March 26, 1968 J. H. CURRENT 3,374,841

PACKER WITH SHEAR MEMBER

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Fig. 1

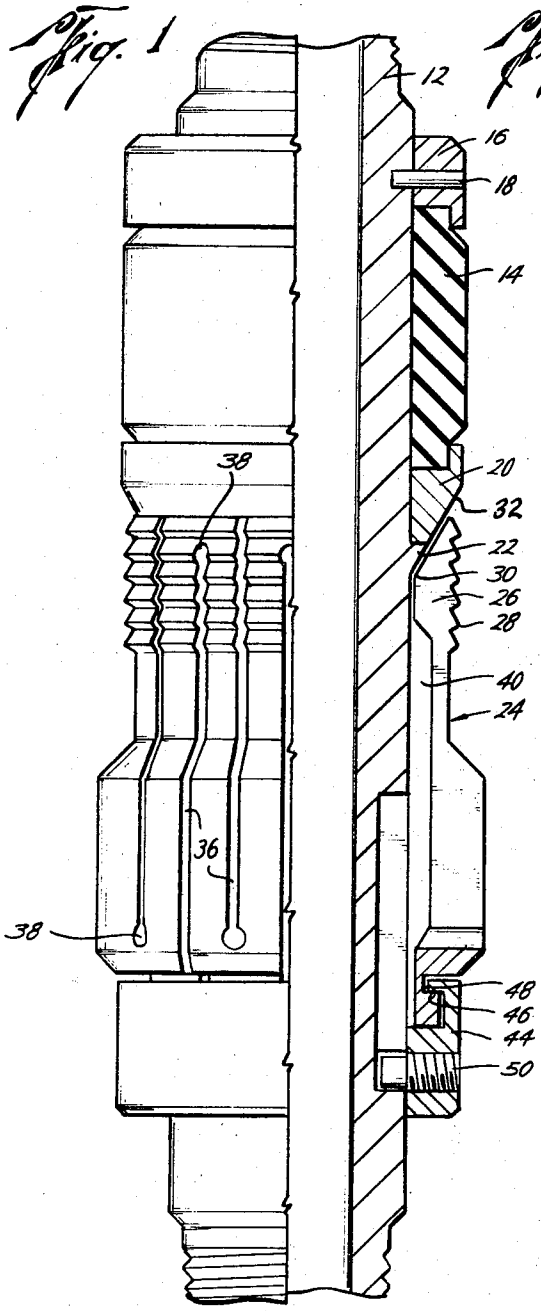

Fig. 2

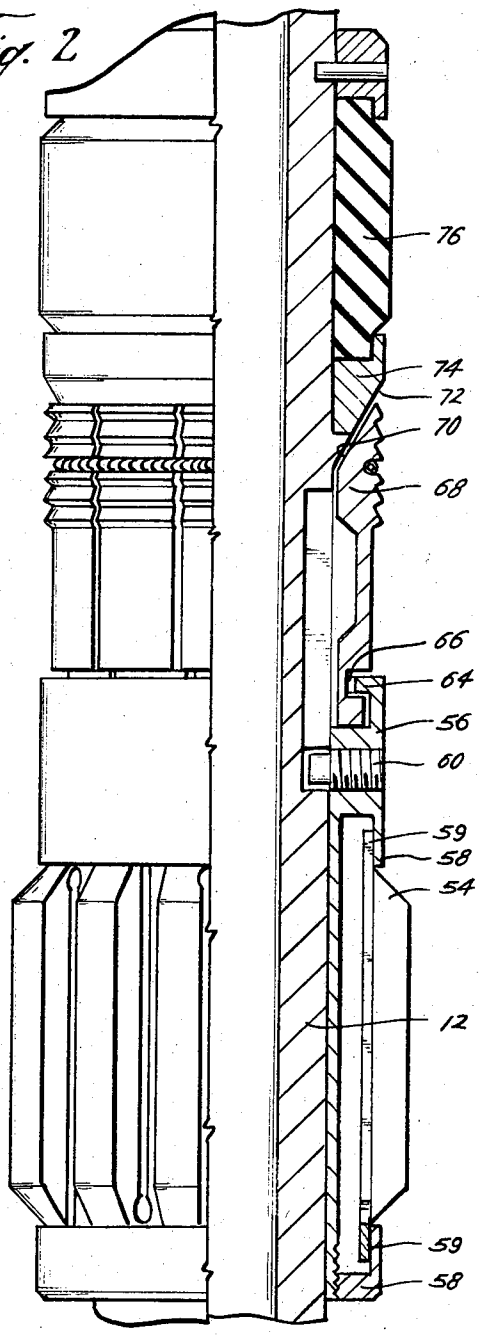

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Fig. 3

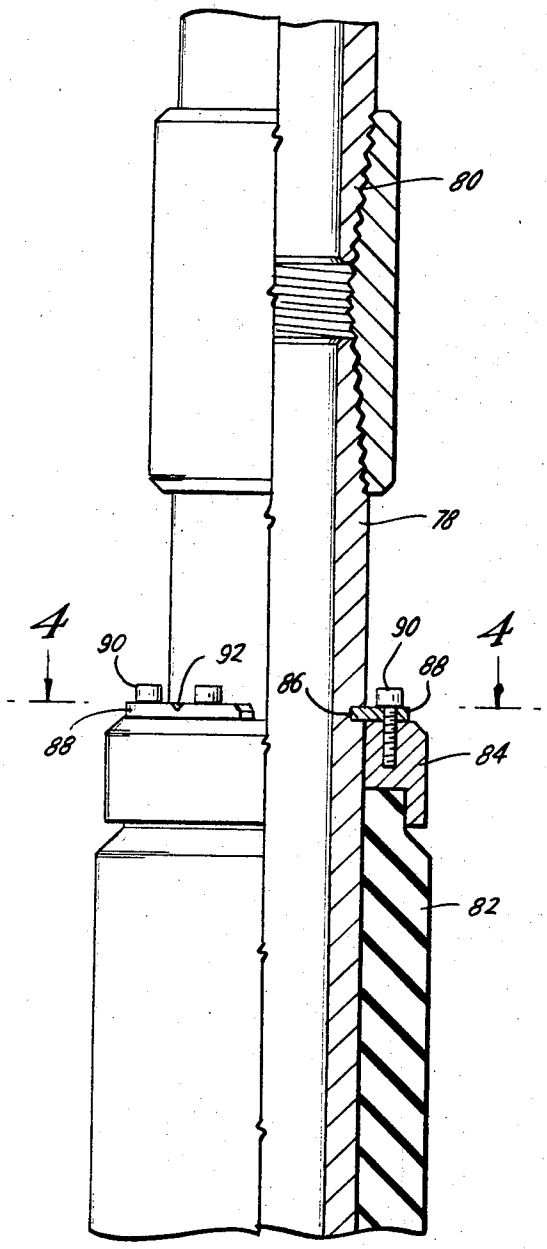
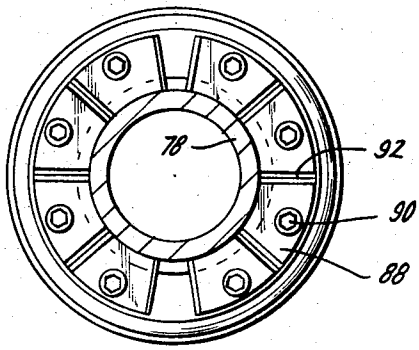


Fig. 4



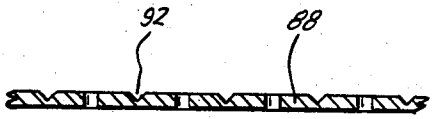


Fig. 5

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3,374,841

PACKER WITH SHEAR MEMBER

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3 Claims. (Cl. 166—138)

ABSTRACT OF THE DISCLOSURE

The particular embodiment described herein as illustrative of one form of the invention in well tools includes a mandrel with a packing element mounted thereon for packing off a well bore. An abutment engages one end of the packing element for exerting compression force thereon, and is releasably coupled to the mandrel by a shear member which normally prevents relative movement between the abutment and body, but which is responsive to a predetermined force to uncouple the abutment and mandrel. The shear member can be weakened along radial lines to permit segments thereof to be conveniently removed in order to selectively change the predetermined force necessary to uncouple the mandrel and abutment.

This invention relates to a well tool and, more particularly, to a packer apparatus for use in a well bore.

In the drilling and production of oil wells, it is often necessary to isolate zones or formations in the well bore in order to produce from and to permit or prevent the treating of such selected zones. The isolation of such zones or formations is commonly done by use of packers or bridge plugs. The present invention is primarily concerned with a tubing-type retrieval packer for use in a cased well bore. Such packers normally include a slip and drag block assembly in combination with a packer element. The packer is set by first unlocking a jaying mechanism and then applying tension or compression to the running in tubing which sequentially sets the slips into the well casing and expands the packer element. The expanded packer element seals off an annulus between the casing and the body of the packer. At some later time, the packer may be retrieved by manipulating the tubing to sequentially contract the packer element and unlock the slips from the casing. The packer is then locked in an inactive position by the jaying mechanism and retrieved to the surface.

In the event the packer should become stuck, a shearing device is usually provided between the packer body and the assembly holding the packer element. By applying greater than normal forces to the tubing string, the stuck parts can be made to shear from the body so that the body portion of the packer may be retrieved. The remainder of the tool is then fished or drilled out.

In the construction of such packers, it is important to maintain the apparatus as simple as possible for the reason that the more complicated the mechanism may be, the more likelihood there is that the mechanism will malfunction and prevent the retrieval of the packer by normal means.

It has been found that springs used for operating the slips and drag blocks are particularly susceptible to corrosive action of well fluids and often fail to operate. The failure of the springs to operate may cause the packer to become stuck in the well. Non-corrosive springs on the other hand are expensive and further add to the cost of the packer. In a typical packer, the slip and drag block assembly may be comprised of six slips, six slip pins, six drag blocks and eighteen springs; each being

separate parts. Cost and susceptibility to malfunction are normally proportional to the number of individual parts comprising the assemblies. Where such packers are left in the well bore for use over extended periods of time, the cost of manufacture of the packer becomes even more important.

It is, therefore, an object of the present invention to provide a new and improved packer which is economical to construct and simple in its operation.

With this and other objects in view, the present invention relates to a packer having a resilient element expandable by virtue of relative movement between upper and lower gauge rings. An expander cone associated with one of the gauge rings actuates slips to provide a rigid stop for that gauge ring against which movement of the other gauge ring compresses the resilient element and thereby laterally expands the element into engagement with the well. Slip and drag block means are constructed as a single unit. The drag block means permits a jaying mechanism to be operated, which, in turn, provides for relative movement between the slips and expander cone. Shear means are provided between one of the gauge rings maintaining the packer element expanded and the packer mandrel so that should the apparatus become stuck in the well bore, the shear ring may be sheared to let the packer element collapse and permit removal of the tool from the well. The shear ring is so constructed as to permit a convenient selection of shearing forces.

A complete understanding of this invention may be had by reference to the following detailed description when read in conjunction with the accompanying drawings illustrating an embodiment thereof, wherein:

FIG. 1 shows a partial sectional view of a packer embodying features of the present invention;

FIG. 2 shows a partial sectional view of a packer utilizing an alternative slip and drag block arrangement;

FIG. 3 shows a sectional view of part of a packer illustrating a shearing mechanism;

FIG. 4 is a sectional view taken along lines 6—6 of FIG. 3; and

FIG. 5 is a side view of the shearing device shown in FIGS. 3 and 4.

Referring to FIG. 1, the packer apparatus is comprised of a mandrel or body **12** which is threaded at its upper end for connection to a string of tubing. An elastomer packer element **14** is positioned about the body and is supported on one end by an upper gauge ring **16** which, in turn, is connected to the mandrel by a shear pin or shear ring **18**. The other end of the packer element is supported by a combination gauge ring and expander **20**. The gauge ring and expander **20** is supported on the mandrel by means of an annular shoulder **22** extending outwardly from the mandrel.

A unitary member **24** is arranged about the packer mandrel below the expander. This unitary member has portions thereon serving as slips and drag blocks. The member is preferably machined or otherwise formed of a single piece of material. An upper portion **26** of this unitary member has teeth **28** formed therein to render the upper portion operable as slips. The upper end of the slip portion **26** has an inwardly sloping surface **30** thereon which mates with an outwardly sloping surface **32** formed on the expander **20**. These sloping surfaces are arranged so that relative movement of the slip and expander toward one another will cause the slip to cam outwardly into engagement with the well casing. An enlarged portion **34** at the other end of the unitary member forms ad rag block means for frictionally engaging the interior of the well casing. A plurality of longitudinal slots **36** are formed through the unitary member with adjacent slots running from alternate ends of the mem-

ber to a terminal point 38 near the opposite end. The terminal point is in the shape of a hole through the member which serves as a stress relief means. This arrangement of slots in the unitary member permits the member to be compressed and thus reduced in size or diameter upon the application of radial forces inwardly against the member. A space 40 is provided between the unitary member and the mandrel to permit such radial compression. The lower end of the unitary member is supported by a drag block cage 42 having a hook-shaped annular lug 44 extending upwardly therefrom. The hook portion 46 on the lug is received within a recess 48 at the lower end of the unitary member. An inwardly extending "J" pin 50 which is attached to the drag block cage 42 is slidably received within a conventional J-slot 52 normally used with such packer devices.

In the operation of the apparatus shown in FIG. 1, the packer is lowered into the well bore to a depth where it is desired to expand the packer against the wall of the wall. At this point, the packer mandrel is raised upwardly and rotated to place the J-pin 50 into a long longitudinal section of the J-slot 52. The mandrel is then lowered with the pin 50 riding upwardly in the long section of the J-slot. The J-pin 50 is held from downward movement with the mandrel by frictional engagement of the drag block 34 against the wall of the well. Relative movement between the mandrel and unitary member, on which the drag block is formed, causes the sloping portion 30 of the slip to ride upwardly on the surface 32 of the expander thereby caming the slips outwardly into gripping engagement with the well bore. Further downward movement of the mandrel pushes the upper gauge ring, packer element, and lower gauge ring expander against the now-anchored slips and compresses the elastomer packing element between the upper and lower gauge rings. Such compression of the ends of the packer element causes the element to expand radially outwardly into sealing engagement with the wall of the well.

What it is desired to unset the packer, weight is picked up off the mandrel 12 by lifting on the tubing string. This permits the packer element to contract and lets the expander cone slide upwardly from behind the slip thereby permitting the slip to disengage from the wall of the well. Then teeth 48 on the slips are slanted downwardly to facilitate their disengagement from the wall of the well when pulled upwardy. Should the packer fail to unset, a larger than normal force may be applied upwardly on the mandrel which force is sufficient to shear the pin 18 connecting the upper gauge ring to the mandrel. Shearing of this pin releases the upper gauge ring to permit decompression of the elastomer packing element thus releasing the sealing engagement.

The apparatus has thus far been described as being operated as a compression set packer. However, it is readily seen that by inverting the apparatus on the tubing string, the packer may be set by applying tension forces to the mandrel.

Referring now to FIG. 2 of the drawings, an alternate arrangement of parts is shown which features a separate slip and drag block. The drag block 54 is constructed from a unitary piece of material and has the same slotted arrangement as shown with respect to the unitary member in FIG. 1. A drag block cage 56 is slidably received about the mandrel 12, the cage having overlapping flange members 58 which engage end tabs 59 on the drag block to support the drag block on the packer. A J-pin 60 which is connected to the cage 56 extends inwardly therefrom and is movably received within J-slot 62 in the mandrel 12. A hook-shaped annular lug 64 extends upwardly from the cage and is received in a complementary recess 66 on a slip member 68. One end of slip member 68 has a sloping portion 70 thereon which cooperates with oppositely sloping portion 72 on the expander cone 74 positioned below the packer element 76.

In the operation of the apparatus shown in FIG. 2, the

packer is run into the well bore to a point at which it is desired to expand the packer. The mandrel is raised upwardly and rotated to move the J-pin 60 into an elongated portion of the J-slot 62 whereupon the mandrel is lowered. Lowering of the mandrel at this point causes the expander cone 74 to move downwardly beneath the slips 68. The slips are prevented from moving downwardly due to the frictional engagement of the drag block 54 against the well bore. This downward movement of the expander cone 74 cams the slips 68 outwardly into gripping engamement with the well bore to anchor the slips therein. Continued downward movement compresses the packer element between the upper and lower gauge rings and radially expands the packer element 76 outwardly into sealing engagement with the well bore. The packer of FIG. 2 is unset in a manner simiar to that set forth with respect to the operation of the apparatus of FIG. 1.

FIGS. 3, 4 and 5 show a shearing means to be used with a well tool such as the packer described herein. Referring to FIG. 3, the upper end of a packer mandrel 78 is shown attached to the lower end of a tubing 80. A packer element 82 is shown positioned about the mandrel. An upper gauge ring 84 is positioned over the end of the packer element. An annular recess 86 is formed in the outer wall of the packer mandrel. An arcuate shaped shear member 88 is positioned about the mandrel with the inner edge of the shear member fitted into the recess 86 on the mandrel. A plurality of openings in the shear member receive screws 90 for fastening the shear member to the gauge ring 84. Radial slots or grooves 92 (FIGS. 4, 5) are formed part way through the shear member 88 so that portions or segments of the shear member may be easily broken therefrom. Each of the portions between the recesses 92 in the shear member has an opening for receiving a screw or bolt 90 to fasten each segment of the member to the gauge ring 84.

With the arrangement of shearing means as set forth above, the amount of shear means needed in a well tool may be determined and selected at the well location. The tool is shipped to the well location with a maximum amount of arcuate segments or shear means which would be needed in any situation. The operator then removes segments of the arcuate member until the number of the segments remaining corresponds to the shear value he wishes to provide on the tool. Each of the segments represents an equal amount of shear resistive material, for each segment may require 10,000 pounds force to shear the segment. The grooves 92 in the arcuate shear member are sufficiently deep to permit the pieces to be easily broken from the ring. As will be appreciated, the shear members would be placed about the mandrel in such a way as to balance or distribute the shearing forces applied about the mandrel.

Although the features of the invention herein have been described for use with a packer, it is readily seen that such features would have application to other well tools. Additionally, while particular embodiments of the present invention have been shown and described, it is apparent that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. In a tool for use in a well; a body, a first member telescopically mounted on said body and arranged for relative movement therewith, and a shear member coupled between said body and said first member in a manner to prevent such relative movement, said shear member being responsive to sufficient force applied to said body and first member to shear and thereby permit relative movement between said body and first member, said shear member being weakened along lines radially dividing said shear member into equal shear segments of predetermined shear strength thereby permitting said seg-

ments to be conveniently removed from said shear member to change the amount of force required to shear said shear member.

2. A packer for use in a well comprising: a body, packer means on said body including an elastomer packer element and expander means, selectively operable means for expanding said packer element into sealing engagement with the wall of the well, and shear means coupled between said body and packer means in a manner to prevent relative movement between a portion of said packer means and said body, said shear means being responsive to forces applied to said body to shear and thereby permit such relative movement, said shear means being comprised of an arcuate member having weakened portions thereon dividing said arcuate member into segments of equal shear strength, said weakened portions permitting said segments of said arcuate member to be conveniently removed from said arcuate member and thereby change the amount of force required to shear said arcuate member.

3. A packer for use in a well comprising: a mandrel, first means on said mandrel including drag block means for frictionally engaging the wall of a well bore and slip means for gripping the wall of a well bore, second means on said mandrel including a packer element and expander means, selectively operable means for permitting relative movement between said first means and one portion of said second means to set said slip means in gripping engagement with the wall of a well bore and to expand said packer element into sealing engagement with the wall of the well, said drag block means being a slotted annular sleeve which is compressible about said mandrel, annular groove means on said mandrel, and a shearable member connected to the other portion of said second means and fitted in said groove means to normally prevent relative movement between said mandrel and said other portion, said shearable member being responsive to a certain force applied to said mandrel to shear and thereby permit such relative movement, said shearable member being comprised of an arcuate member having radial notches therein dividing said arcuate member into segments which permit such segmented portions of said arcuate member to be conveniently broken off to thereby select the amount of force required to shear said arcuate member.

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JAMES A. LEPPINK, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,374,841 March 26, 1968

James H. Current

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

In the heading to the printed specification, lines 3 and 4, "Schlumberger Well Surveying Corporation" should read -- Schlumberger Technology Corporation --. Column 2, line 68, "ad rag" should read -- a drag --. Column 3, line 20, "wall", second occurrence, should read -- well --; line 39, "What" should read -- When --; line 44, "Then" should read -- The --; line 46, "upwardy" should read -- upwardly --; line 58, "alternate" should read -- alternative --. Column 4, line 11, "engamement" should read -- engagement --; line 16, "simiar" should read -- similar --.

Signed and sealed this 26th day of August 1969.

(SEAL)
Attest:

EDWARD M. FLETCHER,JR.
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Commissioner of Patents