Jan. 1, 1963 H. C. EHLERT 3,071,190

WELLHEAD ATTACHMENT FOR USE WITH WIRE LINE TOOLS

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Fig. 1

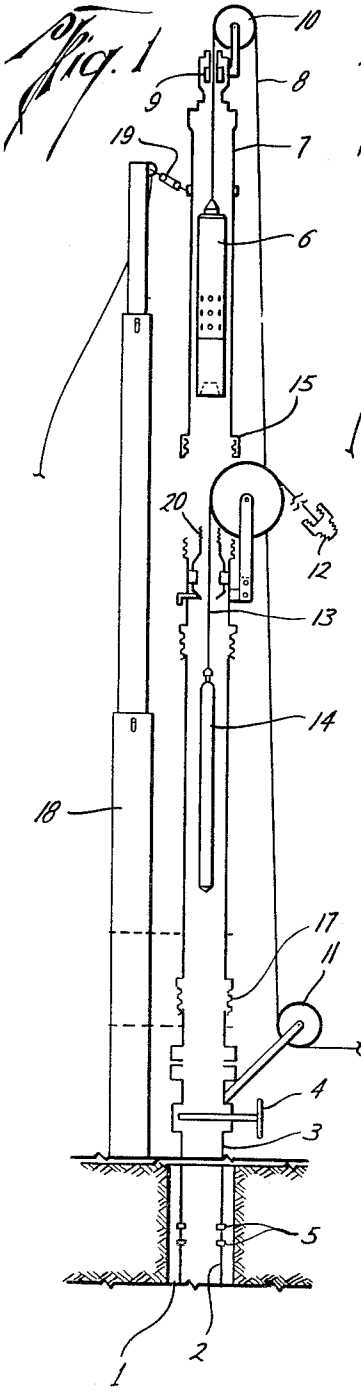


Fig. 2

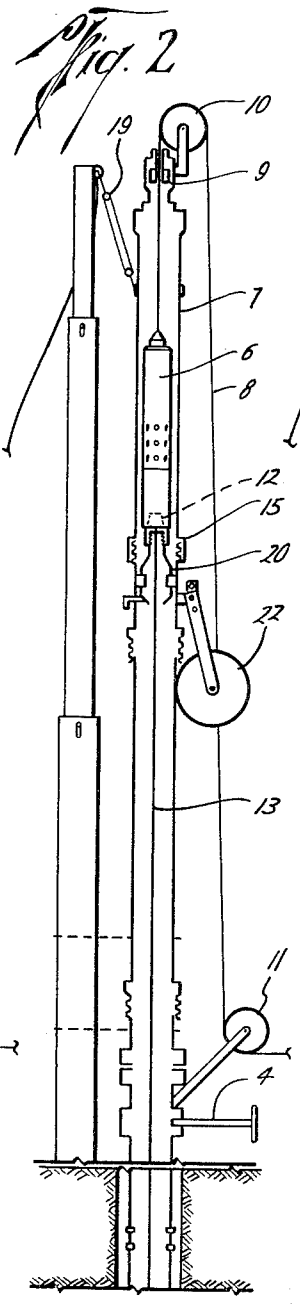
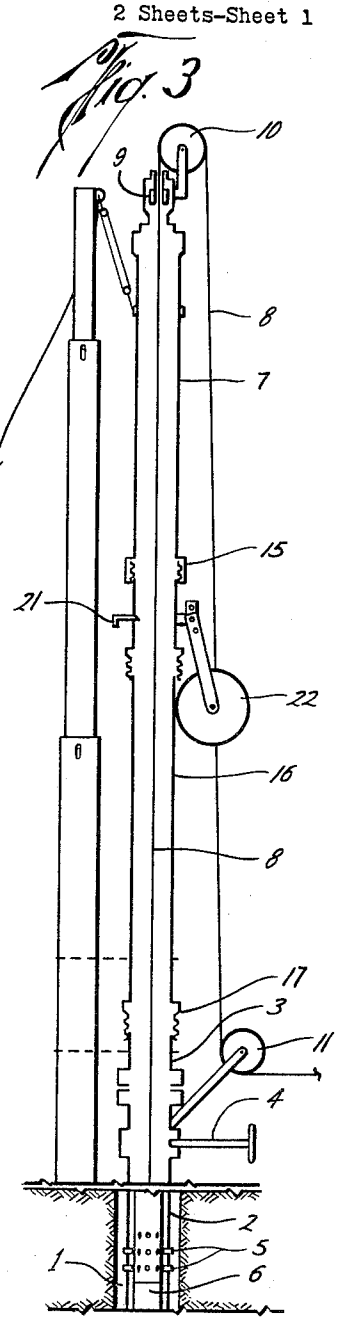


Fig. 3



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WELLHEAD ATTACHMENT FOR USE WITH WIRE LINE TOOLS

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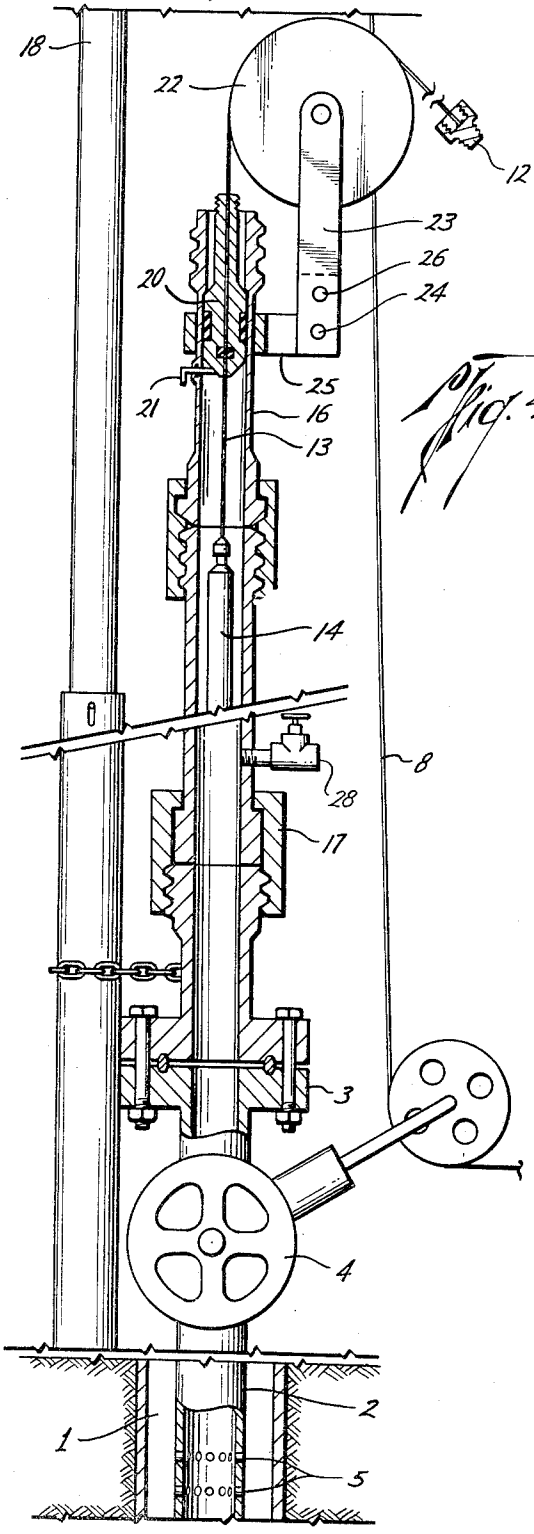
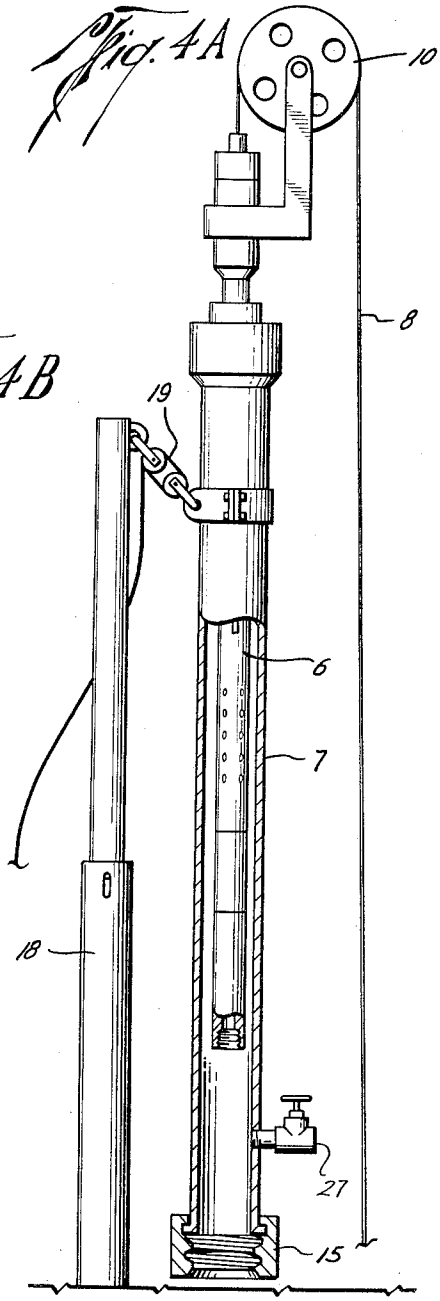


Fig. 4B

Fig. 4A



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WELLHEAD ATTACHMENT FOR USE WITH WIRE LINE TOOLS

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This invention relates to well working equipment and more particularly to the use of wire line tools and wellhead attachable extensions for facilitating entry and removal of tools to and from wells which are under pressure and for providing safety precaution against blowouts.

One known type of working equipment with which the invention is concerned and which will be discussed by way of example, comprises an electrically fired perforating tool suspended by a long current transmitting cable from a wire line suspended circuit closing tool which, upon a lowering operation, traverses and responds to a subsurface signal stationed at a known depth in the well and closes a firing circuit whereby to render the perforating tool effective to perform its operation at a controlled depth determined by the length of current transmitting cable hanging below the signaling station.

A long cable between the perforator and the signal responsive tool presents practical space problems for maintaining a blowout preventing closure at the upper end of well tubing during the working procedure and especially at the start and the end of the operation and an object of the present invention is to provide for detachably joining the suspension cable for the perforator tool and the signaling tool and to employ an improved tool receiver housing for detachable connection with the wellhead as an upward extension thereof and which housing is formed in longitudinally separable halves, one for housing the perforator tool and the other for housing the signal receiving tool at the beginning and ending of a work performing operation.

Another object of the invention is to provide closure seals in the upper ends of companion tool receiver housings for embracing and accommodating sliding travel of suspension lines, with the mounting of the closure in the lower housing arranged for closure displacement while the housings are coupled in end to end succession whereby to afford clearance passage through the lower housing of the upper or signal receiving tool.

A further object is to provide separable tubular extension members whose separation enables the lower member by itself to house the work performing tool while its suspension cable projects through the sealed upper end and in that condition to be connected with a wellhead whose shutoff valve is closed but which can be opened immediately following such connection with maintenance of well closure by reason of the interior sealed off housing space throughout an interval in which the suspension cable is payed out to lower the tool until cable length above the seal is substantially shortened and is ready to be joined to the signal receiving tool for continued suspension of the perforator from the upper tool, whereupon the upper tubular extension can be coupled and its interior sealed off space brought into communication with the lower extension tube by displacing the seal of the latter to afford clearance passage for descent as a unit of the wire line assembly.

The foregoing and other objects will be apparent from the accompanying drawings wherein FIGS. 1, 2 and 3 are sectional views of a well fragment and well working equipment illustrating in somewhat diagrammatic fashion several operative relationships and FIGS. 4A and 4B are companion sectional views of the operating equipment on a larger scale.

In the drawing, a fragment of a cased well hole 1

is illustrated with a well production tubing string 2 whose upper end terminates in a conventional Christmas tree or wellhead portion 3 containing a shutoff valve 4. At the time of installation of the well tubing 2, it will have incorporated in it one or more signaling stations at predetermined depths and each of which, for example, may consist of permanent magnets arranged in spaced apart rows, as indicated at 5. When more than one signal transmitting station is employed, there is contemplated a variation in spacing between the rows of magnets so that the relation of the magnetic fields at each station will differ from others. Subsequently, when various well working operations are to be performed, a wire line tool having a set of field responsive switches selectively spaced apart in relation to any one of the stations can be lowered by usual wire line practices through the well tubing for concurrent response to the magnetic fields of the station to which the tool has been coded. Such equipment is commercially available and the signal receiving tool has a self-contained battery circuit having the magnetic field influenced switches in series relation.

As seen in the drawing, the signal responsive tool 6 is receivable within a tubular housing 7 forming the upper section or part of a wellhead extension tubing assembly. A wire line 8 is coupled to the upper end of the tool 6 and projects upwardly in slide relation through an annular packing seal 9 closing the top of the extension tube 7. For convenience, the wire line is entrained on a top pulley 10 and extends downwardly around a bottom pulley 11 to a suitable power operated winding drum, not shown. At its lower end, the signal receiving tool 6 is provided with a socket for suspension of and electrical connection with a detachable plug 12 at the upper end of a suspension and current conducting cable 13 whose lower end is joined to a work performing tool such as an electrically fired perforating gun 14 of any well known type. The length of the cable 13 is selected beforehand with reference to the depth within the well hole at which a perforating operation is to be performed below the known position of a work station 5. Accordingly, when the cable connector 12 is suspended from the signal receiving tool 6 and the whole assembly is lowered by means of the wire line 8, the gun 14 will be fired by reason of electric current transmitted through the cable 13 from the switch controlled battery circuit within the tool 6 when the descent of the latter brings its field actuated switches into alignment with the magnetic fields of the station 5.

Such firing relation is illustrated generally in FIG. 3, which also shows the upper tube extension 7 as having its lower end detachably connected by means of a rotary nut 15 to the upper end of a lower extension tube 16 which in turn has its lower end detachably connected by means of a coupling nut 17 with the upper end of the wellhead 3. In this figure also, the gate valve 4 is completely open and the upper end of the well tube communicates with the wellhead extension tubing assembly and is sealed off by the upper packing closure 9, through which the wire line 8 is slidable.

In preparation for the perforating operation as described, the well is shut in by closing the wellhead valve 4 and erecting beside the well a suitable gin pole 18 illustrated as comprising collapsible telescopic sections. A suitable block and tackle 19 is secured to the top of the gin pole and is used first to hoist the lower tube extension 16 to an upright position in vertical alignment with the wellhead 3, whereupon the coupling nut 17 is threaded down on the wellhead and holds the tubing 16 as an upward extension thereof. Prior to the hoisting operation, the extension tube 16 will have placed therein the perforating gun 14 with the suspension cable 13 extended through the upper end of the tube. To close such upper

end around the suspension cable 13, an annular packing seal 20, preassembled to embrace the cable 13, is located in fixed relation to the upper end to completely close the same. As shown in FIGS. 1, 2 and 4B, the packing unit 20 is seated upwardly against an internal shoulder of the tube assembly and is releasably joined to the lower tube and held against displacement by engagement at its lower face with a radially retractable latching plunger 21. This latching plunger extends through the wall of the tube extension 16 and has an exterior handle for manipulation. It can be pulled outwardly to a suitable limit stop to permit downward passage of the packing 20 after the upper tube has been placed in position. For facilitating the downward travel of the suspension cable 13 through the packing 20, the cable is looped around a pulley 22. This pulley is rotatably mounted on an arm 23 whose lower end is pivotally connected at 24 to an L-shaped bracket 25 carried by the extension tube 16. A removable pin 26 extends through aligned openings in the bracket 25 and the arm 23 and holds the arm 23 upright. Following the complete pay-out of the conductor and suspension cable 13, the holding pin 26 may be removed and the arm 23 swung downwardly, as seen in FIGS. 2 and 3, out of interference with the succeeding operation. Once the extension tube 16 has been coupled to the wellhead, the shutoff or gate valve 4 can be opened without well pressure loss and it will accommodate lowering of the perforating gun 14 as the cable 13 is payed out to the limit afforded by the sealed upper end of the tube.

Following the mounting of the first extension tube 16 on the wellhead 3 and either before or after initial lowering of the perforator suspension line section 13, the block and tackle 19 and its supporting gin pole 18 will be employed to elevate the upper tubing section 7, with the signal receiving tool 6 housed therein and suspended by the wire line 8 somewhat as seen in FIG. 1. After an internally threaded socket in the bottom of the connector plug 12 has been screwed on a top terminal tip of the closure or seal sleeve 20 and after the pulley supporting arm 23 has been swung downwardly, the upper suspension cable section or wire line 8 can be payed out for a short distance to lower the upper tool 6 below the upper tube 7 and enable the tool bottom socket end to be screwed down on the pin end of the connector plug 12. This establishes both suspension and electrical connection between the longitudinally spaced apart tools 6 and 14 through the length of cable line section 13. There now follows a controlled lowering through the block and tackle of the upper extension tube 7 and its bottom end connection by the coupling nut 15 with the top end of the lower tube 16. The position of the parts will be that illustrated in FIG. 2.

As a next step, pressures on opposite sides of the packing sleeve 20 should be equalized and for that purpose the interiors of the upper and lower extension tubes 7 and 16 are communicated with one another through their hand valves 27 and 28 when temporarily and detachably coupled by a flexible hose. Thereafter, external manipulation of the locating plunger 21 will withdraw it form blocking relation and permit downward travel displacement of the packing sleeve 20, as the wire line 8 is let out, and such displacement opens the path for free passage of the upper tool 6 downwardly through the lower extension tube 16 and beyond the wellhead for eventual traverse of the signal sending station 5.

After the work performing operation has been completed, the wire line 8 will be wound in to pull the tools back to the surface, first re-establishing the FIG. 2 relationship. The packing seal 20 will come back into seating relation with the upper end of the tube 16 at the time the upper tool 6 is again received within the extension tube section 7. Thereupon, the latch plunger 21 can be projected inwardly to hold the packing 20 in place. With the upper end of the tubing section 16 so sealed off, pressure within the upper tube 6 is relieved by opening the hand valve 27 and the coupling nut 15 between the adjoining ends of the upper and lower tubing sections is manipulated to break the connection so that the upper tubing extension can again be raised by the block and tackle 19 and the connector head 12 detached from the upper tool 6 and also from the closure seal 20. Upon such detachment and the raising and latching of the pulley 22 in its uppermost position of FIG. 1, the suspension cable 13 can be raised to bring the perforator 14 back into housed relation within the lower tube 16. Closing of the gate valve 4 will now shut off the well tubing and relief of pressure within the lower tube 16 by opening the hand valve 28 will safely permit detachment of the coupling nut 17 for removal of the lower tube 16.

Such modification can be made of the detail arrangement herein described without departing from the invention as set forth in the attached claims.

What is claimed is:

1. Well working equipment to project upwardly at the wellhead, comprising upper and lower tubular members detachably coupled in end to end tandem succession, wellhead detachable connection means on the lower member, upper and lower tools positioned initially one within the upper member and the other within the lower member and adapted to be lowered through the tubular members, a suspension cable joined to the lower tool and projected initially through the upper end of the lower tubular member, a detachable connection between said cable and the upper tool, a suspension cable for the upper tool extended through the upper end of the upper tubular member, cable embracing packer elements sealing the upper ends of the tubular members respectively and accommodating relative cable slide travel therethrough and a releasable connection joining one of the packer elements in the upper end of the lower tubular member and being releasable for accommodating displacement of the last mentioned packer element from interference to passage of the upper tool through the lower tubular member.

2. Well working equipment for attachment to a wellhead, comprising a work performing tool to be lowered in a well and to be actuated upon receipt of a signal and having a suspension and signal transmitting line, a housing member initially receiving said tool therein with said line extending through the upper end of the housing member, a seal positionable to close the upper end of the housing member and slidably embracing said line, means releasably connecting said seal to the housing in position to close said upper end and being releasable to accommodate seal displacement to open said upper end of the housing member, means to detachably connect the housing member to the wellhead as an upward extension thereof, a signal receiving and transmitting device having detachable connection with the upper end of said line for the suspension of the work performing tool and for the transmission thereto of an actuating signal, a second housing member having detachable connection with the previously mentioned housing member as an upward extension thereof and initially enclosing said signal receiving and transmitting device, a suspension line connected with said device and projected through the top of said second housing member and means sealing the top of said second housing member around said suspension line.

3. Well working equipment for attachment to a wellhead, comprising a first housing, means for mounting the same on a wellhead as an upward extension thereof, a closure for the upper end of the housing, a second housing detachably connectable to the first housing as an upward extension thereof and having a closure for the upper end of said second housing, a work performing tool adapted for travel below and to and from a position in which the tool is housed within said first housing, a tool suspension line slidably projecting through the closure at the upper end of the first housing, a second suspension line slidably projecting through the closure for the upper end of the second housing and having a con-

nector device adapted for travel to and from a position within the second housing and through and below said first housing and detachably connectable with the first suspension line and a releasable connection mounting the closure for the upper end of the first housing within said first housing and being releasable for displacement of the closure from interference to travel of said connector device through the upper end of said first housing.

4. For use with a wellhead containing a shutoff valve, an extension tube having a closure seal at its upper end and means at its lower end for detachably connecting the same to the wellhead while said shutoff valve is closed, a down-hole work performing tool initially housed within said tube and provided with a suspension line slidably projecting through said closure seal for movement relative thereto in lowering and raising said tool through the shutoff valve when the same is open and the tube is connected to the wellhead, a second suspension line having a coupler device in detachable connection with the first mentioned suspension line, a second extension tube having a closure at its upper end in which the second suspension line is slidable to and from an upper limit in which said coupler device is housed in the second extension tube, means at the lower end of the second extension tube for detachably connecting the same with the upper end of the first mentioned extension tube as an upward extension thereof and a releasable connection joining said closure seal to the first mentioned extension tube and being releasable for seal displacement to open the tubes for communication with one another for the free passage of said coupler device to and from its housed position within the second extension tube and while the work performing tool is suspended by the first mentioned suspension line from the coupler device.

5. Wire line well working equipment for use with a wellhead containing a shutoff valve, said equipment including a two-part extension tube for detachable connection with the wellhead as an upward extension thereof, said extension tube having a lower tube part and an upper tube part in end to end detachable succession and each having a sealing closure at its upper end, upper and lower suspension lines arranged to be detachably coupled in end to end succession and projected slidably one through the sealing closure of the upper tube part and the other through the sealing closure of the lower tube part, a work performing tool suspended from the lower line and receivable within the lower tube part and arranged to travel into and out of the same, said lower line being of a length greater than the combined lengths of the lower and upper tube parts and serving separately to control the suspended position of the tool when at the same time the lower line is uncoupled from the upper line and the tube parts are detached from one another and a releasable connection mounting the sealing closure in the lower tube part and being releasable for closure displacement to open the tube parts to one another while they are in end to end succession as an upward extension of the wellhead.

6. Signal responsive well working equipment for use with a well installation having a wellhead shutoff valve and a subsurface signaling means, said equipment comprising wire line receiving and wellhead extension tubing constituted by separable extension tubes having detachable connection in end to end succession and having closure seals for their upper ends in which tool suspension line sections are slidable, separate suspension line sections projecting through the respective closure seals and of greater lengths than said extension tubes, means to attach the lowermost tube to a wellhead, a work performing tool initially housed within the lowermost tube, said work performing tool having suspension connection with one of said line sections and being responsive for a work performing operation to energy transmitted thereto through its suspension line section, an energy supplying tool having means detachably joining the same to the last mentioned line section and having suspension connection with the suspension line section which projects through the closure seal of the upper extension tube, said upper extension tube serving to house the energy supplying tool at the upper limit of its suspension line travel, a releasable charge of energy carried by said energy supplying tool and means also carried by said energy supplying tool for travel therewith into the range of said signaling means and responsive to the signal thereof to effect release of said charge.

7. In combination, subsurface signaling means located at a known depth in a well, a wellhead having a shutoff valve, a work performing tool adapted to be lowered past said valve and into the well and to be rendered active upon receipt of a force transmitted thereto, a tool suspension and force transmitting cable connected with the tool, a signal responsive force supplying device detachably connected with said cable and adapted to be lowered through the wellhead to the location of the signaling means and thereupon to be signaled into action for the transmission of force through the cable to the work performing tool, a suspension line for said device, a pair of wellhead extension tubes having detachable connection in end to end succession and having detachable connection with the wellhead above said shutoff valve, closure seals for the upper ends of said tubes respectively with the closure seal for the upper tube slidably receiving the suspension line and the closure seal for the lower tube slidably receiving said cable and a releasable connection joining the lower tube and the last mentioned seal and being releasable for seal displacement to provide passage clearance through the lower tube for said signal responsive and force supplying device.

8. Wellhead equipment for use with a suspension line assembly having one line section connected to a first tool for suspension thereof and another line section suspending a second tool in spaced relation below and from the first tool, said equipment including a first wellhead extension tube, means to detachably connect the same to a wellhead as an upward extension therefrom, a closure seal for the upper end of said extension tube for slide reception therein of the last mentioned suspension line section, a second wellhead extension tube removably attachable in end to end succession with the first tube, means sealing the upper end of the second extension tube and slidably embracing the first mentioned line section and means detachably securing the closure seal in said first wellhead extension tube.

9. For use with a well tool suspension line, a wellhead extension assembly including a first tubular housing having means at its lower end for connection to a wellhead as an upward extension thereof, a suspension line embracing seal at the upper end of said housing, a second tubular housing having detachable interconnection between its lower end and the upper end of the first housing and affording an upward extension thereof, a suspension line embracing seal at the upper end of said second tubular housing and releasable means connecting the first mentioned seal to the first mentioned housing.

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