;

the pivotal axes of said parallel arms and said gripping jaws being parallel and the pivotal axis of said inner jaw being spacedly disposed, in relation to a plane through the pivotal axes of said parallel arms and said outer jaw member, in the direction of desired movement of said elongated member.

2. The device of claim 1 including means for interchangeably pivotally mounting said inner jaw on either side of said plane so as to adjust the direction of the gripping action.

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