Aug. 5, 1952 W. K. VAN BRUNT ET AL 2,605,846

DEEP WELL BRIDGE

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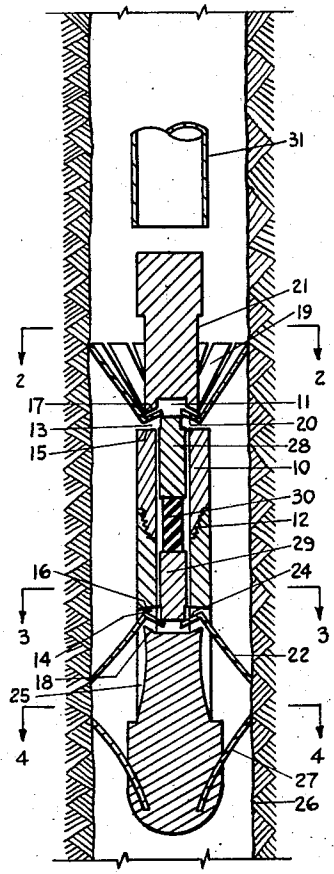


FIG. 1

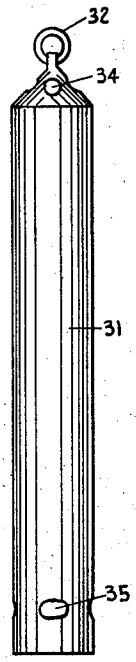


FIG. 6

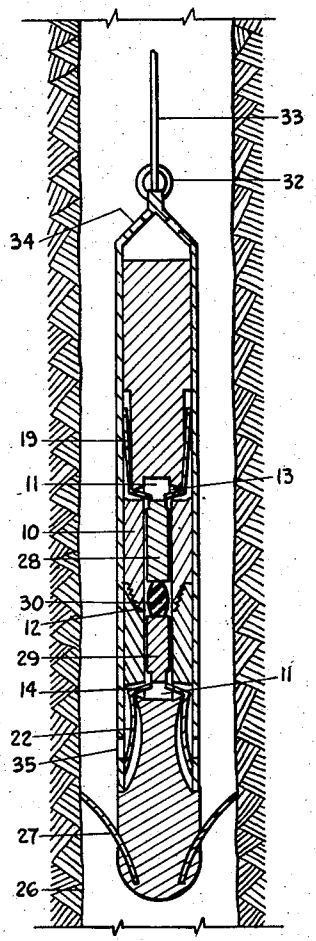


FIG. 5

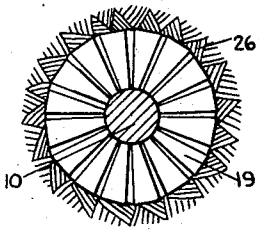


FIG. 2

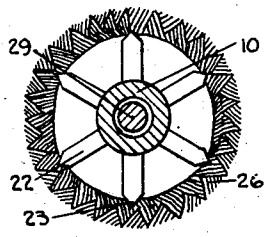


FIG. 3

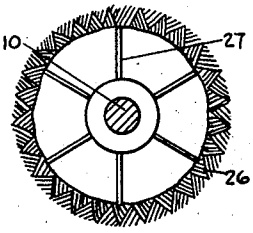


FIG. 4

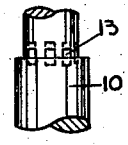


FIG. 7

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DEEP WELL BRIDGE

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6 Claims. (Cl. 166—13)

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This invention relates to apparatus for plugging the borehole of a well and pertains more particularly to a bridge adapted to be anchored in a borehole for supporting plugging or cementing materials which effectively close the borehole.

During the drilling of wells, it is necessary on occasion to close off the lower portion of a borehole. For example, when it is desired to produce from the higher of two producing formations, it is often advantageous to seal off the borehole at some point below the higher formation. Also, before casing is cemented in a well borehole, the producing formation is generally isolated by sealing or plugging the borehole below the casing shoe to prevent cement from coming in contact with the oil-bearing formation.

Various types of bridging plugs now used generally possess one or more undesirable characteristics. One type of bridging plug may be attached to and set by a pipe string, which necessitates the time-consuming operation of making up the pipe string. Other types of bridging plugs are fragile and are often damaged before being set in place; still others employ setting mechanisms which are released prematurely.

It is therefore the primary object of the present invention to provide a simple, effective bridging device which may be lowered to and firmly anchored at any desired depth in a well borehole for supporting any quantity of bridge forming material, such as rock, plastic, cement, etc.

Another object of the present invention is to provide a bridging device adapted to be automatically anchored within a well to provide a bridge that conforms to the cross section of the well at the point at which it is set.

A further object of this invention is to provide a bridging device having its bridging and anchoring elements protected from damage as it is lowered into a well borehole.

An additional object of this invention is to provide a bridging device which may be lowered through well casing or open hole and anchored in the open portion of a well borehole.

Another object of this invention is to provide a bridging device which is sufficiently sturdy to retain bridging materials, yet which is constructed of materials which may readily be drilled out of the borehole with a drill bit.

These and other objects of this invention will be understood from the following description of a preferred embodiment of the invention as shown in the accompanying drawing, wherein:

Figure 1 is a longitudinal view, in cross section, of the present bridging device in anchored position within the well borehole.

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Figures 2, 3 and 4 are cross-sectional views taken along the lines 2—2, 3—3 and 4—4 of Figure 1, respectively.

Figure 5 is a longitudinal view, in cross section, of the present device enclosed within its container and being lowered through a well borehole.

Figure 6 is a longitudinal view of a container employed with the present bridging device.

Figure 7 is a detail view of a portion of the body member of the present device showing the radial slots through the wall thereof.

Referring to Figure 1 of the drawing, the present bridging device comprises an elongated body member 10, said body being preferably cylindrical in shape and preferably made of a material which is relatively strong and at the same time readily grindable under the action of a drill bit. Such materials include aluminum alloys, hard rubber, Bakelite and other thermosetting plastics. Thermoplastics are not generally suitable due to high temperatures which may be encountered in deep wells.

The body member 10 has formed therein a bore 11. To facilitate the assembly of the present device the body member may be threaded as at 12. Extending radially through the wall of said body member 10 are two rows of spaces, slots or openings 13 and 14 (Figs. 1 and 7), said rows being displaced axially along said body with regard to each other, and each row extending completely around said body. One wall, 15 and 16 of slots 13 and 14, extends in a direction substantially normal to the axis of the body member 10 while the opposite walls 17 and 18 are beveled inwardly, as shown in Figure 1.

Swingingly mounted in the upper row of slots 13 are a plurality of semi-rigid fins or thin plate members 19 which surround the body member 10 to form an umbrella opening upwardly, as shown in Figures 1 and 2. One end of each fin 19 has an arm 20 fixedly secured thereto (as by welding) or formed thereon at substantially right angles. The arm 20 extends through the slot 13 and projects a short distance into the bore 11 of the body 10. The fins 19 are preferably made of a thin gauge aluminum alloy and are substantially triangular in shape forming, in their own or operative position, the segments of a circle around the body member 16 (Fig. 2). As shown, the fins are secured to the body 10 so that their broad dimension faces upwardly.

Above the slots 13, the body 10 may be provided with a recess 21 in its outer surface to accommodate the upwardly-extending fins 19 when they are in their retracted position, as shown in

Figure 5. The recess 21 is at least equal in length to that of the fins 19 and in depth to the thickness of the fins.

In a like manner the lower row of slots 14 in the body 10 is adapted to contain anchoring means, which may comprise a plurality of broad, flat, downwardly-extending knife elements 22 having their outer ends 23 pointed. The other end of each knife element is equipped with an arm 24 which extends through one of the slots 14 and projects a short distance into the bore 11, in a manner similar to arm 20, previously described. The arm 24 is formed or secured to the knife element at substantially a right angle.

The knives are preferably flat so as to fit, in their retracted position, in an annual recess 25 provided in the outer surface of the body member 10. In their operative position, Figure 1, the knives 22 thrust against the wall of the well borehole 26.

Fixedly mounted on the lower end of the body member 10, as by bolting, welding, etc., are a plurality of positioning spring wires 27. The wires are secured to the body 10 so that they extend upwardly and radially therefrom, being of sufficient length to contact the inner walls of the well borehole 26 (Figs. 1, 4 and 5). The angle at which the spring wires 27 are attached permits the wires, while being inserted into and through a well casing, to slide freely over any irregularities in the well casing, such as exist at a joint between two casing sections, and to slide freely over any irregularities in the open borehole 26. Upon movement of the body member 10 upwards, however, the free ends of the wires are adapted to engage any projection on the sidewalls of the well, whereupon the upward movement of the body 10 is arrested.

Slidably mounted within the bore 11 of the body member 10 are a pair of rigid metallic or plastic plugs 28 and 29 separated by an intermediate resilient plug 30 of rubber. One end of the plugs 28 and 29 bears against opposite ends of the rubber plug 30 while the other ends of plugs 28 and 29 bear against the arms 20 and 25, respectively, which project into the bore 11 of the body 10. The length of the rubber plug 30 employed is selected so that when the body member 10 is assembled, the expansive force of the resilient plug 30 is applied to each of the plugs 28 and 29, forcing them against the arms 20 and 24 whereby the fins 19 and knives 22 are forced outwardly away from the body member 10 and against the well wall or borehole 26. The diameter of the rubber plug 30 is preferaly smaller than that of the bore 11 and the other plugs 28 and 29 so that when the fins 19 and knives 22 are manually forced into their retracted or inoperative position the rubber plug can expand radially when compressed between the adjacent plugs 27 and 28 (Fig. 5).

After the fins 19 and knives 22 have been manually forced into their retracted position, the portion of the body member 10 above the positioning wires 27 is inserted in the open bottom of a hollow, cylindrical container 31 (Fig. 6) whose inner wall frictionally engages the outer surface of the body member 10. The top of the container 31 is provided with suitable means, such as a ring 32 to which a cable 33 may be attached. Preferably, the container 31 is also provided with ports 34 and 35 in the wall thereof at the top and bottom, respectively, to facilitate removal of the container from the body member 10 by obviating any suction effect which may be created within the container during the removal thereof.

In using the present bridging device for plugging an open borehole 26 at a predetermined depth, the portion of the body member 10 containing the fins 19 and knives 22 is inserted into the container 31 which is then lowered by means of the cable or wire line 33 through the well casing into the well borehole 26, as shown in Figure 5. While the device is being run into the casing, the positioning wires 27 scrape along the inner wall of said casing and borehole and center the device therein. The weight of the device is sufficient to permit it to be rapidly dropped in the borehole. Since the operative elements are covered by the container 31, they cannot normally be injured or prematurely actuated.

When the bridge has been lowered to the desired point within the well borehole 26, an upward pull is applied to the cable 33 which tends to raise the bridging device. However, the free ends of the positioning wires 27, which are in contact with the wall of the borehole, resist any upward movement of the body member, whereby a continued upward pull on the cable 33 causes the container 31 to be removed upwardly from the body member 10.

As the container 31 is removed from the body 10, the anchoring knives 22 and the fins 19 are forced outwardly (Fig. 1) against the inner wall of the well borehole 26 by the action of the rubber plug 30 expanding and forcing the adjacent plugs 28 and 29 to actuate the fins and knives 19 and 22 into contact with the wall of the well. The knives 22 penetrate said wall and insure positive support of the bridging device within the borehole and the expanding fins 19 form an open top umbrella adapted to receive and support any desired materials which may be delivered into the borehole to form a plug above the umbrella. After the bridge has been set, said plugging materials may be introduced into the borehole 26 by a bailer, or any other suitable means.

We claim as our invention:

1. A well-bridging device adapted to be lowered into a well on a cable, comprising an elongated cylindrical body, a plurality of positioning arms carried about the lower end of said body, said arms being extendible outwardly and upwardly to contact the walls of the well, a plurality of anchoring cutters carried about the lower end of said body above said positioning arms, said cutters being extendible outwardly and downwardly to penetrate the walls of the well, a plurality of fin members carried about the upper end of said body, said fin members being extendible outwardly and upwardly to form a basket having its outer rim in contact with the walls of the well, resilient means carried by said body urging said anchoring cutters and said fin members to an outwardly extending position, a cover member slidingly fitting over said body to retain said fin members and said anchoring cutters in a retracted position substantially parallel with the arms of said body, and means attaching said cover to said cable, said cover being removable from said body by a pull exerted on said cable when said positioning arms are in contact with the wall of the well.

2. A well-bridging device adapted to be lowered into a well on a cable, comprising an elongated cylindrical body having a cylindrical bore in the central portion thereof, a plurality of positioning arms carried about the lower end of said body, said arms being extendible outwardly and up-

wardly to contact the walls of the well, a plurality of anchoring cutters carried about the lower end of said body above said positioning arms, said cutters being extendible outwardly and downwardly to penetrate the walls of the well, a plurality of fin members carried about the upper end of said body, said fin members being extendible outwardly and upwardly to form a basket having its outer rim in contact with the walls of the well, resilient means in compression carried within the bore of said body urging said anchoring cutters and said fin members to an outwardly extending position, a cover member slidingly fitting over said body to retain said fin members and said anchoring cutters in a retracted position substantially parallel with the arms of said body, and means attaching said cover to said cable, said cover being removable from said body by a pull exerted on said cable when said positioning arms are in contact with the wall of the well.

3. A well-bridging device adapted to be lowered into a well on a cable, comprising an elongated cylindrical body having a cylindrical bore in the central portion thereof, a plurality of positioning arms carried about the lower end of said body, said arms being extendible outwardly and upwardly to contact the walls of the well, first and second rows of lateral slots through the body into the bore thereof, a plurality of anchoring cutters carried about the lower end of said body above said positioning arms, said cutters being extendible outwardly and downwardly to penetrate the walls of the well, arms secured at substantially right angles to one end of said cutters, said arms extending through said first row of lateral ports into said bore, a plurality of fin members carried about the upper end of said body, said fin members being extendible outwardly and upwardly to form a basket having its outer rim in contact with the walls of the well, arms secured at substantially right angles to one of said fin members, said arms extending through said second row of lateral ports into said bore, resilient means carried in compression between the extending arms of said anchoring cutters and fin members within the bore of said body for urging said anchoring cutters and said fin members to an outwardly extending position, a cover member slidingly fitting over said body to retain said fin members and said anchoring cutters in a retracted position substantially parallel with the arms of said body, and means attaching said cover to said cable, said cover being removable from said body by a pull exerted on said cable when said positioning arms are in contact with the wall of the well.

4. A well-bridging device comprising an elongated body member adapted to be lowered by a cable into a well, positioning arms secured near the lower end of said body member, said arms extending upwardly and outwardly from the body member to engage the wall of the well, downwardly-extending anchoring means exteriorly carried by said body member above said arms, said anchoring means tending to spread outwardly from said body member to engage the well wall, upwardly-extending fin means carried by said body member above said anchoring means, said fin means tending to spread outwardly from said body to contact the wall of the well whereby an annular pocket is formed between the body member and the wall of the well, and container means surrounding said body member above said positioning arms to retain said anchoring means and said fin means in retracted position, said container means being upwardly removable from said body member to release said anchoring and said fin means.

5. A deep well-bridging device comprising an elongated body member adapted to be lowered by a line into a well, outwardly-extending positioning arms secured to the lower end of said body member for engaging the well wall, anchoring means carried outwardly on said body member above said arms, said anchoring means extending downwardly and outwardly from said body member, upwardly-extending overlapping fin means carried by said body member above said anchoring means, said fin means tending to spread outwardly against the well wall whereby an annular pocket is formed in the space between said body member and the well wall, and upwardly-removable container means surrounding said body member above said positioning arms to retain said fin and said anchoring means in retracted position so they are inoperative when said bridge is being run into the well on a line, said container means being adapted to be removed from said body member by an upward pull on said line.

6. A well-bridging device adapted to be lowered by a line into a well, said bridge comprising an elongated element having a bore through at least a portion of its length, a plurality of positioning arms carried on the lower end of said body member, said arms extending outwardly and upwardly in resilient contact with the well wall to resist upward movement of said member in said well, first slot means through the wall of said body member to said bore, downwardly-extending anchoring knives pivotally mounted in said first slot means, one end of said knives extending into the bore of said body member, second slot means above said first slot means through the wall of said body member to said bore, upwardly-extending fin means pivotally mounted in said second slot means, one end of said fin means extending into the bore of said body, resilient means carried within the bore of said body member under compression between the ends of said knives and fin means extending into said bore, said resilient means tending to actuate said knives and fin means to force them against the well wall, an upwardly-removable container surrounding said body member in frictional engagement above said positioning arms to retain said knives and fin means in retracted position, and means for securing said lowering line to the top of said container, whereby an upward pull on said line removes the container from said body member thereby releasing the knives and fin means.

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