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2,249,171

BRIDGING PLUG PACKING SLEEVE

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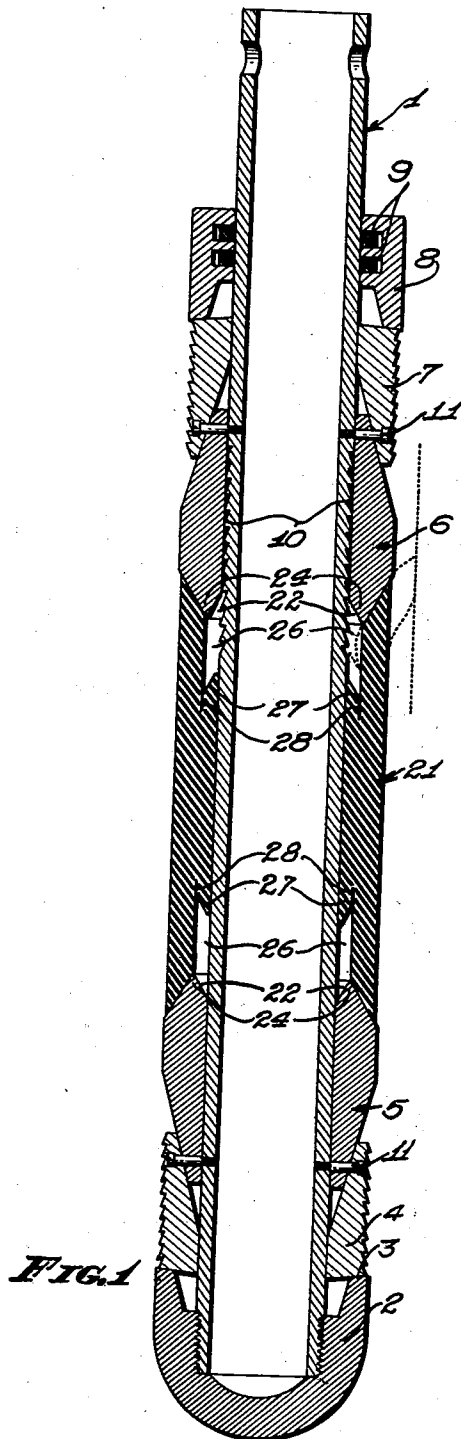


FIG. 1

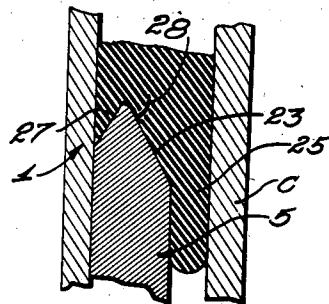


FIG. 3

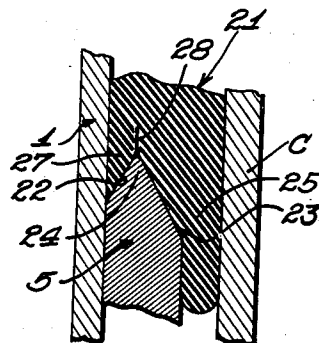


FIG. 2

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BRIDGING PLUG PACKING SLEEVE

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5 Claims. (Cl. 166—13)

My invention relates to bridging plug packing sleeves, and among the objects of my invention are:

First, to provide a packing sleeve which, with a minimum of effort, may be caused to pack off between a surrounding casing and a central mandrel in order to effect a fluid-tight seal therebetween capable of withstanding enormous hydrostatic pressure differentials between the zones isolated by the packing sleeve;

Second, to provide a packing sleeve which is particularly designed for use with bridging plugs adapted to be lowered into a well bore on a wire line or electric cable and set by tools in which the force available to move the parts of the bridging plug into packed relation with the casing is inherently limited; and

Third, to provide a packing sleeve which is capable of effecting a seal between a bridging plug and surrounding casing even though the clearance between the plug and casing is relatively great, thereby facilitating design of the bridging plug, which provides a maximum circulation area.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is a longitudinal sectional view through a bridging plug incorporating my invention;

Figure 2 is an enlarged fragmentary detail showing one end of the packing sleeve and adjacent parts of the bridging plug and surrounding casing when the packing sleeve is in its packing or sealing position; and

Figure 3 is a similar view illustrating the manner in which the packing sleeve tends to seal when the movement of the parts of the plug is greater than the ideal conditions shown in Figure 2.

The bridging plug which incorporates my packing sleeve comprises a tubular mandrel 1 of uniform diameter, which is threaded at its lower end for connection to an end piece 2. The end piece or cap 2 extends upwardly along the outer side of the mandrel 1 and forms, at its upper end, a shoulder 3 which is adapted to engage a plurality of slips 4. The slips 4 are wedge-shaped in cross section with casing engaging teeth on their outer peripheries. The slips 4 ride upon a cone 5 which is slidably mounted on the mandrel 1. A second or upper cone 6 is also mounted on the mandrel and is engaged by slips 7 similar to the slips 4, the slips and their respective cones

moving in opposite directions to lock the bridging plug against movement in either direction.

Above the upper slips 7 there is fitted around the mandrel 1 a locking ring collar 8 having internal channels which receive locking rings 9 adapted to engage serrations 10 provided on the mandrel 1 when the parts of the packer are moved into their packing position. The upper end of the mandrel 1 is suitably arranged for attachment to a setting tool, not shown. The slips and cone are held together and to the mandrel 1 by shear pins 11 adapted to give way when the setting tool or other means is used to urge the bridging plug into engagement with a surrounding casing.

My present invention has particular reference to the confronting axial ends of the cones 5 and 6, and to a packing sleeve 21 disposed therebetween. The packing sleeve engaging-end of each cone is beveled outwardly from the mandrel 1 to form therewith an annular channel 22 of V-shaped cross section and is beveled inwardly from its outer side, as indicated by 23. The two beveled faces of the cones 5 or 6 thus define an axially directed ridge 24 spaced outwardly from the mandrel 1 a distance approximately one-third the thickness of the cone.

The packing sleeve 21 is provided with inwardly beveled ends 25 adapted to rest against and conform to the beveled portions 23. At the mid-portion of the sleeve 21 its bore conforms snugly to the mandrel 1, but at its end the bore of the packing sleeve is enlarged to a diameter approximately equal to the annular ridges 24, forming clearance spaces 26. The clearance spaces 26 terminate in pressure lips 27 directed toward, but normally spaced from, the channels 22. In addition to each pressure lip 27, the packing sleeve 21 is provided with an axially extending annular slit 28 continuing from the base of each pressure lip.

Operation of the packing sleeve is as follows: When the packer is set, the end portions 25 of the packing sleeve tend to move outwardly along the beveled portions 23 and expand radially into engagement with the surrounding casing, as indicated by dotted lines in Figure 1. During this movement the pressure lips 27 move toward their respective channels 22 and there is initially little or no distortion or spreading of the central portion of the packing sleeve. Continued axial compression forces the pressure lips 27 into the channels 22 and the packing sleeve distorts until practically its entire outer surface is in contact with the casing. When the packing sleeve is in

engagement with the casing the end portions 25 are wedged between the beveled portions 23 and the casing, as shown in Figure 2, and form major pressure lips, while the pressure lips 27 fit into the channels 22 and prevent movement of fluid between the mandrel and the packing sleeve. Actually, considerable distortion of the packing sleeve takes place, in which case the slits 28 at each end do not necessarily line up with the apex of the corresponding ridge 24, but may occupy a position such as shown in Figure 3. This, however, does not affect the function of the packing sleeve.

It should be borne in mind that the packing sleeve is capable of moving to approximately its full sealing position in response to a minimum of effort. Major distortion of the packing sleeve does not have to take place until the ends of the packing sleeve are in full contact and in sealing relation with both the mandrel and the surrounding casing, thus rendering the packing sleeve particularly suitable when used in conjunction with bridging plugs which are lowered on wire line or electric cables. The plugs designed for this purpose must necessarily set readily, but the amount of available force for moving the parts of the bridging plug into packing relation with the casing is limited; that is, the available force under such conditions is that of a spring or a piston and cylinder subjected to hydrostatic pressure, and in any case nowhere near the force available where the bridging plug is lowered on tubing or the like.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. In a bridging plug: an expander ring beveled from its inner and outer peripheries to form an axially directed ridge; a packing sleeve undercut from its inner and outer peripheries to form a channel for coaction with said expander ring, the inner peripheral portion of the sleeve being cut back whereby, when the outer peripheral portions of the expander ring and sleeve are in engagement, there is provided a free travel space between the inner peripheral portion of said expander ring and packing sleeve.

2. In a bridging plug: a packing sleeve, the bore thereof being enlarged at its extremities and forming shoulders spaced inwardly from the axial

ends of the packing sleeve, said shoulders being shaped to form pressure lips and other pressure lips formed at the extremities of said sleeve spaced axially from said first mentioned pressure lips, and means including a mandrel for receiving said sleeve and an expander ring engageable with said sleeve to urge said second mentioned pressure lips against a surrounding casing and retain the first mentioned pressure lips in sealing relation with said mandrel.

3. In a bridging plug: a mandrel; an expander ring mounted thereon, said expander ring beveled on its inner and outer peripheries to form an axially directed ridge which defines with said mandrel an annular channel; a packing sleeve having pressure-responsive lips adapted to engage and be directed by said outer beveled portion against a surrounding casing and initially engaging said portion; and a minor pressure lip at the inner periphery of said sleeve engageable with said mandrel and initially spaced from said channel, and adapted upon compression of said sleeve to move into said channel to seal against fluid transfer along said mandrel.

4. In a bridging plug: a mandrel; a pair of expander rings; a packing sleeve fitted on said mandrel between said expander rings adapted to be urged by axial compression of said expander rings into engagement with a surrounding casing, said expander rings defining channels adjacent the mandrel and pressure lips formed in the inner periphery of said packing sleeve initially spaced from said expander rings a distance approximately equal to the calculated axial movement of said expander rings, to accomplish packing of said sleeve against a surrounding casing.

5. In a bridging plug: a mandrel; a pair of coating expander rings having beveled inner and outer peripheries, defining respectively with said mandrel and a surrounding casing V-shaped channels; a packing sleeve mounted between said expander rings on said mandrel and adapted to be urged by axial compression of said expander rings into said channels, the ends of said packing sleeve being recessed axially to provide an initial clearance between said packing sleeve and said channels defined partially by said mandrel, calculated to permit engagement of said sleeve with a surrounding casing before engagement with said mandrel-defined channels.

HARRY J. QUINTRELL.