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Yonker

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[54] **LANDING AND RUNNING TOOL ASSEMBLY**

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[52] **U.S. Cl.** **166/217,** 166/125

[51] **Int. Cl.** **E21b 23/00**

[58] **Field of Search** 166/217, 125, 181, 182

[56] **References Cited**

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Primary Examiner—James A. Leppink

[57] **ABSTRACT**

There is disclosed a landing tool for landing apparatus in a well at a selected location. An expander expands lugs into a groove in the tubing wall to position the landing tool and at the same time releases lugs which are securing a running tool to the landing tool. The running tool illustrated has locator dogs which while the tool is being run can retract into an out of the way position. Upon reverse movement of the running tool in the well these dogs are prevented from retracting until at a predetermined load a snap ring detent is overcome and thereafter movement of the running tool in the well in the original direction will result in the running tool being arrested upon engaging the first shoulder in the tubing. Continued movement in such direction of the running assembly moves a pusher into engagement with the expander on the landing tool to latch the landing tool in the well and release the running tool from the landing tool. Also shown is a pulling tool having a collet which can be run into the landing tool and engage an internal shoulder therein. Subsequent upward pull on the pulling tool will release the landing tool from the well tubing and witndraw it from the well.

7 Claims, 6 Drawing Figures

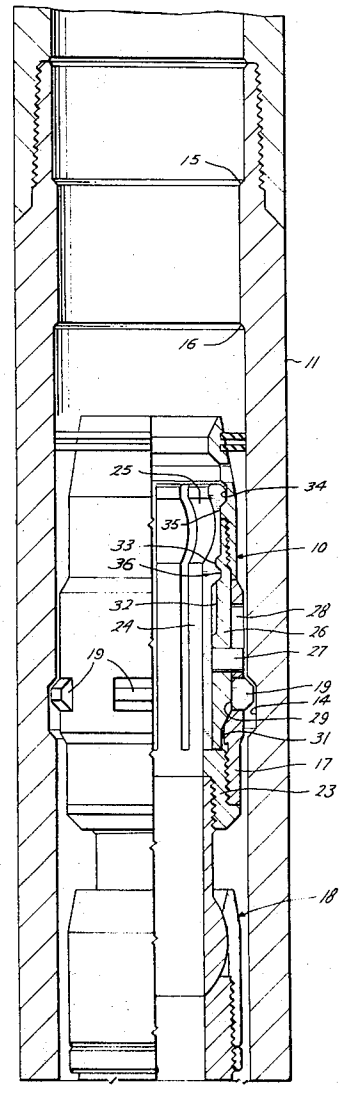

Fig. 1A

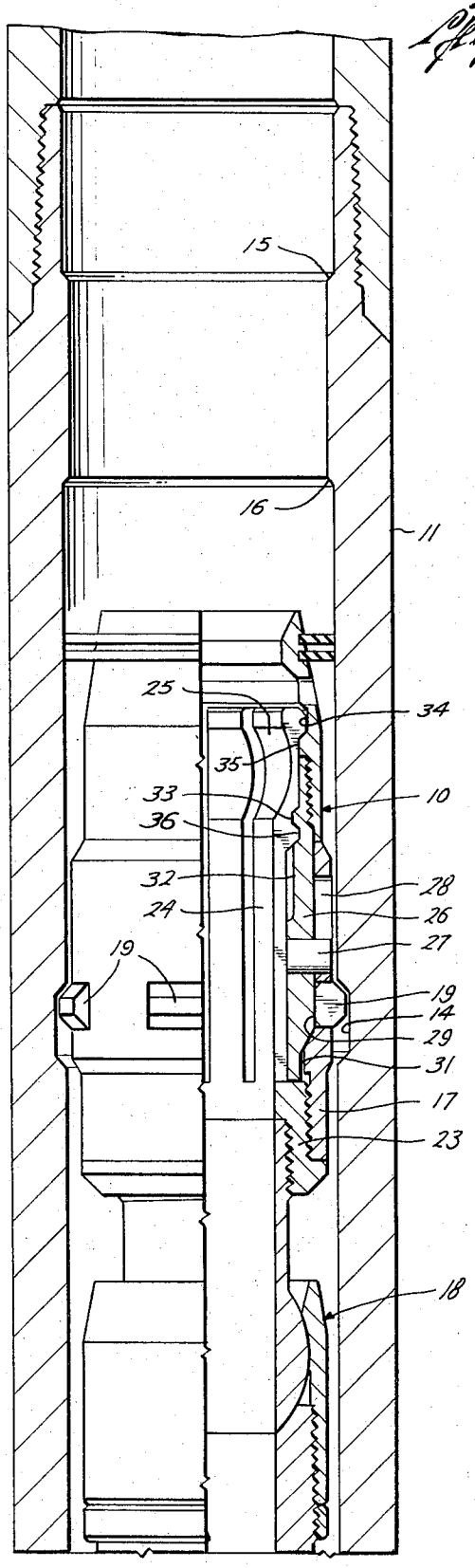

Fig. 1B

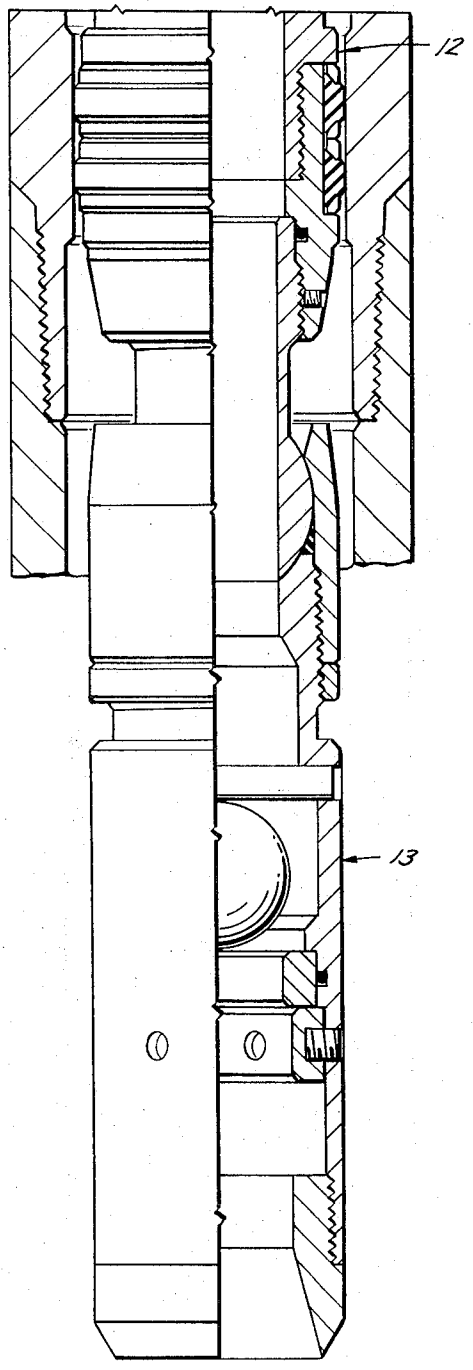

Fig. 2

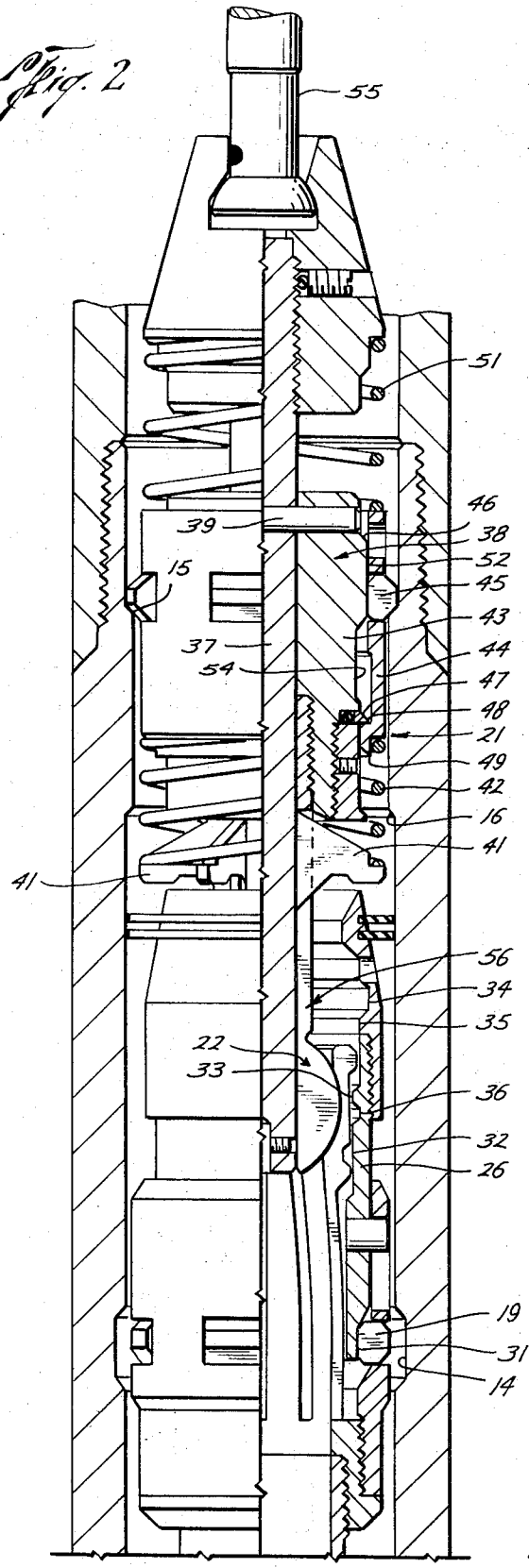
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Fig. 3

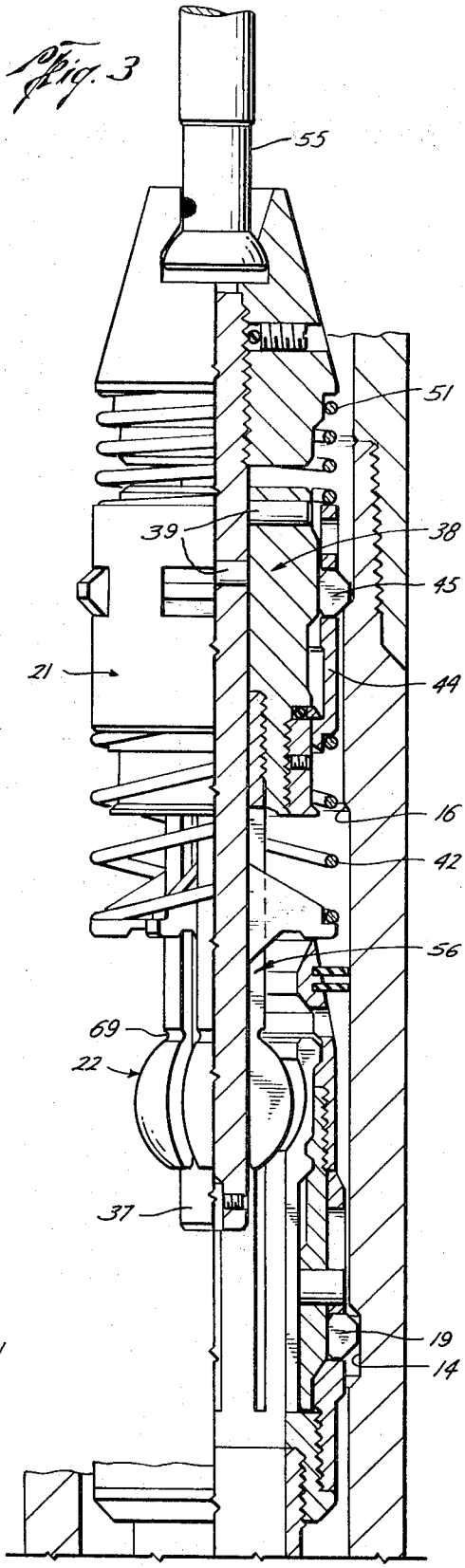
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Fig. 4

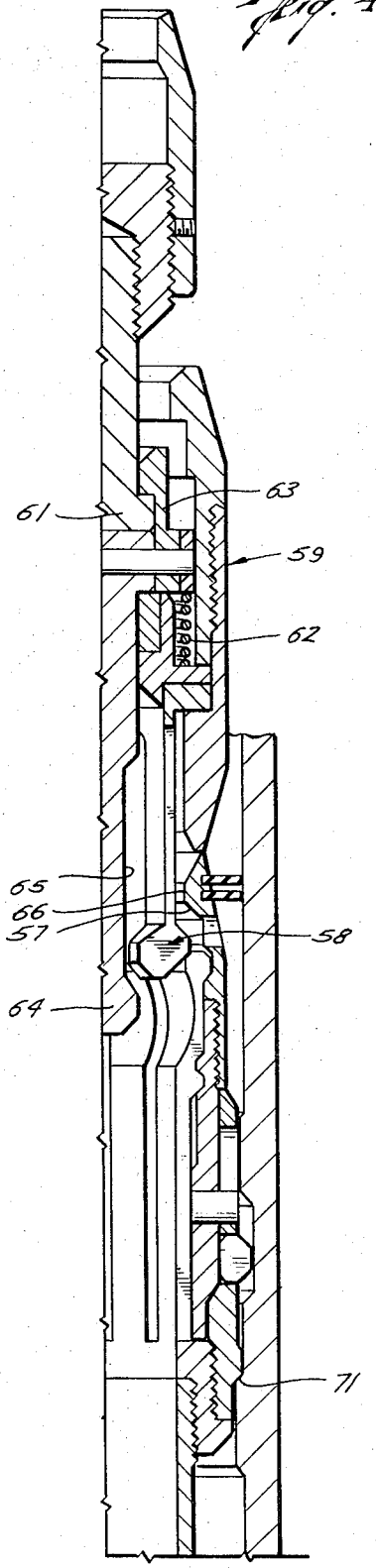
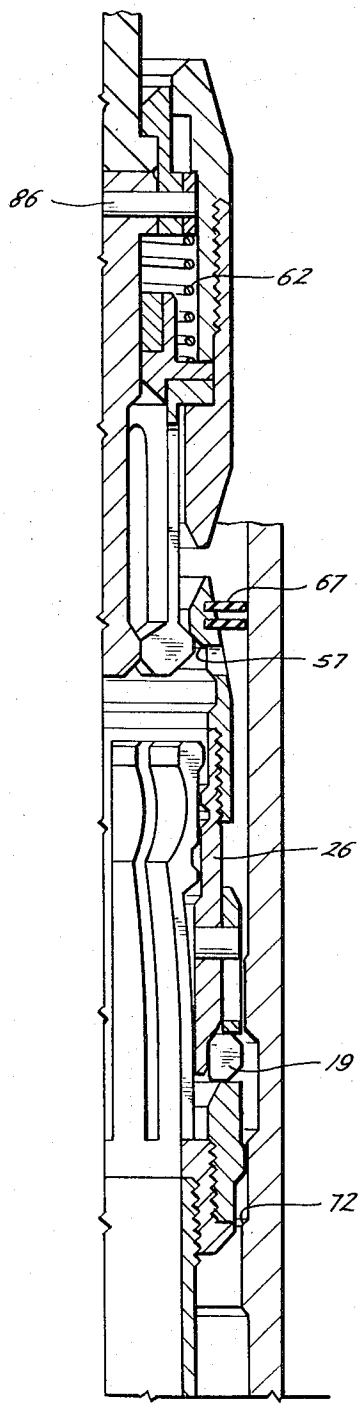


Fig. 5



LANDING AND RUNNING TOOL ASSEMBLY

This invention relates to well tools and more particularly to a landing and running tool assembly for positioning the landing tool in the well. In one aspect the invention relates to a novel landing tool for landing equipment in a well.

Anchoring tools are conventionally used to anchor pieces of equipment in a well. These tools are commonly run by a variety of running tools and are removed from the well by a variety of pulling tools. For instance, see the patents to A. W. Carroll U.S. Pat. No. 3,638,723, Joseph L. Pearce, Jr. U.S. Pat. No. 3,646,996, and P. S. Sizer U.S. Pat. No. 3,411,584. While landing tools such as those shown in the above patents have been utilized for many years as an acceptable system of positioning tools in a well problems are sometimes encountered which results in the landing tool being released in a tubing at a position other than opposite a landing groove. This problem has become more accute with the advent of pump down equipment and the high pressure fluid utilized to move such equipment. For instance, if a tight place in the tubing is encountered by a string of tools, this may be read at the surface as bottoming of the tool on a landing shoulder. The tool may then be manipulated according to its design to go through the landing steps and the running tool then released from the landing tool. Even if the operator realizes that the tool is not in proper position to be landed, if the tool becomes stuck in the well the operator is limited in the amount of force he can apply in attempting to withdraw the tool without exceeding the forces normally required to release the running tool from the landing tool. When this occurs, the running tool will be released and an extra trip will be required to withdraw the tool from the hole for redressing.

It is an object of this invention to provide a running and landing tool assembly in which the tools may only be disassembled when the anchoring tool is opposite an anchoring groove in the well tubing.

Another object is to provide a landing tool in which an expander sleeve is shifted between two positions, one of which locks the tool to a running tool and the other of which releases the running tool and locks the landing tool in the well.

Another object is to provide a landing tool in which an associated running tool is secured by latching dogs carried in the landing tool and in which the landing tool cannot release the running tool unless the landing tool is properly positioned opposite a landing groove in a well tubing.

Another object is to provide a landing tool in which an expander sleeve is shifted between two positions, one of which locks the tool to a running tool and the other of which releases the running tool and locks the landing tool in the well, with the parts so arranged that the expander sleeve cannot be shifted to release position unless the landing tool is opposite a landing groove in the well tubing.

Other objects, features and advantages of the invention will be apparent from the drawing, the specification and the claims.

In the drawings within like reference numerals indicate like parts and wherein an illustrative embodiment of this invention is shown;

FIGS. 1A and 1B are continuation figures showing a well tubing in cross section and a landing tool carrying a standing valve with the tool and valve shown partly in elevetion and partly in quarter section;

FIG. 2 is a view of a tubing in cross section and a running tool secured to the upper end of the landing tool of FIGS. 1A and 1B with the parts shown partly in elevation and partly in quarter section illustrating the assembly in a position to land the landing tool in the well;

FIG. 3 is a fragmentary view similar to FIG. 2 showing the landing tool to have been landed and latched in the well and the running tool to have been released therefrom and ready for removal from the well;

FIG. 4 is a fragmentary quarter sectional view of the upper section of the landing tool and a pulling tool for removing the landing tool from the well; and

FIG. 5 is a quarter sectional view similar to FIG. 4 showing the landing tool to have been released from the well and ready for removal therefrom.

Referring first to FIGS. 1A and 1B, the landing tool indicated generally at **10** is landed in a mandrel **11** which is part of a tubing string, not shown. The landing tool **10** carries a seal assembly **12** which in turn supports a standing valve indicated generally at **13.** The standing valve **13** is only one of a large number of tools utilized in wells which could be landed in place by the use of a landing tool of this invention.

The mandrel **11** is especially designed to receive a landing tool and for this purpose has an internal landing groove **14** with which the landing tool cooperates to latch the tool in position within the mandrel. The mandrel also has an upwardly facing shoulder **15** and a downwardly facing shoulder **16** for cooperation with the running tool in positioning the landing tool within the mandrel in a manner to be explained hereinbelow.

The anchoring tool includes a body **17** to which the seal assembly **12** is attached as by the ball joint indicated generally at **18.** It will be noted that throughout the assembly ball joints are utilized to permit the assembly to articulate and freely negotiate bends in the tubing as is desirable in pump down equipment. It will be understood that where the system is used with wire line equipment these articulating joints may be dispensed with if desired.

External lug means are carried by the body and are adapted to be extended into the latching groove **14** in the mandrel to lock the anchoring tool in place in the mandrel. Preferably the lug means is provided by a plurality of lugs **19** carried in suitable slots in body **17.** When these lugs are retracted the anchoring tool is free to move within the mandrel. When the lugs are extended into groove **14** the landing tool is latched against movement in either direction within the mandrel.

In order to latch the landing tool to a running tool such as indicated at **21** in FIGS. 2 and 3 internal lug means are provided which when extended extend above a shoulder provided by the ball indicated generally at **22** (FIG. 3) and prevent separation of the running tool shown in FIGS. 2 and 3 from the landing tool so long as the lug means is extended.

In the preferred form of the invention, the lug means is provided by a collet **23** having a plurality of upwardly extending collet fingers **24.** The fingers **24** each have at their upper end arcuate sections **25** which together form a socket. When the ball **22** is within the socket **25** and the socket is extended inwardly to snugly receive the ball the running tool cannot be disassociated from the landing tool.

An expander means is provided which in its running position holds the collet fingers **25** extended inwardly to closely surround the balls and prevent the two tools from being disassociated. In this position of the expander means the external lugs **19** are free to retract. In the landed position of the expander means the lugs **19** are extended and the collet lugs are permitted to retract to free the ball **22** of the running tool and permit the disassociation of the two tools. Preferably the collet fingers **25** are resilient and are retracted in their unbiased position as shown in FIG. 1A. In the preferred form, the expander means is provided by a sleeve **26** which is movable in a reciprocal fashion within the body **17.** The expander means carries a pin **27** which reciprocates within the closed slot **28** and limits the extent of longitudinal travel of the expander **26** relative to the body **17.**

In order to expand and permit the external lugs **19** to retract, the expander means **26** has thereon a land **29** and a groove **31** which cooperate with the lugs **19** to permit their expansion and contraction. With the expander means in landing position as shown in FIG. 1A the land **29** is behind the lugs **19** and holding them in expanded position to lock the landing tool in the well. When the expander means is moved to its running or upper position the groove **31** is behind the lugs **19** permitting them to retract as shown in FIG. **2.**

The expander **26** is provided with land means **32** and **33** for holding the collet fingers in extended position. The expander **26** is also provided with groove means in the form of surfaces **34, 35** and **36** which permit the collet fingers **25** to retract and release the ball **22.** As shown in the drawings the exterior surface of the collet fingers **25** are formed with surfaces which generally mate with the land and groove surfaces on the interior of the expander **26** when the expander is in its upper or landed position as shown in FIG. 1A.

From a comparison of FIGS. **2** and **3,** it will be noted that when the expander means is in its upper or running position the external groove means **31** cooperates with the external lug means **19** permitting them to retract and the internal land means provided by lands **32** and **33** cooperate with and extend the internal lugs or collet fingers **25** inwardly. When the expander means is in its anchoring position, the external land **29** cooperates with and extends the external lug means **19** and the internal grooves **34, 35** and **36** cooperate with and permit the internal lugs or collet fingers to retract. This alternating latch and release prevents premature disengagement of the running and landing tools because the lug means **19** cannot expand to permit the expander means **26** to move downwardly unless the lugs are opposite a suitable landing groove such as groove **14.** As in the absence of such a groove the expander cannot move downwardly, the internal lugs cannot retract and release the ball **22.** Thus, the running tool cannot be separated from the landing tool except in those areas of the tubing where the landing tool can be latched in position in a groove such as the mandrel groove **14.**

The landing tool may be run with any suitable running tool having a shoulder which will cooperate with the internal lugs of the landing tool to prevent the two tools from being disassociated until the expander means is in the landing position. The running tool may take many different forms. In FIGS. **2** and **3** a preferred form of running tool is shown.

Referring to FIGS. **2** and **3,** the preferred form of running tool is shown at **21.** The tool includes a central stem **37** to which the locator section of the tool indicated generally at **38** is pinned by the shear pin **39.**

In order to move the expander means **26** of the landing tool downwardly from the running to the landing position, the shaft **37** is provided with a plurality of fingers **41** which radiate outwardly from the shaft at the bottom of the running tool in a position to overlie the upper end of the expander means **26.** Thus, when downward movement of the locator section **38** of the running tool is arrested as shown in FIG. **2,** further downward movement of the shaft **37** shears pin **39** and moves the fingers **41** downwardly to move the expander means **26** of the running tool to the downward position shown in FIG. **3** to thus release the running tool from the landing tool. This downward movement may be assisted if desired by the spring **42.**

The locating section of the running tool includes an expander section **43** and a lug carrier **44** movable therealong and having a plurality of lugs **45.**

In order to provide for upward movement of the lug carrier **44** and retraction of the lugs **45** into the groove section **46** during running of the tool and to prevent such action during the landing manipulations of the tool a snap ring **47** cooperates with a shoulder **48** on the lug carrier. When the lug carrier is above the snap ring as is the case during running of the tool the lower end **49** of the lug carrier **44** butts against the snap ring **47** and prevents further downward movement of the lug carrier under the force of spring **51.** The lugs **45** are normally held in expanded position by the land **52** on the expander **43** but as the lugs **45** engage the shoulder within the tubing the lug carrier rides up against the force of spring **51** and permits the lugs **45** to retract into the groove section **46.**

When the running tool reaches a depth in the well at which it is desired to set the landing tool, the direction of movement of the running tool is reversed. Thus, if the movement is downwardly in the attitude of the tools shown in FIG. **2** an upward movement would be imparted to the tools after they reach the setting depth plus a few additional feet to move the lug **45** past shoulder **16.** When the tool is moving upwardly and the lugs **45** engage shoulder **16,** the force thus exerted on the lug carrier **44** will contract the snap ring **47** and permit the lug carrier to move into the position shown in FIG. **2.** In this position, the tool may be run upwardly and the lug carrier **44** will move downwardly when a shoulder is encountered to a position opposite the groove **54** to permit the tool to continue movement in the hole. With the lug carrier in the position shown in FIG. **2** however, downward movement of the running tool will be arrested the first time the lugs **45** engage a shoulder in the well as shown in FIG. **2.** Thus, after the tool has been raised to engage a shoulder such as shoulder **16** and move the lug carrier **44** down below the snap ring **47,** the tool is again reversed in its direction of movement to a downward direction as shown in FIG. **2** in which the lugs **45** engage the shoulder **15** in the well. Further downward movement of the running tool carrier **55** results in shearing of pin **39** and downward movement of fingers **41** and consequent movement of the landing tool expander ring **26** from its running position shown in FIG. **2** to its landing position shown in FIG. **3.** At this time the ball **22** which is carried on a segmented annular collet type rod indicated generally

at 56 and carried by the locator assembly 38 is released from the landing tool and the running tool may be withdrawn from the well. During withdrawal engagement of the locator lugs 45 with any shoulder in the well will cause downward movement of the lug carrier 44 to a point in which the lugs 45 overlie the groove 44 to permit a passage of the lugs past the shoulder.

When it is desired to remove the landing tool any desired form of pulling tool may be utilized. A preferred form is shown in FIGS. 4 and 5. The pulling shoulder on the landing tool may be internal such as shoulder 57 and the pulling tool may have an external collet indicated generally at 58 for engagement with shoulder 57 to pull the tool. In the pulling tool illustrated, the pulling tool collet 58 is carried by the pulling tool body 59. Internal of the body 59 is a central rod 61 which is attached to the pulling line or pulling motor. The spring 62 urges the pulling rod and its associated stop sleeve 63 upwardly to the position shown in FIG. 5. As the pulling tool is moved downwardly into engagement with the landing tool the collet 58 strikes the upper end of the expander means 26 and its movement is arrested. Further downward movement of the internal rod 61 against the force of spring 62 will move the expander knob 64 from behind the collet 58 and permit the collet to retract into the reduced diameter section 65 of the rod assembly 61. This action permits the collet to pass the shoulder 66 and enter into the upper end of the landing tool. At this time the spring 62 returns the assembly to the relationship illustrated in FIG. 5 and upward movement of the pulling tool will move the expander sleeve 26 to its upper or running position to release the dogs 19 and permit the landing tool to be withdrawn from the well. It might be noted that it is preferred to provide a wiper rubber 67 at the upper end of the expander means 26 to prevent sand or other objects from interfering with the normal action of the anchoring tool.

If for any reason the anchoring tool cannot be withdrawn from the well or become stuck while being withdrawn, the pulling tool may be released from the anchoring tool by exerting a sufficient force to shear pin 68 which will permit the expander 64 to move above the lower enlarged ends of the collet fingers thus permitting them to retract and be withdrawn from the anchoring tool.

The running tool is also provided with safety provisions to permit it to be detached from the landing tool in the event the landing tool becomes stuck within the well. The ball 22 is held against contracting by the stem 37 (FIG. 3). If however the landing tool becomes stuck in the well a sufficient force may be applied to the running tool to shear the ball 22 from the running tool at the shear groove 69. The strength of shear groove 69 would normally be substantial and would not fail during normal operation of the tool.

In the FIG. 4 form of the landing tool, it will be noted that the body is provided with a downwardly facing shoulder 71 which engages an upwardly facing shoulder 72 of the mandrel. This form of body is utilized when it is desired to run the tool into a nonselective mandrel assembly in which the tool can be landed in only one mandrel which has the shoulder 72. This contrast with the form of tool shown in FIG. 2 which has no such shoulder and may be selectively landed in any of a number of mandrels.

When the nonselective landing tool is utilized, the locating lug assembly of the running tool need not be utilized and would preferably be stripped from the running tool together with its associated springs 42 and 51 as these parts are not needed in running the tool into a nonselective well.

From the above it will be seen that all of the objects of this invention have been attained. The landing tool cannot be released from the running tool during normal operation unless the tool is positioned with its landing lug opposite an appropriate groove in a landing mandrel. Thus, accidental or unintentional release of the landing tool is impossible.

The foregoing disclosure and description of the invention are illustrative and expanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. An anchoring tool comprising,
an elongate body,
external lug means carried by the body and adapted to be extended into a latching groove in a mandrel,
internal lug means carried by the body adapted to be extended above a shoulder on a running tool,
said body holding said internal lug means against movement along said elongate body relative to said external lug means while permitting said internal lug means to move laterally of the elongate body,
expander means having external land means and groove means cooperable with the external lug means and internal land means and groove means cooperable with the internal lug means,
said expander means movable between a running position in which the external groove means cooperates with the external lug means permitting them to retract and the internal land means cooperates with and extends the internal lug means and an anchoring position in which the external land means cooperates with and extends the external lug means and the internal groove means cooperates with and permits the internal lug means to retract.

2. The tool of claim 1 including means for securing a well tool to the anchoring tool.

3. The tool of claim 1 in combination with
a running tool having a shoulder cooperable with said internal lug means for latching the running and anchoring tools together when the expander means is in running position.

4. The tool of claim 1 in combination with
means for limiting movement of the running and anchoring tools in one direction to position the tools at a selected position in a well while the expander means is shifted to release the tools from each other.

5. An anchoring tool comprising,
a body,
external lug means carried by the body and adapted to be extended into a latching groove in a mandrel,
collet means including collet fingers on the body having a socket at the free end of the collet fingers adapted to receive a ball of a running tool,
and expander means having external lands means and groove means cooperable with the external lug means and internal land means and groove means cooperable with the collet means,

said expander means movable between a running position in which the external groove means cooperates with the external lug means permitting them to retract and the internal land means cooperates with and extends the collet fingers and an anchoring position in which the external land means cooperates with and extends the external lug means and the internal groove means cooperates with and permits the collet fingers to retract.

6. The tool of claim **5** in combination with a running tool having,

ball means cooperable with said collet for latching the running and anchoring tools together when the expander means is in running position, and

means for shifting the expander means to anchoring position to release the running tool from the anchoring tool,

and further in combination with means on one of said running, anchoring tools for limiting movement of the running and anchoring tools in one direction to position the tools at a selected position in a well while the expander means is shifted to release the tools from each other.

7. An anchoring tool comprising,

a body,

external lug means carried by the body and adapted to be extended into a latching groove in a mandrel,

internal socket means carried by the body adapted to be extended about a ball on a running tool,

expander means having external land means and groove means cooperable with the external lug means,

said expander means having internal land means and groove means cooperable with the internal socket means,

said expander means movable between a running position in which the external groove means cooperates with the external lug means permitting them to retract and the internal land means cooperates with and extends the internal socket means and an anchoring position in which the external land means cooperates with and extends the external lug means and the internal groove means cooperates with and permits the internal socket means to retract,

a running tool having a ball cooperable with said internal socket means for latching the running and anchoring tools together when the expander means is in running position, and

means for shifting the expander means to anchoring position to release the running tool from the anchoring tool.

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