Sept. 20, 1960 F. N. B. YOUNG 2,953,406

CASING SPEAR

Filed Nov. 24, 1958

Fig. 1

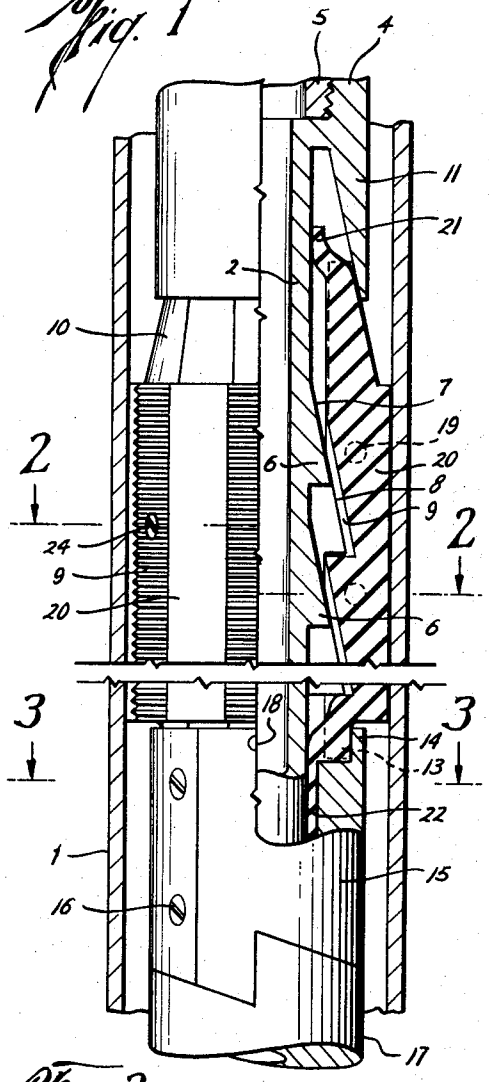


Fig. 2

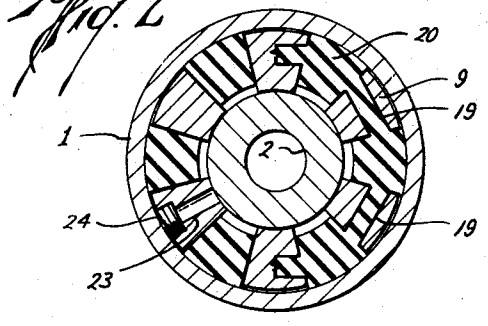


Fig. 3

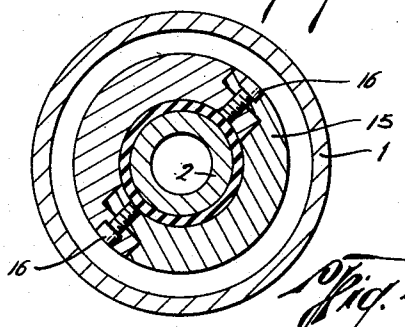
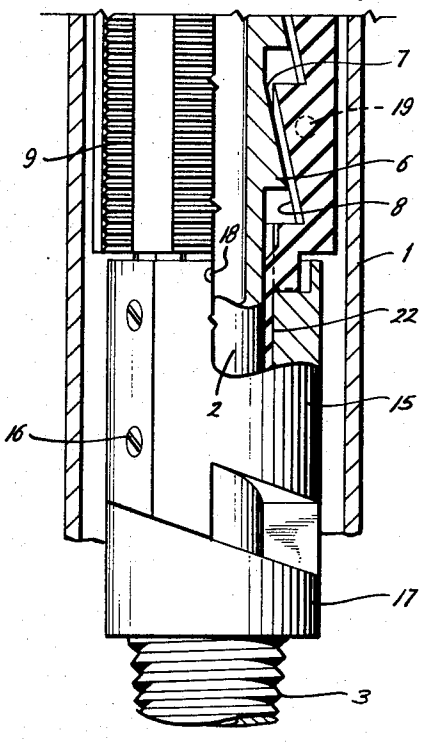


Fig. 4



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CASING SPEAR

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10 Claims. (Cl. 294—86)

This invention relates to an improved casing spear assembly adapted to be lowered on a drill string into a well hole and to be actuated into clutching or gripping engagement with a well casing section or fish, whereby the latter can be suspended by the drill string for a position adjustment in or removal from a well bore.

A primary object of the invention is to protectively enclose and seal the mating slide bearing surfaces on clutching slips and their co-operating expander portions against loss of lubricant and exposure to abrasive dirt and gummy substances in which the spear assembly may be submerged during use, whereby tool life is greatly prolonged by the preservation of lubricated and clean bearing surfaces and by their freedom from sticky sludge accumulation and from galling and accelerated wear.

A further object of the invention is to provide a rubberlike elastic deformable sleeve having slips embedded therein for slide bearing engagement on their interior surfaces with peripheral expander surfaces on a carrier or mandrel with which opposite ends of the elastic sleeve have sealing relation in all relative positions of parts so that the mandrel embracing sleeve protectively encloses such mating bearing surfaces and accommodates their relative movement through sleeve deformation.

Other objects and advantages will become apparent during the course of the following specification and in reference to the accompanying drawing in which Fig. 1 is a view partly in elevation and partly in vertical section illustrating a spear assembly with its slips expanded into engagement with a casing wall; Figs. 2 and 3 are transverse sections on lines 2—2 and 3—3, respectively, of Fig. 1; and Fig. 4 is a part elevation and part vertical section of a fragment of a spear assembly with the slips in contracted relation.

In the drawing there is shown a fragment of a tubular well casing 1 which is to receive a spear assembly for movement therewith when the slips are expanded. The spear assembly includes a hollow carrier or mandrel 2 having a threaded coupling pin 3 at its lower end and on which there usually will be mounted a suitable guide nose. At its upper end the mandrel 2 is formed with an internally threaded box 4 for coupling connection with the lower end of a hollow drill string 5 to be suspended by the usual well working equipment for vertical movement in the well bore and also for rotational movement in controlling radial positioning of the slips.

Intermediates its length the mandrel 2 carries slip expander means consisting of three or four axially spaced apart annular ribs 6—6, each having an upwardly inclined or tapered peripheral wedging face 7. Axially slidably seated on the tapered expander surfaces 7 are mating tapered bearing surfaces 8 formed on the inner sides of each of a series of circularly spaced slips or clutching elements 9 whose outer faces are for frictional engagement with the interior of the well casing 1. These outer faces preferably are serrated or provided with force concentrating buttons for insuring a more secure face to face engagement with the casing when the slips are expanded or wedged outwardly by reason of the relative sliding of their bearing surfaces 8 on the expander surfaces 7 of the mandrel when movement of the latter is upward in relation to the slips.

At their upper ends the several slips 9 each terminate in an upwardly and inwardly inclined or tapered tip portion 10 having axial slide bearing with a corresponding upwardly tapered inner surface of a surrounding skirt 11 carried by the mandrel. The tapered bearing surfaces on the skirt 11 and tip portion 10 have the same inclination as the tapered expander surfaces 7 and co-operate with the latter in controlling the radial position of the slips in response to relative axial movement of the mandrel.

At their lower ends, each expansible slip 9 has an inwardly shouldered or dependent lip 13 which fits within an upstanding annular wall 14 at the internally rabbeted upper end of a cam follower collar 15 surrounding the mandrel below the expander ribs 6. These vertically overlapping wall portions 13 and 14 are tied together by radial pins 18 which are fixed to the wall 14 and project slidably through openings in the dependent wall or lip 13 of each radially displaceable slip. For convenience of assembly, the collar 15 is formed in two halves having vertically overlapping edge lugs secured together as by means of studs 16, as seen in Fig. 3. At its bottom edge the collar 15 terminates in each circular half in a helical cam and has rotary slide contact with similar camming surfaces on the upper edge of an enlarged head 17 at the bottom of the mandrel 2. The lead and direction of the helical cam surfaces is such that if the collar 15 is held against rotation, then rotation of the drill string 5 in a clockwise direction results in a relative axial movement between the slips 9 and the mandrel 2 such that the several slips pinned to the collar 15 will slide outwardly on the expander portions 6 of the mandrel.

According to the present improvement, the several circularly spaced apart metal slips 9 are embedded in and form a part of an annular sleeve which embraces or surrounds the mandrel portion in its intermediate region containing the tapered rib 6, and the opposite ends of the sleeve are in slide bearing sealing relation with the mandrel periphery above and below the wedging ribs 6. This sleeve consists primarily of a molded elastic deformable or rubberlike material 20. In its intermediate body portion it fills the spaces between and is bonded to the several slips 9 and preferably also extends through one or more tangential openings 19 in each slip, and, as best seen in Fig. 2, the annular sleeve is thus made up of alternate segments comprising the metal slips 9 and the rubber material 20 between the slips. The radial wall dimension of the rubber material 20 is such that its segment inner faces normally are outward from the inner tapered faces 8 of the slips which engage the expander surfaces 7. The peripheral faces of the rubber sleeve segments, if desired, may extend slightly father beyond the casing engageable faces of the slip segments 9 and this can be relied on for a frictional drag relation with the casing before the slips are expanded. Usually a frictional drag relationship between the casing and the slips will be better afforded by outwardly bowed centralizer springs fitted to the cam follower 15 in the conventional manner for resisting collar rotation during its motion transmitting action to set the slips upon mandrel rotation.

Beyond the upper and lower ends of the expansible slips 9, the rubber sleeve projects in annular ring form and provides top and bottom collars 21 and 22, both of internal diameters initially smaller than the outside diameters of adjacent portions of the mandrel 2, with which they abut in final assembly. The elastic end collars 21 and 22 will, therefore, tightly hug the mandrel surfaces with a sliding fit, and the resulting sealing relation protectively encloses the bearing surfaces interiorly of the sleeve so as to exclude dirt and liquids in which the spear may be submerged. In addition, the sliding

end seals 21 and 22 resist and minimize escape from within the sleeve of bearing surface lubricant introduced periodically into the enclosed clearance space between the sleeve and the mandrel embraced thereby.

Conveniently, lubricant can be supplied through a radial port, as shown at 23, extending from the outside to the inside face of one of the slips 9 and having its outer end closed by a plug 24.

The lower sealing collar 22 as shown in the drawing extends as an interior lining within the collar 15 and preferably is under slight radial pressure, so that the collar serves as a backing for the elastic sealing collar and insures a wiping seal contact with the mandrel. A similar wiping seal contact exists between the mandrel and the expansively fitted and stressed upper sealing ring 21 by reason of the elastic resiliency of the sleeve material and the seal is maintained in all relative radial positions of the parts as accommodated by sleeve deformation. If desired, the upper seal 21 may have associated with it a metal stiffening ring, to be applied around its periphery in assembly of the tool.

In the assembly of the parts, the premolded elastic sleeve with the slips 9 secured therein will be telescoped on a tapered expanding fixture which can be brought into alignment with the box end 4 of the mandrel, whereupon the expanded sleeve can be slipped axially over and past the mandrel end for contraction about the mandrel portion containing the expanders 6—6. After the sleeve has been shifted upwardly into underlapping relation with the inwardly tapered skirt 11, the split collar 15 can be applied around the bottom seal ring 22. Then the pins 18 can be inserted radially through the upper end 14 of the collar and the lower end 13 of each slip 9 and the ends of the pins riveted or otherwise secured to the collar portion 14.

Upon lubricant being supplied to the sealed space, the tool is ready for use and in such use the enclosed tapered bearing surfaces will be properly greased and maintained clean and free from exposure to deleterious substances so that they will function effectively for long periods of time without attention. Deformation of the resilient sleeve accommodates slip expansion and contraction without disturbing the opposite end seals and the elasticity of the rubberlike material tends to contract the slips when outward wedging force thereon is relieved by counterclockwise rotation of the mandrel for a resulting relative axial movement between the expanders 7 and the slips as mandrel rotation is converted to relative axial movement by co-action of the helical camming surfaces on the collar 15 and the mandrel head 17.

While only one specific embodiment of the invention has been disclosed, it is to be understood that such modifications may be made as come within the scope of the appended claims.

What is claimed is:

1. A casing spear including a mandrel having an axially tapered peripheral portion, an elastic rubber sleeve surrounding the tapered mandrel portion and having sealing engagement with the mandrel at opposite ends of said tapered peripheral portion and a series of casing slips embedded within the rubber sleeve and axially slidably engaged with the tapered mandrel portion for radial slip movement with relative axial movement between the slips and the mandrel.

2. A casing spear including a mandrel having an axially tapered peripheral portion and a sleeve surrounding said tapered portion and comprising a series of circularly spaced apart expansible slips having peripheral casing engageable surfaces and inwardly disposed surfaces slidably bearing on the mandrel peripheral portion, together with elastic deformable material filling the spaces between and being joined to said slips and extending beyond opposite ends thereof as annular collars, each in sealing relation with the mandrel at opposite ends of said tapered peripheral portion.

3. A casing spear including a mandrel having an axially tapered peripheral portion and a sleeve surrounding said tapered mandrel portion and comprising a series of circularly spaced apart expansible slips having peripheral casing engageable surfaces and inwardly disposed surfaces slidably bearing on the mandrel peripheral portion, together with elastic deformable material filling the spaces between and being joined to said slips and extending beyond opposite ends thereof as annular collars, each in sealing relation with the mandrel at opposite ends of said tapered peripheral portion, one of said slips having a port therethrough for the introduction of lubricant to the inwardly disposed slip surfaces.

4. In a casing spear, a mandrel having a slip expander wedging portion in one region thereof, a sleeve surrounding and enclosing the mandrel throughout the region of said wedging portion and including a casing engageable slip segment movably bearing on said wedging portion and an elastic rubberlike segment and annular collar means projected from said sleeve beyond the ends of its segments and sealingly engaged with the mandrel.

5. In a casing spear, a mandrel having a slip expander wedging portion, a casing engageable slip interiorly bearing on said wedging portion and a protective shield enclosing the bearing surfaces on the slip and the wedging portion and having sealing relation with the mandrel.

6. In a casing spear, a mandrel having an annular and axially tapered expander portion and a helical cam portion spaced axially from the expander portion, an elastic sleeve of rubberlike material surrounding the expander portion and having sealing engagement at opposite ends with the mandrel, a series of casing engageable slips embedded within the sleeve and slidably bearing on said expander portion, a mandrel carried cam follower having a surface engaged with said helical cam portion for axial travel upon mandrel rotation and a motion transmitting connection joining said cam follower with the slips.

7. In a casing spear assembly, a mandrel having a slip expander portion, a casing engageable slip slidably bearing on the expander portion, co-operating cam means on the mandrel and the slip responsive to mandrel rotation for sliding the slip on the expander portion and sealing means protectively enclosing the bearing surfaces of the slip and expander portion and comprising a rubber sleeve surrounding said expander portion and sealingly embracing said slip and the mandrel on both sides of the expander portion.

8. In a casing spear assembly, a mandrel having a slip expander portion, a casing engageable slip slidably bearing on the expander portion, and a sleeve of elastic rubber-like material surrounding and enclosing said mandrel and being joined to said slip, terminal collar portions integral with the sleeve and embracing said mandrel beyond both ends of said expander portion and in sealing relation therewith, the elasticity of said sleeve accommodating relative movement of the slip and the expander portion.

9. In a casing spear assembly, a mandrel having a slip engageable surface, an elastic sleeve surrounding the slip engageable surface of the mandrel and having sealing relation with said mandrel at opposite ends of said surface, a casing slip embedded in said sleeve and provided with an interior surface engageable with said surface of the mandrel, at least one of said surfaces being inclined for outward wedgement of the slip upon relative axial movement of the slip and the mandrel.

10. In a casing spear assembly, a mandrel and a slip having slide bearing interengageable surfaces to effect slip radial movement in response to relative axial movement of the mandrel and slip and means protectively housing said surfaces and comprising a tubular member of elastic deformable material having the slip embedded therein and being concentrically sleeved on the mandrel and in sealed embracement therewith.

No references cited.