

May 29, 1956

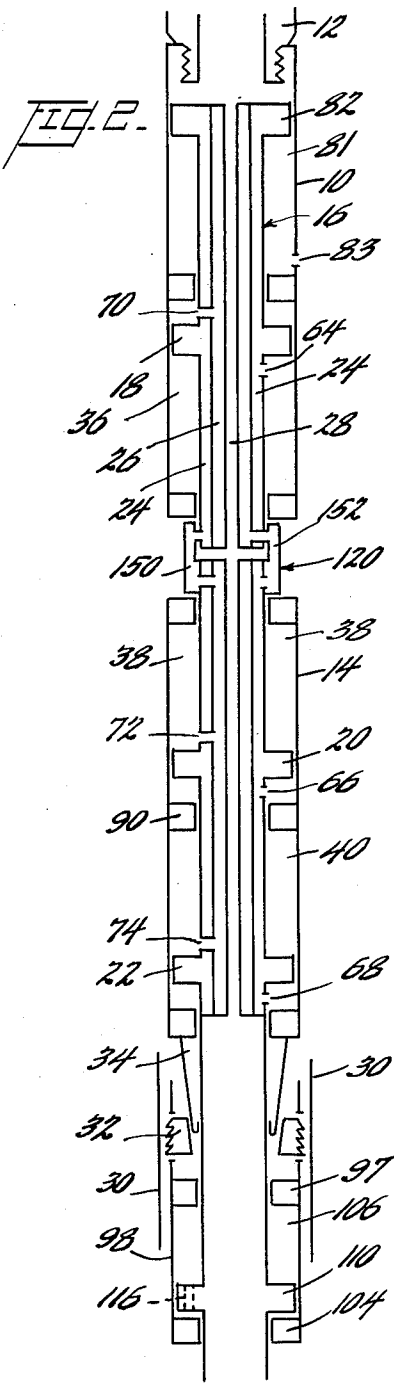
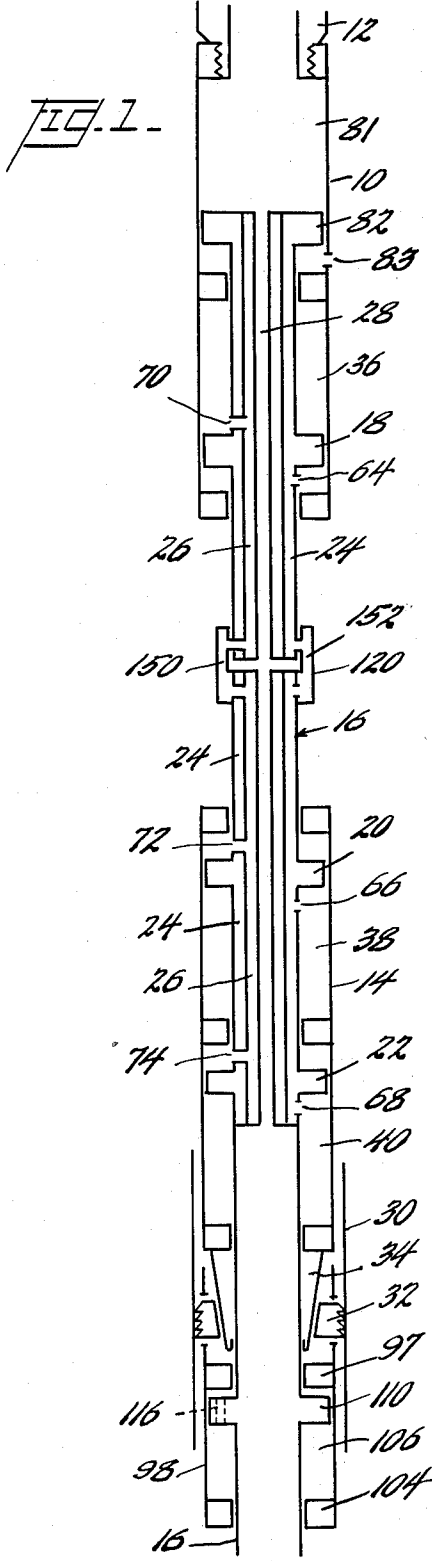
R. R. LAWRENCE

2,747,673

PULLING TOOL

Filed Oct. 23, 1952

6 Sheets-Sheet 1



INVENTOR

Richard R. Lawrence

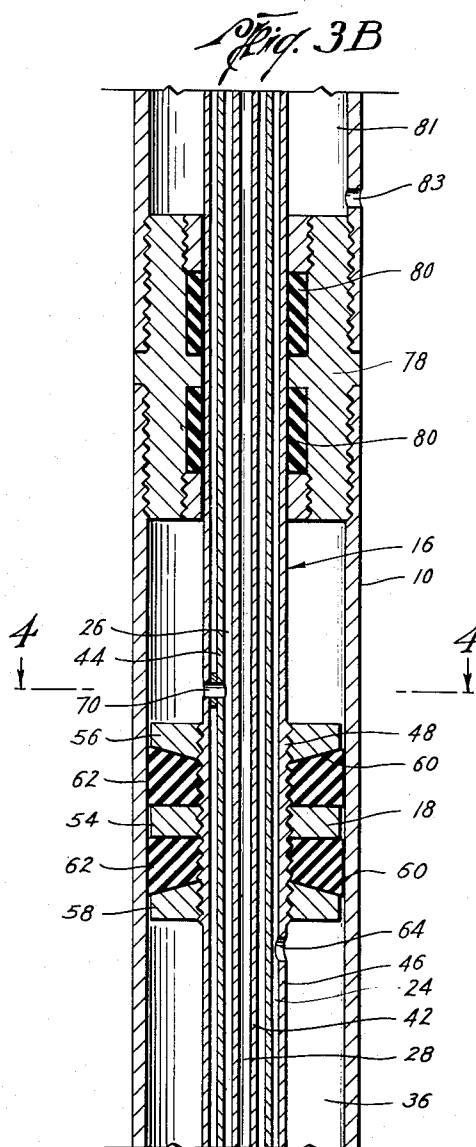
BY Charles E. Lightfoot

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2,747,673

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6 Sheets-Sheet 2



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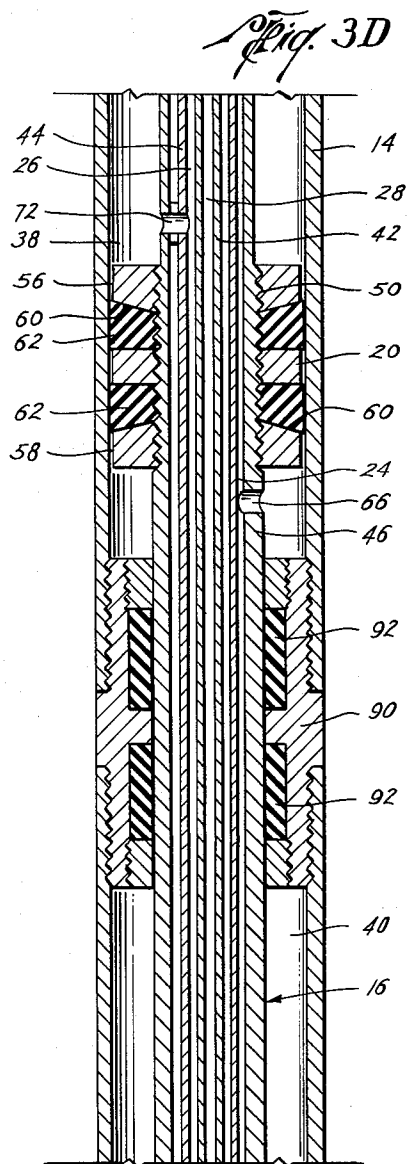
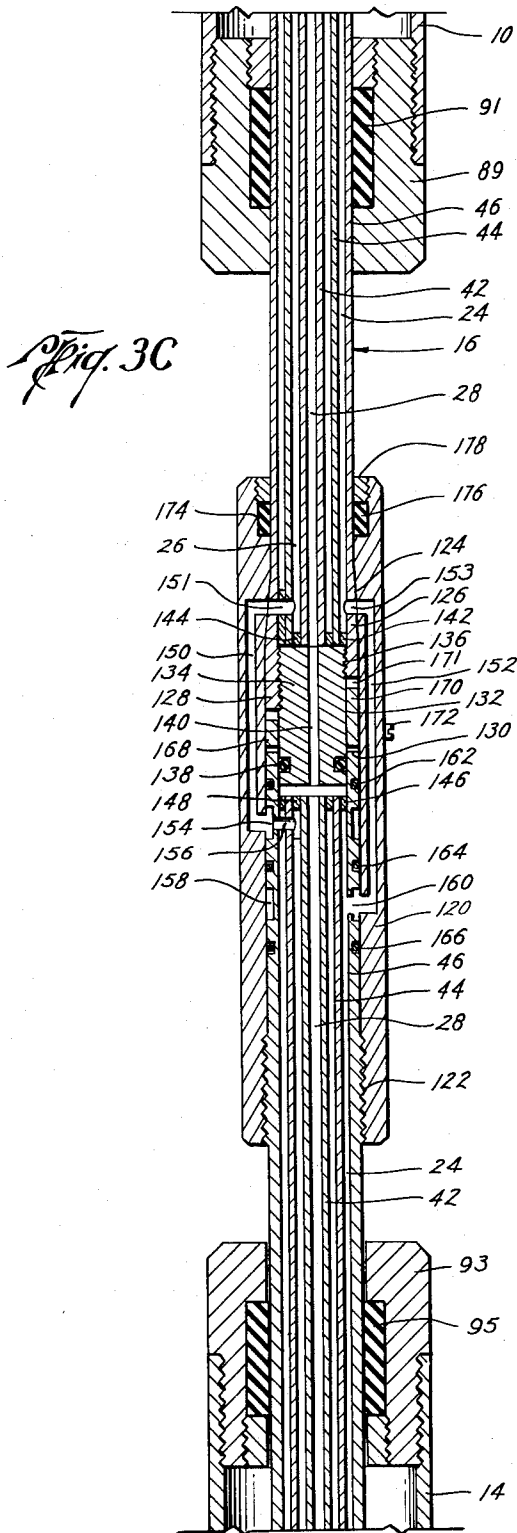
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6 Sheets-Sheet 3



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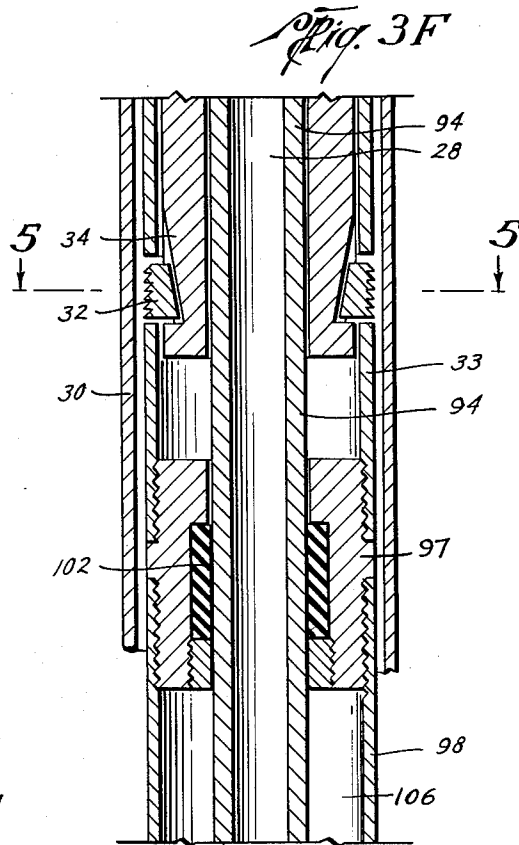
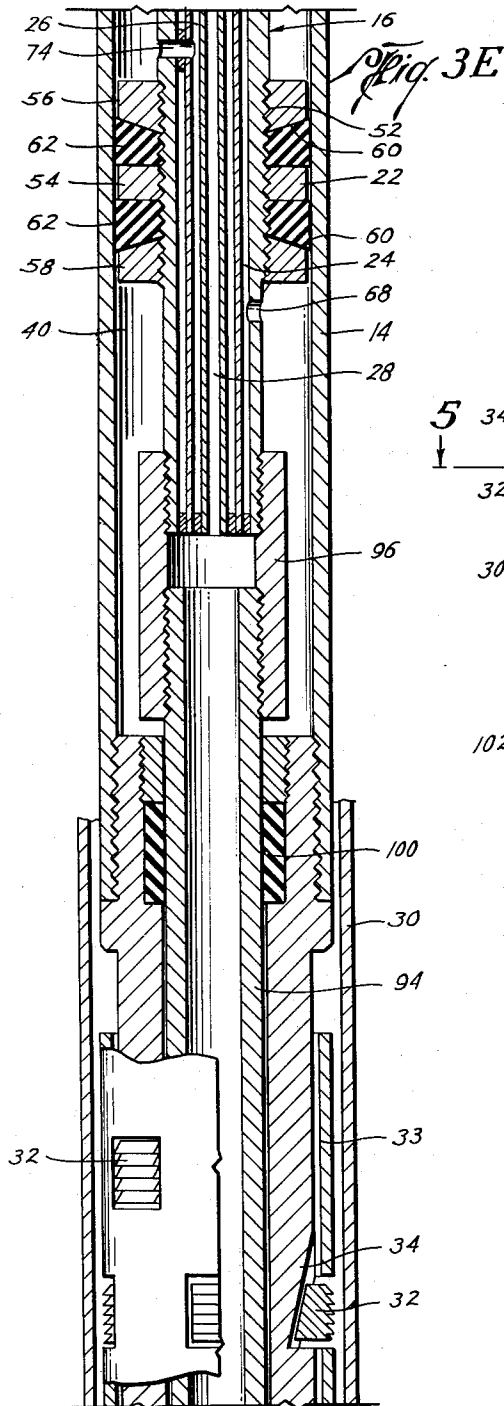
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6 Sheets-Sheet 4



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PULLING TOOL

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Fig. 36

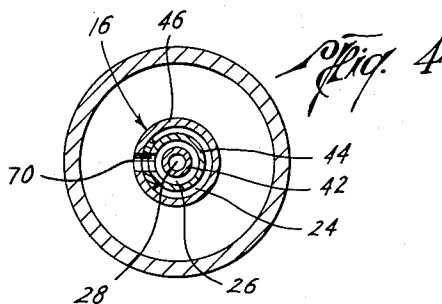
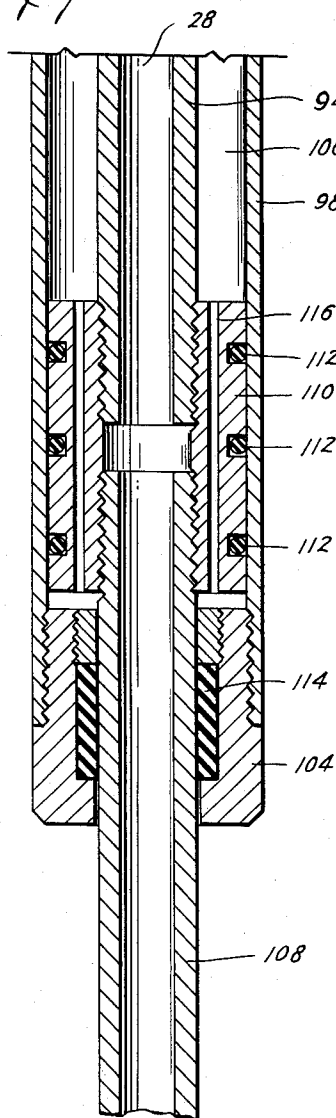


Fig. 4

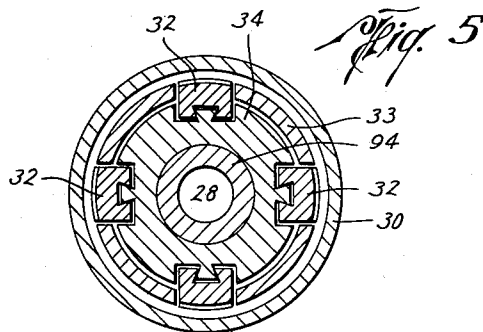


Fig. 5

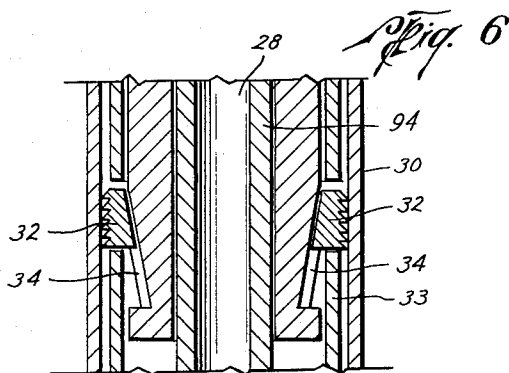


Fig. 6

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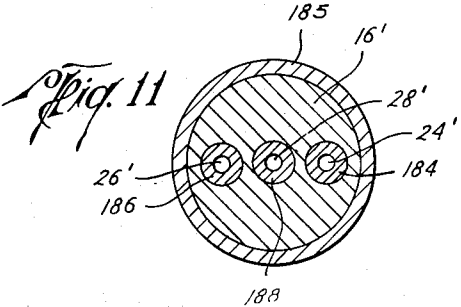
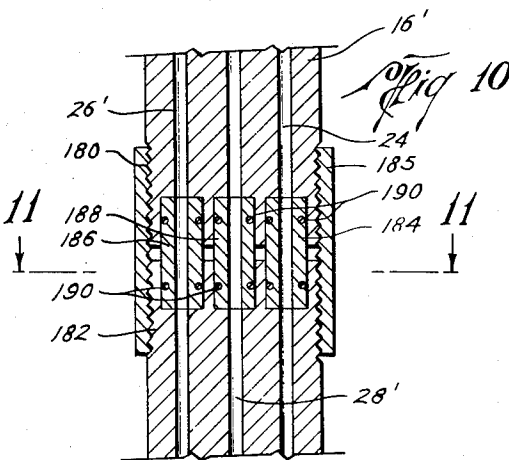
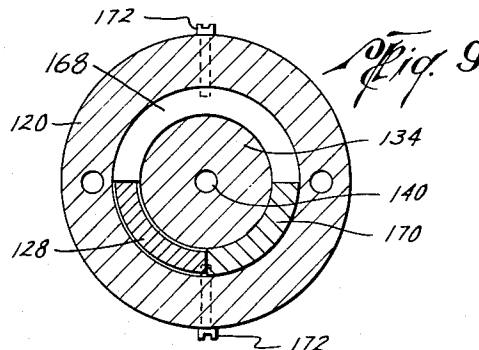
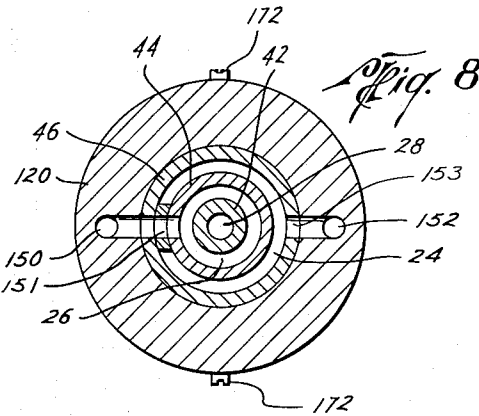
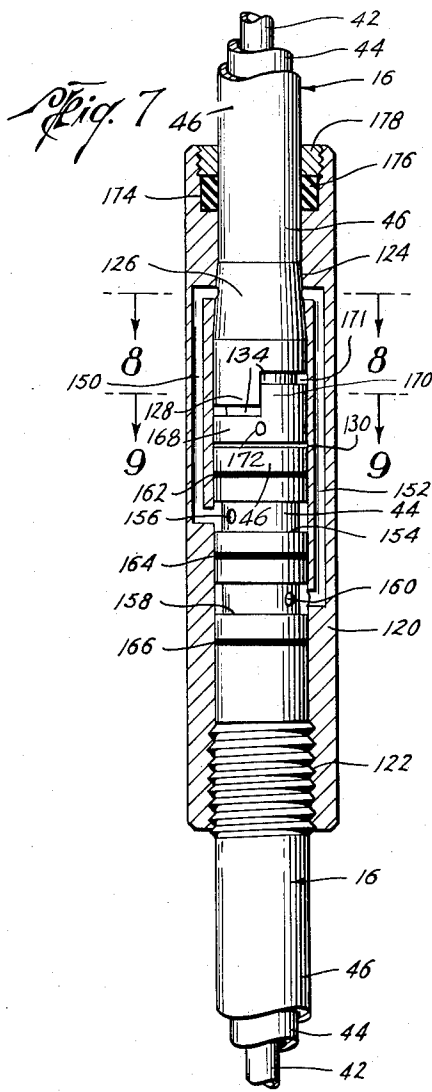
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2,747,673

PULLING TOOL

Filed Oct. 23, 1952

6 Sheets-Sheet 6



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2,747,673

PULLING TOOL

Richard R. Lawrence, Liberty, Tex.

Application October 23, 1952, Serial No. 316,410

13 Claims. (Cl. 166—98)

This invention relates to a pulling tool and more particularly to a tool for use in wells for releasing and removing stuck objects therefrom and which is hydraulically operated.

An important object of the invention is to provide a hydraulically operated pulling tool having a closed fluid system in which the introduction of pressure fluid from outside of the tool is unnecessary, and which is operable by manipulation of an operating string to develop hydraulic pressure through which a pulling force is exerted on an object stuck in the well.

Another object of the invention is the provision of a pulling tool of the kind referred to having a closed liquid filled system operable to produce hydraulic pressure, and including mechanism responsive to the hydraulic pressure in the system for exerting a pull on a stuck object.

A further object of the invention is to provide a pulling tool which includes mechanism operable by manipulation of an operating string or pipe for delivering liquid under pressure, and means responsive to the pressure of the liquid for exerting a pull on an object stuck in a well.

Another object of the invention is to provide a pulling tool of the character described, which is actuated by a pulling force applied to the string from which it is supported, and which embodies hydraulic means energized by such pull on the string but by means of which a pulling force is exerted on an object stuck in the well, which force is many times greater than the mechanical force applied to the string.

More particularly, the invention contemplates the provision in a pulling instrumentality of the class described, of a closed-circuit pump-and-motor combination wherein the driven element of the motor is adapted to be connected, by means of a grapple, to the fish or object to be removed from the well, and the active or driving element of the pump is connected to and reciprocated by the suspending string of pipe; and in which certain novel valving means are provided in the fluid connections between the pump and motor units for reversing the action of the motor element and for "short-circuiting" or relieving load from the pump portion.

The invention also embodies a pulling tool of the hydraulic type having an upper and a lower cylinder, pistons movably disposed in the cylinders, means for delivering hydraulic fluid under pressure from one side of the piston in the upper cylinder to one side of the piston in the lower cylinder and for delivering hydraulic fluid from the other side of the piston in the lower cylinder to the other side of the piston in the upper cylinder, means for anchoring the lower cylinder to the well casing, and means for moving the upper cylinder longitudinally relative to the piston therein to apply pressure to a hydraulic fluid in the tool.

Another object of the invention is the provision of a pulling tool of the hydraulic type, having a lower cylinder with means for anchoring the same to a sur-

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rounding well casing, an upper cylinder connected in fluid flow relation with the lower cylinder, pistons in the cylinders connected together and connected with a grapple and arranged to be actuated by liquid under pressure in the cylinders upon longitudinal movement of the upper cylinder.

The above and other important objects and advantages of the invention will best be understood from the following description, constituting a specification of the same, when considered in conjunction with the annexed drawing, wherein—

Figure 1 is a diagrammatic cross-sectional view of the invention, showing the relative positions of the parts with the tool in anchored position in a well, during a pulling operation;

Figure 2 is a view similar to that of Figure 1 showing the relationship of the parts when the tool is in released condition;

Figures 3A and 3B are fragmentary, cross-sectional views of the upper portions of the pulling tool including the pumping mechanism;

Figures 3C, 3D, 3E, 3F and 3G are fragmentary, cross-sectional views, showing the lower portions of the tool including the motor member and the valving;

Figure 4 is a cross-sectional view taken along the line 4—4 of Figure 3B, looking in the direction indicated by the arrows;

Figure 5 is a cross-sectional view taken along the line 5—5 of Figure 3F, looking in the direction indicated by the arrows;

Figure 6 is a fragmentary, vertical, cross-sectional view of a preferred form of anchoring means employed in the invention, the same being shown in anchoring position in gripping engagement with a surrounding well casing;

Figure 7 is a fragmentary, side elevational view, partly in cross-section, showing the intermediate or valving portion of the tool illustrated in Figure 3C;

Figure 8 is a cross-sectional view taken along the line 8—8 of Figure 7, looking in the direction indicated by the arrows;

Figure 9 is a cross-sectional view taken along the line 9—9 of Figure 7, looking in the direction indicated by the arrows;

Figure 10 is a fragmentary cross-sectional view of a somewhat modified form of connection employed in the invention; and

Figure 11 is a cross-sectional view taken along the line 11—11 of Figure 10, looking in the direction indicated by the arrows.

Referring now to the drawings in greater detail, wherein a preferred embodiment of the invention is illustrated diagrammatically in Figures 1 and 2, and in more detail in Figures 3A to 3G inclusive, the numeral 10 designates an upper or pump cylinder adapted to be connected at its upper end to the lower end of an operating string 12. A lower or motor cylinder 14 is positioned beneath the upper cylinder, and there is an inner connecting stem or plunger rod 16 which extends into the upper and lower cylinders, and is provided within the upper cylinder with an actuating pump piston or plunger 18, and within the lower cylinder with a number of longitudinally spaced motor pistons or plungers, such as those indicated at 20 and 22. It will, of course, be understood that the lower cylinder may be made as long as may be desired, and that as many pistons may be positioned therein as required to obtain the necessary or desired pulling force when the tool is operated, only two such pistons being shown in the drawings which are intended by way of example only. The connecting stem or plunger rod 16 is provided with a passageway 24 which is in communication at 64 with the upper cylinder 10 beneath the piston 18 and with the lower cylinder 14

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beneath the pistons 20 and 22, as at 66 and 68. The connecting stem also has a passageway 26, which is in communication at 70 with the cylinder 10 above the piston 18 and in communication with the lower cylinder 14 above the pistons 20 and 22 therein as at 72 and 74. The connecting stem 16 also has a central by-pass bore 28 there-through, through which fluid may pass from the operating string into the well beneath the tool, or may flow in the opposite direction through the tool.

Anchoring mechanism is also provided for anchoring the lower cylinder to a surrounding well casing, indicated at 30, the anchoring mechanism including casing engaging slips or gripping members 32, carried by a slip cage 33 mounted on the stem and a tapered slip actuating member 34, carried by the lower cylinder 14 and positioned to engage the slips 32 to move the slips into gripping engagement with the casing upon downward movement of the lower cylinder relative to the connecting stem.

The piston 18 moves in a closed chamber 36 in the upper cylinder, and the pistons 20 and 22 move in closed chambers 38 and 40, respectively, within the lower cylinder, and the chambers and passageways 24 and 26 of the stem are completely filled with hydraulic fluid, thus forming a closed hydraulic system.

The stem 16 extends downwardly beyond the lower cylinder and is connected by any suitable means such as the elements 95 and 108 as described below to a grapple tool of any preferred type which is adapted to engage and grip an object to be removed from the well.

In making use of the invention the tool, attached to the lower end of the operating string, is lowered into the well in the condition shown in Figure 2, until the grapple on the lower end of the connecting stem is brought into gripping engagement with the object to be removed.

The coupling assembly indicated generally at 120 will be described at greater length further along in the specification, but it is sufficient for present purposes, to state that the parts of this coupling are relatively rotatable to selectively present the passageways 150 and 152 to the passageways of the two sections of the pipe 16, so as to connect the upper portion of passageway 24 to the lower portion of passageway 24 and the upper portion of passageway 26 to the lower portion thereof, or by reversal to connect the upper portion of passageway 24 to the lower portion of passageway 26 and the upper portion of passageway 26 to the lower portion of passageway 24. Thus, in the condition for lowering the tool in the well, shown in Figure 2, the weight of the piston rod or tension element 16 and the lower cylinder 14, the grapple tool, etc., will tend to cause fluid to flow from beneath piston 18 through opening 64, upper portion of outer passageway 24, coupling passageway 150, lower portion of passageway 26, and openings 72 and 74 into the chambers 38 and 40 above the motor pistons 20 and 22, thus maintaining the motor cylinder 14 and the slip actuating portions 34 in their upper inactive positions.

When the grapple is engaged with the fish or obstruction, the string 12 and its attached pump cylinder 10, and the upper portion of the piston or tension member 16 (which is splined or otherwise nonrotatably secured to the cylinder 10), the string is rotated through such an angle (as later described in detail) to cause the coupling passageways 150 and 152 to assume the positions and relationships shown in Figure 1.

An upward pull is then taken on the operating string, and because of the fact that the stem 16 is held immovably by engagement with the object to be removed the cylinder 10 will move upwardly with the operating string, thus exerting pressure on the hydraulic fluid in the chamber 36 beneath the piston 18 therein, and forcing the fluid through the opening 64 and the upper portion of the passageway 24, the coupling passageway 152 and the lower portion of passageway 24 into the chambers 38 and 40 beneath the pistons 20 and 22 therein. The pressure

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thus applied within the lower cylinder causes the lower cylinder to move downwardly relatively to the stem 16, moving the slip actuator 34 downwardly to actuate the slips 32 into gripping engagement with the casing 30. In this manner the lower cylinder 14 is securely anchored to the well casing against downward movement during the initial portion of the pulling action, and further upward movement of the cylinder 10 with the operating string results in an increase in the hydraulic pressure exerted in the chambers 38 and 40, which exerts an increased pull on the piston rod or stem 16, which constitutes a tension member and through which the pulling force is transmitted to the object to be removed.

In order to release the slips 32 from anchoring engagement with the casing the operating string is moved downwardly, which results in a reversal of the flow of hydraulic fluid through the passageways 24 and 26 of the stem 16, causing the cylinder 14 to move upwardly relative to the stem, thus withdrawing the slip actuator member 34 and releasing the slips 32 to return the motor cylinder and slips to the condition shown in Figure 2.

The details of construction of a preferred form of the invention are illustrated in Figures 3A, 3B, 3C, 3D, 3E, 3G, 4, 5, 6, 7, 8 and 9. In those figures the connecting stem 16 may conveniently take the form of three concentrically arranged pipes 42, 44 and 46, the innermost pipe 42 forming the central bore 28 through which fluid may pass from the operating string into the well beneath the tool, while the intermediate pipe 44, and the outer pipe 46 form, respectively, the passageways 26 and 24, through which fluid may flow from beneath the piston 18 to beneath the pistons 20 and 22, and may return from above the pistons 20 and 22 to above the piston 18 in the chamber 36, during operation of the tool.

The pistons 18, 20 and 22 are secured upon the outside of the stem 16, upon externally threaded portions 48, 50 and 52, respectively, each of these pistons preferably being formed of a central ring 54, threaded upon the stem, and upper and lower annular members 56 and 58, also threaded upon the stem, and having inner tapering surfaces 60. Between the inner ring 54 and each of the outer rings 56 and 58, suitable packing, such as that indicated at 62, is confined, for sealing engagement with the interiors of the cylinders. By compressing the packing 62 between the tapering faces 60 of the outer rings and the adjacent faces of the intermediate ring 54, the packing may be adjusted for most efficient sealing engagement with the inner walls of the respective cylinders.

The outer pipe 46 is provided with an opening 64, leading into the chamber 36, beneath piston 18, and communicating with the upper portion of passageway 24, and openings 66 and 68, respectively, are also provided in the pipe 46 beneath the pistons 20 and 22, and leading from the passageway 24 into the chambers 38 and 40, respectively, whereby fluid may flow from the chamber 36 beneath the piston 18, through the passageway 24 and into the chambers 38 and 40, beneath the respective pistons 20 and 22, upon upward movement of the upper cylinder relative to the connecting stem when the parts are in the positions shown in Figure 1.

An opening 70 is provided in the stem 16, above the piston 18, which communicates with the intermediate passageway 26, and with the chamber 36 above the piston 18. Similar openings 72 and 74, respectively, are provided in the connecting stem, above the pistons 20 and 22, also in communication with the passageway 26, and opening into the chambers 38 and 40, respectively, whereby fluid above the pistons 20 and 22 may flow back through the passageway 26 and into the chamber 36, above the piston 18, when the cylinder 10 moves upwardly relative to the stem.

The upper cylinder 10, is conveniently formed of two sections, which may be coupled together by a connecting element 78, shown in Figure 3B, and through which the stem 16 passes, suitable packing elements, such as those

indicated at 80, being provided within the chamber 78, to form a fluid tight seal between the member and the stem. At its upper end the stem 16 carries the annular elements 82 and 84, between which suitable packing 86 is disposed, forming a piston having a fluid tight seal with the upper cylinder, which moves in an upper chamber 81 therein. At the upper end of the chamber 81 the upper cylinder is connected by an upper coupling 88 to the lower end of the operating string 12. A breather port 83 is also provided in the upper cylinder which leads from the chamber 81 beneath the piston 82, 84, 86 to the outside of the cylinder to prevent the development of pressure or suction beneath the piston as the same moves in the chamber.

The lower cylinder 14 may also be composed of two sections, which are coupled together by a connecting member 90, similar to the connecting member 78, by which the sections of the upper cylinder are connected, the stem 16 extending through the member 90, as seen in Figure 3D, and the coupling being provided with internal packing elements 92, which form a fluid tight seal between the member and the stem.

A tubular extension 94 is attached to the lower end of the stem 16, by a suitable coupling element 96, and this extension extends through the tubular expander 34, connected to the lower end of the lower cylinder, and also passes through a packed coupling member 97, located below the expander. The coupling 97 connects a lower tubular section or cylinder 98 to the lower end of the slip cage 33. Suitable packing 100 is located inside of the upper end portion of the expander 34, which forms a fluid tight seal between the expander and the tubular extension 94, and similar packing 102 is disposed in the connecting member 97, to form a fluid-tight seal between the same and the extension, as will best be seen in Figures 3E and 3F.

The tubular section or cylinder 98 is closed at its lower end by a plug 104, so that a chamber 106 is formed between the connecting member 97 and the plug 104, and the extension 94 has a lower section 108, which extends through the plug 104, and is connected to the lower end of the upper section 94 of the extension by a coupling member 110, which forms a piston movable in the chamber 106, and which is provided with external packing, such as the O-rings indicated at 112 sealingly engageable with the inside of the tubular section 98. Suitable packing 114, is disposed within the plug 104, which forms a fluid-tight seal between the plug and the lower section 108 of the tubular extension. The coupling member 110 has one or more passageways 116 therethrough, in communication with the chamber 106, above and below this member, whereby fluid may flow from one end of the chamber 106 to the other end thereof, during the movement of the member 110 in the chamber. The lower section 108 of the extension may be connected to any suitable type of grappling member, not shown, for engagement with a stuck object to be removed from the well. The lower end of the upper cylinder is closed by a suitable plug 89, through which the stem 16 passes, and which has a packing element 91 therein, in sealing engagement with the stem and with the plug. The upper end of the lower cylinder 14 is similarly closed by a plug 93, through which the stem 16 passes, and which is likewise provided with suitable packing 95 which forms a seal between the stem and the plug.

The stem 16 may be formed in two sections adapted to be coupled together between the upper and lower cylinders, as best illustrated in Figures 3C and 7 of the drawings. The means by which the sections of the stem 16 are coupled together includes a tubular outer member 120, which is threadably attached at its lower end to the lower section of the stem, as indicated at 122 to rotate with the stem. The tubular member 120 has an upwardly tapering inside seat 124, and the upper section of the stem 16 extends within the member and has

an externally enlarged upwardly tapering portion 126 which seats on the seat 124. A clutch jaw element in the form of an arcuate quadrant shaped portion 128 is also formed on the lower end of the pipe 46 of the upper section of the stem 16. The upper end of the lower section of the stem 16 terminates below the clutch element 128 as seen at 130 and a complementary annular jaw clutch element is shown at 168 as fixed to the tubular member 120 by means of the screws 172 or the like, which extend through the member 120 and into the clutch element 168. The element 168 is provided with a clutch jaw 170 of quadrant shape which is engageable with the clutch jaw 128 of the upper stem section, whereby lost motion to the extent of an arc of 180° is permitted between the two sections but beyond which relative rotation of the upper section causes the lower section to rotate with the upper section. The inner pipe 42 and intermediate pipe 44 are cut away adjacent the ends of both the upper and lower stem sections to form an inner chamber 132 with the upper and lower portions of the outer pipe 46 and the intermediate clutch element 168, and in this chamber a plug 134 is disposed, which plug is threadably attached to the upper stem section as indicated at 136 for rotation therewith. The plug 134 has an external annular groove therein within which suitable packing means such as an O-ring 138 is disposed to form a fluid tight seal between the plug and the inner wall of the chamber 132 adjacent the clutch element 168, and the plug is also somewhat shorter than the length of the chamber to permit the plug to move longitudinally therein. A passageway 140 extends longitudinally through the plug 134 which is in communication at both ends with the passageway 28, whereby fluid may flow through the connection.

Passageways 24 and 26 are closed, as indicated at 142, 144, 146 and 148 at the chamber 134.

Within the wall of the tubular member 120 there are passageways 150 and 152, respectively, which open at their upper ends inwardly through the seat 124. An opening 151 is provided in the upper stem section, which opens into the passageway 26 and with which the upper ends of passageways 150 and 152 may be brought selectively into communication, and another opening 153 is similarly provided opening into the passageway 24 and with which the upper ends of the passageways 150 and 152 may be brought alternatively into communication. An external annular groove 154 is provided in the lower stem section, which communicates with the passageway 26 through a port 156 into which the lower end of the passageway 150 opens. A similar external groove 158 is also provided in the lower stem section beneath the groove 154 therein, the groove 158 communicating with the passageway 24 through a port 160, and the lower end of the passageway 152 opening into the groove 158.

Above and beneath the annular groove 154 the stem has external annular grooves within which suitable packing, such as O-rings indicated at 162 and 164, respectively, are disposed to form fluid tight seals between the member 120 and the exterior of the lower stem section. A similar external groove is formed in the lower stem section beneath the groove 158, and within which suitable packing, such as the O-ring 166 is disposed to form a fluid tight seal between the member 120 and the lower stem section.

Clutch elements 128 and clutch member 168, having a clutch jaw element 170 are axially spaced apart somewhat, as indicated at 171 in Figures 3C and 7, so that upon lowering the upper stem section relative to the lower stem section the tapering portion 126 of the upper stem section may move away from the seat 124 to establish communication between passageways 24 and 26 through ports 151 and 153, whereby fluid may bypass idly from above the piston 18 to beneath the same through the upper stem section, which permits the upper cylinder 10 to move to its lowermost position relative to the

piston 18 of the stem 16, upon lowering of the drill stem.

The upper end of the tubular member 120 has a packing gland 174, within which packing means, such as that indicated at 176 is located, in surrounding engagement with the upper stem section, and held in position by a gland nut 178.

In the position of the coupling means shown in Figure 1 and Figure 3C, the passageway 24 in the upper section of stem 16 is in communication with the passageway 24 in the lower stem section through the port 153, the passageway 152 of the member 120, the groove 158, and the port 160; and passageway 26 of the upper stem section is likewise in communication with passageway 26 of the lower stem section through the port 151, the passageway 150 of the member 120, the groove 154, and the port 156. Upon rotation of the upper stem section 180 degrees within the member 120, however, the passageway 24 of the upper stem section may be brought into communication with the passageway 150, while passageway 152 will be in communication with passageway 26 of the upper stem section, so that the flow of fluid through the stem may be reversed if desired, and takes place from above the piston 18 to beneath pistons 20 and 22, and from above pistons 20 and 22 to beneath piston 18. In this latter case the parts will be in the positions shown diagrammatically in Figure 2.

The tool is operated in the manner previously indicated, by lowering the same into the well so that the grapple on the lower end of the stem or tension member 16 is grippingly engaged with the stuck object.

When lowering the tool into the well, the parts will be in the positions illustrated in Figure 2, where the coupling means of the stem 16 is turned to a position in which the passageway 150 is in communication with passageway 24 of the upper section but with passageway 26 of the lower section, while passageway 152 is in communication with passageway 26 of the upper section but with passageway 24 of the lower section. Thus the portions of the upper chamber 36 above the piston 18 are in communication with the portions of chambers 38 and 40 beneath the pistons 20 and 22, and the portions of the upper chamber 36 beneath piston 18 is in communication with chambers 38 and 40 above pistons 20 and 22, so that no movement takes place between the upper and lower cylinders and the slips 32 can not accidentally move into engagement with the casing. After the grapple has been engaged with the stuck object, however, the operating string is rotated to move the valve-clutch parts into the positions shown in Figures 3C or 1, and upon the exertion of an upward pull on the string the slips will be set in the manner already described and an upward force is exerted on the stuck object. This is accomplished, as described above, by the fluid under pressure in chamber 36 beneath the piston 18 being forced through opening 64, upper passageway 24, by-pass 150, lower passageway 24, openings 66 and 68, into the portions of the chambers 38 and 40 beneath the respective pistons 20 and 22.

When the parts reach the positions indicated in Figure 1, the slips 32 are wedged outwardly to grip the casing wall 30, and the utmost pulling stress is exerted upon the stuck object. To renew the grip for another pull, the operating string may be lowered, causing the tapered portion 126 of the valve clutch coupling 120—178, to be moved away from the seat 124, "short-circuiting" the passageways 24 and 26, and permitting fluid to flow from above piston 18 to beneath the same, so that the upper cylinder returns to its lowermost position, as shown in Figure 2. The operating string may then be rotated to bring passageway 150 into communication with upper passageway 24, and passageway 152 into communication with upper passageway 26 (as in Figure 2), whereupon an upward pull on the string causes fluid to flow from beneath piston 18 to above pistons 20 and 22, and fluid is displaced from beneath pistons 20 and 22 to above piston 18, which

moves the lower cylinder upwardly relative to the stem and releases the slips 32.

The above operations may be repeated as often as necessary to exert successive pulls on the object in removing it from the well.

When desirable or expedient fluid may also be pumped down through the operating string 12 into the chamber 81 and due to the relatively small size of the passageway 28, pressure will be built up in the chamber 81 to exert an additional force tending to lift the upper cylinder resulting in an additional pulling force on the tension member.

Figures 10 and 11 illustrate a somewhat modified form of connecting stem and means by which sections of the stem are connected together. In this form of the invention the stem 16' takes the shape of a solid shaft in which suitable passageways are provided, as by drilling the same through the length of the stem. Thus, the stem 16' has a central passageway 28' and passageways 24' and 26' corresponding to the passageways 28, 24 and 26, respectively, of the stem 16, and which perform the same functions as in the previously described form of the invention.

The adjacent ends of the upper and lower sections of the stem 16' are exteriorly oppositely threaded, as indicated at 180 and 182, respectively, to threadably receive an interiorly threaded coupling member 185 by which the sections may be coupled together. Counterbores are provided in the adjacent ends of the sections, into which the passageways 24', 26' and 28' open, and tubular inserts 184, 186 and 188, are fitted into corresponding counterbores of the sections, whereby fluid may pass through the passageways. Each of the inserts may be provided with external grooves within the counterbores, in which grooves sealing elements, such as the O-rings indicated at 190, are disposed for sealing engagement with the inserts and the sections in the counterbores to prevent the leakage of fluid from the passageways. The arrangement of the cylinders and pistons employed with this modified form of the stem is the same as that used with the stem 16, previously described, and the tool is operated in a similar manner assuming the provision of a valve coupling corresponding to that shown in Figures 3C, 7, 8 and 9.

It will thus be seen that the invention as herein disclosed provides a pulling tool which employs a closed hydraulic system including a pump section and a motor section and by which a tremendous pulling force may be exerted on a stuck object by a relatively small force transmitted to the tool by means of the operating string.

While the invention has been disclosed in connection with certain specific embodiments of the same, it will be understood that these are intended by way of illustration only, and that numerous changes may be made in the construction and arrangement of the various parts, without departing from the spirit of the invention or the scope of the appended claims.

Having thus clearly shown and described the invention, what is claimed as new and desired to secure by Letters Patent is:

1. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple at the lower portion of the tool adapted to be attached to such stuck objects and a self-contained, wholly hydraulic, closed circuit, pump-and-motor assembly, which includes a pump unit connected to and actuated by movement of said string, a motor unit having parts relatively movable by fluid pumped by said pump unit, the first of said parts being connected to said grapple, and means for holding the second of said parts in a stationary position in the well, whereby the fluid may operate to move the first part with respect to said second part to move said grapple, and fluid circulating conduits between the pump-and-motor units.

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2. The tool as set forth in claim 1 in which the pump unit has relatively movable operative parts and the relatively movable parts of both said pump and motor units comprising cylinders and plungers, and in which there is provided a continuous elongated tension member extending vertically through both said pump-and-motor units, and carrying said plungers, said tension member itself serving to operatively connect said pump-and-motor unit, and being connected at its lower end to the grapple.

3. The tool as set forth in claim 1 in which the pump-and-motor assembly is of the reciprocating type, the two relatively movable parts of the motor unit being relatively reciprocable axially of the well, and slips carried by the second part of the motor unit and engageable with the walls of the well casing to grip the same, thus to detachably secure said second part to the casing when driving the motor unit in one direction.

4. The tool as set forth in claim 3 in which the pump unit has relatively movable operative parts and the relatively movable parts of both said pump-and-motor units comprising cylinders and plungers, and in which there is provided a continuous elongated tension member extending vertically through both said pump-and-motor units, and carrying said plungers, said tension member itself serving to operatively connect said pump-and-motor unit, and being connected at its lower end to the grapple.

5. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple, an elongated tension member having its lower end operatively connected with said grapple and its upper end adjacent to but relatively movable longitudinally with respect to the lower end of said supporting string, a motor cylinder slidably surrounding the lower portion of said tension member and provided with slips operable for anchoring it to the well casing wall, a plunger on said lower portion of said tension member within a hydraulic pressure chamber in said cylinder, a pump unit operatively connected with the upper portion of said tension member and with said string and operable by relative movement between said string and said tension member to force hydraulic fluid to said motor cylinder upon one side of said plunger to effect relative movement of said tension member and said motor cylinder in a given direction, and fluid connections between said pump unit and said motor cylinder forming a closed hydraulic circuit therebetween, and a working liquid filling said circuit.

6. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple, an elongated tension member having its lower end operatively connected with said grapple and its upper end adjacent to but relatively movable longitudinally of the lower end of said supporting string, a motor cylinder surrounding the lower portion of said tension member and provided with slips operable upon relative movement between themselves and the motor cylinder to anchor the cylinder to the well casing wall, a plunger on said lower portion of said tension member within a hydraulic pressure chamber in said cylinder, said motor cylinder and said plunger comprising relatively movable elements of a motor unit, a pump unit operatively connected with the upper portion of said tension member and with said string and operable by relative movement between said string and said tension member to force fluid to the motor unit, and fluid connections leading from said pump unit to the chamber in said motor cylinder at a point above and at a point below said plunger therein, and means selectively actuatable to control said fluid connections to alternatively cause the pressure fluid to flow to one side of said plunger to move the motor cylinder relative to said tension member to actuate said slips to anchor the cylinder to the casing wall and subsequently to urge the tension member relative to the thus fixed motor cylinder to pull on the grapple, and alternatively to cause the pressure

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fluid to flow to the other side of said plunger to move the motor cylinder in the opposite direction to release said slips.

7. The tool as set forth in claim 6 in which there is provided a return flow fluid connection between said motor and said pump units, and means for short-circuiting the flow in said first named fluid connections which lead from said pump unit to said motor unit, and the flow in said return flow fluid connection at a point between said pump unit and said motor unit, to cause the pump to idle and the motor to remain inoperative.

8. The tool as set forth in claim 7 in which said tension member is multi-tubular, containing parallel conduits respectively conducting working fluid from the pump unit downwardly to the motor unit and return fluid back from said motor unit to said pump unit, said tension member with its conduits formed in vertically aligned sections, and in which coupling means are provided between said aligned sections providing for relative rotary movement of said sections and relative longitudinal movement of said sections, and in which the first named selectively actuatable means for reversing the connections is operable by rotating one section of the tension member with respect to the other with a consequent interchange of alignment of the conduits, and the second named or short-circuiting connection controlling means is operable by effecting relative longitudinal axial movement of said sections, and a consequent disruption of separation of said conduits.

9. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple, an elongated tension member having its lower end operatively connected with said grapple and its upper end adjacent to but relatively movable longitudinally of the lower end of said supporting string, a motor cylinder surrounding the lower portion of said tension member and provided with slips operable for anchoring it to the well casing wall, a plunger on said lower portion of said tension member within a hydraulic pressure chamber in said motor cylinder, the plunger and cylinder constituting a motor unit, a pump unit operatively connected with the upper portion of said tension member and with said string and operable by relative movement between said string and said tension member, fluid connections between said pump unit and said motor cylinder forming a closed hydraulic circuit therebetween, a working liquid filling said circuit, said circuit comprising a conduit leading pressure fluid from the pump unit downwardly to said motor unit and a conduit leading return fluid from said motor unit to said pump unit, and means for short-circuiting the flow of fluid in said conduits at a point between said pump unit and said motor unit, to cause the pump to idle and the motor to remain inoperative.

10. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple, an elongated tension member having its lower end operatively connected with said grapple, an upper and a lower liquid containing cylinder respectively slidably surrounding axially spaced portions of said tension member, a plunger in each of said cylinders, said plungers fixed to said tension member to move therewith, casing gripping slips carried by said lower cylinder and arranged to be actuated into engagement with the surrounding casing wall upon downward movement of the lower cylinder relative to said member to anchor the lower cylinder to the casing, means connecting the upper cylinder to the operating string for movement with said string, passageways in said tool providing communication between said cylinders to conduct working liquid from the space beneath the plunger in the upper cylinder to the space beneath the plunger in the lower cylinder to move said lower cylinder downwardly to set the slips and anchor the cylinder and thereafter to urge said

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plunger upwardly relatively to the anchored cylinder to apply great pulling force to the stuck object.

11. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple, an elongated tension member comprising two aligned sections, an articulated coupling joining said sections, means connecting the lower section of said tension member with the grapple, the upper section of said tension member being disposed adjacent the lower end of said string for relative longitudinal movement with respect thereto, a motor cylinder slidably surrounding said lower section of said tension member and provided with slips operable for anchoring it to the well casing wall, a plunger on said lower portion of said tension member within a hydraulic pressure chamber in said motor cylinder, a pump cylinder secured to the lower end of said string and surrounding the upper section of said tension member, a plunger on said upper section of said tension member within said pump cylinder, working fluid passageways in said tension member selectively connecting the spaces in the pump cylinder above and below said plunger with the spaces in said motor cylinder above and below said plunger, whereby when said pump cylinder is reciprocated by manipulation of said string, working fluid is forced by the pump unit into the motor unit to cause relative movement between said motor cylinder and said tension member, valving means in said articulated coupling controlling said passageways to direct working fluid from one side of the plunger in the pump unit to the corresponding side of the plunger in said motor unit and adjustable to reverse the flow of working fluid to cause it to flow from one side of said pump plunger to the opposite side of the plunger in said motor unit.

12. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple, an elongated tension member comprising two aligned sections, an articulated coupling joining said sections, means connecting the lower section of said tension member with the grapple, the upper section of said tension member being disposed adjacent the lower end of said string for relative longitudinal movement with respect thereto, a motor cylinder slidably surrounding said lower section of said tension member and provided with slips operable for anchoring it to the well casing wall, a plunger on said lower portion of said tension member within a hydraulic pressure chamber in said motor cylinder, a pump cylinder secured to the lower end of said string and surrounding the upper section of said tension member, a plunger on said upper section of said tension member within said pump cylinder, working fluid passageways in said tension member selectively connecting the spaces in the pump cylinder above and below said

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plunger with the spaces in said motor cylinder above and below said plunger, whereby when said pump cylinder is reciprocated by manipulation of said string, working fluid is forced by the pump unit into the motor unit to cause relative movement between said motor cylinder and said tension member, by-pass means in said articulated coupling operable to short-circuit the passageways leading from said pump unit to cause the pump unit to idle and the motor unit to remain inactive.

13. A tool for pulling stuck objects from a well, said tool adapted to be suspended in its entirety from an operating string of tubing and comprising, in combination, a grapple, an elongated tension member comprising two aligned sections, an articulated coupling joining said sections, means connecting the lower section of said tension member with the grapple, the upper section of said tension member being disposed adjacent the lower end of said string for relative longitudinal movement with respect thereto, a motor cylinder slidably surrounding said lower section of said tension member and provided with slips operable for anchoring it to the well casing wall, a plunger on said lower portion of said tension member within a hydraulic pressure chamber in said motor cylinder, a pump cylinder secured to the lower end of said string and surrounding the upper section of said tension member, a plunger on said upper section of said tension member within said pump cylinder, working fluid passageways in said tension member selectively connecting the spaces in the pump cylinder above and below said plunger with the spaces in said motor cylinder above and below said plunger, whereby when said pump cylinder is reciprocated by manipulation of said string, working fluid is forced by the pump unit into the motor unit to cause relative movement between said motor cylinder and said tension member, valving means in said articulated coupling controlling said passageways to direct working fluid from one side of the plunger in the pump unit to the corresponding side of the plunger in said motor unit and rotatively adjustable to reverse the flow of working fluid to cause it to flow from one side of said pump plunger to the opposite side of the plunger in said motor unit, by-pass means in said articulated coupling operable by relative reciprocation of said tension member sections to short-circuit the passageways leading from said pump unit to cause the pump unit to idle and the motor unit to remain inactive.

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