

June 17, 1969

C. C. BROWN ET AL

3,450,204

WELL CASING HANGER

Filed Sept. 6, 1967

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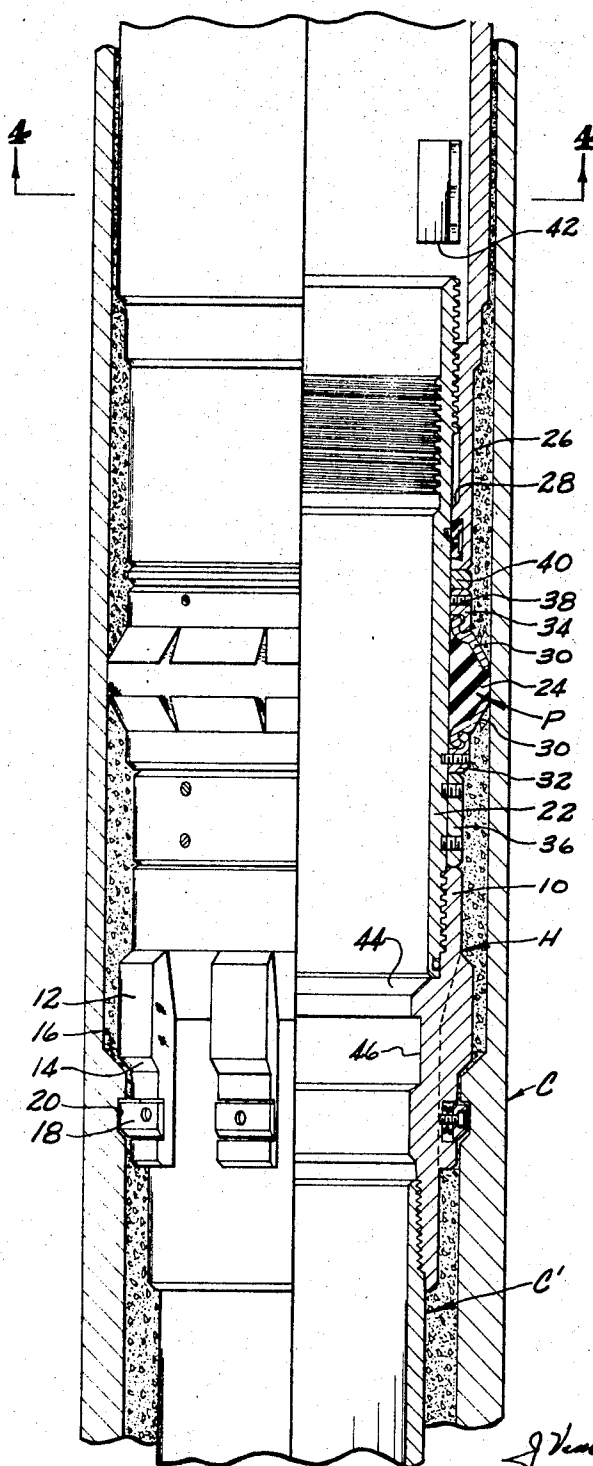


Fig. 1

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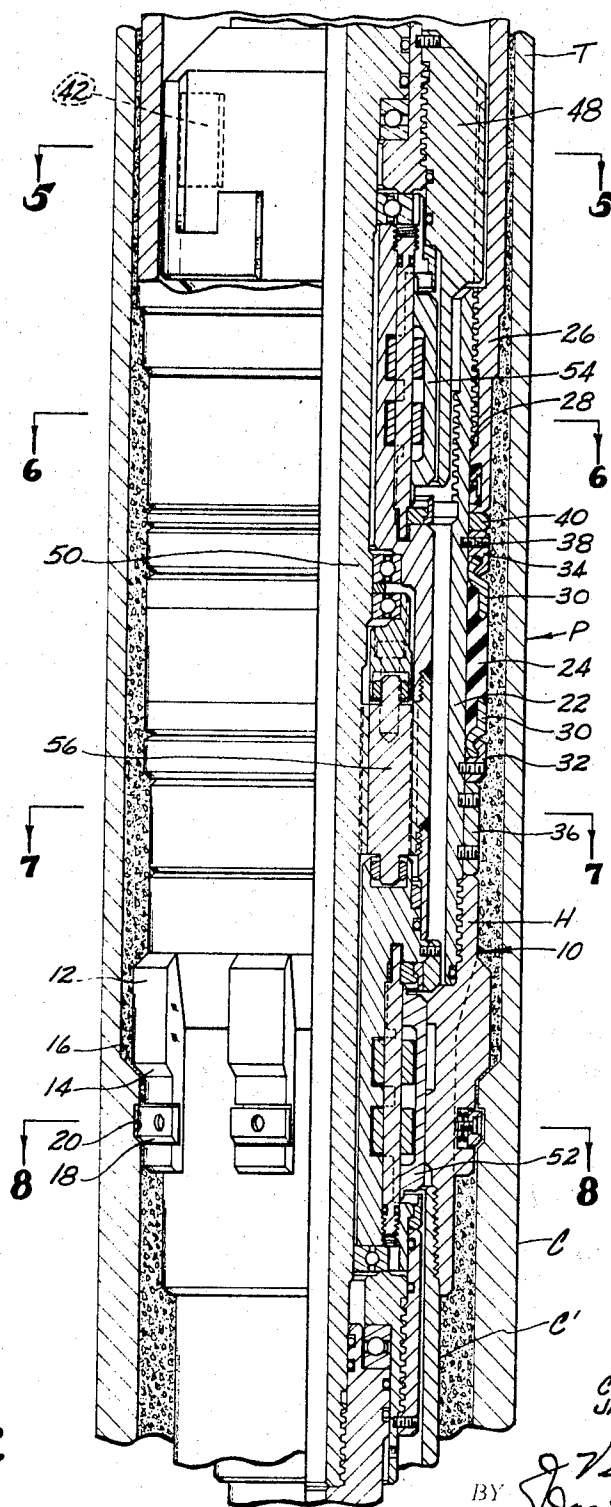
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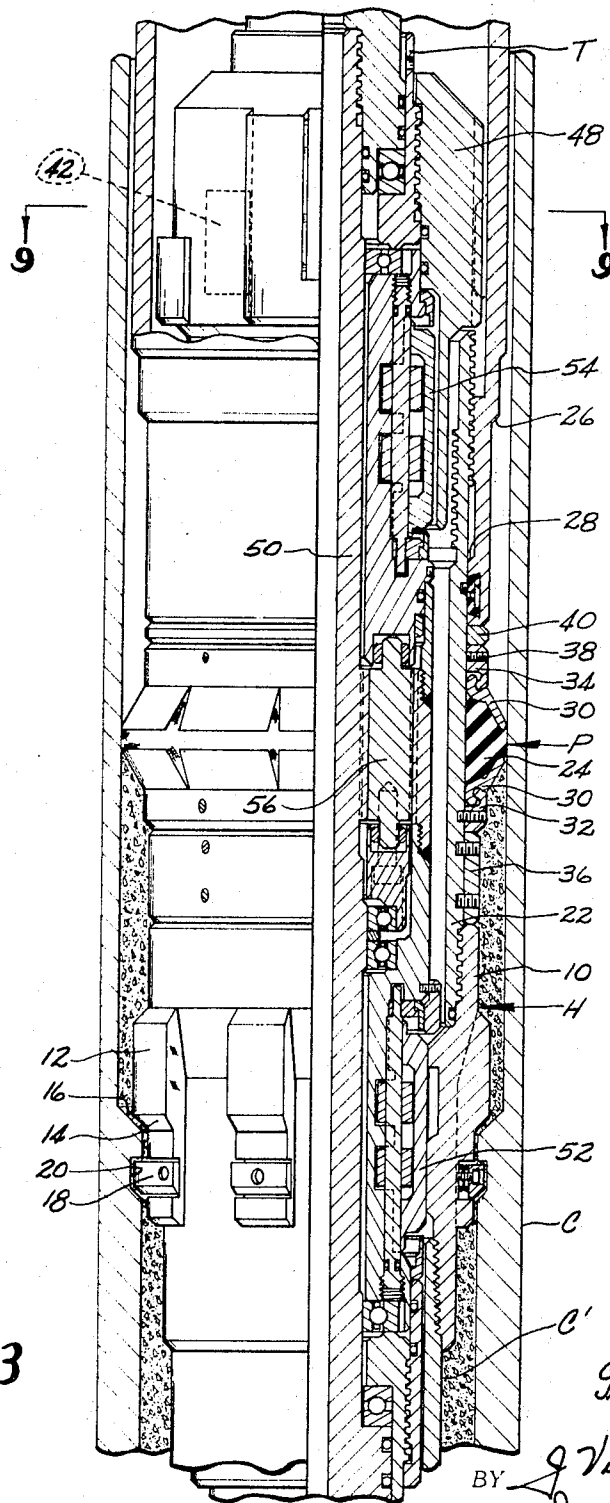
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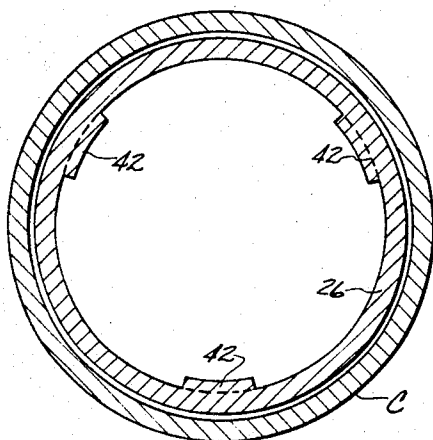


Fig. 4

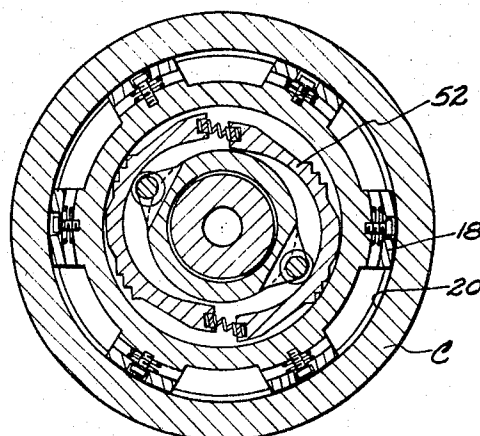


Fig. 8

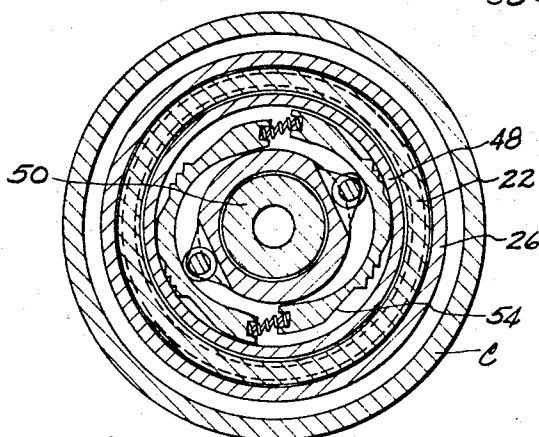


Fig. 6

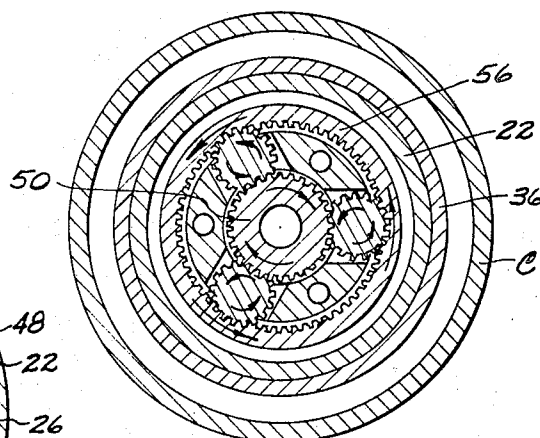


Fig. 7

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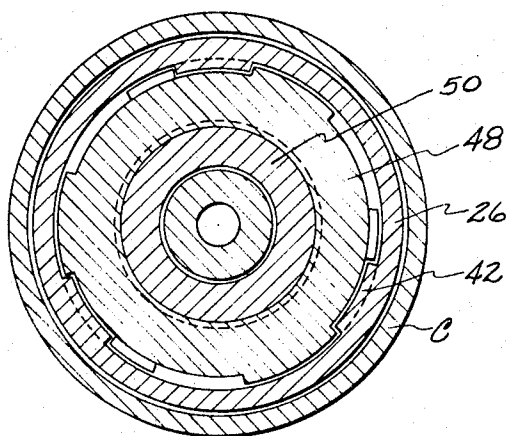


Fig. 5

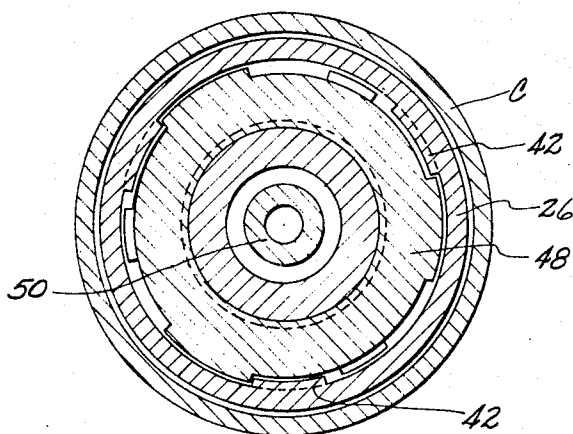


Fig. 9

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3,450,204

WELL CASING HANGER

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Filed Sept. 6, 1967, Ser. No. 665,857

Int. Cl. E21b 33/12, 23/00

U.S. Cl. 166—124

6 Claims

ABSTRACT OF THE DISCLOSURE

This specification discloses a well casing hanger having a mandrel and a packer which may be set after it is landed in a casing head and the packer may be relaxed and retrieved after the hanger has been cemented in place in the casing head.

Background of the invention

The present invention relates to an improved well casing hanger which is adapted to be cemented in a casing head and its packing element set after the cement is in place in which the packing element of the hanger may be relaxed and the packer structure retrieved even after the cement is set.

Prior to the present invention, well casing hangers when cemented in a casing head could not be retrieved. Thus, if a leak developed by channeling in the cement within the annulus and a failure of the packing, such leak could not be stopped by removal and replacement of the packing element. In such situations, the leakage could only be stopped by perforating the casing and attempting a squeeze cementing of the annulus in hopes of closing off the channeling in the cement.

Summary

The present invention provides an improved well casing hanger having a packing element which can be replaced after the hanger has been cemented within a casing head to assure a tight seal between the hanger and casing head.

An object of the present invention is to provide an improved casing hanger, having a releasable packer structure which is retrievable even after the casing hanger has been cemented within a casing head.

Another object is to provide an improved well casing hanger including a packer structure with a packing element which packer structure, after the hanger has been set in a casing head by cementing, may be removed from the casing head for ready replacement of the packing element and re-installed within the casing head to assure a tight seal in the annulus between the casing hanger and the casing head.

A further object is to provide an improved casing hanger including a packer structure with a packing element, which hanger is adapted to be set in a casing head by cementing, and the packing element moved to set position to seal the annulus between the hanger and the casing head wherein by rotation of a portion of said packer structure in one direction, the packing element may be relaxed from set position and by continued rotation in the same direction of said portion of the packer structure, the packer structure is disconnected from the remainder of the casing hanger.

These and other objects and advantages of the present invention are hereinafter described and explained.

Brief description of the drawings

FIGURE 1 is an elevation view partly in section, of the casing hanger of the present invention set in a casing head.

FIGURE 2 is a similar view of the casing hanger with

the packer structure thereof being released by a rotation imparted by a well tool and showing the packing element in released position.

FIGURE 3 is another similar view of the casing hanger with the packer structure being re-installed by the well tool.

FIGURE 4 is a sectional view taken along line 4—4 in FIGURE 1.

FIGURE 5 is a sectional view taken along line 5—5 in FIGURE 2.

FIGURE 6 is a sectional view taken along line 6—6 in FIGURE 2.

FIGURE 7 is a sectional view taken along line 7—7 in FIGURE 2.

FIGURE 8 is a sectional view taken along line 8—8 in FIGURE 2.

FIGURE 9 is a sectional view taken along line 9—9 in FIGURE 3.

Description of the preferred embodiment

The casing hanger H of the present invention, as shown in FIGURE 1, is adapted to support a casing string C' within the casing head C and includes the packer structure P including a packing element. When the placement of cement in the annulus between the casing head C and the casing C' has been completed, the packing element may be moved into set position to seal the annulus as shown in FIGURE 1. The casing hanger H includes the mandrel 10 and the packer structure P. The exterior of the mandrel 10 defines a plurality of spaced-apart projections 12 positioned around the mandrel 10 and defining downwardly facing shoulders 14 which are adapted to support the hanger H on the upwardly facing annular shoulder on seat 16 defined within the casing head C. In order to prevent the hanger H from being dislodged from its seated position within the casing head C during cementing, each of the projections 12 includes a spring-loaded dog 18 adapted to be received within the groove 20 defined in the interior of the casing head C immediately below the seat 16. As the hanger H is being lowered within the casing head C, the lower tapered surface of the dogs 18 engage the seat 16 and force the dogs 18 to clear the seat 16 and then dogs 18 are urged into the groove 20 to latch the hanger H in seated position. The spaces between the projections 12 provide a passageway to provide communication from the annulus below seat 16 to the annulus above seat 16.

The packer structure P includes the packing sleeve 22 which is threaded into the upper end of the mandrel 10, the packing element 24 which surrounds the packing sleeve 22 and the setting sleeve 26 which is in threaded engagement with the upper exterior of the packing sleeve 22. The setting sleeve 26 is provided with the inner upwardly facing shoulder 28 which is adapted to engage the lowermost threads on the exterior of the packing sleeve 22 to limit the upward movement of the setting sleeve 26 with respect to the packing sleeve 22. The packing element 24 is provided with upper and lower extrusion dogs 30 which support the packing in set position. The extrusion dogs 30 are connected pivotally to the rings 32 and 34.

In assembled position of the packer structure P, the lower ring 32 is secured to the packing sleeve 22 and abuts the spacer sleeve 36 which is also secured to the packing sleeve 22 and which abuts the upper end of the mandrel 10. Thus, the ring 32 provides a lower abutment for the packing 24. The ring 34 is initially shear-pinned by the pin 38 to the packer sleeve 22 in position with the packing element 24 in its completely relaxed position, such position being shown in FIGURE 2. The bearing ring 40 is positioned between the upper surface of the upper packing ring 34 and the lower surface of the setting sleeve 26 so that when the setting sleeve 26 is rotated to

be moved downwardly, such downward forces are transmitted by the bearing ring 40 and the upper packing ring 34 to compress the packing element 24 longitudinally causing it to expand radially outward into sealing engagement with the interior of the casing head C. The lugs 42 are positioned on the interior of setting sleeve 26 to provide for engagement and rotation of the setting sleeve by a suitable tool as hereinafter explained.

The interior of mandrel 10 defines the annular upwardly facing seat 44 and annular groove 46 immediately therebelow to allow another casing hanger to be positioned therein to thereby provide for a nesting of casing hangers when multiple casings are to be set in a well bore.

Initially when the casing hanger H is lowered within the casing head C, the packing element 24 is in relaxed position. After landing hanger H in casing head C, cement is circulated down through the interior of the casing hanger H and the interior casing C' and returns up through the annulus between the exterior of the casing C' and the interior of the casing head C. After the cement is in place, the setting sleeve 26 is rotated with a suitable tool as hereinafter described with respect to the packing sleeve 22 and the mandrel 10 whereby the setting sleeve 26 is moved downwardly thereon to move the packing element 24 outwardly into set position. Assuming the threads between the setting sleeve 26 and the packing sleeve 22 are right-hand threads, such setting rotation will be in a clockwise direction.

If, after the cement has set, a leak is detected in the annulus above the packing element 24, the packing element 24 may be relaxed and reset to try to seal off the leak. If resetting of the packing element does not stop the leak, then the packing element is relaxed and the packer structure P disconnected from the mandrel 10. This allows retrieval of the packing structure P whereby the packing element 24 which has developed a leak may be replaced with a new packing element 24. When such packing structure has been reassembled with a new packing element, it may be lowered into the well bore for reconnection to mandrel 10 and thereafter the new packing element 24 is set to provide an adequate sealing of the annulus and seal off such leak.

In FIGURE 2 the reversing tool T has been shown lowered into position within the casing hanger H. The packing element 24 as shown, has been relaxed and the tool T is positioned to provide disconnection of the packer structure P from the mandrel 10 to allow retrieval of the packer structure 10. The reversing tool T, as shown, is a tool similar to that disclosed in the C. C. Brown Patent No. 3,322,006 issued May 30, 1967. Such tool is adapted to be suspended on a pipe string and to engage two portions of a structure such as the setting sleeve 26 and the mandrel 10 to cause one to rotate relative to the other. The setting tool T is designed so that right-hand rotation of the string supporting the tool causes a threading or unthreading of the parts. Thus, where the mandrel 10 and the packer sleeve 22 are connected by right-hand threads, and the packer sleeve 22 and the setting sleeve 26 are connected by right-hand threads, rotation of the string supporting the tool T as shown in FIGURE 2, tends to rotate the mandrel 10 to the right. Since the mandrel 10 is fixed by the cement in the annulus, such rotation is transmitted through the gearing to the tool head 48. Head 48 is provided with J-slot configuration on its exterior surface into which the lugs 42 on the interior setting sleeve 26 extend. Therefore, the tool T rotates setting sleeve 26 to the left or counterclockwise. Initial rotation by the tool threads the setting sleeve 26 upwardly on the packing sleeve 22 allowing the packing element 24 to relax. When the shoulder 28 on the interior of setting sleeve 26 engages the lowermost threads on the upper exterior of packing sleeve 22, further rotation of the setting sleeve 26 causes the packing sleeve 22 to rotate with respect to mandrel 10 thereby disconnecting the threaded connection between the packing sleeve 22 and the mandrel

10. When the packing sleeve 22 has been disengaged from the mandrel 10, the packer structure P is then supported by the lugs 42 in the J portion of the tool head 48 and may be lifted and retrieved by lifting of the tool T from within the casing head C.

The reversing tool T as explained in the aforementioned patent includes a central rotatable mandrel 50, the upper tool head 48 previously discussed, the lower gripping unit 52 adapted to engage the mandrel 10, the upper gripping unit 54 which is adapted to engage the interior of head 48. The gripping engagements of such units when the tool is rotated, results from the cam connections provided in each of such units. The reversing gear assembly 56, which is shown in FIGURE 2, is connected to provide a right-hand drive to the lower gripping unit 52 and a left-hand drive to the upper gripping unit 54 and to the tool head 48. Thus, in this position, the reversing tool T is constructed to utilize a right-hand rotation of the string on which it is supported to release the packing element 24 and remove the packer structure P from engagement with the mandrel 10 allowing retrieval of the packer structure P. Thereafter with a new packing element 24 mounted in the packer structure P, the setting tool T is reversed end for end except that the tool head 48 and the lower sub 58 are disconnected and reassembled with the tool head 48 on what is the upper portion of the tool in its reversed position and the sub 58 is assembled on the lower end of the tool in its reversed position.

With the tool reversed as described, the packer structure P is positioned thereon and lowered into the casing head C with the J portion of the head 48 supporting the structure by its engagement with the lugs 42 on the interior of the setting sleeve 26. When the structure has been lowered so that the lower end of the packing sleeve 22 is ready to be threaded into the mandrel 10, the string supporting the tool is rotated to the right. Such right-hand rotation, through the gearing system, sets the lower gripping unit 52 on the interior of the mandrel 10 and the upper gripping unit 54 on the interior of head 48. Further right-hand rotation tends to rotate the mandrel 10 in a reverse or left-hand direction. Since as previously described, the mandrel 10 is set in cement, the lower part of tool T is held and the head 48 is rotated in a right-hand direction. This right-hand rotation of head 48 rotates the packer structure P with respect to the mandrel 10 to thread the packing sleeve 22 into the mandrel 10. Relative rotation between the setting sleeve 26 and the packing sleeve 22 is prevented by the shear pin 38 during the threading of the packing sleeve 22 into the mandrel 10. When this connection is completed, continued rotation rotates the setting sleeve 26 with respect to the packer sleeve 22, initially shearing the pin 38 and further rotation causes the setting sleeve 26 to move downwardly with respect to the packer sleeve 22 whereby the packing element 24 is moved outwardly into sealing engagement with the interior of the casing head C. In this position, the tool T is disengaged from the lugs 42 and removed from the interior of the hanger H. It should be noted that in running the packer structure P downwardly, that the lower portion of the tool T which extends into the mandrel 10 and the inner casing C' guides the packing sleeve 22 to center it with respect to the mandrel 10 to assure that rotation causes the packing sleeve 22 to thread downwardly into the mandrel 10 and thereby avoids misalignment problems. Also, it should be noted that the gripping units on the reversing tool T are such that they resist rotation with respect to the mandrel 10 but will allow the longitudinal movement with respect thereto to compensate for the downward movement of the setting sleeve 26. The lugs 42, when the unit is set as shown in FIGURE 3, are positioned in the vertical slots and out of the J-slot on head 48 allowing the reversing tool T to thereafter be lifted directly upwardly and completely disengaged itself from the hanger.

From the foregoing it can be seen that the casing

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hanger of the present invention includes a packer structure which is retrievable even after being cemented in a casing head. This allows the packing element to be replaced and reset to assure that there is no leakage in the annulus between the hanger and the casing head even though the cement may have developed leaks.

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

What is claimed is:

1. A casing hanger comprising:

a mandrel,

a packer structure including a packing element,

a setting sleeve threadedly connected to said packer structure which when rotated in one direction moves said packing element to set position and when rotated in the opposite direction relaxes said packing element, and

means releasably connecting said packer structure to said mandrel whereby said packer structure may be released from said mandrel after said casing hanger has been cemented within a casing head.

2. A casing hanger according to claim 1, including:

releasable means preventing relative rotation between said setting sleeve and said packer structure whereby said packing element is held in relaxed position until said packer structure is completely connected to said mandrel.

3. A casing hanger according to claim 1, including:

means preventing disengagement of said setting sleeve from said packer structure whereby further rotation in said opposite direction after said packing element is relaxed, releases said packer structure from said mandrel.

4. A casing hanger adapted to be seated on a shoulder defined in a casing head, comprising:

a mandrel having external spaced-apart shoulders adapted to engage on an internal shoulder in a casing head, while defining a passageway therebetween for the flow of fluids,

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a packing sleeve releasably connected to said casing mandrel,

a packing element surrounding said packing sleeve and adapted when compressed longitudinally, to distort outwardly to seal between the exterior of said packing sleeve and the interior of said casing head,

a setting sleeve surrounding and threaded to said packing sleeve whereby rotation of said setting sleeve in one direction compresses said packing element into set position and rotation of said setting sleeve in the opposite direction relaxes said packing element from its set position,

means releasably connecting said setting sleeve to said packing sleeve, and

means preventing disengagement of said setting sleeve from said packing sleeve whereby when said setting sleeve has been rotated to relax said packing element from its set position, continued rotation in the same direction releases said packing sleeve from said mandrel to allow retrieval of said packing sleeve, said packing element and said setting sleeve.

5. A casing hanger according to claim 4, including:

means releasably preventing relative rotation between said setting sleeve and said packing sleeve whereby inadvertent moving of said packing element to set position is prevented.

6. A casing hanger according to claim 4, including:

means on said spaced-apart shoulders and adapted to engage said casing head to prevent relative longitudinal movement of said casing hangers with respect to said casing head after said casing hanger has been landed on said internal shoulder of said casing head.

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U.S. Cl. X.R.

166—182, 208