March 24, 1959 T. L. LONG 2,878,876

WELL PACKING TOOL

Filed Oct. 3, 1956 2 Sheets-Sheet 1

FIG-1

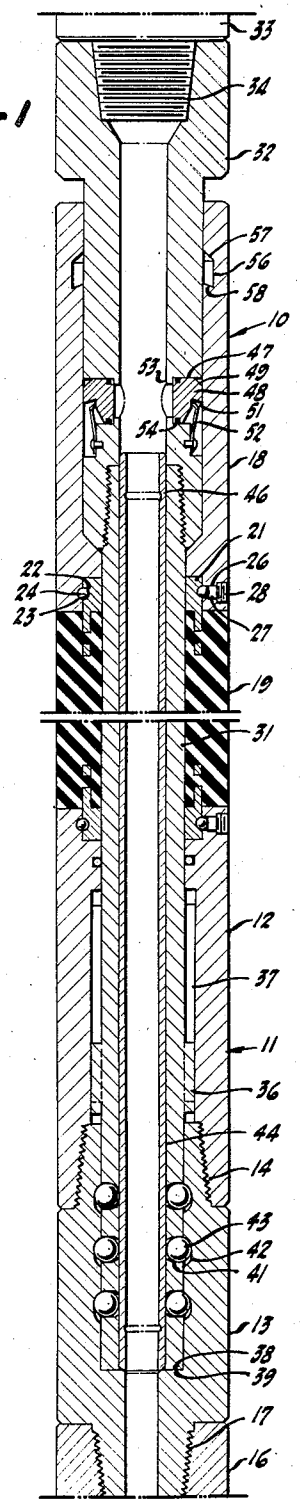
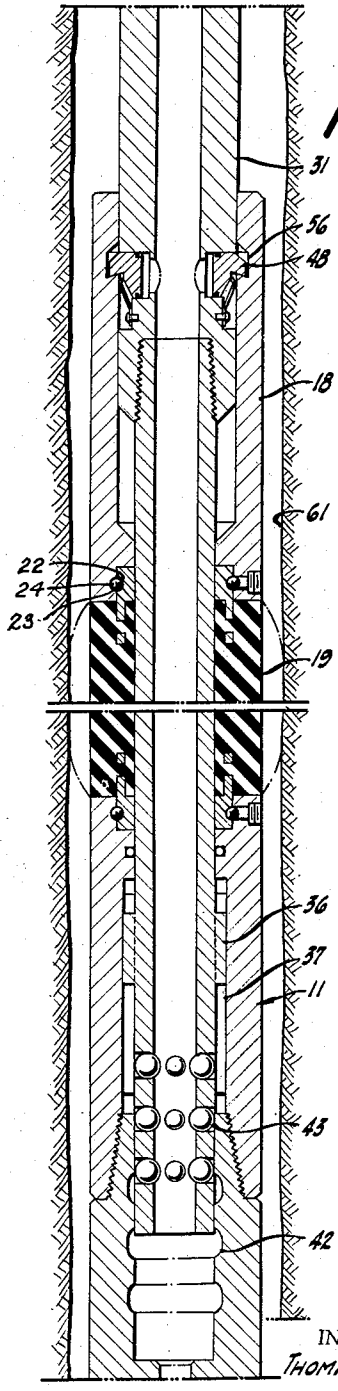


FIG-2



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WELL PACKING TOOL

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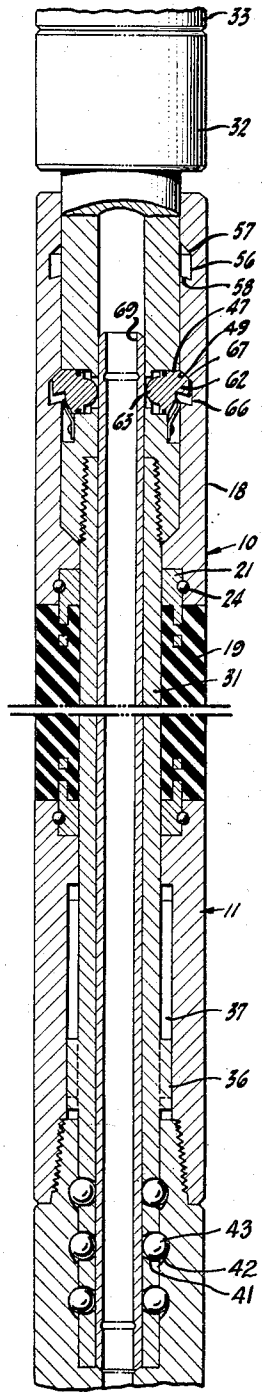

FIG-4

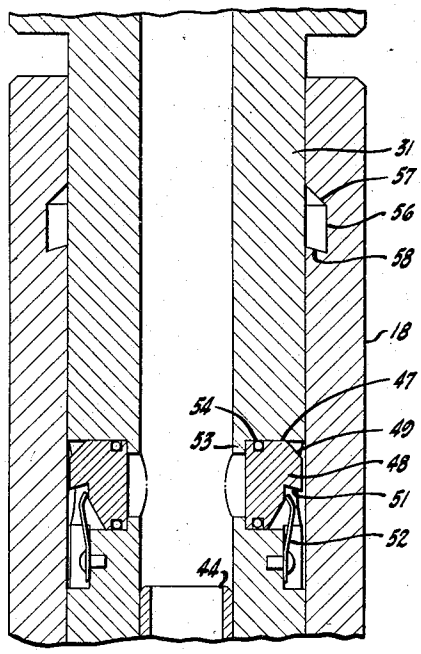

FIG-3

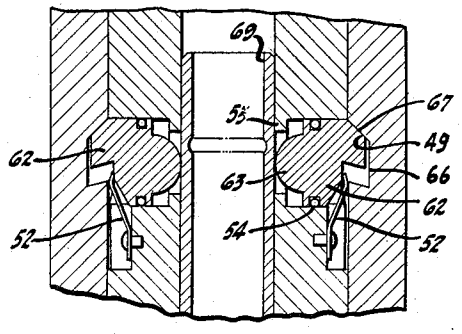

FIG-5

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WELL PACKING TOOL

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Application October 3, 1956, Serial No. 613,723

9 Claims. (Cl. 166—201)

This invention relates to well packing tools and, more specifically, to well packing tools which may be conditioned for setting by wire line operations.

An object of this invention is to provide new and improved well packing tools for packing off the annulus about a pipe string while affording a full, open bore therethrough.

Another object of this invention is to provide new and improved well packing tools of the foregoing character which may be released from a latched condition by wire line operations to permit setting by manipulation of the pipe string.

A further object of this invention is to provide new and improved well packing tools of the foregoing character which are releasable and may be reset when desired.

A further object of this invention is to provide new and improved well packing tools of the foregoing character which are suited for connection in drill string to form a seal above the drill bit during a cessation of drilling operations so that water bearing formations may be squeezed off without removing the drill string from the borehole.

In accordance with the present invention, a well packing tool is provided including annular housing members connected above and below an annular packing member and a tubular mandrel extending telescopically through said members for limited sliding movement. Locking means are provided between the mandrel and lower housing member operated by wire line manipulation of a sleeve within the bore of the mandrel to retain the mandrel and packing member in a collapsed position. Upon release of the locking means, the mandrel may be extended by pulling up on a pipe string in which the tool is connected so that latching means may engage the upper housing member with the mandrel. When so engaged, the mandrel and upper housing member may be lowered relative to the lower housing member to expand the packing member.

In a modification, the latching means is engageable in both the collapsed and extended positions of the mandrel.

The invention will be better understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is an elevational sectional view of a preferred embodiment of the invention showing the elements in collapsed relation;

Fig. 2 is a view similar to Fig. 1, showing the elements in an extended relation immediately prior to packing off;

Fig. 3 is a partial elevational view of Fig. 1 showing the latching members on an enlarged scale;

Fig. 4 is a view similar to Fig. 1 illustrating a modification of the invention; and

Fig. 5 is a partial elevational view of Fig. 4 showing the modified latching members on an enlarged scale.

Referring to Figs. 1–3, the well packing tool **10** comprises a lower annular housing member **11** having two

sections **12** and **13** joined by screw threads **14**, the lower end of the lower housing member **11** being adapted to be connected by screw threads **17** to the upper end of a conventional drill bit **16** or a drill collar connected thereabove. An upper annular housing member **18** has the same outside diameter as the lower housing member **11**.

An annular packing element or member **19**, preferably made of rubber, is carried between the upper and lower housing members **18** and **11**, and has a normal relaxed outside diameter equal to the outside diameters of the housing elements **11** and **18**. The packing member **19** is fixed to the upper housing member **18** by means of a packer head **21** anchored to the packing element **19** and having a circumferential groove **22** adapted to register with a circumferential groove **23** formed in the lower end of the upper housing member **18**. A plurality of locking balls **24** is inserted through a lateral bore **26** in the upper housing member to fill the grooves **22** and **23** and thus lock the packing member **19** to the upper housing member **18**. A ball retainer pin **27** and pipe plug **28** retain the locking balls in place. The packing member **19** is fixed to the lower housing member **11** in the same manner.

A mandrel **31** is slidably received for longitudinal movement in the upper and lower housing members **18** and **11** and packing member **19** and has an enlarged upper section **32** adapted to be connected to the lower end of a drill string **33** by a screw connection **34**. The lower portion of mandrel **31** has a plurality of longitudinally extending splines **36** which ride in corresponding longitudinal grooves **37** formed in section **12** of the lower housing member **11** to prevent relative rotation between the mandrel **31** and lower housing member **11**. The splines **36** are of less height than the grooves **37**, thus allowing limited longitudinal movement between the mandrel **31** and lower housing member **11**. The lower end **38** of the mandrel **31** is adapted to seat on an annular shoulder **39** formed in the lower housing member **11**.

The lower portion of mandrel **31** is provided with three sets of latching or locking elements to latch the mandrel **31** to the lower housing member **11** in a manner supporting high tensile loads. As each set is identical, it will suffice to describe one set alone. A plurality of lateral bores **41** is formed circumferentially of the mandrel **31**, and a groove **42** is formed on the inner surface of the lower housing member **11**, the groove being in register with the bore when the tool is in collapsed relation with the mandrel **31** seated on shoulder **39** of the lower housing member **11**. A locking ball **43** is carried within each bore **41**, and has a diameter greater than the thickness of the wall of the mandrel **31**. A sleeve **44** slidably received within the mandrel **31** for longitudinal movement therein forces the balls **43** partially into the grooves **42**, thus preventing relative longitudinal movement between the mandrel **31** and the lower housing member **11**. The sleeve **44** has a circumferential groove **46** formed on its inner surface to receive a fishing tool (not shown) to enable the sleeve to be fished from the mandrel **31**. The lower end of sleeve **44** rests on the annular shoulder **39** of the lower housing member **11**.

The upper portion of the mandrel **31** has another set of lateral bores **47** formed therethrough, each bore carrying a lock or latch element **48** adapted to latch the mandrel **31** to the upper housing member **18** in an extended position wherein the bottom end **38** of mandrel **31** is remote from the lower housing member shoulder **39**. The latch element **48** is provided with an outwardly and downwardly directed upper cam face **49** and an inwardly and downwardly directed lower cam face **51**, the purpose of which will be hereinafter described. A leaf spring **52** urges the latch element **48** inwardly against a shoulder **53**

of the bore 47. An O-ring 54 prevents any passage of fluid from the center bore of mandrel 31 past the latch element 48.

The upper end of the upper housing member 18 is provided with a groove 56 extending circumferentially of the inner surface of the housing member, the groove having a downwardly and inwardly directed upper cam face 57 and a downwardly and outwardly directed lower cam face 58 for a purpose to be hereinafter discussed.

The manner of operation is as follows. The elements are all assembled as shown in Fig. 1, with sleeve 44 lowered into place, resting on shoulder 39, forcing the locking balls 43 into groove 42 to lock the mandrel 31 in collapsed relation with the lower housing member 11. The packing tool 10 is connected to the upper end of a well bit and to the lower end of a pipe string, and a conventional drilling operation proceeds. In the event that water is encountered in drilling and it is desired to force gel into the formation to seal off the water, the tool 10 may be operated in the following manner.

A line and fishing tool (not shown) is run in, and sleeve 44 is fished out. With the sleeve 44 removed, the locking balls are permitted to move inwardly in the bores 41, releasing the lower housing member from the mandrel 31 to seat the bit on the bottom of the well hole. The mandrel 31 is raised until the latch elements 48 come into register with the groove 56, and the latch elements will drop into the groove against the bias of springs 52 due to pump pressure on the inner surfaces of the latch elements 48 as illustrated in Fig. 2. As downward pressure is applied to the mandrel, with the bit on the well bore floor, the pressure is transmitted through the latching elements 48 to the upper housing member 18 to apply compressive force to the packing element 19, causing it to expand laterally outwardly to the dotted line position in Fig. 2 in engagement with the inner bore of the well 61. At this time, the plastic or gel for sealing the sand may be forced out into the sand under pressure. The overlapping and interengaging surface 51 of the latch element 48, and 58 of the groove 56 ensure a positive lock when downward pressure is applied to the mandrel 31.

To release the packing element and to reset the tool 10, the mandrel 31 is pulled upwardly. The outwardly and downwardly directed cam face 49 of the latching element 48 and the mating face 57 of the groove 56 cooperate with the springs 52 to move the latching elements inwardly out of engagement with the groove 56. With no pump pressure applied, the mandrel 31 is then lowered so that the mandrel again seats on the shoulder 39 of the lower housing member, and the sleeve 44 is reinserted to force the locking balls 43 into locking engagement with the lower housing member.

The modification shown in Figs. 4 and 5 is similar to that shown in Figs. 1, 2, and 3 except that in lieu of latching elements 48, there are employed latching elements 62 which act to latch the mandrel 31 to the upper housing member 18 in both collapsed and extended positions.

The latching elements 62 have the same general configuration as the latching elements 48 except that an inwardly directed, rounded head 63 has been added to each latching element to extend the latching element so that it protrudes beyond the wall of the upper mandrel section 32. A second groove 66 is formed in the upper housing member 18, spaced below the groove 56, the second groove 66 being in register with the latching elements 62 when the lower end of the mandrel 31 seats on the lower housing member shoulder 39. The groove 66 has a downwardly and inwardly directed upper face 67.

A sleeve 69, similar to sleeve 44 but long enough to extend from the lower housing member shoulder 39 to above the latching elements 62, forces the latching elements 62 partially into the groove 66.

The operation of the modification shown in Figs. 4 and 5 is as follows. The sleeve 69 is fished out, similarly to sleeve 44, and the mandrel 31 is pulled upwardly. The inwardly directed surface 67 of groove 66 cams against surface 49 of latching elements 62 to move the latching elements inwardly with the assistance of spring 52, permitting the mandrel to be extended and latched in the upper groove 56 as before. Downward pressure on the mandrel 31 is again applied through the latching elements 62 and the upper housing member 18 to the packing element 19, causing it to expand outwardly into sealing engagement with the well bore.

The invention is susceptible to various additional modifications, for example, in the latching or locking means employed. If desired, the tool may be inverted for connection in a pipe string, provision being made for seating and withdrawal of the sleeve from the other end of the tool. While the tool has been described as connected in a drill stem for use in the introduction of fluids under pressure into the drilled formations, it may also be used as an open hole, retrievable packer for drill stem tests. The invention is, therefore, not to be restricted to the illustrative embodiments but is of a scope defined in the appended claims.

I claim:

1. A well packing tool comprising a first annular housing member having an internal shoulder, a second annular housing member, and an annular resilient packing member fastened to and between said first and second housing members, said first and second housing members and said packing member being coaxially aligned, a mandrel slidably mounted for longitudinal movement within said first and second housing members and said packing member with one end of said mandrel being adapted to seat on said first housing member shoulder, said mandrel and said first housing member having opposite ends arranged for connection in a well string releasable means for locking said mandrel to one of said housing members in a first relative position wherein said one end of said mandrel abuts said shoulder, and means for latching said mandrel to said second housing member in a second relative position wherein said one end of said mandrel is remote from said shoulder.

2. A well packing tool comprising a lower annular housing member having an internal shoulder, an upper annular housing member, and an annular packing member fastened to and carried between said lower and upper housing members, said lower housing member, packing member, and upper housing member being coaxially aligned, a mandrel slidably mounted for limited longitudinal movement in said upper and lower housing members and having a lower end adapted to seat on said lower housing member shoulder whereby downward force applied to said mandrel will be directly applied to said lower housing member, said mandrel and said lower housing member having opposite ends arranged for connection in a well string, releasable means for latching said mandrel to said lower housing member in a first relative position with the lower end of said mandrel seated on said shoulder, and means for latching said mandrel to said upper housing member in a second relative position wherein said lower end of said mandrel is remote from said shoulder, whereby downward force applied to said mandrel will be directly applied to said upper housing member to apply compressive force to said packing member.

3. A well packing tool comprising a lower annular housing member having an internal shoulder, an upper annular housing member and an annular packing member fastened to and carried between said lower and upper housing members, said lower housing member, packing member, and upper housing member being coaxially aligned, a mandrel slidably mounted for limited longitudinal movement in said upper and lower housing members and having a lower end adapted to seat on said lower housing member shoulder whereby downward

force applied to said mandrel will be directly applied to said lower housing, said mandrel and said lower housing member having opposite ends arranged for connection in a well string, a first lateral bore through the wall of said mandrel, a first locking element carried in said bore for lateral displacement and having a thickness greater than said wall, said lower housing member having an internal groove adapted to be in register with said first bore when said lower mandrel end is seated on said shoulder, a sleeve slidably received in said mandrel for longitudinal movement therein, means for releasably retaining said sleeve in said mandrel to displace said first locking element at least partially into said groove, a second lateral bore through the wall of said mandrel, and a second locking element carried in said second bore, said upper housing member having an internal groove adapted to be in register with said second lateral bore when the lower end of said mandrel is remote from said shoulder whereby said second locking element may lock said mandrel to said upper housing member.

4. A well packing tool comprising a lower annular housing member having an internal shoulder, an upper annular housing member, and an annular packing member fastened to and carried between said lower and upper housing member, said lower housing member, packing member, and upper housing member being coaxially aligned, a mandrel slidably mounted for limited longitudinal movement in said upper and lower housing members and having a lower end adapted to seat on said lower housing member shoulder whereby downward force applied to said mandrel will be directly applied to said lower housing member, said mandrel and said lower housing member having opposite ends arranged for connection in a pipe string, a first lateral bore through the wall of said mandrel, a first locking element carried in said bore for lateral displacement and having a thickness greater than said wall, an internal groove formed in said lower housing member and adapted to be in register with said first bore when said lower mandrel end is seated on said shoulder, a sleeve slidably received in said mandrel for longitudinal movement therein, means for releasably retaining said sleeve in said mandrel to displace said first locking element at least partially into said groove, a second lateral bore through the wall of said mandrel, a second locking element carried in said bore, said second locking element having an upper cam face and a lower locking face, an internal groove formed in said upper housing member and adapted to be in register with said second lateral bore when the lower end of said mandrel is remote from said shoulder whereby said second locking element may be partially received in said second groove, said second groove having a lower locking face and an upper cam face for moving said second locking element inwardly when said mandrel is raised to unlock said lower faces.

5. A well packing tool, as set forth in claim 4, including means normally urging said second locking element radially inwardly of said mandrel, and means for sealing said second locking element with said mandrel so that it may be extended outwardly by application of fluid pressure through said pipe string.

6. A well packing tool comprising a first annular housing member, a second annular housing member, and

an annular resilient packing member secured between said first and second housing members, a mandrel slidably mounted for limited telescopic movement within said first and second housing members and said packing member, said mandrel and said first housing member having opposite ends arranged for connection in a well string, releasable means for locking said mandrel to said first housing member in a retracted position, and means for latching said mandrel to said second housing member in an extended position for movement relative to said first housing member to set said packing member.

7. A well packing tool for connection in a pipe string comprising a lower annular housing member, an upper annular housing member, and an annular packing member secured between said lower and upper housing members, said lower housing member, packing member, and upper housing member being coaxially aligned, a mandrel slidably mounted for limited longitudinal movement in said upper and lower housing members and providing internal support for said packing member, said mandrel and said lower housing member having opposite ends arranged for connection in a well string, releasable means for locking said mandrel to said lower housing member in a retracted position for transmitting stress from said mandrel to said lower housing member, said releasable means including a sleeve slidable in the bore of said mandrel and releasably retained therein, and means for latching said mandrel to the upper housing member in an extended position whereby downward force applied to said mandrel will be directly applied to said upper housing member to apply compressive force to said packing member.

8. A well packing tool, as defined in claim 7, including spline means for corotatively securing said mandrel and said lower housing member while limiting extension of said mandrel relative to said lower housing member.

9. A well packing tool comprising a first annular housing member, a second annular housing member, means including an annular packing member disposed between and in alignment with said first and second housing members for coupling said housing members together while permitting their relative movement between an extended position and a contracted position for contracting and expanding said packing member, a tubular mandrel slidably interfitted within said housing and packing members for limited longitudinal movement relative thereto, one end of said mandrel and the opposite end of said first housing member being arranged for connecting said well tool in a string of pipe whereby said mandrel may be extended and contracted relative to said housing and packing members by manipulation of said string, first latching means for releasably retaining said mandrel with respect to said first housing member, and second latching means for engaging said mandrel with said second housing member for movement with respect to said first housing member when said first latching means is released.

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