Jan. 18, 1966 G. L. LOOMIS 3,229,960

HOISTING APPARATUS FOR WELL RIG

Original Filed Aug. 20, 1962 2 Sheets-Sheet 1

FIG. 1

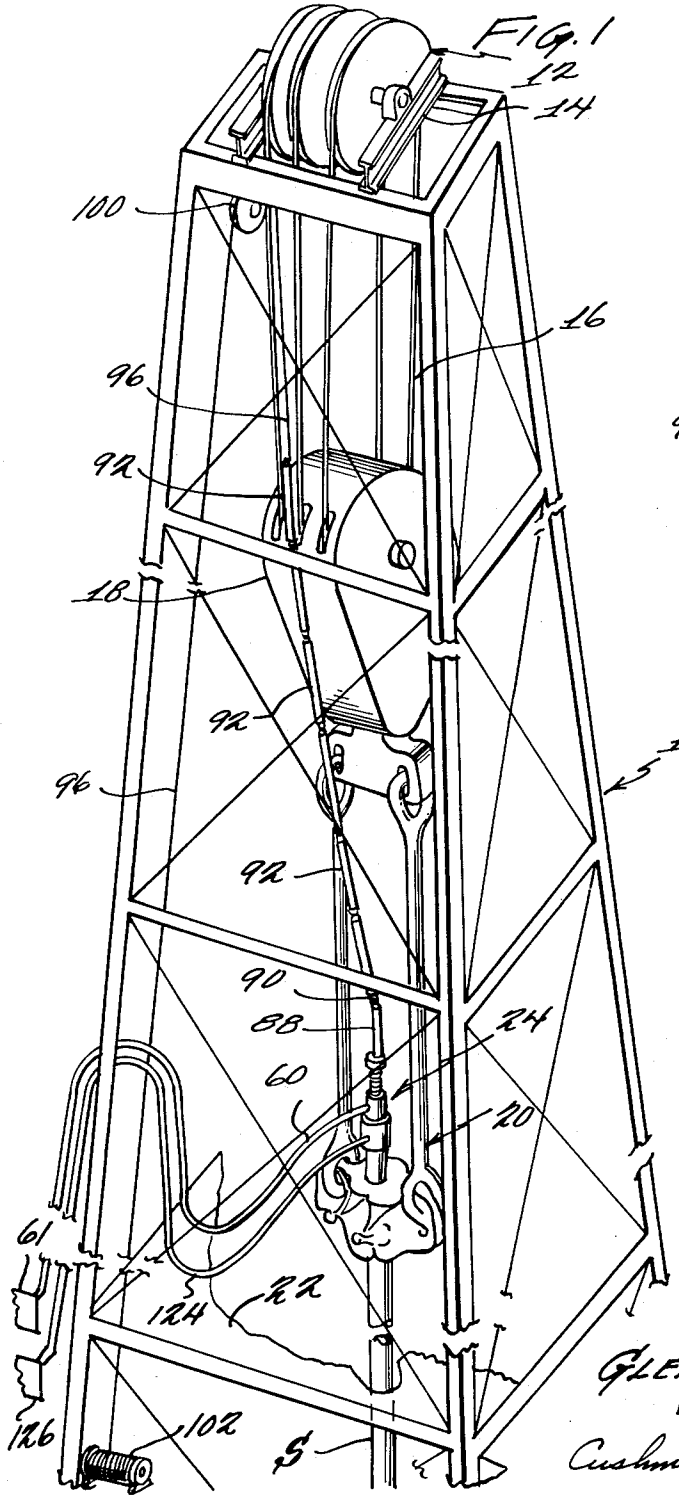
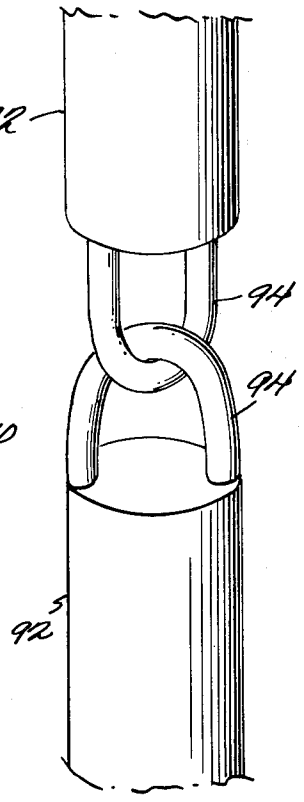


FIG. 2



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FIG. 3

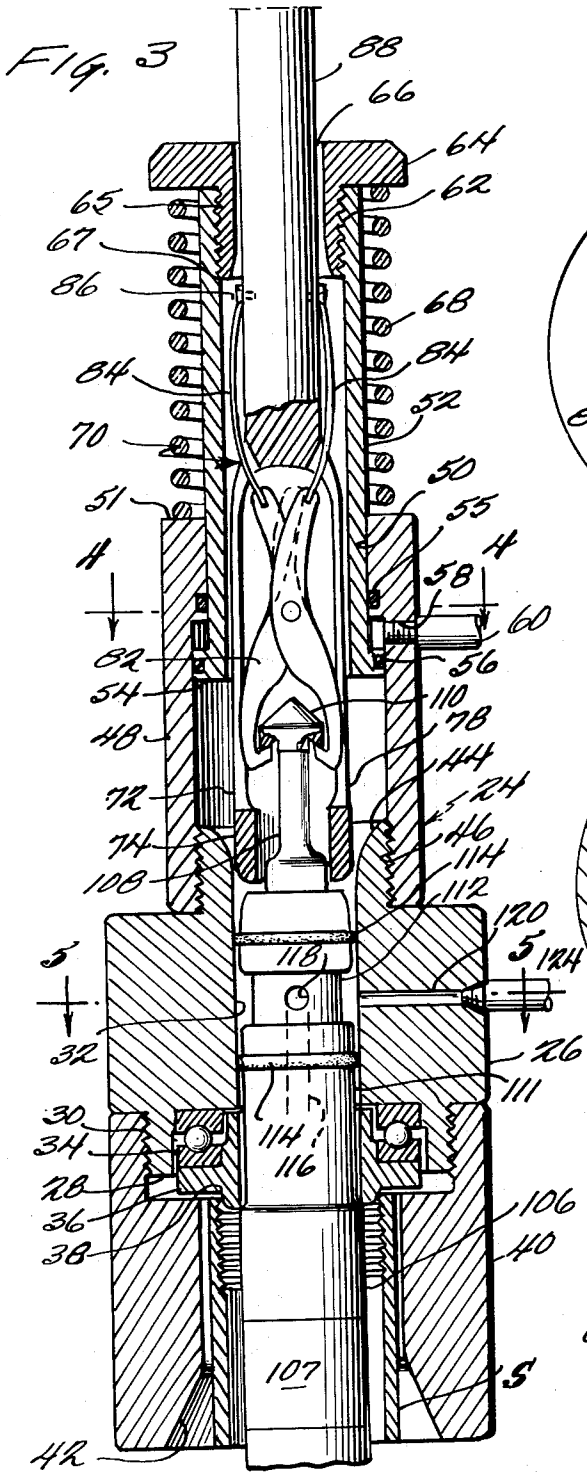
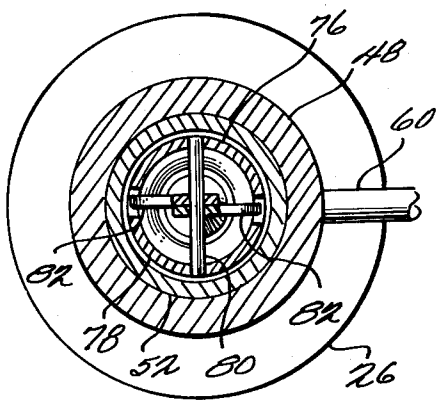


FIG. 4



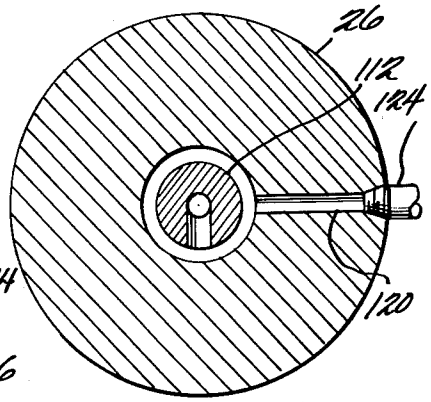


FIG. 5

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3,229,960

HOISTING APPARATUS FOR WELL RIG

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Original application Aug. 20, 1962, Ser. No. 217,791, now Patent No. 3,193,015, dated July 6, 1965. Divided and this application Mar. 23, 1964, Ser. No. 360,157
4 Claims. (Cl. 254—135)

This application is a division of my copending application, Serial No. 217,791, filed August 20, 1962, and now Patent No. 3,193,015.

The present invention relates to a connect and disconnect apparatus for tools insertable into well tubing or the like, and, more particularly, to an automatic connect and disconnect apparatus for use with testing tools used in testing stands of well tubing as the well tubing is installed in oil and gas wells or the like.

In my prior United States Patent No. 2,731,827, issued January 24, 1956, a tool for testing well tubing is disclosed as well as a procedure for installing the well tubing in oil and gas wells. The procedure disclosed in the aforementioned patent, which is generally used today for assembling and installing well tubing in oil and gas wells, includes joining together a multiplicity of tubing sections and placing these sections or stands, as they are generally referred to, in a generally upright position in a rack adjacent the derrick. This is done in order to save time during the actual tubing installation, as the stands may be joined together more rapidly than is the case when one tubing section is installed at a time. A well derrick is usually provided with a platform or "monkeyboard" near the top thereof about fifty to seventy-five feet or higher above the derrick floor on which a crew member is stationed. The crew member, at this position, latches the conventional elevator device onto the upper end of an upright stand and the stand is then hoisted into position for attachment of its other end to a previously-run stand.

The connections between two stands are usually threaded connections or threaded collar joints although they may be welded to one another. Each connection, as well as the length of the stand, must be tested for leaks at least at pressures which the well tubing will encounter when lowered within the well. In the hydrostatic testing of the stand and its threaded connections to another stand, a test tool of sufficient length is utilized to encompass the entire stand, and usually such test tool is left suspended within the tubing string after the test, as shown in the prior United States Patent No. 2,610,691, issued September 16, 1952, to Berry, or United States Patent No. 2,652,717, issued September 22, 1953, to Bush and Collet, and then the string is lowered down in the well bore prior to the attachment of another stand. Heretofore, a wire line grapple was lowered through the newly-attached stand to engage the testing tool so that the same may be pulled upwardly into the newly-attached stand until its upper packer is near the top of the same. With the test tool in this position, hydraulic pressure is applied, and the testing operation is performed, this operation being performed above the floor level of the derrick and above the usual slip-holding devices which engage the previously-run stand.

It is desirable to test a newly-attached stand and its joint above the derrick floor level from a safety standpoint because, if there is a failure of the tubing or a failure of the threaded coupling, the entire tubing string will not be dropped into the well bore but is retained by the slip-holding device. Also, testing above the floor of the derrick and above the slip-holding device eliminates an expensive fishing job caused by the tubing string being dropped

and also eliminates the danger of rapid agitation of the weighting fluid and the resultant blowout of the well.

Ancillary to the above, it is more efficient to test a stand and its threaded joints above the derrick floor as the testing crew member can make a visual test as well as a test determined by the drop of pressure on a pressure gauge. Oftentimes, small leaks which are detrimental in high pressure gas wells are difficult to locate by means of a pressure drop and can only be located by use of visual means.

In addition to the above, it is a further advantage to test well tubing above the holding slips, as wells are usually loaded with a heavy viscous mud for creating sufficient hydrostatic head to overcome well pressure at the producing level. If testing below the well surface, this heavy mud oftentimes mixes with testing fluid and prevents a true test, insomuch as the nature and viscosity of the mud will stop a leak which would otherwise appear with clear water or other fluids.

Although testing has been accomplished heretofore above the floor of the derrick, there have been many difficulties encountered in performance of the operation. One of the principal difficulties arises from the fact that the top of the stand to be tested, after it has been hoisted into position and threaded onto a previously-installed stand, is above and out of reach of the man on the "monkeyboard" even though the "monkeyboard" may be positioned upwardly in the derrick fifty feet or more above the derrick floor. In order that the wire line grapple may be disconnected from the test tool after it has been raised in the stand to be tested and the pressure lines attached to the top of the test tools, it is necessary for the crew man to unbuckle his safety belt and climb up the derrick and swing out to disconnect the grapple and connect the pressure lines.

Oftentimes, it is necessary to place a second derrick man on the "monkeyboard" to perform this operation and, at best, this is a very hazardous operation as it is done a considerable distance above the "monkeyboard" floor. During nighttime and inclement weather, it is also impossible to accomplish, and oftentimes results in a delay in completion of a well.

Another difficulty in the prior procedure of testing wells is due to the fact that the hoisting sheaves and hooks used on modern well rigs are massive and require considerable space in the derrick. Heretofore, a weight such as a rigid steel bar several feet long has been attached to the top of the wire line grapple in order to counterbalance the weight of the test tool hoisting cable which runs over a pulley attached near the top of the derrick. The grapple with the weight bar was inserted by the derrick man in the tubing stand before the elevator was latched, but when the stand was attached to the tubing string, the derrick man had to unlatch the elevator in order that the grapple and bar could be withdrawn to be disconnected. In other words, the elevator was unlatched and pulled to one side out of the way so that the weight bar and the grapple could be withdrawn and the grapple disconnected. After the test is completed, the elevator had to be relatched to the stand; and, as will now be evident, such operation consumed additional time and was a hazard to the derrick man working on the "monkeyboard."

An important object of the present invention is to provide an automatic connect and disconnect apparatus for use with tools insertable into the well, the apparatus obviating dangers to personnel as well as reducing the time for completion of the well.

Another important object of the present invention is to provide an automatic connect and disconnect apparatus for tools insertable in the well tubing and to which fluid under pressure is flowed, the apparatus providing means for automatically connecting the fluid pressure sup-

ply to the tool. Ancillary to the immediately preceding object, it is a further object to provide such apparatus for use with testing tools.

Still another object of the present invention is to provide an automatic connect and disconnect apparatus which may be operated by remote control in the will of the derrick man stationed on the "monkeyboard" or at the derrick floor, the apparatus providing means for remotely disconnecting the grappling hooks from a tool within a stand of well tubing, and remote controlling operation of a tool in the well tubing.

A further object of the present invention is to provide an improved grappling device for inserting into a stand to engage a tool or the like, the grappling apparatus being provided with a flexible weight insertable into the well tubing and capable of being deflected past the traveling block in order that the elevator does not have to be disconnected.

Ancillary to the immediately preceding object, it is a further object of the present invention to provide a jointed weight bar capable of insertion into a tubing stand and also capable of deviating from its axis so that it can pass over the traveling block or hoisting sheave as it is being withdrawn from the stand.

A still further object of the present invention is to provide an automatic connect and disconnect apparatus for test tools for oil and gas wells, the apparatus being generally supported on the end of stand of well pipe and capable of being connected to a test tool, the stand being rotatable relative the apparatus and tool connected thereto.

Throughout the specification, the invention will be described in connection with its use with an oil or gas well testing tool, but, of course, could be used on any tool used within well tubing for various other treatments of the same such as a tubing leak repair tool, a cement tool, a blowout tool, or the like.

The above objects, as well as other objects and advantages of the present invention, will appear more fully in the following specification, claims and drawings in which:

FIGURE 1 is a schematic, perspective view showing the upper portion of a derrick and illustrating the present invention attached to the upper end of a stand of well tubing;

FIGURE 2 is an enlarged, fragmentary, perspective view of the jointed weight bars or flexible weight;

FIGURE 3 is an enlarged, fragmentary, vertical, sectional view of the automatic connect and disconnect apparatus and illustrating the same positioned on the upper end of a stand of well tubing and further illustrating the grappling hooks elevating a test tool to a position for accomplishing a test of the stand;

FIGURE 4 is a sectional view taken substantially on the line 4—4 of FIGURE 3; and

FIGURE 5 is a sectional view taken on the line 5—5 of FIGURE 3.

Referring now to the drawings wherein like character and reference numerals represent like or similar parts, the numeral **10** generally represents a typical derrick used in completion of oil and gas wells. Such a derrick **10** may be a hundred feet or more in height and includes, at its upper end, a hoisting sheave **12** commonly known in the industry as a "crown block," the hoisting sheave **12** being suitably supported on a frame structure **14**. Suspended below the hoisting sheave **12** by means of hoisting cables **16** which pass over the hoisting sheave, is a vertically movable hoisting sheave **18** known in the industry as a "traveling block." The hoisting sheave **18** is massive in size and supports the usual elevator generally designated at **20**, the elevator being capable of detachably clamping to the end of a stand S of well tubing for elevating the same from a rack (not shown) and positioning the same in axial alignment with a previously-run stand of well tubing so that it may be threaded or suitably secured to the previously-run stand of well tubing.

A platform **22** is provided on the derrick at an elevation above the floor of the derrick, the platform being provided for the derrick man who connects and disconnects the elevator **20** from a stand **5**. The platform **22** which is known as a "monkeyboard" is usually fifty feet or more above ground level or the floor of the derrick. In any event, the platform **22** is supported on the derrick at a position where the derrick or crew man can easily reach the upper end of a stand S positioned in a rack beside the derrick. When it is desired to attach a stand to a stand of a previously-run tubing string, the derrick man swings the elevator **20** over and latches the same on a racked stand. Then the derrick man swings the stand back to a position where it is longitudinally aligned with the tubing string, and in order to do this, the elevator **20** must be hoisted by the traveling block **18** and the upper end of the stand will then be out of reach of the derrick man. However, the lower end of the stand is in position adjacent the upper end of a previously-run stand which has been lowered into the well to a position where its upper end is above the usual holding slips. With the stand S in the axially aligned position with the well tubing string, the stand S is then threaded onto the previously-run stand and, after the coupling operation is completed, the usual testing of the threaded joint, as well as the length of the stand, is accomplished above the holding slips. If there is any failure either in the threaded joint or coupling or in the length of the stand, the previously-run stands of the tubing string will not fall down into the well. Once the test has been made, and it has been found that the coupling joint as well as the length of stand is satisfactory, the well tubing string is lowered until the last tested stand has its upper end immediately above the holding slips.

Referring now to FIGURE 3, which discloses a vertical section through a portion of the automatic connect and disconnect apparatus generally designated at **24**, it will be noted that such apparatus includes a body portion **26** which is provided with a downwardly-facing annular collar **28** threaded exteriorly as indicated at **30**. The body portion **26** is generally of greater diameter than the diameter of the stand S and is provided with a bore **32** extending therethrough. Carried within the collar **30** is a thrust bearing assembly **34** having a ring member **36** for engaging the upper end of the stand S at **38**. Threaded onto the threads **30** of collar **28**, is an annular guide sleeve **40** having an inside diameter greater than the outside diameter of the stand S, the sleeve **40** having its lower end tapered as indicated at **42**, and, thus, providing a guide when the apparatus **24** is placed over the end of a stand.

An upwardly-extending annular collar **44** is provided on the body portion **26**, the collar **44** being exteriorly threaded as indicated at **46**, and receiving the lower end of a cylinder **48**. The cylinder **48** is provided with a bore **50** in its upper end or head **51** through which extends a hollow piston **52** having a piston head **54**. The piston head **54** is provided with suitable piston rings **56** for engaging the interior walls of the cylinder **48**, while O-rings **55** are provided in the cylinder head **51** for engaging the exterior walls of the hollow piston. A lateral port **58** in the wall of the cylinder **48** has connected thereto a conduit **60** through which a fluid under pressure can be flowed from a suitable source of fluid pressure **61** to the area beneath the piston head **54** so as to extend the piston downwardly within the chamber of the cylinder **58**. A portion of the hollow piston **52** extends out of the cylinder **48** and is interiorly threaded as indicated at **62**. A ring nut **64** having a center bore **66** is threaded into the end of the piston **52** and a spring **68** interposed between the head of nut **64** and the cylinder **48** normally causes the piston to assume a retracted position.

The lower end of grappling means generally indicated at **70** extends into the hollow piston **52** as best shown in FIGURE 3. The grappling means **70** includes a cage member **72** having ring **74** at its lower end from which

extend oppositely-disposed side members 76 and 78 respectively. Supported within the cage member by means of a pivot pin 80 are a pair of grappling hooks 82 which are spring-urged to a "grappling position" by means of leaf springs 84. The leaf springs 84 fit into suitable slots in the upper ends of the grappling hooks 82, the other ends of the springs 84 being fixedly secured by means of screws 86 to the stem portion 88 of the grappling means. The maximum exterior diameter of the cage 72 is less than the diameters of the bore 32 in the body portion 26 as the grappling means 70 must be capable of being lowered vertically through the body portion 26 down into the stand S.

The ring nut 64 is provided on its stem 65 with a camming surface 67. When the piston 52 is extended, the camming surface 67 of ring nut 64 engages the leaf springs 84 to compress the same and cause the hooks 82 to move to the dotted line release position 83 as shown in FIGURE 3.

The stem portion 88 as shown in FIGURE 1, is provided with a hook 90 at its upper end to which is connected a plurality of bars 92. Each bar 92 is jointed to another bar 92 so that it can be pivoted with respect thereto. As shown in FIGURE 2, the bars 92 may be connected by means of links 94. The uppermost bar 92 is connected to a hoisting cable 96 which extends over a pulley or sheave 100 supported from the frame structure 14 on the upper end of the derrick 10. The hoisting cable 96 extends downwardly to a suitable hoisting drum 102 carried either on the floor of the derrick as schematically shown in FIGURE 1, or on the platform 22 if so desired. As will now be apparent, the short sections of bars 92 connected to each other provide a flexible weight which can be deviated from the axis of the stand so that it can pass by the hoisting sheave or traveling block 18 when in the position shown in FIGURE 1. The bars 92 are usually on the order of seven feet in length and have a combined weight to substantially counterbalance the weight of the hoisting cable 96 when the grappling means 70 is in its uppermost position. In other words, the counter weight made up by the short bars 92 is necessary in order to counterbalance the weight of the length of hoisting cable 96 between the sheave 100 and the hoisting drum 102, otherwise, the grappling means 70 might be pulled completely out of the stand and over top of the sheave 100. The elongated bars 92 are substantially circular in cross section and have a maximum diameter less than the minimum diameter of the bore 32 in body portion 26, as well as the diameter of the stand S as the bars pass through the bore 32 into the stand S when it is desired to grapple onto a tool supported in a previously-run stand.

As shown in FIGURE 3, the grappling means 70 is illustrated hooked onto the end of a desired tool generally indicated by the numeral 106. The tool 106 is provided with the usual stem 108 having a neck 110 under which the tongs of the grappling hooks 82 engage. Tool 106 may be a testing tool of the type disclosed in my prior United States Patents Nos. 2,731,827, issued January 4, 1956; 2,807,955, issued October 1, 1957; or 2,841,007, issued July 1, 1958. Such tools usually include spaced packers mounted on a body, one being shown at 108, and at least one fluid passageway through the tool opening to the area between the packers. After the packers are expanded into sealing engagement with the interior wall of the stand to form spaced barriers therein, fluid under pressure is applied through the passageway and discharged externally of the tool to the annular space between the packers at a predetermined pressure in order to test the stand and the coupling joint for leaks.

While the invention is being described in connection with a testing tool for oil or gas well flow tubing, it is appreciated that any tool insertable into well tubing and used for supplying a fluid to the well to treat the same may be employed.

In the partcular environment shown, the test tool 106 is provided with a reduced neck 110 which can fit up into the bore 32. The neck 110 is provided with an annular groove 112, and O-rings 114 provided on either side of the groove 112 seal off the same. The tool 106 is provided with at least one fluid passageway 116 which opens in a port 118 within the groove 112. Body portion 26 is provided with a lateral passageway 120 which opens in the bore 32 at a position between the barriers formed by the O-rings 114. A conduit 124 is connected to the passageway 120 and extends to a suitable source of fluid pressure 126. When the tool 106 has been moved by the grappling means 70 to the position shown in FIGURE 3, fluid under pressure is flowed from the source 126 through the conduit or line 124 to the tool, and the packers 108 are expanded to form spaced barriers in the stand, and then the fluid is applied to the areas between the spaced barriers to test the stand for leaks.

The operation of the apparatus of the present invention may be described briefly as follows. The derrick man is stationed on the platform 22, and, when it is desired to add another stand to the string of well tubing, the derrick man swings the elevator 20 over to a position beside the derrick and latches the same onto the upper end of a racked stand. At the time the derrick man latches the elevator onto the stand S, the automatic connect apparatus 10 is placed over the top of the stand as shown in FIGURE 3. The stand S with the automatic connect and disconnect apparatus is then elevated by the driller and swung back into axial alignment to a previously-run stand which has been lowered into the well with its upper end positioned immediately above the usual holding slips. With the stand S in a position alinged with the previously-run stand, the automatic connect and disconnect apparatus 10, as well as the point where the elevators 20 are attached to the stand, are at a position out of reach of the derrick man on the platform 22. However, the stand S can be threaded onto the previously-run stand, as the thrust bearing 34 interposed between the body portion 26 and the end of the stand permit the stand to be rotated without rotating the automatic connect and disconnect apparatus 10 and its various fluid pressure conduits. When the stand S is in its elevated position, the grappling means 70 is supported within the cylinder 48 and its hoisting cable, including its flexible weights 92, is deviated past the traveling block 18.

After the stand S has been coupled to the previously-run stand, and prior to the testing of the stand, the testing operator who may be either at the floor level or on the platform 22 depending on where the hoisting drum 102 and the sources of fluid pressure 61 and 126 are located, then operates the hoisting drum 102 to lower the grappling hooks 82 downwardly through the body portion 26 and the stand S into the previously-run stand until the hooks 82 pass over the head 110 of the test tool 108 which is supported in the previously-run stand. The grappling means 70 is then raised so as to slide the testing tool 106 upwardly through the stand to be tested until the neck 110 of the testing tool is in the position shown in FIGURE 3 within the bore 32. When the testing tool 106 is in this position, the testing operator can then apply fluid under pressure from the source 126 through the conduit 124 into the testing tool to reset the packers 108, if the same are set by fluid pressure, and then to apply fluid to the space between the barriers set up by the packers.

Once the testing operation has been completed, and it is determined that the stand S has a satisfactory coupling joint to the previously-run stand and is leakproof, the testing operator then applies fluid pressure from the source 61 through the conduit 60 into the cylinder 48. This causes the piston 52 to be extended into the cylinder and the ring nut 64, traveling with the piston,

has its camming surface **67** engage the leaf springs **84** to compress the same inwardly. This causes the hooks **82** to be released from the head **110**, and the connect and disconnect apparatus **24** then can be elevated off the end of the stand, and the stand along with the rest of the string can be lowered into the well. The procedure is then repeated with additional stands being attached and tested in sequence.

While the apparatus described above fully accomplishes the objects and advantages of the present invention, it is, of course, within the scope of the present invention that certain changes and modifications may be made without departing from the spirit of the invention. Therefore, the terminology used in this specification is for the purpose of description and not for limitation, as the scope of the invention is defined in the claims.

What is claimed is:

1. For use in a well derrick having a crown block and a traveling block with an elevator supported immediately therebeneath for making up tubing and lowering the same in a well, a connect and disconnect apparatus for raising or lowering a tool within the well tubing comprising: a sheave supported on the derrick adjacent the crown block and offset with respect to the traveling block, a hoisting cable passing over said sheave, an elongated flexible weight having one end attached to said hoisting cable and having a size capable of insertion into the stand

of well tubing, said weight being capable of flexing about the traveling block and including a plurality of elongated bars pivotally connected together, and grappling means supported on the other end of said weight for connecting and disconnecting to the tool.

2. The connect and disconnect apparatus of claim **1** wherein said elongated flexible weight counterbalances the weight of said cable when the grappling means is supported in its uppermost position.

3. The connect and disconnect apparatus of claim **1** wherein each of said bars has a length on the order of seven feet and longer.

4. The connect and disconnect apparatus of claim **1** wherein each of said bars is rigid.

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