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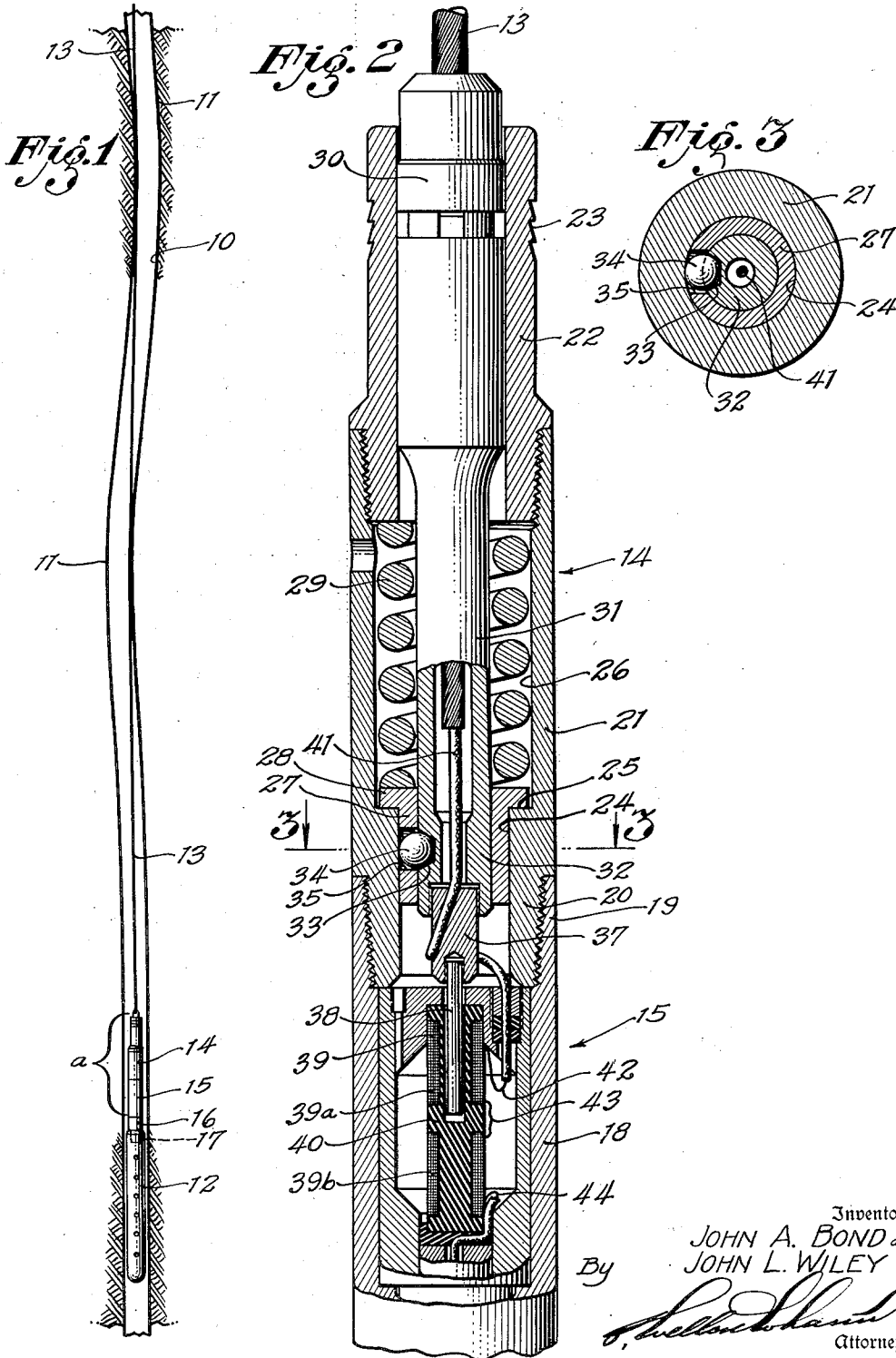
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RELEASABLE ROPE SOCKET WITH WEIGHT INDICATOR

Filed Dec. 7, 1946

2 SHEETS—SHEET 1



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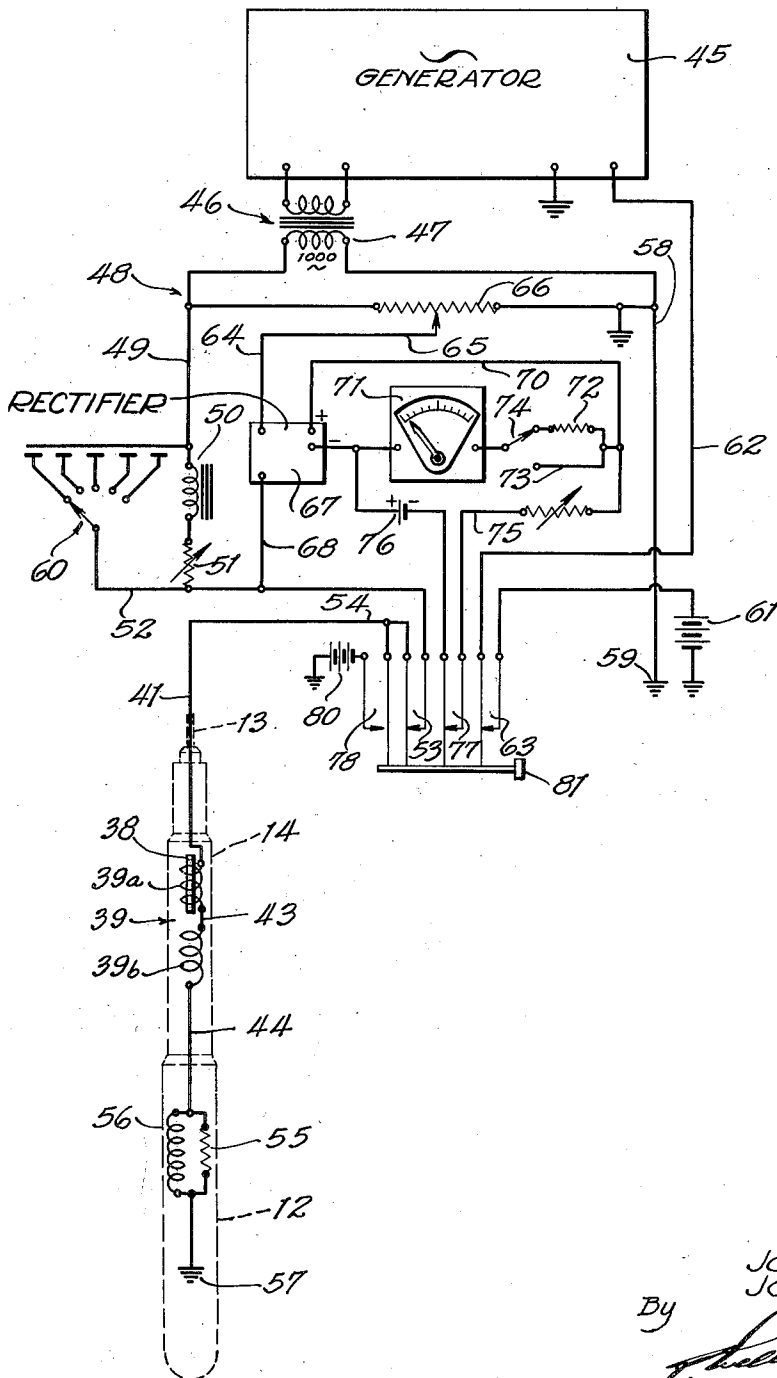
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2 SHEETS—SHEET 2

Fig. 4



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RELEASABLE ROPE SOCKET WITH WEIGHT INDICATOR

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This invention relates to means for moving members, tools, or other devices, in a well, by use of a suspension means, such as a string of tubing or a cable, and relates in particular to a connection for use between the suspension means and the part which is lowered into and/or removed from the well, whereby the suspension means may be disconnected from the part should it become stuck in the well.

Although not limited to such use, the present invention has especial utility as a means for connecting a member to the lower end of a cable or rope which serves as a suspension element whereby the member may be lowered into the well and later removed. It is an object of the invention to provide a connector of this character having parts which will separate in response to excessive torque or axial stress, thereby releasing the lower end of the suspension means from the member and avoiding the possibility of breaking the suspension means at some intermediate point. As an example of the utility of the invention, the following is recited. When a member, such as a tool, lowered into a well on a cable, becomes stuck in the well, pull upon the cable in an attempt to release the member may result in breakage of the cable at an intermediate point, leaving in the well that portion of the cable below the point at which the break occurs. In order to remove the member from the well, it is necessary to first remove the cable so that the stuck member may be engaged by a fishing tool situated at the lower end of a string of tubing, this operation involving considerable difficulty. Where the present invention is used, excessive stress applied to the connector, but below the breaking stress of the suspension means, results in disconnection of the lower end of the suspension means from the member, thus leaving a clean part in the well which can be easily recovered by fishing methods already well known to the industry.

It is an object of the invention to provide a connector of the character set forth in the preceding paragraph having in association therewith means for indicating to a worker at the top of the well when an abnormal stress has been applied to the connector.

It is a further object of the invention to provide a device of the character described herein having means whereby the magnitude of the stress applied to the connector is continuously indicated at the top of the well. In the use of the invention, the strain applied to the connector may be compared to the pulling force applied

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to the upper end of the suspension means, thereby making it possible for the operator to determine whether the suspension means or the member in the well is stuck or retarded. The indicating means associated with the connector measures the weight of the tool which is carried by the lower end of the suspension means. When, in moving downward, the tool passes from air or gas into a body of liquid, the apparent weight of the tool will be diminished and the indicating means at the top of the well will make this fact known to the operator. If the weight shown by the indicator at the top of the well drops to a low value, the operator will be thereby informed that the downward progress of the tool has been retarded, and if the indicated weight drops to zero value, he will know that the tool has met with an obstruction in the well and/or has become stuck. Having this knowledge, the operator may immediately pull up on the suspension means for the purpose of freeing the tool before it has become stuck to an extent preventing its release by upward pull exerted by the suspension means. Oil wells, if they are of any material depth, are crooked; therefore, the suspension means is brought into frictional contact with the wall of well at a number of points. This friction increases the load on the upper end of the suspension means when upward force is applied to pull it from the well. Previously, the operator had no means of determining how much of the load on the cable was caused by the tool or by friction on the cable at a point or points between the tool and the surface of the ground. In the use of our invention, when the load on the upper end of the cable is great, the operator may immediately determine what proportion of this load may be attributed to the tool. Upon finding that the excess load on the upper end of the cable is caused by sticking of the tool, the operator may, by continuing the pull on the cable, increase the pull on the connector, while observing the weight indicators at the top of the well, and may release the connector, whereupon the entire length of the cable may be withdrawn from the well, leaving the well between the tool and the surface unobstructed so that suitable fishing means may be lowered into the well for the purpose of removing the tool.

It is a further object of the invention to provide a connector of the character described herein having in association therewith an electrical circuit which extends to the top of the well, there being means at the connector operative in response to strain on the connector for varying

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at least one of the electrical values in the circuit, and indicating means at the top of the well, utilizing such variations as a means for indicating strain applied to the connector.

Further objects and advantages of the invention may be brought out in the following part of the specification, wherein we have employed detailed and specific description for the purpose of fully disclosing the invention without limiting the scope thereof set forth in the appended claims.

Referring to the drawings which are for illustrative purposes only:

Fig. 1 is a schematic view showing a form of our invention in a well.

Fig. 2 is an enlarged fragmentary sectional view of the section of the connector indicated by *a* in Fig. 1.

Fig. 3 is a cross section taken as indicated by the line 3—3 of Fig. 2.

Fig. 4 is a diagram showing the electrical constituents of the invention.

For the purpose of showing the utility of an embodiment of our invention, we have in Fig. 1 schematically depicted a well casing 10 which, in accordance with normal conditions, has a number of bends 11 therein, and have shown in the lower part of the casing 10 a member 12, shown specifically as a perforating gun, suspended from the lower end of a cable 13 by means of a releasable cable or rope socket 14. Owing to the well being crooked, the cable 13 drags across the bends 11 in the casing 10.

As shown in Fig. 1, the releasable socket or connector 14 comprises a shell 15 having at the lower end thereof a fitting 16 provided with a threaded pin 17 for connection to the upper end of the gun 12. As shown in Fig. 2, the shell 15 includes a lower cylindric body 18, the lower end of which is connected to the fitting 16 and the upper end of which has an internally threaded box 19 to receive the threaded pin 20 at the lower end of an upper cylindric body 21. A sleeve 22 is threaded into the upper end of the body 21. This sleeve 22 has thereon serrations 23 adapted to be engaged by a fishing tool. In the lower part of the body 21 there is a bore 24 separated by a shoulder 25 from a bore 26 of larger diameter. In the upper part of the bore 24 there is a bushing 27 having a flange 28 which is forced against the shoulder 25 by a heavy spring 29 held in compression in the bore 26 between the upper end of the sleeve 27 and the lower end of the sleeve 28 which is threaded into the upper end of the body 21.

The cable 13 is secured in a tubular mandrel 30 slidably disposed in the sleeve 22 and having a diametrically reduced stem 31 which extends downwardly through the bore 26 and is of such length that its lower end 32 lies within the bushing 27. The lower end 32 of the stem 31 has therein a recess 33 which receives a portion of a ball 34, the outer portion of this ball 34 occupying an opening 35 in the bushing 27 at a point within the bore 24 of the upper cylindric body 21. The recess 33, ball 34, and the opening 35 cooperate in forming a latch for preventing disengagement from the cylindric body of the mandrel 30 from the shell part 15 of the connector 14. When an upward pull is exerted upon the cable 13, or, conversely, when a downward force is applied to the shell 15, the resulting relative movement of the mandrel 30 will move the bushing 27 toward the sleeve 22, thereby compressing the spring 29. Should the magnitude of the force exerted be

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sufficient to move the opening 35 of the bushing 27 upwardly past the shoulder 25, the ball 34 will be permitted to move radially outwardly in the lower part of the bore 26, and out of the recess 33 in the lower end 32 of the stem 31, permitting the mandrel 30 to move upwardly out of the sleeve 22. When there is minimum separating force or strain applied to the connector parts 15 and 30, the spring 29 will hold the bushing 27 in the position in which it is shown in Fig. 2, the mandrel being then in what is referred to as the first position thereof with relation to the shell 15. As the stress, tending to separate the parts 15 and 30 is increased, the part 30 will move relatively upwardly toward a second position which is reached when the opening 35 of the bushing 27 has passed the shoulder 25 so as to permit the ball 34 to move radially outwardly and thereby release the part 30 so that it may be disconnected from the part 15. Since the part 30 is moved upwardly against the compression of the spring 29, its movement relatively to the shell 15 will be proportionate to the stress applied. In the present invention the movement of the part 30 relatively to the part 15 is employed as an indication of the application of stress, and the extent of compression of the spring 29 is employed as a measure of the applied stress. In carrying out this conception, we connect to the lower end of the stem 31 by means of a brass block 37, an iron pin or armature 38 which extends into the upper end of an inductance winding 39 supported on an insulator 40 in the cavity of the lower cylindric body 18 of the shell 15.

In the form of the invention shown, the cable 13 has therein an insulated electrical conductor 41 which is extended down from the lower end of the cable and from the lower end of the pin 31 of the mandrel 30 into the member 18 so that it may be connected by a conductor 42 to the upper end of the inductance winding 39. This inductance winding 39 is shown as consisting of upper and lower sections 39*a* and 39*b* which are connected in series by a conductor 43. A conductor 44 extends from the lower end of the section 39*b* of the inductance winding 39 and is carried downwardly through the shell 15 to the gun 12, as will be further explained with relation to Fig. 4, wherein we have schematically shown the electrical parts of the invention.

In Fig. 4 we have provided an oscillation generator 45 of thermionic type. For output of oscillating current therefrom, this generator 45 has a transformer 46, the secondary winding 47 of which is in series with a circuit 48 which includes in series the inductance coil or winding 39 previously described with relation to Fig. 2. On the left side this circuit 48 includes a conductor 49, an inductance 50, a variable resistance 51, a conductor 52, a switch 53, and a conductor 54 which includes the insulated conductor 41 of the cable 13. As shown in the lower part of Fig. 4, the conductor 44 which leads downwardly from the inductance winding 39 connects to the upper end of a gun firing means 55 and a choke coil 56 arranged in parallel in the body of the gun 12, the lower ends of these parts 55 and 56 being connected to a ground 57, which may consist of the metal body or shell parts of the gun 12 and the connector 14 and the sheath of the cable 13. The right hand side of the oscillating circuit 48 comprises a conductor 58 which is connected to a ground 59, and the electrical ground parts referred to in the preceding sentence. In the form of the invention shown, the operating current

delivered by the secondary 47 of the transformer 46 is 1000 cycles and of relatively low voltage, such, for example, as 7 volts. In cooperation with the inductance 50 and the variable resistance 51 a variable condenser assembly 60 is bridged thereacross, as shown. A B battery 61 is provided for the generator 45, this B battery 61 being in series with a circuit 62 including a switch 63 disposed in ganged relation to the switch 53, so that when the switch 53 is opened, the switch 63 will be likewise opened.

For measurement of the current flow in the oscillating circuit 48, a bridge circuit 64 is provided, this bridge circuit including a conductor 65, the upper end of which is connected through a potentiometer 66 with the conductors 49 and 58 of the circuit 48. The lower end of the conductor 65 is connected through a rectifier 67 and a conductor 68 with the conductor 52. The D. C. output circuit 70 of the rectifier 67 is in series with a direct current meter 71, and this circuit 70 is adjustable so as to include resistance 72 or a direct connection 73, either of which parts 72 or 73 may be included separately in the circuit 70 by adjustment of a switch 74. For balancing the meter 71, a balancing circuit 75 is provided, this balancing circuit 75 including a source of electrical potential shown as a battery 76 and a switch 77 which is in ganged relation to the switches 53 and 63. A firing switch 78 for the gun 12 is provided in ganged relation to the switches 53, 63 and 77. The purpose of this switch 78 is to connect to the conductor 54 a source of firing current or potential 80 when a switch button 81 is pressed inwardly (leftwardly) so as to open the switches 53, 63, and 77 and close the switch 78.

In the operation of the invention, the variable inductance, comprising the winding 39 and the axially movable armature 38, varies the oscillating current flow in accordance with the deflection of the spring 29, Fig. 2, of the connector which is suspended in the well at the lower end of the cable 13. In the arrangement shown, the bridge circuits are easily balanced so that any small weight put on the lower part 15 of the connector will at once cause an upscale reading on the instrument meter 71 as a result of a slight movement of the coil 39 away from the plunger 38. Reduction of stress on the connector 14, tending to separate the parts 15 and 30, will, of course, cause the meter to return toward or to zero reading. Information of this character is obtained preferably when the meter 71 is connected into the circuit 70 through the direct connection 73. The switch 74 may be adjusted so as to connect the meter 71 through the resistance 72, so that the meter will operate through a low sensitivity range, and the meter may be calibrated so that it will show the full range of force applied, tending to separate the parts 15 and 30 from minimum value when the flange 28 of the bushing 27 is in engagement with the shoulder 25 to maximum value wherein the spring 29 is deflected sufficiently to bring the ball 34 upwardly beyond the shoulder 25, at which time the latch, comprising the parts 33, 34, 35, will release the part 30.

We claim as our invention:

1. In a means for connecting a suspension element to a member which is lowered into a well, the combination of: first and second cooperating connector parts, one of which is connectible to said element and the other of which is connectible to said member; resiliently constituted means

connecting said parts together and releasing said parts in response to a predetermined strain therein resulting from stress received from said connector parts and strain responsive means at the lower end of the suspension element for measuring the strain in said resiliently constituted means and an indicator at the top of the well operatively associated with said strain responsive means adapted to indicate strain in said resiliently constituted means as an indication of the stress transmitted from one of said connector parts to the other.

2. In a means for connecting a suspension element to a member which is lowered into a well, the combination of: first and second cooperating connector parts, one of which is connectible to said element and the other of which is connectible to said member; latch means connecting said parts together; resilient means for holding said latch in operative condition and releasing the same in response to a releasing strain therein under stress received from said parts; and strain responsive means at the lower end of the suspension element for measuring the strain in said resilient means and an indicator at the top of the well operatively associated with said strain responsive means adapted to indicate strain in said resilient means in the range of values below said releasing strain.

3. In a means for connecting a suspension element to a member which is lowered into a well, the combination of: first and second cooperating connector parts, one of which is connectible to said element and the other of which is connectible to said member, said parts being movable relatively to each other between first and second positions; means for releasably holding said parts together comprising a latch, yieldable means for resisting movement of said parts from said first position to said second position, said latch being so formed that it will release said parts when they reach said second position thereof; and means for indicating to a worker at the top of the well movement of said parts between said first and second positions thereof.

4. A device as defined in claim 3, wherein said indicating means comprises an electrical circuit including a means in proximity to said parts operating when there is relative movement of said parts to change at least one of the electrical values of said circuit, and indicating means at the top of the well for showing said change.

5. A device as defined in claim 3, wherein said indicating means comprises an oscillating electrical circuit including a variable inductance means in proximity to said parts operating when there is relative movement of said parts to change the electrical flow in said circuit, and indicating means at the top of the well for showing said change.

6. In a means for connecting a suspension element to a member which is lowered into a well, the combination of: first and second cooperating connector parts, one of which is connectible to said element and the other of which is connectible to said member, said parts being movable relatively to each other between first and second positions; means for releasably holding said parts together comprising a latch, and a spring for resisting movement of said parts from said first position to said second position, said latch being so formed that it will release said parts when they reach said second position thereof; and means adapted to indicate the deflection of said spring.

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7. In a means for connecting a suspension element to a member which is lowered into a well, the combination of: first and second cooperating connector parts, one of which is connectible to said element and the other of which is connectible to said member; a releasable latch for holding said parts together; means adapted to release said latch in response to a predetermined force applied tending to separate said connector parts, said means comprising a resilient member connected so that it will be deformed in accordance with the change in magnitude of said force tending to separate said connector parts; and means having an indicator at the top of the well adapted to indicate the deformation of said resilient member.

8. In a means for connecting a suspension element to a member which is lowered into a well, the combination of: first and second cooperating connector parts, one of which is connectible to said element and the other of which is connectible to said member, said parts being movable relatively to each other between first and second positions; resilient means disposed between said connector parts so as to resist movement of said connector parts from said first to said second position, said resilient means being

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deformed in accordance with the movement of said connector parts from said first to said second position; and means having an indicator at the top of the well adapted to indicate the deformation of said resilient member, said last named means having a portion in the well acting to measure the deformation of said resilient means, and said indicator at the top of the well being adapted to indicate the measure of said deformation.

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