June 27, 1933. N. W. WICKERSHAM ET AL 1,915,771

BRIDGING PLUG

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Fig. 1

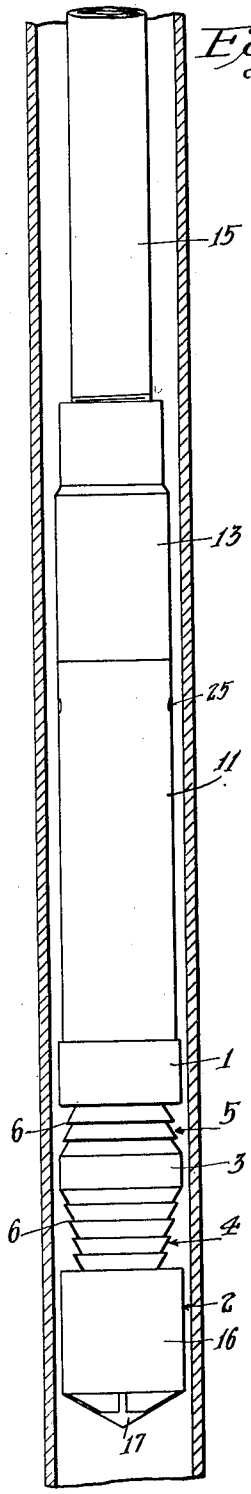


Fig. 2

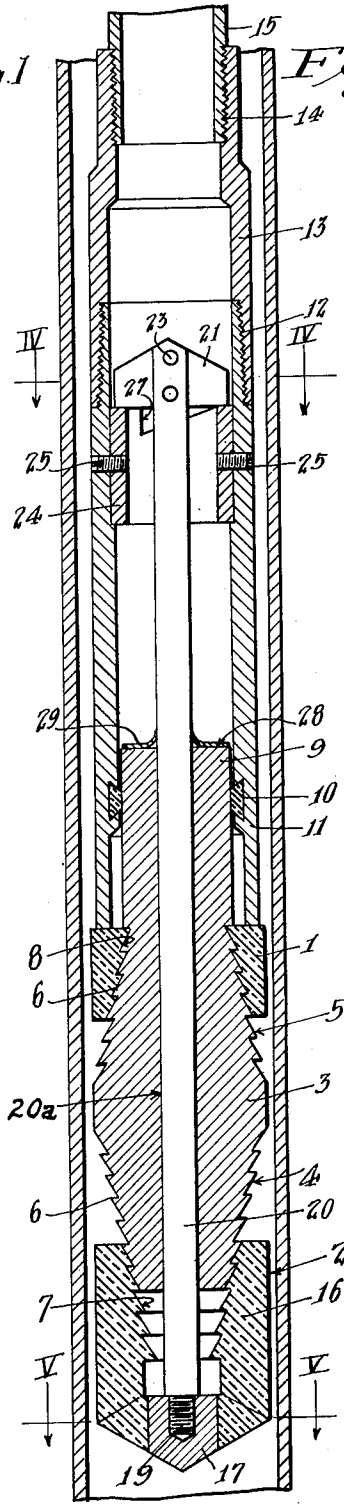


Fig. 3

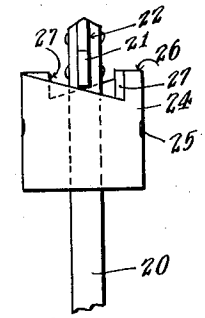


Fig. 4

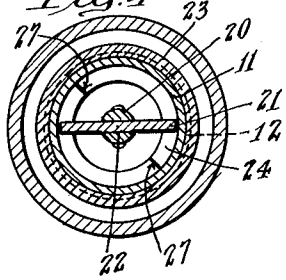
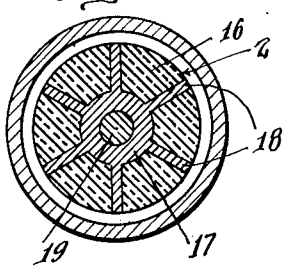


Fig. 5



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Fig. 6

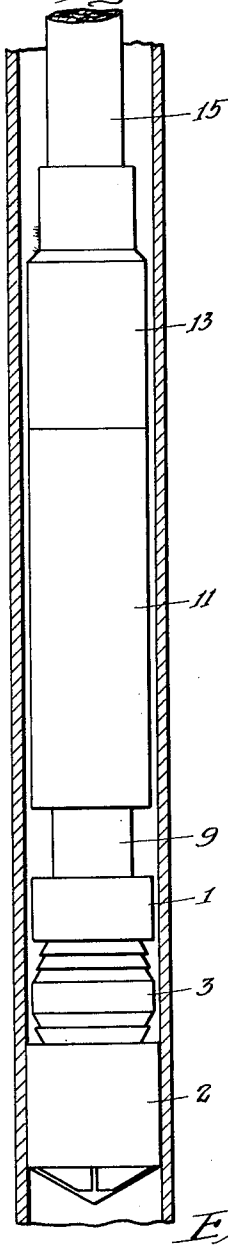


Fig. 7

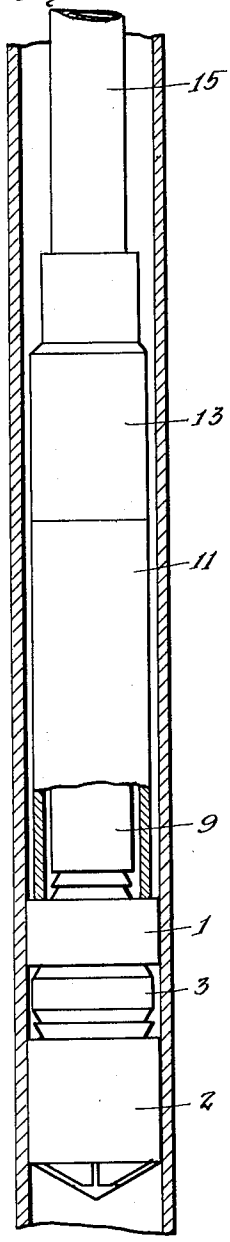


Fig. 8

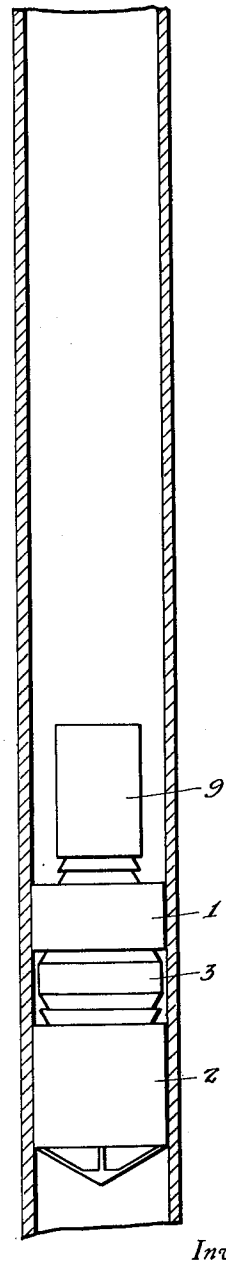
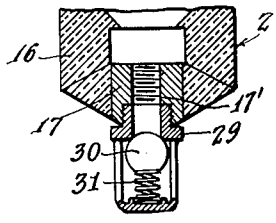


Fig. 9



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UNITED STATES PATENT OFFICE

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BRIDGING PLUG

Application filed March 28, 1932. Serial No. 601,562.

This invention relates to bridging plugs for wells, (particularly oil wells) such as are used to seal off a well casing in preparation for cementing operations, or for other purposes.

An object of the invention is to provide a reliable plug that can be quickly set that is simple and cheap to manufacture, and is positive in operation.

A full understanding of the invention can be most quickly conveyed by a detailed description of its construction and operation, together with the drawings, in which

Figure 1 is an elevational view of the device shown positioned within a casing before the packer is set;

Figure 2 is a sectional elevational view illustrating the construction of the packer;

Figure 3 is a detail elevational view of a portion of the device;

Figure 4 is a cross sectional view in the plane IV—IV of Figure 2;

Figure 5 is a cross sectional view in the plane V—V of Figure 2;

Figure 6 is an elevational view of the device with the lower packer set in the casing;

Figure 7 is an elevational view partly in section showing how the upper packer is set;

Figure 8 is an elevational view of the packer after it has been set in a casing and the tubing withdrawn; and

Figure 9 is a detail sectional view showing a modified form of the invention in which a valve is provided within the lower packing member.

Referring to Figures 1 and 2, our device comprises an upper packing member 1 and a lower packing member 2 of rubber or similar resilient material. These packers 1 and 2 are mounted upon and surround an expander 3 which can be made of various materials but is preferably constructed of aluminum or maple wood or any other material that is cheap, has reasonable strength in compression, and can be readily worked or machined. As shown clearly in the drawings, the expander 3 is provided with a lower conical face 4 on the lower part of which the packing member 2 is normally positioned, and an upper conical face 5 upon the upper part of which the upper packing member 1 is normally positioned. The faces 4 and 5 are serrated to provide edges 6 which engage with cooperating serrations 7 and 8 on the inner conical surfaces of the upper and lower packing members 1 and 2. These serrations serve to retain the packing members in position when they are forced up onto the expander 3, as will be described later.

At the top of expander 3 above the conical face 5 there is provided a cylindrical member 9 which extends some distance above the main body 3 as shown. The outer surface of member 9 is machined to a smooth surface so that it seals with a sealing ring 10 of rubber or similar material which is contained in a groove in a sleeve 11. Sleeve 11 surrounds the tubular extension 9 and extends for some distance thereabove where it is joined by screw threads shown at 12 to a coupling member 13 which in turn is connected by screw threads 14 to the lower end of a string of tubing 15. The string of tubing 15 extends upwardly to the top of the well and is used to lower the packer into the desired position in the casing. The bore of the lower portion of the sleeve 11 below the packing ring 10 is of larger diameter than the main portion of the sleeve, thus forming a skirt to engage the top of the upper packing member 1 as shown in the drawings.

The lower packing member 2 comprises a packing body 16 of rubber which is attached at its lower end to a hub 17 which is preferably constructed of metal and is provided with a plurality of radiating spoke or fin members 18. The rubber body 16 extends down about the hub 17 and between the fins 18 and is molded about the hub so that a firm bond is formed between the hub and the rubber. The hub is drilled and threaded at its center to receive the threaded end 19 of a shaft 20 which extends upwardly through an aperture 20*a* in the expander 3 to a point adjacent the top of sleeve 11. The upper end of shaft 20 is connected to a cross member 21 which is, in this instance, formed from a piece of sheet steel inserted in a cleft 22 in

the end of shaft 20 and held securely thereto by rivets 23.

To support shaft 20 and the lower packing member 2 a tubular member 24 is seated within the upper end of sleeve 11 and secured rigidly in position by set screws 25. The outer ends of the cross piece 21 rest on the upper edge 26 of the tubular member 24; thus the plunger 20 and the lower packing member 2 are supported through the tubular member 24 by the sleeve 11. The upper edge 26 of member 24 is cut to form a pair of shoulders 27 so that when the sleeve 11 is rotated to the left, by rotation of the tubing 15, the shoulders 27 engage the outer ends of the cross piece 21, thus turning the shaft 20 and unscrewing its lower threaded end 19 from the hub 17 of the lower packing member 2 to permit withdrawal of the shaft 20 with the tubing 15 and the sleeve 11 after the plug has been set.

The device is operated as follows: Assume that the device is in the condition shown in Figures 1 and 2 and has been lowered on the tubing 15 to the level where it is desired to pack off the casing. The device is then supported at this point by the tubing 15, and fluid is forced down through the tubing 15 from the surface under pressure. This fluid flows through the hollow connecting member 13 down through the tubular member 24 and into the space within the sleeve 11 above the upper face 28 of the cylindrical extension 9 on the expander 3.

The liquid is prevented from flowing down between the sleeve 11 and the cylindrical extension 9 by the packing ring 10, and as the shaft 20 fits snugly in the aperture 20*a*, little leakage can occur through this space. To further limit leakage about the shaft 20, a leather or rubber sealing member 29 may be provided to seal off the cylindrical extension 9 from the shaft 20. Since there is no escape for liquid from the space within sleeve 11, considerable pressure can be built up and this pressure exerts a downward force on the face 28 of member 9 which forces the entire expander 3 down into the lower packing member 2, thus expanding this member until it is compressed tightly between the expander and the well casing, as shown in Figure 6.

When the lower packing member has been set in the manner described, the tubing 15 is lowered, thus forcing sleeve 11 downward against the upper edge of the upper packing member 1 and forcing the packing member 1 down onto the expander 3 until it is also wedged firmly between the packer and the casing, as shown in Figure 7.

When both the lower and the upper packing members 1 and 2 have been set in the manner described, the tubing 15 is elevated, thus elevating the sleeve 11, until the ends of the cross piece 21 on shaft 20 are engaged with the upper edge 26 of tubular member 24. The tubing 15 is then rotated to the left. This causes the shoulders 27 of tubular member 24 to engage with the sides of the cross piece 21, thus rotating the latter together with the shaft 20 until the lower threaded end 19 is unscrewed from the hub 17 in the lower packing member 2. Thereafter the sleeve 11 and shaft 20 may be hoisted out of the well on the tubing 15, leaving only the upper and lower packing members 1 and 2 and the expander 3 in the well hole, as shown in Figure 8.

It will be observed that any pressure below the packer after it has been set in the casing as described will tend to force the lower packing member 2 up further on the expander 3, thus wedging it even more tightly in the casing. Likewise, any pressure exerted downwardly on the packer will tend to force the upper packing member 1 further down on the expander 3, thus wedging it even more firmly into the casing. As a result the packer is admirably designed to resist pressure either from above or below.

In some instances it may be desirable to force fluid such as cement past the packer from the top after the latter has been set. To permit this, the core 17 of the lower packing member 2 may be provided with an opening extending completely therethrough as shown in Figure 9. In Figure 9 the central threaded aperture adapted to engage with the threaded end 19 of the plunger 20 is extended clear through the core 17′ and is countersunk and threaded to receive a valve cage 29 which contains a ball valve 30 and a spring 31 for normally forcing the valve ball against the opening in the cage. Of course, if it is not necessary to provide means for preventing return flow of liquid upward through the packer, the valve cage 29 may be removed.

We claim:

1. In a well plug a downwardly and inwardly tapered expander member, an expansible packing member normally positioned around the lower portion of said expander, means for mechanically attaching said packing member to the lower end of a well tube to maintain it in a desired position in a well casing while it is being expanded, and means for applying fluid under pressure from the well tube to the upper face of said expander to force the expander downwardly into said packing member to expand the latter.

2. A device as described in claim 1 in which said means for mechanically attaching said packing member to the well tube is detachable from said packing member by rotation thereof.

3. In a well plug, an expansible packing member, a tapered expander movable downward within said packing member to expand it, said expander having a central vertical aperture therein and a cylindrical upper end portion, a sleeve surrounding and sealing

with said cylindrical upper end portion and attachable at its upper end to a string of tubing, a member extending through and slidably mounted in said aperture in said expander, said member being connected at its lower end to said packing member, and being supported at its upper end by said sleeve whereby said expander may be forced downward with respect to said packing member by fluid under pressure applied to the upper end of said expander through the well tubing and sleeve.

4. In a well plug, an expansible packing member, a tapered expander movable downward within said packing member to expand it, said expander having a central bore extending vertically therethrough and a cylindrical upper end portion, a sleeve surrounding and sealing with said cylindrical upper end portion and attachab'e at its upper end to a string of well tubing, a member extending through and slidably mounted in said bore, said member having its lower end threaded to engage with cooperating threads in said lower packing member, and having means at its upper end engageable with said tubular sleeve, whereby said expander may be forced downward with respect to said packing member by fluid under pressure applied to the upper end of said expander through the well tubing and tubular member and said slidably mounted member thereafter unscrewed from said packer by rotation of said sleeve and tubing and removed from the well with said sleeve and tubing.

5. In a well plug an expander member having a lower downwardly tapered expanding face, and an upwardly tapered expanding face thereabove, said expander having a cylindrical face above said upwardly tapered face, and having an opening extending vertically completely therethrough, upper and lower expansible packing members positioned around said upwardly and downwardly tapered faces respectively, a sleeve surrounding and sealing with said cylindrical portion and extending thereabove, a shoulder in said sleeve above said expander member extending inwardly therefrom, a link connected at its lower end to said lower packing member and extending up through said opening, means on the upper end of said link engageable with the upper edge of said inwardly projecting shoulder to limit downward motion of said lower packing member with respect to said sleeve, means for attaching said sleeve to a string of drill tubing and for forming a liquid connection therebetween whereby liquid forced under pressure through said tubing will be applied to the upper end of said expander to move the expander downward with respect to said lower packing member, said sleeve having an annular lower edge engageable with the top of said upper packing member for forcing said upper packing member downwardly about said expander after the latter has been set within the casing by expansion of said lower packing member.

6. Means as described in claim 5, further characterized in that the lower end of said link is attached to said lower packing member by a screw thread and that the upper edge of said inwardly projecting shoulder is provided with dogs whereby said link may be rotated by rotation of the sleeve to unscrew the link from the lower packing member.

7. In a well plug an expander member having an upwardly tapered expander face thereon, an expansible packing member positioned about the upper end of said tapered face, means for supporting said expander member from a string of tubing while permitting downward movement of said string with respect to said expander, a sleeve surrounding said expander and having a lower annular face dimensioned to contact with the upper end of said expansible packing means, means for securing said sleeve to said string of tubing, and means for anchoring said expander to a casing while suspending the assembly at a desired point within the casing from the string of tubing whereby further downward movement of said string of tubing and said sleeve forces said packing means down about said expander, said anchoring means comprising a member operable into locking engagement with the casing by fluid pressure transmitted through said drill string.

Signed at Los Angeles, California, this 19th day of March, 1932.

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