

Oct. 29, 1963

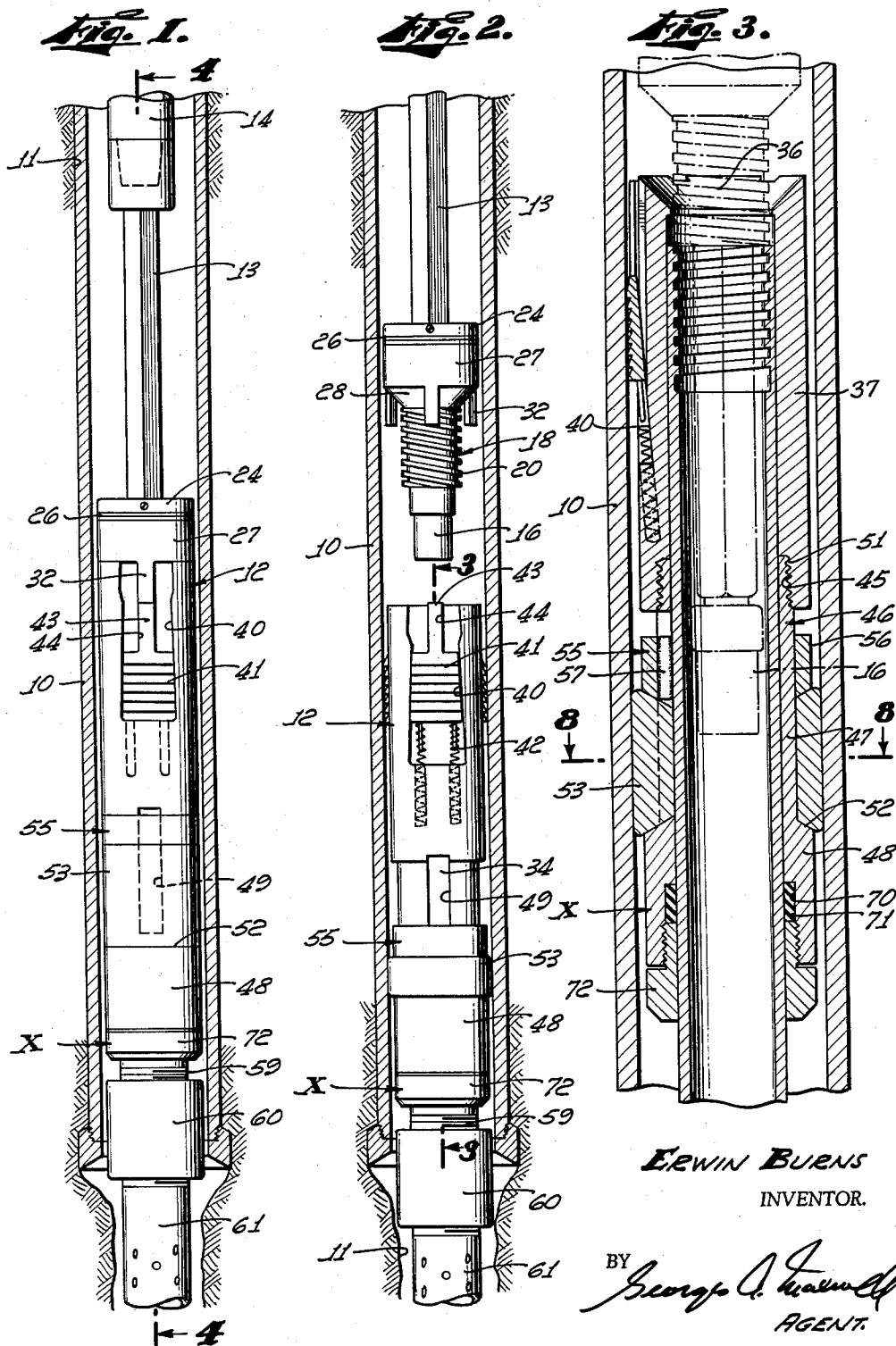
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LINER HANGER AND PACKER CONSTRUCTION

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2 Sheets-Sheet 1



Oct. 29, 1963

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2 Sheets-Sheet 2

Fig. 4.

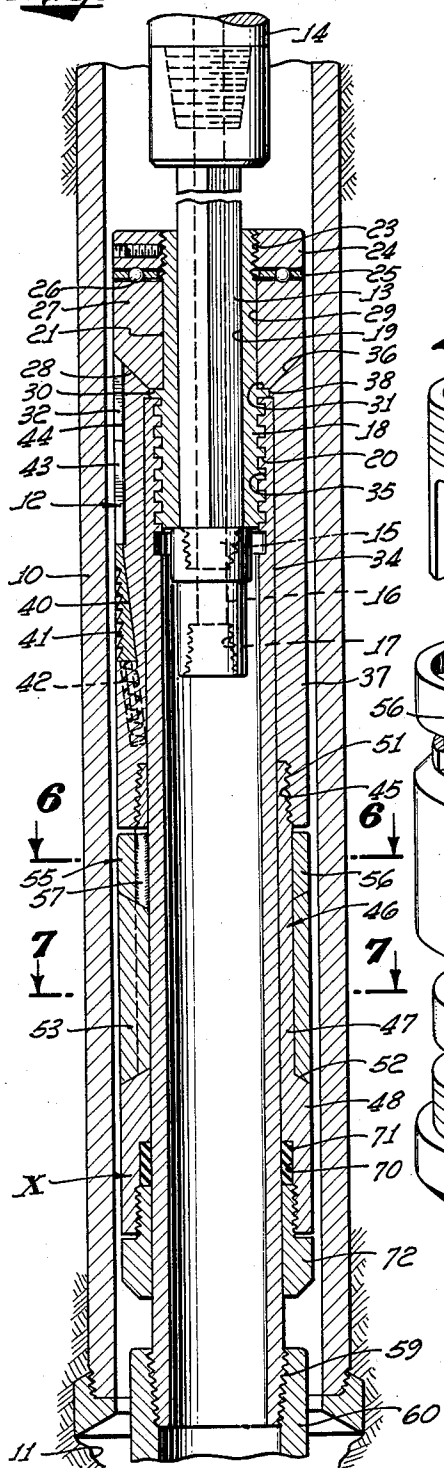


Fig. 5.

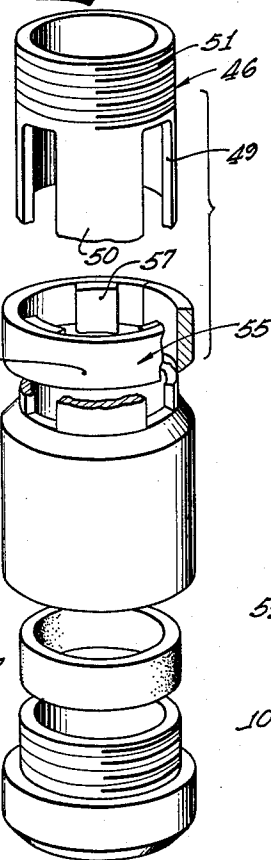


Fig. 6.

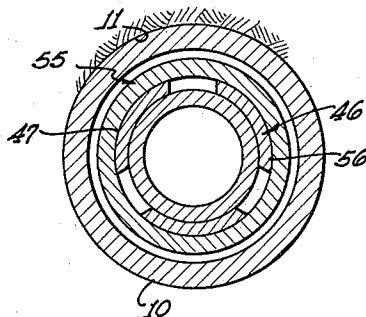


Fig. 7.

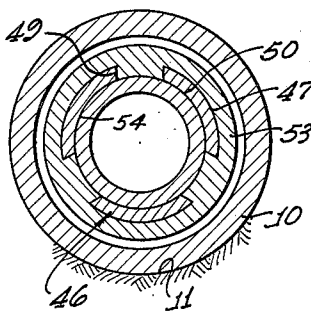
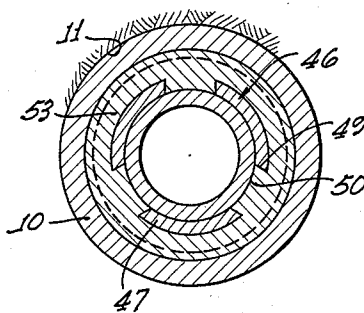


Fig. 8.



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1

3,108,638

LINER HANGER AND PACKER CONSTRUCTION

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5 Claims. (Cl. 166—124)

This invention relates to an oil well tool and is more particularly concerned with a combination liner hanger and packer and is of the general construction shown in United States Patent No. 2,337,733, to Erwin Burns and Frank C. Boyd, entitled "Liner Hanger," and issued December 28, 1943.

In the type of liner hanger disclosed in the above-identified patent, a structure is provided which includes an elongate vertically disposed body adapted to be secured to the upper end of a liner, hanging and setting means at the upper end of the body and including a barrel slidably engaged around the body and carrying casing engaging slips, and a deformable packer including an apertured cage fixed to and depending from the hanger barrel to slidably receive the body, a lead packer engaged around the cage and an actuating sleeve surrounding the cage above the packer and connected to the body through the apertures in the cage and adapted to distend the packing and urge it into sealing engagement with the well casing when the body of the tool is shifted downwardly through the barrel and the cage.

Although the above general construction has, for many years, proven reasonably satisfactory, it has been found that fluid in the annulus around the tool and occurring above or below the packer, is free to bypass and flow around the packer between the body and the cage and through the apertures in the cage, after the packer is set. In wells where extremely high pressures are encountered, the flow of fluid through and around the packer, in the manner set forth above, rapidly wears or cuts away the portions of the packer which it engages, as well as the body, cage and actuator sleeve of the construction, thereby rendering the entire construction useless. In certain circumstances, cutting away of the construction in the manner set forth above, can, in time, cut the body in two, dropping the liner in the well and necessitating the expensive operation of fishing and retrieving the liner.

Liner and packer constructions such as that disclosed in my co-pending application Serial No. 660,106, filed May 20, 1957, and entitled "Liner Hanger and Packer," have been designed to overcome the above-mentioned defects. However, such constructions fail to utilize any of the elements of existing constructions in which the defect mentioned above exists and necessitates that an entirely new tool be provided.

An object of the present invention is to provide a novel sealing means applicable to the lower end of the packer cage in a construction such as illustrated in Patent No. 2,337,733, to seal between the cage and the body of the tool and thereby prevent the leakage of fluid therebetween.

Another object of the present invention is to provide a sealing means of the character referred to above that can be easily and conveniently applied to existing liner and packer constructions of the character referred to, thereby making it possible for owners or purchasers of such tools to have their tools modernized by a simple modification and without the necessity of incurring the expense of purchasing an entirely new tool.

Other objects and features of this invention will be made apparent and fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawings, in which:

FIG. 1 is a longitudinal elevational view showing the

2

tool provided by the present invention engaged in a well structure and showing the tool in an unactuated position.

FIG. 2 is an elevational view showing the tool that I provide in an actuated position in the well.

FIG. 3 is a longitudinal sectional view taken substantially as indicated by line 3—3 on FIG. 2.

FIG. 4 is a longitudinal sectional view taken as indicated by line 4—4 on FIG. 1.

FIG. 5 is an exploded sectional view showing a portion of the hanger cage and the actuating ring.

FIG. 6 is a transverse sectional view taken as indicated by line 6—6 on FIG. 4.

FIG. 7 is a transverse sectional view taken as indicated by line 7—7 on FIG. 4.

FIG. 8 is a transverse sectional view taken as indicated by line 8—8 on FIG. 3.

Referring particularly to the form of the invention illustrated throughout the drawings, 10 indicates a well casing which is set within a well bore 11 and within which a liner hanger 12 is mounted. The liner hanger is shown as including a square mandrel or stem 13 which is threaded into the lower end of a drill pipe joint 14. This stem is square in cross section and has a lower threaded end 15 which threadedly receives a nut 16. The nut 16 is internally threaded as at 17 and may receive the threaded end of a suitable length of tubing through which circulating fluid or cement may be forced downwardly into the liner. The square stem 13 extends through a liner nut 18 of the setting tool. This nut has a central bore therethrough of square cross-section, as indicated at 19, and through which the stem 13 may slide while positively engaging the nut to impart rotation thereto. The exterior surface of the lower cylindrical portion of the liner nut is formed with threads 20. These threads are square left hand threads. The upper length of the nut is cylindrical, as indicated at 21. The upper end of this cylindrical portion is threaded at 23 to receive an annular bearing nut at 24. The bearing nut 24 has a lower shoulder forming a ball race 25, which rests an anti-friction bearing 26, which bearing is shown as being of conventional ball bearing type. The anti-friction bearing rests upon the upper end face of a sleeve 27 of the setting tool. The sleeve 27 is cylindrical and is formed at its lower end with a frusto-conical face 28. A cylindrical bore 29 is formed in the sleeve and the sleeve has a running fit with the upper cylindrical portion 21 of the nut 18. The lower end of the sleeve is machined or turned down and forms a square shoulder 30 which rests against a shoulder 31 at the upper end of the threaded section 20 of the nut. This restrains the sleeve 27 from longitudinal movement upon the extension 21 of the nut 18.

Extending downwardly from the sleeve 27 are a plurality of separate slip-engaging fingers 32 which fingers are mounted on the outer circumference of the sleeve 27 and overhang the threaded portion 20 of the nut 18, as shown in FIGS. 2 and 4 of the drawings. Three of these fingers are here shown and their purpose in the structure will hereinafter be described.

The liner hanger is shown as including a tubular body 34, which is internally threaded at its upper end, as indicated at 35. The threads 35 are complementary to the threads 20 on the nut 18. The upper end of the body 34 is formed with an internally and downwardly tapered seat 36 which is complementary to the end face 28 of the sleeve 27. Slidably mounted upon the tubular body member 34 is a slip barrel 37. The barrel 37 is provided with a radially inwardly projecting flange 38 at its upper end, which flange engages the upper end of the body 34 and prevents downward shifting and displacement of the slip barrel on the body 34. Formed within the cylindrical outer face of the slip barrel 37 are guideways 40,

3

which receive wickered slips 41. These slips are designed to move upwardly and outwardly in the guideways 40. A plurality of springs 42 are mounted in the barrel at the heel of the slips to normally yieldingly urge the slips upwardly in the guideways. The upper end of each slip is formed with a finger 43, which extends along a longitudinal slot 44 provided in the exterior of the barrel and into which the fingers 43 on the slips 41 extend. The fingers 32 and 43 are in longitudinal alignment and when the sleeve 27 is in its lowermost position. The fingers 32 engage the fingers 43 and force the slips downwardly and hold them retracted so that they will not grip the wall of the casing 10 until released.

The lower end of the slip barrel 37 is internally threaded as indicated at 45. This receives the upper end of a packer cage 46. The packer cage 46 is shown as having a substantially cylindrical body portion 47 and an enlarged collar portion 48 at the lower end thereof. The body portion is cut away at intervals about its circumference to establish elongate slot-like apertures 49 therein and has longitudinal wall portions 50 between the apertures. The upper end of the cylindrical portion 47 is externally threaded as indicated at 51 and is threadedly engaged into the threaded bore 45 of the slip barrel 37. It will be seen that due to the fact that the enlarged collar 48 is of a diameter somewhat greater than the diameter of the cylindrical body 47, a radially outwardly and substantially vertically disposed shoulder 52 is established at the upper end thereof.

Engaged or cast around the portion 50 of the cage and filling the slot-like openings or apertures 49 therein is a sleeve-type packer 53. This packer may be of any desired design or construction and of any suitable deformable material, such for example as lead. It will be apparent from a study of the drawings, that the packer sleeve is cylindrical and of an outside diameter agreeing with that of the enlarged collar 48 on the cage. The inside diameter of the packing sleeve, indicated at 54, fits snugly around the exterior of the cage and about the circumferential face of the body 34 occurring adjacent the apertures 49 in the cage, as clearly illustrated in FIGS. 4 and 7 of the drawings.

The length of the packer sleeve is such as to insure space for a packer actuating ring 55. The actuating ring 55 is shown as including an annular wall section 56. The outer diameter of this section agrees with the normal outside diameter of the packer barrel and the outside diameter of the slip barrel 37. Arcuate lugs 57 extend inwardly from the annular portion 56 of the ring and are spaced at equal intervals therearound. These lugs fit into the upper ends of the slotted openings or apertures 49 in the packer cage and have the inner portions fixed to the exterior of the body 34 as by welding. As illustrated in the drawings, the packer sleeve is of a length shorter than the openings 49 and sufficient to permit the lugs 57 to assume a position in the ends of the openings and resting against the upper end face of the packer sleeve 53.

The other or lower end of the body 34 extends downwardly below the cage 46 a desired distance and is externally threaded at 59 to receive a coupling collar 60 into which is threaded the upper end of a perforate liner 61.

Before use, the structure is assembled in the manner illustrated in FIGS. 1 and 4 of the drawings, by placing the packer cage with the packing ring therearound the body member 34 and with the actuating ring 55 disposed above the sleeve 53, and so that the lug-like portions of the ring 55 will protrude through the apertures or openings 49 in the cage 46. Thus, the under surface of the ring 55 extends entirely across the upper surface of the packing sleeve 53. The lugs on the ring 55 are then fixed to the body, as by welding. The slip barrel 37 is then attached to the top of the packer cage 46 by threading the portion 51 of the packer into the threaded section 45 of the barrel 37. When thus threaded, the flange 38 at the

4

upper end of the slip barrel engages and rests on the upper end of the body 34 and limits downward movement and displacement of the slip barrel and the elements of the packing means related thereto, relative to the body. The liner nut 18 carrying the sleeve 27 is then threaded into position with the upper end of the body member 34 and by engagement of the threads 20 on the nut with the threads 35 in the body member. When the nut is tightened into position, the tapered face 28 on the sleeve 27 will rest against the upwardly tapered face 36 on the slip barrel. It will be understood that when this assembly is made, the sleeve 37 does not rotate since the fingers 32 extend into the longitudinal recesses 44 in the slip barrel 37. While thus held, the nut 18 is tightened and will move the fingers 32 downwardly to engage fingers 43 on the ends of the wickered slips 41. These slips will be held in their retracted position so long as the nut is tightened to its seated position. Attention is directed to the fact that while the nut 18 is rotated as controlled by the mandrel 13, the tubular body 34 is stationary and produces advantages to be more clearly set forth hereinafter.

When the structure is assembled as directed above, the perforated liner 61 is attached to the lower end of the tubular body 34 by the coupling collar 60. The structure is then ready to be lowered into a bore of an oil well and to be set with relation to the casing 10 therein.

The construction thus far described, is substantially the same as that disclosed in Patent No. 2,337,733, which patent is fully identified above.

In addition to the foregoing, the construction provided by the present invention further includes a suitable sealing means X at the lower end of the packer cage 46, below the packing sleeve 53 and adapted to establish a fluid tight seal between the cage and the body and thereby prevent the flow of fluid upwardly between the cage and the body, past the packing sleeve after the said packing sleeve has been actuated.

In the particular case illustrated, the sealing means X is shown as including a downwardly opening socket 70 entering the lower end of the enlarged collar 48 at the lower end of the cage, and through which the body 34 extends, an annular body of deformable sealing material 71 engaged in and seated on the bottom of the socket 70 and slidably receiving the body 34, and an annular follower nut 72 slidably engaged around the body and threaded into the socket 70 from the open bottom end thereof and adapted to be advanced into the socket and into engagement with the packing 71 to urge it into tight sealing engagement with the body.

In operation of the present invention, and when the liner hanger is assembled and set in the manner illustrated in FIGS. 1 and 4 of the drawings, it is ready to be run into the well bore 11. It is to be pointed out that in the event that the lower end of the packer cage 46 should strike an object or meet resistance while being lowered into the casing, it will in no way effect the tool and the tool will remain in its set assembled position, since the packer 46 is directly connected to the slip barrel through the threaded connection 35 and the slip barrel, in turn, is held against longitudinal movement by means of the sleeve which is held by the hanger nut 18. It will be therefore seen that no amount of end thrust on the lower end of the cage 46 will ever deform the packer sleeve 53.

When the structure is lowered into the well it will be understood that the liner 61 is in place on the lower end of the liner hanger body 34. Due to the length of the stem 13 it is possible for the hanger to have considerable longitudinal movement on the stem so that the hanger and the liner may be manipulated sufficiently to facilitate the handling of the table slips and other means used at the surface of the well. When the liner has reached the desired point in the well, rotation of the drill pipe 14 to the right will impart similar rotation to the stem 13 and will result in positive rotation of the hanger nut 18. The nut will then advance longitudinally upwardly. This move-

5

ment will correspondingly move the sleeve 27 upwardly due to the abutting engagement of the shoulders 30 and 31. As previously explained, the sleeve 27 carries the fingers 32. The fingers 32 will move upwardly and away from their abutting engagement with the fingers 43 carried at the upper ends of the wickered slips 41. This will permit the springs 42 at the heel of the slips to force the slips upwardly and outwardly into engagement with the inner face of the casing 10 engaged in the well bore 11. At this time, the sleeve 27 is held against rotation, due to the fact that the fingers 32 on the sleeve extend into the longitudinal grooves 33 formed in the outer face of the slip barrel 37. When relative rotation takes place between the nut 18 and the sleeve 27, the anti-friction bearing 26 serves to reduce frictional resistance. When the slips 41 engage the wall of the casing with sufficient force to hold the hanger in position and the nut 18 is further rotated and shifted out of engagement from the body 34, the weight of the liner is transmitted directly onto the actuating ring 55 through the body. Thus this weight will be imposed by the ring 55 and its lugs 57 upon the packer sleeve 53 to deform the same and to face it outwardly and into sealing engagement with the wall of the casing, as clearly illustrated in FIGS. 2 and 3 and 8 of the drawings. Thus, the hanger with the liner suspended therefrom will be set and sealed in position within the casing. When the construction is actuated or set in the manner described above, and the body 34 shifts downwardly through the packer cage 47, it will be apparent that the sealing means X at the lower end of the cage in no way interrupts the operation of the device and suitably packs off and seals between the cage and the body after the construction is set.

In practice, the liner is of sufficient size and mass and the threads 20 on the nut 18 are of such pitch that when the tool is run into the well and rotation of the drill pipe 14 is rotated to actuate the tool, the insertion of the liner is sufficient to prevent the liner from rotating with the drill string and to assure operation of the tool. If the liner is not of sufficient size and mass to assure the desired operation of the tool, a suitable formation engaging spring cage or other suitable device can be applied to the liner to frictionally engage the well bore or casing to hold the liner against rotation.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

Having described my invention, I claim:

1. A structure of the character referred to including, an elongate casing in a well bore, a liner hanger in said casing including, an elongate cylindrical body having upper and lower ends and a central flow passage, a tubular liner fixed to and depending from the lower end of the body, an elongate slip barrel having upper and lower ends slidably engaged about the exterior of the body and having a plurality of circumferentially spaced casing engaging slips about its exterior, said slips being shiftable upwardly and radially outwardly from an unactuated position where they are clear of the casing to an actuated position where they engage the casing, a setting tool to releasably hold the body up in an unactuated position in the barrel and to releasably hold the slips in their unactuated position including, an elongate mandrel fixed to and depending from a run-in string extending into said casing, a nut in driving engagement on the mandrel and threadedly engaged in the upper end of the body, a sleeve rotatably carried by the nut and engaging the upper end of the barrel and slip engaging fingers carried by the sleeve and releasably holding the slips down in their unactuated position, said tool being operable to rotate the nut out of engagement with the body and to shift the sleeve and the fingers out of engagement with the barrel

6

and the slips, whereby the slips are actuated to engage the casing and the body is free to shift downwardly relative to the barrel, an elongate tubular packer cage having an upper portion fixed to the lower end of the barrel, a central portion having a plurality of circumferentially spaced slot openings defining a plurality of circumferentially spaced longitudinal wall portions and an enlarged lower portion defining an upwardly disposed shoulder, said cage having a straight cylindrical bore slidably receiving the portion of the body depending from the barrel, said wall portion of the cage being arcuate in cross-section and establishing sliding bearing support about adjacent portions of the body, an elongate deformable packing sleeve having upper and lower ends slidably engaged about the exterior of the central portion of the cage and having rib-like portions projecting into the openings in the cage to engage the body, said packing sleeve being of less longitudinal extent than the central portion of the cage and positioned with its lower end in bearing engagement on the shoulder, an annular actuating ring having a plurality of radially inwardly projecting lugs slidably engaged about the central portion of the cage to occur adjacent the upper end of the packer sleeve and with the lugs projecting through the openings in the cage and fixed to the body, said actuating ring being the same in cross-sectional configuration as the packer sleeve whereby, upon downward shifting of the body and the ring, the weight of the liner and body is exerted on the packer sleeve to compress it between the actuating ring and the shoulder on the cage and distend it radially inwardly and outwardly into sealing engagement with the wall portions of the cage, the portions of the body between the wall portions of the cage and the casing, said actuating ring slidably engaging and holding said wall portions of the cage in sliding bearing engagement on the body, and sealing means carried by the lower portion of the cage below the slots in the cage and sealing with the body, said sealing means including a downwardly opening socket in the lower end of the cage, an annular packing ring in the socket engaging the body and a follower nut threadedly engaged in the socket to engage and retain the packing ring.

2. A packer assembly, comprising an elongate vertically disposed tubular body having a central flow passage and a straight cylindrical exterior, an elongate tubular packer cage having upper and lower ends engaged about the body and adapted to engage a supporting member at its upper end, said cage having a straight cylindrical bore establishing sliding bearing engagement with the exterior of the body throughout the longitudinal extent of the cage, the lower end of the cage being formed with a shoulder in a plane transverse of the longitudinal axis of the cage and extending outwardly therefrom, the wall of the cage being formed with a plurality of longitudinally extending and circumferentially arranged slotted openings intermediate the upper and lower ends and defining a plurality of longitudinally extending circumferentially arranged wall portions, each being segmental in cross-section and establishing sliding bearing support about a portion of the body throughout its longitudinal extent, an elongate vertically disposed tubular deformable packer sleeve engaged about and carried by the cage and being of a thickness normally represented by the outside diameter of the shoulder on the cage and the outside diameter of the cage, said packer sleeve having a plurality of longitudinally extending circumferentially spaced, radially inwardly projecting ribs formed integrally therein and projecting into the slots in the wall of the cage and establishing bearing engagement on the outer surfaces of the body between the said wall portions of the cage, an actuating ring at the upper end of the cage having an outside diameter agreeing with the outside diameter of the packer sleeve in its normal position, an inside diameter agreeing with the outside diameter of the cage and carrying lugs which extend through the slots through the wall of the

cage and fixed to the body, whereby downward pressure upon the body and the ring will act against the upper end of the sleeve to deform the same and distend it radially into sealing engagement with the shoulder, the wall portions of the cage, the portions of the body between the wall portions of the cage and a circumscribing well structure, said ring slidably engaging and supporting the longitudinal wall portions of the cage and holding said wall portions in sliding engagement on the body, and a sealing means carried by the lower end of the cage below the slots in the cage to engage and seal with the body.

3. A packer assembly comprising an elongate vertically disposed tubular body having a central flow passage and a straight cylindrical exterior, an elongate tubular packer cage having upper and lower ends engaged about the body and adapted to engage a supporting member at its upper end, said cage having a straight cylindrical bore establishing sliding bearing engagement with the exterior of the body throughout the longitudinal extent of the cage, the lower end of the cage being formed with a shoulder in a plane transverse of the longitudinal axis of the cage and extending outwardly therefrom, the wall of the cage being formed with a plurality of longitudinally extending and circumferentially arranged slotted openings intermediate the upper and lower ends and defining a plurality of longitudinally extending circumferentially arranged wall portions, each being segmental in cross-section and establishing sliding bearing support about a portion of the body throughout its longitudinal extent, an elongate vertically disposed tubular deformable packer sleeve engaged about and carried by the cage and being of a thickness normally represented by the outside diameter of the shoulder on the cage and the outside diameter of the cage, said packer sleeve having a plurality of longitudinally extending circumferentially spaced, radially inwardly projecting ribs formed integrally therein and projecting into the slots in the wall of the cage and establishing bearing engagement on the outer surfaces of the body between the said wall portions of the cage, an actuating ring at the upper end of the cage having an outside diameter agreeing with the outside diameter of the packer sleeve in its normal position, an inside diameter agreeing with the outside diameter of the cage and carrying lugs which extend through the slots through the wall of the cage and fixed to the body, whereby downward pressure upon the body and the ring will act against the upper end of the sleeve to deform the same and distend it radially into sealing engagement with the shoulder, the wall portions of the cage, the portions of the body between the wall portions of the cage and a circumscribing well structure, said ring slidably engaging and supporting the longitudinal wall portions of the cage and holding said wall portions in sliding engagement on the body, and a sealing means carried by the lower end of the cage below the slots in the cage to engage and seal with the body, said sealing means including a downwardly opening socket in the lower end of the cage, an annular packing ring in the socket engaging the body and a follower nut threadedly engaged in the socket to engage and retain the packing ring.

4. A structure of the character referred to including, an elongate casing in a well bore, a liner hanger in said casing including, an elongate cylindrical body having upper and lower ends and a central flow passage, a tubular liner fixed to and depending from the lower end of the body, an elongate slip barrel having upper and lower ends slidably engaged about the exterior of the body and having a plurality of circumferentially spaced casing engaging slips about its exterior, said slips being upwardly and radially outwardly slidable from an unactuated position where they are clear of the casing to an actuated position where they engage the casing, a setting tool to releasably hold the body up in an unactuated position in the barrel and to releasably hold the slips in their unactuated position including, an elongate mandrel fixed to and depend-

ing from a run-in string extending into said casing, a nut in driving engagement on the mandrel and threadedly engaged in the upper end of the body, a sleeve rotatably carried by the nut and engaging the upper end of the barrel and slip-engaging fingers carried by the sleeve and releasably holding the slips down in their unactuated position, said tool being operable to rotate the nut out of engagement with the body and to shift the sleeve and the fingers out of engagement with the barrel and the slips, whereby the slips are actuated to engage the casing and the body is free to shift downwardly relative to the barrel, an elongate tubular packer cage having an upper portion fixed to the lower end of the barrel, a central portion having a plurality of circumferentially spaced slot openings defining a plurality of circumferentially spaced longitudinal wall portions and an enlarged lower portion defining an upwardly disposed shoulder, said cage having a central bore slidably receiving the portion of the body depending from the barrel, an elongate dependable packing sleeve having upper and lower ends slidably engaged about the exterior of the central portion of the cage and having rib-like portions projecting into the openings in the cage, said packing sleeve being of less longitudinal extent than the central portion of the cage and positioned with its lower end in bearing engagement on the shoulder, an annular actuating ring having a plurality of radially inwardly projecting lugs slidably engaged about the central portion of the cage to occur adjacent the upper end of the packer sleeve and with the lugs projecting through the openings in the cage and fixed to the body, said actuating ring being the same in cross-sectional configuration as the packer sleeve whereby, upon downward shifting of the body and the ring, the weight of the liner and body is exerted on the packer sleeve to compress it between the actuating ring and the shoulder on the cage and distend it radially inwardly and outwardly into sealing engagement with the wall portions of the cage, the portions of the body between the wall portions of the cage and the casing, and an annular seal in the lower portion of the cage and sealing between the body and the cage below the packer sleeve and the central portion of the cage.

5. A structure of the character referred to including, an elongate casing in a well bore, a liner hanger in said casing including, an elongate cylindrical body having upper and lower ends and a central flow passage, a tubular liner fixed to and depending from the lower end of the body, an elongate slip barrel having upper and lower ends slidably engaged about the exterior of the body and having a plurality of circumferentially spaced casing engaging slips about its exterior, said slips being upwardly and radially outwardly slidable from an unactuated position where they are clear of the casing to an actuated position where they engage the casing, a setting tool to releasably hold the body up in an unactuated position in the barrel and to releasably hold the slips in their unactuated position including, an elongate mandrel fixed to and depending from a run-in string extending into said casing, a nut in driving engagement on the mandrel and threadedly engaged in the upper end of the body, a sleeve rotatably carried by the nut and engaging the upper end of the barrel and slip-engaging fingers carried by the sleeve and releasably holding the slips down in their unactuated position, said tool being operable to rotate the nut out of engagement with the body and to shift the sleeve and the fingers out of engagement with the barrel and the slips, whereby the slips are actuated to engage the casing and the body is free to shift downwardly relative to the barrel, an elongate tubular packer cage having an upper portion fixed to the lower end of the barrel, a central portion having a plurality of circumferentially spaced slot openings defining a plurality of circumferentially spaced longitudinal wall portions and an enlarged lower portion defining an upwardly disposed shoulder, said cage having a central bore slidably receiving the portion of the body depending from the

9

barrel, an elongate dependable packing sleeve having upper and lower ends slidably engaged about the exterior of the central portion of the cage and having rib-like portions projecting into the openings in the cage, said packing sleeve being of less longitudinal extent than the 5 central portion of the cage and positioned with its lower end in bearing engagement on the shoulder, an annular actuating ring having a plurality of radially inwardly projecting lugs slidably engaged about the central portion of the cage to occur adjacent the upper end of the pack- 10 er sleeve and with the lugs projecting through the openings in the cage and fixed to the body, said actuating ring being the same in cross-sectional configuration as the packer sleeve whereby, upon downward shifting of the body and the ring, the weight of the liner and body is exerted on the packer sleeve to compress it between the actuating ring and the shoulder on the cage and distend

10

it radially inwardly and outwardly into sealing engagement with the wall portions of the cage, the portions of the body between the wall portions of the cage and the casing, and sealing means carried by the lower portion of the cage below the slots in the cage and sealing with 5 the body, said sealing means including a downwardly opening socket in the lower end of the cage, an annular packing ring in the socket engaging the body and a follower unit threadedly engaged in the socket to engage 10 and retain the packing ring.

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