United States Patent

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[54] **WELL PACKERS**
6 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **166/134,** 277/188, 277/116.2
[51] **Int. Cl.** **E21b 33/129**
[50] **Field of Search** 166/134, 135; 70/459; 277/116.2, 188, 220, 221

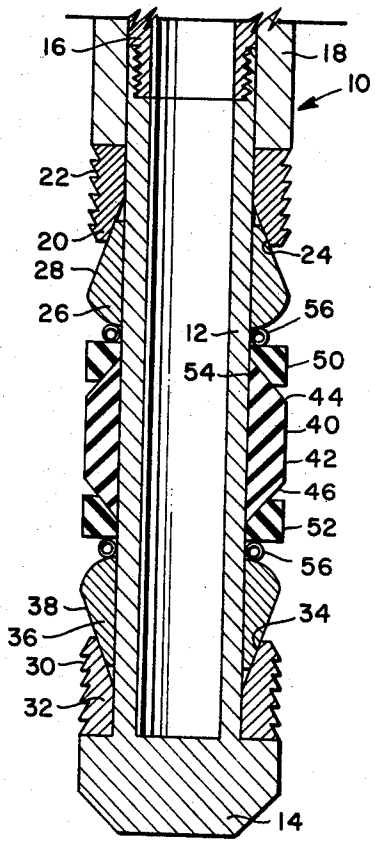
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ABSTRACT: A packing element support for well packers to prevent movement of the packing element between the anchoring means of the packer and the well bore, the support comprising an annular body with a gap therein and a curved member carried by said body bridging said gap. A well packer carrying at least one packing element support of this invention.



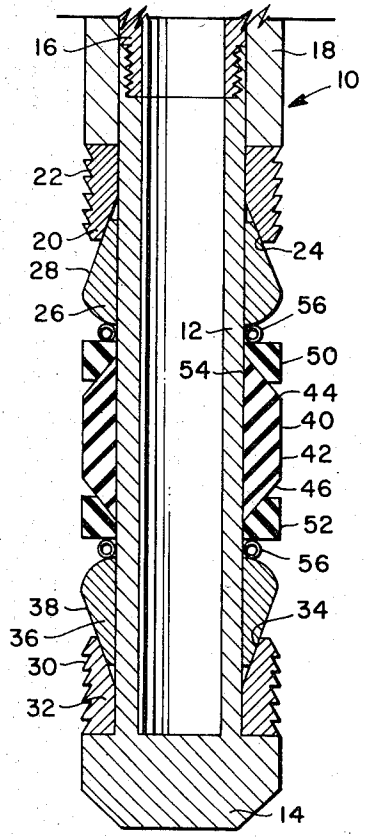


FIG. 1

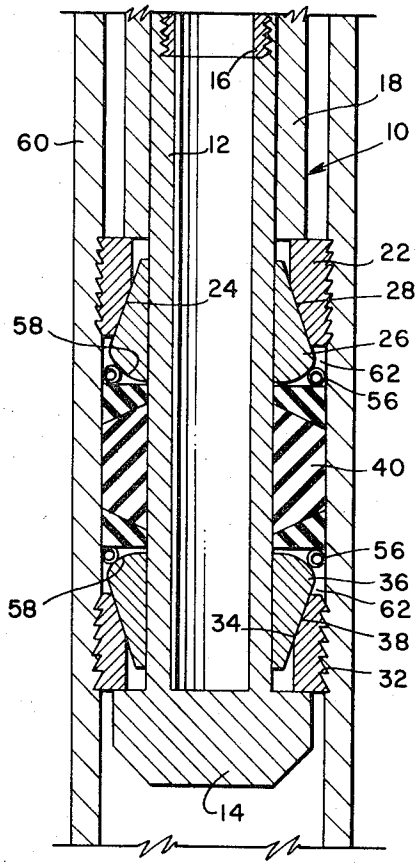


FIG. 2

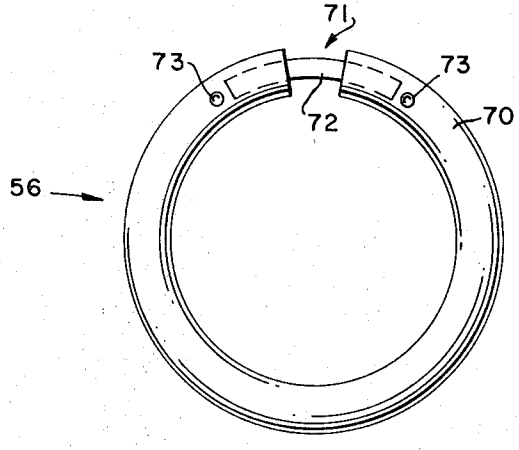


FIG. 3

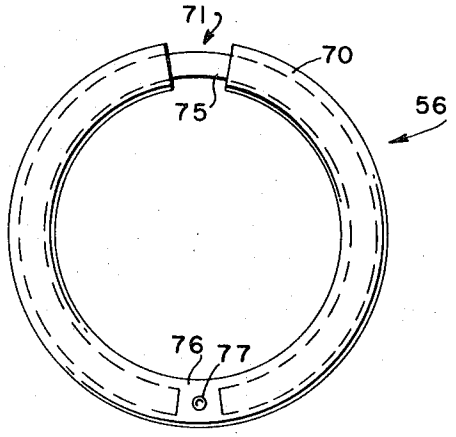


FIG. 4

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WELL PACKERS

BACKGROUND OF THE INVENTION

In well packers the packing element is formed from a deformable material such as rubber so that the packing element can be forced into sealing engagement with the well bore. In this invention, the term "well bore" broadly covers the natural walls of the well or any artificial cement, steel, or the like casing or liner disposed between the packer and the natural walls of the well.

There is normally an open space between at least a portion of the anchoring apparatus carried by the packer and the well bore. The packer element, being a deformable material, tends to flow into this space and this can prevent good sealing between the packer element and the well bore.

SUMMARY OF THE INVENTION

According to this invention there is provided a packing element support which is associated with the anchoring means of the packer and which expands upon setting of the anchoring means to deform the packing element. Thus, the space between the anchoring means and the casing in the area adjacent the packing element is blocked by the support thereby preventing movement of the packing element into the space between the anchoring means and the well bore. This results in a more effective seal for the packer element.

The packer element support of this invention comprises an annular body having a segment of the body removed to provide a gap therein. A curved member is carried by said body, the curved member being of a length greater than the length of the gap of the body. Stop means is provided for positioning the curved member so that it bridges the gap in the body.

This invention also relates to a well packer wherein the anchoring means of the packer has at least one of the packing element supports of this invention.

Accordingly, it is an object of this invention to provide a new and improved packer element support. It is another object to provide a new and improved packer. It is another object to provide apparatus for blocking the space between the anchoring means of a packer and the well bore in the area adjacent the packing element of the packer.

Other aspects, objects, and advantages of this invention will be apparent to those skilled in the art from the disclosure and the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a cross-sectional view of a well packer constructed in accordance with this invention.

FIG. 2 is a cross-sectional view of the packer of FIG. 1 showing the packer in the set condition in a well bore.

FIG. 3 is a plan view of one of a packer element support embodied in this invention.

FIG. 4 is a plan view of another embodiment of the packer element support of this invention.

FIG. 1 shows a packer assembly **10**, more specifically a packer known in the art as a bridge plug.

Packer **10** includes a mandrel **12** having a plugged lower end **14**. Plug **14** may be located in mandrel **12** in any desired position, e.g., at the upper end of mandrel **12** rather than the lower end as shown in FIG. **1**.

In packer **10** the upper end of mandrel **12** is connected with an inner member **16** of a setting mechanism. The setting mechanism is not illustrated in detail but is well known in the art and includes an outer setting sleeve **18** which is slidable relative to inner member **16**.

Disposed in encircling relationship to mandrel **12** is upper anchor mechanism **20** which includes a plurality of toothed slips **22** and annular expander member **26**. Each of slips **22** has an inner tapered surface **24**. Expander **26** has an upwardly and inwardly tapering surface **28** that mates with the inner tapered surfaces **24** of slips **22**. Slips **22** and expander **26** are movable on mandrel **12** and movable relative to each other. The movement therebetween moves slips **22** radially outward relative to mandrel **12**.

Packer **10** also includes a lower anchor mechanism **30** which also comprises a plurality of toothed slips **32** with tapered inner surfaces **34**, and expander member **36** having a downwardly and inwardly tapered surface **38** for mating with surfaces **34** of slips **32**. Slips **32** and expander **36** are slidably mounted on mandrel **12** and movable relative to each other so that movement between slips **32** and expander **36** with surfaces **34** and **38** in engagement moves slips **32** radially outward relative to mandrel **12**.

Various means (not shown) are provided to retain the various components of packer assemblies in their running-in positions and to control the relative movement of the components. For example, as is well known, shear pins (not shown) having different shear values can be used between the mandrel, slips, and expanders to provide for the retention of and to control the time of movement of the slips and expanders relative to the mandrel and relative to each other.

Disposed between the spaced apart (upper and lower) anchor mechanisms **20** and **30**, is packing element **40**. Packing element **40** is a generally cylindrical body **42** having tapered upper and lower ends **44** and **46**. Body **42** is formed from a deformable material such as synthetic rubber, elastomeric plastic, and the like.

Packing element **40** also includes upper and lower annular backup members **50** and **52**. Backup members **50** and **52** are identically constructed, although inverted in their assembly on packer **10**. Backup members **50** and **52** each include a tapered inner surface **54** that is in engagement with the tapered surfaces **44** and **46** of body **42**. Backup members **50** and **52** are optional to this invention and packing element **40** can be employed in a packer without backup members **50** and **52** if desired.

Expanders **26** and **36** are spaced from the packing element, including any backup members such as members **50** and **52**. The packing element supports **56** of this invention are inserted in this spacing so as to encircle mandrel **12**.

In operation, in FIG. **2**, packer **10** is connected to a conventional wireline (not shown) and lowered into the well bore. The well bore in FIG. **2** is represented by casing **60**. Casing **60** is inserted in the natural well bore and, therefore, is disposed between packer **10** and the natural walls of the well bore. Packer **10** is useful without casing **60** if desired in which case the natural walls of the well bore can be utilized instead of the artificial walls of casing **60**.

Upon reaching the desired depth in the well bore for setting packer **10**, the setting device is actuated thereby pulling inner member **16** upwardly and lowering outer sleeve **18** substantially simultaneously.

Since mandrel **12** is connected with inner member **16**, mandrel **12** moves upwardly therewith. As shown in FIG. **2**, outer sleeve **18** is in engagement with upper slips **22** forcing the upper slips downwardly relative to expander **26**. The relative movement between slips **22** and expander **26** moves the slips radially outwardly until the teeth thereon holdingly engage casing **60**.

The upward movement of mandrel **12** whose lower end **14** carries lower slips **32**, lower expander **36**, and packing element **40** upwardly against upper expander **26**. The relative movement between expander **36** and expander **26** will apply force on both ends of packing element **40** deforming it outwardly into sealing engagement with casing **60** as shown in FIG. **2**. The upward movement of expander **36** continues until packing element **40** is completely deformed at which time the upward movement terminates and slips **32** move relative to expander **36**.

The relative movement of slips **32** and expander **36** moves slips **32** outwardly into holding engagement with casing **60**. At this time, the packer assembly **10** is set in casing **60** as shown in FIG. **2**.

When packing element **40** is deformed outwardly into sealing engagement with casing **60** by pressure exerted from expanders **26** and **36**, the force is transmitted through packing element supports **56**. Due to the inclined surfaces **58** on expanders **26** and **36**, and the gap **71** (FIGS. **3** and **4**) provided in

thc body of supports 56, supports 56 expand and move outwardly into engagement with casing 60. This blocks spaces 62 between expanders 26 and 36, and casing 60. This blockage prevents packing element 40 from being deformed into spaces 62 thereby retaining all of packing element 40 for sealing engagement with casing 60 and providing a seal which is much improved over what it would have been had packing element 40 been allowed to flow into spaces 62.

FIG. 3 shows support 56 to be composed of a hollow annular body 70 having a segment of the body removed to provide gap 71 in the body.

Curved member 72 is carried by body 70 in the interior thereof, member 72 being of a length greater than the length of gap 71 so that member 72 can bridge gap 71 and both its ends overlap with body 70.

Stop means 73 are carried by body 70 and are placed adjacent either end of member 72 to permanently position member 72 so that it will bridge gap 71. The stop means can be carried by body 70 or member 72 or both so long as they effectively position member 72 to bridge gap 71.

Member 72 can telescope with the interior of body 70 or the exterior of body 70 or both as desired.

It can be seen from FIG. 3 that gap 71 will allow body 70 to expand when forced outwardly by expanders 26 and 36 into engagement with casing 60. Thus, the length of member 72 should also be greater than the length of gap 71 in its most open position, i.e., when body 70 is expanded out to meet the well bore, and still have its ends overlap body 70 to an extent that member 72 and body 70 are not disengaged and will retelescope with one another upon contraction of body 70 when packer 10 is unset for removal from casing 60.

FIG. 4 shows body 70 with gap 71 but shows curved member 75 extending into the hollow interior of body 70 for substantially the total circumference of body 70 except for gap 76 formed by removal of a segment of member 75. This is in contrast to FIG. 3 wherein member 72 extended internally of body 70 for less than half the circumference of body 70. The greater length of extension of member 75 into body 70 provides reinforcement for body 70 for maximum strength in use.

Stop means 77 are provided away from gap 71, and in gap 76 to thereby insure bridging of gap 71 by member 75.

Although stop means 73 and 77 can be any suitable structure obvious to one skilled in the art, a preferred embodiment is at least one surface indentation on body 70, the indentation extending into the hollow interior of body 70 for a distance sufficient to prevent members 72 or 75 from passing by the indentation. This type of stop means can be readily formed in body 70 by merely stamping a depression into the external surface thereof.

Reasonable variations and modifications are possible within the scope of this disclosure without departing from the spirit and scope of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

I claim:

1. In a well packer having a mandrel, spaced apart anchoring means on the mandrel, a packing element between said anchoring means, and means for setting the anchoring means in a well bore, the improvement comprising at least one packing element support associated with each of said anchoring means so that said support encircles said mandrel and expand upon setting of the anchoring means to form a block between said anchoring means and said well bore thereby preventing movement of said packing element between said anchoring means and said well bore during and after setting of said anchoring means, said packing element support including:

an annular, hollow body having a segment of the body removed to provide a gap in said body;

a member carried by said body and movable relative thereto, said member being curved in accord with said body and being of a length greater than said gap; and

stop means carried by at least one of said body and said member for positioning said member so that it bridges said gap.

2. The well packer according to claim 1 wherein each of said spaced apart anchoring means comprises slips having inner tapered surfaces, an expander member spaced from said slips, said expander member having an outer tapered surface that mates with the inner tapered surface of said slips, said packing element support being carried about said mandrel in said space between said slips and said expander member.

3. The well packer according to claim 1 wherein said member extends internally of said body for less than half the circumference of the body, and stop means is surface indentations in said body which extend into the hollow interior of said body, said indentations being at either end of said member to hold said member in place bridging said gap.

4. The well packer according to claim 1 where said member extends internally of said body for substantially the total circumference of said body, said member having a removed portion to provide a gap therein, and said stop means is at least one surface indentation in said body which extends into the hollow interior of said body, at least one indentation being positioned away from said gap in said body and also being positioned in said gap in said member.

5. A packing element support for well packers comprising:

an annular, hollow body having a segment of the body removed to provide a gap in said body;

a member carried by said body and movable relative thereto, said member being curved in accord with said body and extending internally of said body for less than half the circumference of said body and being of a length greater than the length of said gap; and

stop means carried by said body for positioning said member so that it bridges said gap, said stop means being surface indentations in said body which extend into the hollow interior of said body at either end of said member whereby said member is held in place bridging said gap.

6. A packing element support for well packers comprising:

an annular, hollow body having a segment of the body removed to provide a gap in said body;

a member carried by said body and movable relative thereto, said member being curved in accord with said body and extending internally of said body for substantially the total circumference of said body and having a removed portion to provide a gap therein; and

stop means carried by said body for positioning said member so that it bridges said gap in said body, said stop means being at least one surface indentation in said body which extends into the hollow interior of said body, said at least one indentation being positioned away from said gap in said body and also being positioned in said gap in said member.