Nov. 11, 1958 L. M. WILHOIT 2,859,825

WELL CONTROL AND ANCHORING DEVICE

Filed April 20, 1953

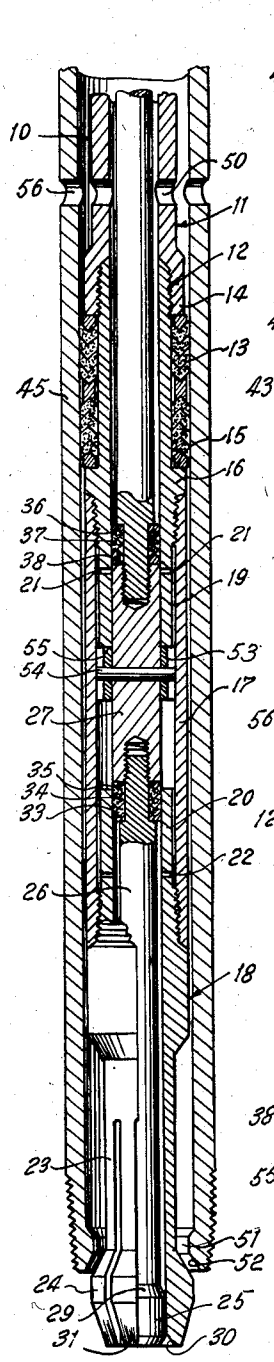


Fig. 3

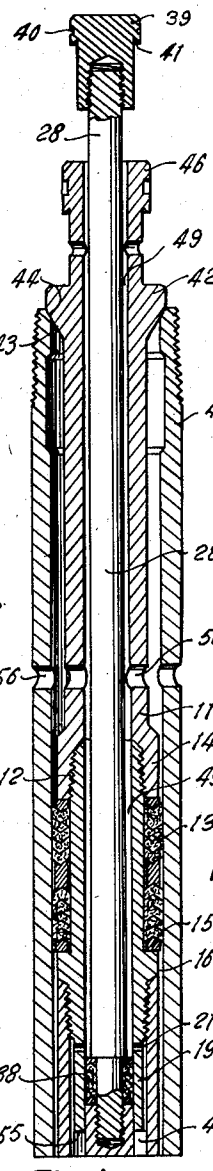


Fig. 1

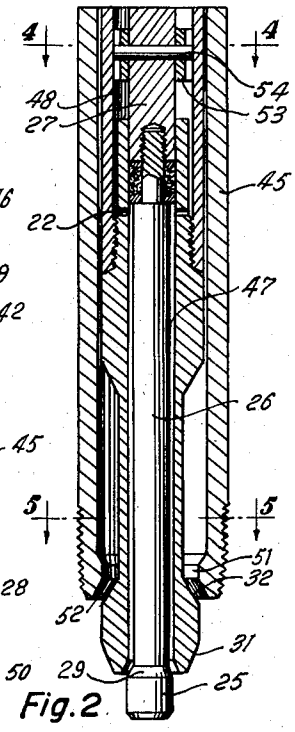


Fig. 2

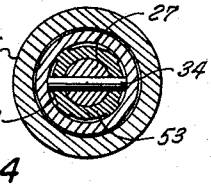


Fig. 4

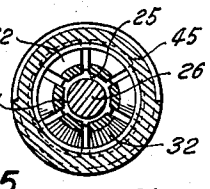


Fig. 5

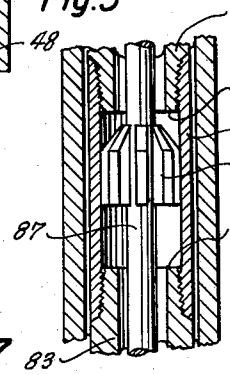


Fig. 7

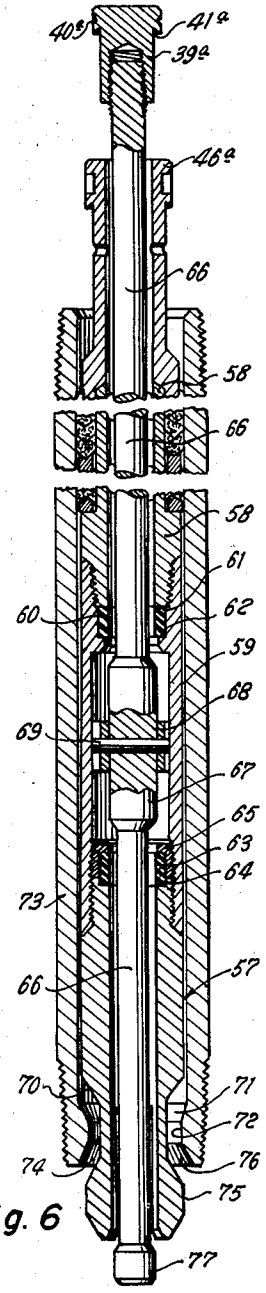


Fig. 6

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WELL CONTROL AND ANCHORING DEVICE

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Application April 20, 1953, Serial No. 349,771

27 Claims. (Cl. 166—133)

This invention relates to well tools and more particularly to a locking means for securing well tools in predetermined position in a well pipe string.

One object of the invention is to provide a new and improved locking means for well tools.

Another object of the invention is to provide a locking means for use in well strings having an upwardly facing shoulder and a downwardly facing shoulder, which locking means has a stop means engageable with the upwardly facing shoulder for limiting downward movement of the tool in the well string and has resilient stop means expansible into engagement with the downwardly facing shoulder to lock the well tool against upward movement in the well string.

A further object of the invention is to provide a new and improved locking means for well tools having a resilient stop means expansible, by a longitudinally movable expander member, into engagement with a downwardly facing stop shoulder of a well string to prevent upward movement of the well tool in the well string.

A still further object of the invention is to provide, in a device of the type described, sealing means operable selectively for sealing the flow course through the well tool in either direction.

Still another object of the invention is to provide a well tool having locking means of the character described which may be readily released from locked position for removal of the well tool from the well string.

Additional objects and advantages of the invention will readily be apparent from the reading of the following description of devices constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

Figures 1 and 2 are a view, partly in elevation and partly in section, showing the locking means in the position assumed while the well tool is being lowered through a well string, and showing the well tool positioned in a landing nipple in the well string.

Figure 3 is a view, similar to Figure 1, showing the lower portion of the well tool with the various elements of the locking means in the positions they assume to lock the well tool in place in the landing nipple and against movement in the well string,

Figure 4 is a horizontal sectional view taken on the line 4—4 of Figure 2,

Figure 5 is a horizontal sectional view taken on the line 5—5 of Figure 2; and

Figure 6 is a view, partly in elevation and partly in section, of a modified form of the locking means shown in Figures 1 to 4, and

Figure 7 is a fragmentary view, partly in elevation and partly in section, showing a modification of the central control member.

In the drawing, the numeral 10 designates a well tool having the locking means of the invention. The well tool has an elongate tubular body 11 threaded on the upper end of a packer mandrel 12, and a packer assembly 13 is disposed on the packer mandrel between the enlarged lower end 14 of the tubular body and the upper annular shoulder 15 of an external flange 16 on the lower portion of the packer mandrel.

An elongate dependent tubular valve sleeve 17 is threaded on the lower end of the packer mandrel, and a collet locking member 18 is threaded in the lower end of the dependent valve sleeve. The packer mandrel and the collet locking member have reduced lower and upper tubular extensions 19 and 20, respectively, which telescope into opposite ends of the dependent valve sleeve 17. The extensions have a plurality of radially spaced lateral ports 21 and 22, respectively, spaced a substantial distance longitudinally from the ends of the extensions; and these ports provide communication between the bores of the extensions and the annular space between the extensions and the interior wall of the dependent valve sleeve, for a purpose which will be hereinafter more fully explained.

The collet locking member has a plurality of resilient prongs 23 each provided with an outwardly extending boss 24 which is thus resiliently movable laterally. The bosses are disposed to be expanded by an enlarged expander head 25 on the lower end of an elongate control rod or member having a lower expander section 26, an enlarged intermediate packing or valve section 27, and an elongate upper operating section 28. The expander head 25 on the lower end of the lower expander section 26 is provided with a downwardly and outwardly extending camming shoulder 29 which is adapted to engage the downwardly and outwardly extending cam shoulders 30 at the lower inner ends of the collet prongs, so that upward movement of the expander head relative to the collet locking member will cause the collet prongs to flex outwardly into expanded position. The collet bosses have upwardly and outwardly extending beveled surfaces 31 on their lower outer ends which cause the collet prongs to flex inwardly when running downwardly past obstructions. The bosses also have a downwardly and outwardly extending locking surface or shoulder 32 at their upper ends which cause the collet prongs to flex inwardly when moving upwardly past obstructions. It will be understood, of course, that when the expander head is in the position shown in Figure 3, the collet prongs are held in expanded position and cannot flex inwardly.

The upper end portion of the lower expander section 26 of the control rod is reduced in diameter and has its upper end threaded into a bore in the lower end 35 of the intermediate section 27 of such rod, so that the upwardly facing annular shoulder 33 formed by such reduced portion is spaced from the lower end of such intermediate section whereby a lower packer assembly 34 may be disposed on the reduced portion of the lower expander section and confined thereon between the annular shoulder 33 and the lower end 35 of the intermediate section. The lower end portion of the upper operating section 28 of the control rod is similarly reduced and threaded into a bore in the upper end 38 of the intermediate packing section 27, so that the downwardly facing annular shoulder 36 formed on the operating section is spaced from the upper end of such intermediate section whereby an upper packer assembly 37 may be disposed on such reduced portion of the upper operating section and confined thereon between the annular shoulder 36 and the upper end 38 of the intermediate section.

A cap or fishing neck member 39 is threaded on the upper end of the upper operating section of the control rod, and is provided with an external flange 40 at its upper end having an undercut annular shoulder 41 which may be engaged by a suitable running or retrieving tool by means of which the elongate control rod may be

actuated in the manner and for the purposes hereinafter set forth.

The tubular body **11** has an external flange **42** near its upper end which provides a downwardly facing stop shoulder **43** adapted to engage an upwardly facing stop shoulder **44** at the upper end of a landing section or nipple **45** to limit downward movement of the well tool through the landing nipple. The tubular body **11** is also provided with an external annular flange **46** at its upper end which may be engaged by a suitable running tool, on a flexible line, whereby the packer mandrel may be lowered into or removed from a tubing string of which the landing nipple **45** constitutes one section.

While the tool is being lowered into a tubing string, the control rod may be moved downwardly until the cap **40** rests on the upper end of the flange **46** so that the expander head **25** is disposed well below the collet locking member **18**. The collet prongs are then free to flex inwardly as the shoulders **31** of the bosses encounter obstructions during downward movement of the tool. During such movement, well fluids may flow exteriorly of the well tool through the annular space between such well tool and the bore wall of the well pipe string. Also, if desired, the control rod may be elevated to the position shown in Figures 1 and 2, and well fluids may then also flow upwardly through the cylindrical passage **47** between the lower expander section **26** of the control rod and the collet locking member **18**, through the ports **22** of the collet extension **20**, the passage **48** between the dependent valve sleeve **17** and the control rod, the ports **21** of the extension **19** of the packer mandrel, and the cylindrical passage **49** between the upper operative section **28** of the control rod and the packer mandrel and the tubular body. The fluids may also flow outwardly through the lateral ports **50** in the tubular body.

When the well tool is lowered into the landing nipple **45** forming a section of the well string, the stop shoulder **43** of the tubular body engages the shoulder **44** of the landing nipple, thus arresting the downward movement of the tool after the bosses **24** of the collet prongs have moved downwardly past an internal annular flange **51** at the lower end of the landing nipple, the prongs flexing inwardly during such passage.

The running tool is now disengaged from the flange **46** of the tubular body and engages under the flange **41** of the cap on the control rod so that upward jars may be delivered to the control rod to move it upwardly to the position shown in Figure 3, wherein the expander head **25** is positioned between the collet prongs so that the bosses on such prongs are in expanded positions below the downwardly facing lock shoulder **52** on the flange **51** at the lower end of the landing nipple, and thus prevent upward movement of the well tool out of said landing nipple. An externally fluted stop ring **53** secured to the intermediate valve section **27** by a pin **54** limits the upward movement of the expander head relative to the collet locking member by abutting the lower end **55** of the packer mandrel extension **19**.

The packer assembly **37** is now positioned above the lateral ports **21** of the packer mandrel extension **19**, so that well fluids are prevented from flowing upwardly through the packer mandrel since the packer assembly **37** seals between the upper operating section **28** of the control rod and the packer mandrel. Flow of well fluids between the packer mandrel and the landing nipple is prevented by the packer assembly **13** which seals between the packer mandrel and the landing nipple. It will be seen, therefore, that the control rod or member acts as a valve to shut off flow of fluids upwardly through the landing nipple when it is moved to the upper position shown in Figure 3. Well fluids may flow inwardly into the landing nipple above the packer mandrel through the lateral ports **56** thereof, and through the lateral ports **50** of the tubular body into the cylindrical passage **49** and thence upwardly to the surface.

If it is desired to circulate fluids downwardly through the well pipe or tubing string, the control rod may be lowered to position the lower packer assembly **34** below the ports **22** in the collet extension **20**, so that the packer assembly seals the bore of the collet extension and fluids cannot flow downwardly therethrough. The packer assembly **13** closes off flow exteriorly of the well tool.

To equalize fluid pressures above and below the well tool, the control rod is moved to the intermediate position shown in Figures 1 and 2, wherein the upper packer assembly **38** is positioned below the ports **21** of the packer mandrel extension, and the lower packer assembly **34** is positioned above the ports **22** of the collet extension. In this position, fluids may flow through the ports and the cylindrical passage **48** to equalize pressures above and below the well tool.

Thus, the intermediate packing or valve section **27** of the control rod may be actuated to act as a valve to control flow in either direction through the well tool, or to permit flow therethrough if desired.

When it becomes desirable to remove the well tool from the well string, a suitable retrieving tool (not shown) is lowered into the well string on a flexible line, and is first used to deliver a downward blow to the cap **39** to move the control rod downwardly to equalize pressures above and below the well tool. Such downward movement of the control rod also moves the expander member **25** downwardly to free the collet prongs **23** so that they may flex inwardly in order that the bosses may pass the locking shoulder **52** of the nipple. The running tool then engages flange **46** of the tubular body **11** and the tool is lifted through the well string, the shoulders **32** of the bosses camming the bosses inwardly upon encountering obstructions, such as the flange **51** of the nipple, during such upward movement.

It will now be seen that a locking means for well tools has been illustrated and described which has a stop shoulder **43** which engages an upwardly facing stop shoulder **44** of a well string to limit downward movement of the well tool in the well string, and which has a resilient locking means, the collet prongs **23** and bosses **24**, which is expansible by an expander member **25** into engagement with the downwardly facing lock shoulder **52** of the well string to lock the well tool against upward movement in the well string. Moreover, it will be seen that the sealing or packer assemblies **34** and **37** provide for sealing off the flow course through the well tool in either direction when the control rod is moved upwardly or downwardly, or to permit flow when in an intermediate position.

It will also be apparent that the ring **53** forms a stop means which limits the movement of the expander member **25** relative to the collet prongs **23** so that the expander member cannot be moved above the collet bosses.

It will further be seen that the well tool may be lowered and the locking means expanded into locking position by means of a flexible line, and that the locking means may also be released from locked position and the well tool removed from the well string by means of the flexible line.

In Figure 6 is shown a modified form of the well tool, wherein the collet locking member **57** and the tubular packer body **58** are connected by a valve sleeve **59** threaded on the lower end of the tubular packer body. An upper packer assembly **60** is disposed in an internal annular recess formed by and between adjacent portions of the valve sleeve and the lower end of the tubular packer body, and is held against longitudinal movement by the lower end **61** of the tubular body and an internal annular flange **62** of the valve sleeve. A similar lower packer assembly **63** is held in a recess **64** at the upper end of the collet locking member by a retaining ring **65** threaded in the lower end of the valve sleeve. The control rod or member **66** has an enlarged intermediate section **67** which, when the control rod is moved upwardly to locked

position, engages the upper packer assembly 60 and thus prevents upward flow of fluid through the tubular body. Similarly, the enlarged section 67 may also be moved downwardly to engage the lower packer assembly 63 and thus prevent downward flow of fluid through the valve sleeve when the control rod 66 is in a lowered position. A fluted stop ring 68 is secured on the enlarged section 67 by a pin 69, and limits movement of the control rod in either direction relative to the collet member 57 and the packer assemblies.

The mode of operation of the well tool shown in Figure 6 is substantially the same as that of the well tool previously described, except that downward movement of the well tool in the landing nipple is limited by the engagement of a stop shoulder 70 on the collet locking member with the shoulder 71 of the internal flange 72 of the landing section or nipple 73, rather than by the engagement of a stop shoulder at the upper end of the well tool as in the previously described form.

The resilient collet prongs 74 of the collet locking member 57 extend substantially below the stop shoulder 70 and are provided with bosses 75 which are thus resiliently movable laterally. The bosses are moved to engage the downwardly facing lock shoulder 76 by the enlargement or expander member 77 on the lower end of the control rod or member 66 when said rod is moved upwardly.

It will be apparent that the mounting of the packer assemblies or rings 60 and 63 could be reversed so that they could be disposed on the central portion of the control rod or member and be movable into engagement with proper sealing surfaces provided in the tubular packer body and collet locking member.

It will now be apparent that the modified form of the well tool shown in Figure 6 also has a stop shoulder 70 which engages an upwardly facing stop shoulder 71 to limit downward movement of the well tool through a well string of which the landing nipple 73 constitutes a section, and that the collet bosses 75 are expanded by an expander member 77 to engage the downwardly facing lock shoulder 76 of the well string. It will also be apparent that this modified form of the locking means also has a stop means or ring 68 which limits relative movement between the control rod 66 and the collet locking member 57, as well as between the control rod and the packer assemblies 60 and 63, for the purposes of locking the well tool in place in the landing nipple and of controlling flow through said well tool.

A slightly modified form of the central control rod and valve sleeve assembly is shown in Figure 7, wherein the internal packing assemblies are omitted and a tubular sleeve 80 has its upper end threaded internally and connected to the lower end of a packer body 81 similar to the packer body 58 of Figure 6. The lower end of the tubular sleeve is also internally screw threaded and is threaded onto the upper end of a collet locking member 83 similar to the collet locking member 57 of Figure 6. The shoulder 84 formed by the lower end of the packer body 81 and the shoulder 85 formed by the upper end of the collet locking member provide spaced opposed stop members for engagement with a fluted stop flange 86 provided on the exterior of an elongate central control rod or member 87 to limit the longitudinal movement of said control rods. The control rod is otherwise cylindrical and similar to the control rod 66 of Figure 6, having an expander member at its lower end and a fishing neck member at its upper end. All other parts of the well tool are similar to those already described.

In this modified form fluids may flow upwardly through the bore of the well tool, while the fluted stop flange provides means for limiting movement of the central control rod in either direction, whereby the well tool may be positively locked in the landing nipple during upward flow.

The foregoing description of the invention is explanatory only, and changes in the details of the constructions illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; an expansible resilient locking means on said tubular member; and a control member in said tubular member movable longitudinally thereof to engage and hold said expansible resilient locking means in position to engage said downwardly facing shoulder to prevent upward movement of said tool after downward movement of said tool has been arrested by said upwardly facing shoulder.

2. A well tool of the character set forth in claim 1 wherein: the control member and said tubular member provide a longitudinal flow course through said well tool.

3. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; an expansible resilient locking means on said tubular member; a control member in said tubular member movable longitudinally thereof to engage and hold said expansible resilient locking means into position to be engageable with said downwardly facing shoulder to prevent upward movement of said tool after downward movement of said tool has been arrested by said upwardly facing shoulder; and stop means on said tubular member and control member co-acting for limiting upward movement of said control member relative to said expansible resilient locking means.

4. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; an expansible resilient locking means on said tubular member; an elongate control member in said tubular member movable longitudinally thereof to engage and hold said expansible resilient locking means into position to be engageable with said downwardly facing shoulder after downward movement of said tool has been arrested by said upwardly facing shoulder to prevent upward movement of said tool; and sealing means in said tubular member engageable with said tubular member and control member for preventing fluid flow through said tubular member when said elongate control member is moved to position holding said expansible resilient locking means expanded.

5. A well tool of the character set forth in claim 4 wherein: said tubular member is provided with external sealing means engageable with the well string for sealing between said tubular member and well string.

6. A well tool of the character set forth in claim 5 wherein: second sealing means is provided in said tubular member at a position spaced longitudinally from the other sealing means in said tubular member, said second sealing means being disposed to sealingly engage both said tubular member and said control member when said control member is moved to its lowermost position spaced below its upper locking means expanding position, both sealing means being disposed to engage only one of said members when said control member is intermediate said upper and lowermost positions and means providing a flow passage through said tubular member exteriorly of said control member, said flow passage being open when said control member is intermediate said upper and lowermost positions.

7. A well tool of the character set forth in claim 4

wherein: second sealing means is provided in said tubular member at a position spaced from the other sealing means in said tubular member and disposed to sealingly engage both said tubular member and said control member when said control member is moved longitudinally to a position in said tubular member opposite the position in which said control member engages said expansible locking means, both sealing means in said tubular member being engageable with only one of said members when said control member is in a position intermediate said locking and opposite positions, there being a flow passage through said well tool between said tubular member and said control member, said flow passage being open when said control member is in said intermediate position whereby fluids may flow through said tool.

8. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; an expansible resilient locking means on said tubular member; a control member in said tubular member movable longitudinally thereof to engage and hold said expansible resilient locking means in position to engage said downwardly facing shoulder to prevent upward movement of said tool after downward movement of said tool has been arrested by said upwardly facing shoulder; stop means on said tubular member and control member co-acting for limiting upward movement of said control member relative to said expansible resilient locking means; and sealing means in said tubular member engageable with said tubular member and control member for preventing fluid flow through said tubular member when said control member is moved to position holding said expansible resilient locking means expanded.

9. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; expansible resilient locking means extending downwardly from said tubular member; an elongate control member slidable longitudinally in said tubular member and having an expander member disposed below said locking means, said control member being movable longitudinally upwardly of said tubular member and locking means to bring said expander member into telescoping relation with said locking means to expand said locking means into position to engage said downwardly facing shoulder after downward movement of said tool has been arrested by said upwardly facing shoulder; and stop means on said tubular member and said control member co-acting for limiting upward movement of said expander member relative to said expansible locking means.

10. A well tool of the character set forth in claim 9 wherein: sealing means is disposed within the bore of said tubular member and surrounding said control member and is adapted to sealingly engage both said tubular member and said control member to prevent fluid flow through said tubular member when said control member is in its uppermost position holding said resilient locking means in locking position, said sealing means also being disposed to sealingly engage both said tubular member and said control member when said control member is in its lowermost out of engagement with said locking means, said sealing means being disposed to engage only one of said members when said control member is in a position intermediate said uppermost and lowermost positions, there being a flow passage through said well tool between said tubular member and said control member, said flow passage being open when said control member is in said intermediate position whereby fluid may flow through said tool when said control member is in such intermediate position.

11. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; expansible resilient locking means extending downwardly from said tubular member; an elongate control member slidable longitudinally in said tubular member and having an expander member disposed below said expansible locking means, said control member being movable longitudinally upwardly relative to said tubular member and expansible locking means to bring said expander member into telescoping relation with said locking means to expand said locking means into position to engage said downwardly facing shoulder after downward movement of said tool has been arrested by said upwardly facing shoulder; and sealing means in said tubular member for engaging and sealing between said tubular member and said control member to prevent fluid flow through said tubular member when said control member is moved upwardly to position said expander member in upper expanding position.

12. A well tool of the character set forth in claim 11, wherein: said tubular member is provided with external sealing means engageable with the well string for sealing between said tubular member and well string.

13. A well tool of the character set forth in claim 11 wherein: second sealing means is provided in said tubular member at a position spaced longitudinally from the other sealing means in said tubular member, said second sealing means being disposed to sealingly engage both said tubular member and said control member when said control member is moved to its lowermost position spaced below its upper locking means expanding position, and means providing a flow passage through said tubular member exteriorly of said control member, said flow passage being open when said control member is intermediate said upper and lowermost positions.

14. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; said tubular member having a plurality of dependent resilient locking prongs; and a control member slidable longitudinally in said tubular member and having an expander member disposed below said resilient locking prongs, said control member being movable longitudinally upwardly relative to said tubular member and prongs to bring said expander member into telescoping relation with said prongs to expand said prongs into position to engage said downwardly facing shoulder to prevent upward movement of said tool.

15. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; said tubular member having a plurality of dependent resilient locking prongs; an elongate control member slidable longitudinally disposed in said tubular member and having an expander member disposed below said resilient locking prongs, said control member being movable longitudinally upwardly relative to said tubular member and prongs to bring said expander member into telescoping relation with said prongs to expand said prongs into position to engage said downwardly facing shoulder to prevent upward movement of said tool; and stop means on said tubular member, and said control member co-acting

for limiting upward movement of said expander member relative to said resilient locking prongs.

16. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; a collet locking member below and connected with said tubular member having outwardly expansible prongs with locking bosses at their lower ends; a control member extending through said tubular member and said collet locking member and having an expander member disposed below said locking bosses, said control member being movable longitudinally upwardly relative to said tubular member and collet locking member to bring said expander member into telescoping relation with said collet prongs to expand said bosses into position to engage said downwardly facing shoulder to prevent upward movement of said tool.

17. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; a collet locking member below and connected with said tubular member having outwardly expansible prongs with locking bosses at their lower ends; a control member extending through said tubular member and said collet locking member having an expander member disposed below said locking bosses, said control member being movable longitudinally upwardly relative to said tubular member and collet locking member to bring said expander member into telescoping relation with said collet prongs to expand said bosses into position to engage said downwardly facing shoulder to prevent upward movement of said tool; and stop means carried by said tubular member co-acting with said control member for limiting upward movement of said expander member relative to said collet prongs.

18. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; means on said tubular member for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; a collet locking member below and connected with said tubular member having outwardly expansible prongs with locking bosses at their lower ends; a central control member extending through said tubular member and said collet locking member and having an expander member disposed below said locking bosses, said central control member being movable longitudinally upwardly relative to said tubular member and collet locking member to bring said expander member into telescoping relation with said collet prongs to expand said bosses into position to engage said downwardly facing shoulder to prevent upward movement of said tool; stop means carried by said tubular member and co-acting with said control member for limiting upward movement of said expander member relative to said collet prongs; external sealing means on said outer tubular member engageable with the well string for sealing therebetween; and sealing means in said outer tubular member between said tubular member and said control member engageable with said members to prevent fluid flow through said tubular member when said control member is in upper position.

19. A well tool for use in a well string having an internal upwardly facing shoulder and an internal downwardly facing shoulder, said tool including: an outer tubular member; a collet locking member below and connected with said tubular member having outwardly expansible prongs with projecting locking bosses at their lower ends; a projecting stop means on said tubular member adjacent the upper ends of the collet prongs for engaging said upwardly facing shoulder to limit downward movement of said well tool in said well string; a control member extending through said tubular member and collet locking member and having an enlarged expander member disposed below said locking bosses, said control member being movable longitudinally upwardly with respect to said collet locking member to move said expander member between said locking bosses to expand said bosses into position to engage said downwardly facing shoulder to lock the well tool against upward displacement from said well string.

20. A well tool for use in a well string having means providing a downwardly facing stop shoulder and an upwardly facing stop shoulder, said tool including: a tubular outer member having integral resilient outwardly expansible locking means; a central control member slidably disposed in said tubular outer member; means on said control member for engaging and holding said expansible means in expanded position wherein said expansible locking means is positioned to engage said downwardly facing shoulder to limit upward movement of said tool in said well string; and means on said tool engageable with said upwardly facing shoulder for limiting downward movement of said tool in said well string to position said tool in said well string.

21. A well device including: an elongate body having an axial passage; said body having an outwardly extending external flange adjacent the upper end thereof providing a downwardly facing stop shoulder which is adapted to engage an upwardly facing stop shoulder within the bore of a well string through which said body is lowered to limit the downward movement of said body, said body having a resilient expansible locking means on its lower end, said locking means having an axial passage aligned with the axial bore of said body; and an elongate member movably extending through said axial passage and having an expander on its lower end disposed below said locking means, said expander engaging and holding said locking means expanded upon upward movement of said elongate member relative to said body.

22. A well device of the character set forth in claim 21 wherein: said elongate member and said elongate body provide a longitudinal flow passage through said well device.

23. A well device including: an elongate body having an upper non-expansible section and a lower section; said sections having communicating flow passages, said lower section having a lower outwardly expansible resilient locking portion, said upper section having an outwardly extending external flange adjacent the upper end thereof and integral therewith providing a downwardly facing stop shoulder which is adapted to engage an upwardly facing internal stop shoulder within the bore of a well string through which said body may be lowered to limit downward movement of said body; and an elongate member extending through and slidable longitudinally of said upper and lower sections and having a downwardly and outwardly extending annular shoulder adapted to enter into the lower end of said lower section to expand said resilient locking portion upon upward movement of said elongate member relative to said sections; said body and said elongate member having co-engageable stop shoulders for limiting upward movement of said elongate member relative to said body.

24. In a well apparatus: a nipple adapted to be incorporated in a string of tubing; a flow control device slidably disposed in the nipple; said flow control device including a tubular member; a head on the upper end of the tubular member engaged with the upper end of the nipple to limit downward movement of the flow control device in the nipple; a plurality of resilient prongs carried by the lower end of the tubular member, each of said prongs having a head thereon engaged with the lower

end of the nipple when said prongs are in relaxed position; a movable member extending longitudinally through the flow control device; and means carried by the lower end of the movable member and engageable with the prongs to prevent the inward movement of the prongs.

25. In a well apparatus: a nipple adapted to be incorporated in a string of tubing; a flow control device slidably disposed in the nipple; said flow control device including a tubular member; a head on the upper end of the tubular member engaged with the upper end of the nipple, to limit downward movement of the flow control device in the nipple; a plurality of resilient prongs carried by the tubular member, each of said prongs having a head thereon engaged with the lower end of the nipple when said prongs are in relaxed position, to prevent upward movement of the flow control device in the nipple; a stem movably extending through the upper end of the flow control device; a locking knot attached to the lower end of said stem and arranged to engage with the inner sides of the heads on the prongs to prevent the inward movement of the prongs when the flow control device is disposed in the nipple.

26. In a well apparatus arranged to be connected in a string of tubing; a nipple; a flow directing device slidably disposed in the nipple; a hollow head carried by the upper end of the flow directing device, said head being engaged with the upper end of the nipple and having a flow passage therethrough; resilient locking means carried by the lower end of the flow directing device and engaged with the lower end of the nipple; a movable member extending longitudinally through the head and the flow directing device; and means carried by the lower end of the movable member engaged with the resilient locking means to prevent the inward movement of the resilient locking means.

27. Claim 26 wherein the resilient locking means are flexible prongs, said prongs having heads thereon engaged with the lower end of the nipple and outside the nipple.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

November 11, 1958

Patent No. 2,859,825

Lowell M. Wilhoit

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, line 67, after "lowermost" insert -- position --.

Signed and sealed this 3rd day of March 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents