Aug. 14, 1945. G. F. TURECHEK 2,382,455

BRIDGING PLUG

Filed Jan. 20, 1942 2 Sheets-Sheet 1

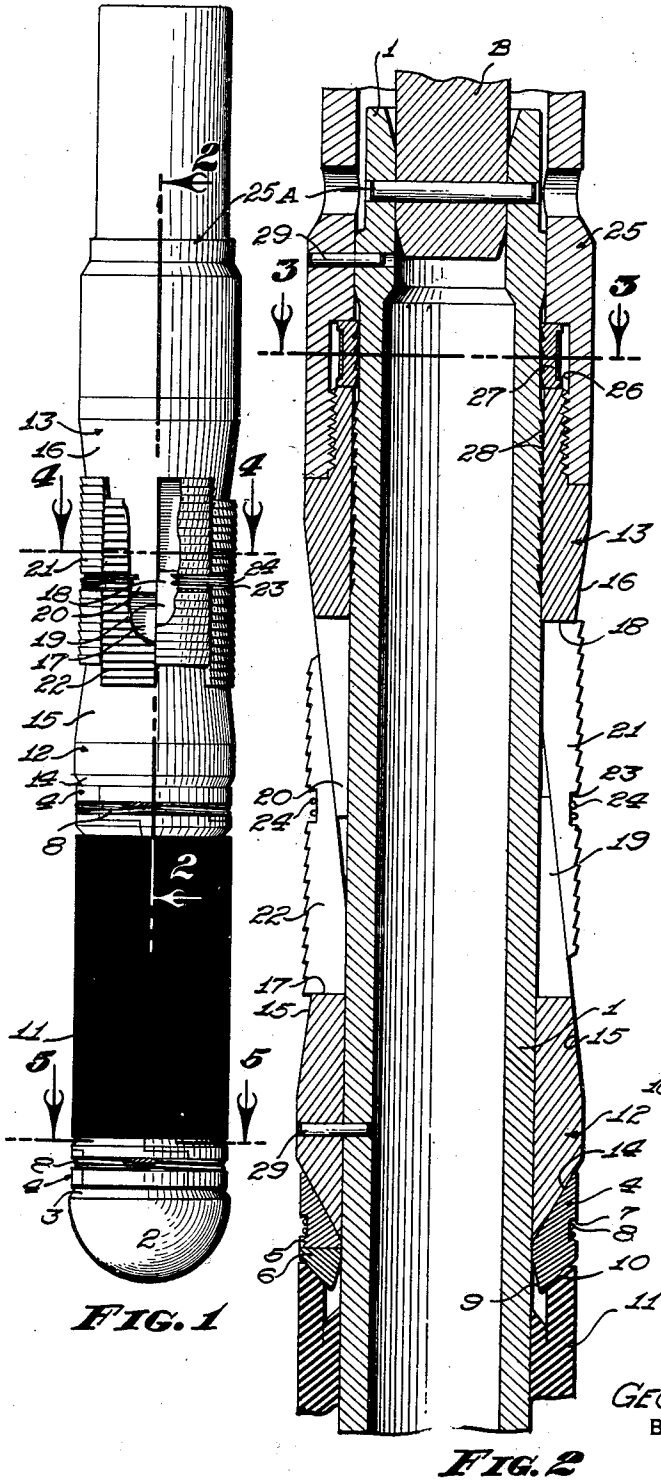


FIG. 1

FIG. 2

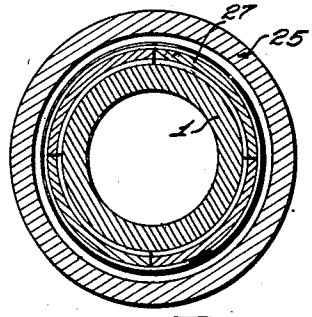


FIG. 3

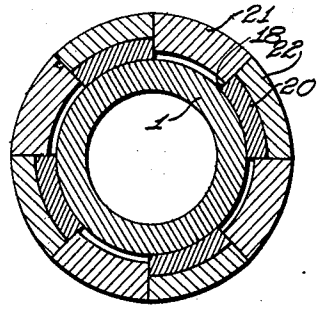


FIG. 4

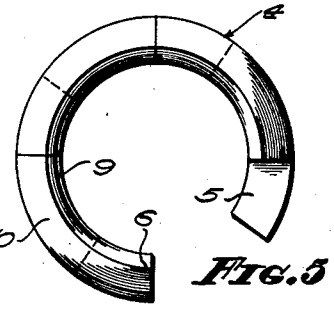


FIG. 5

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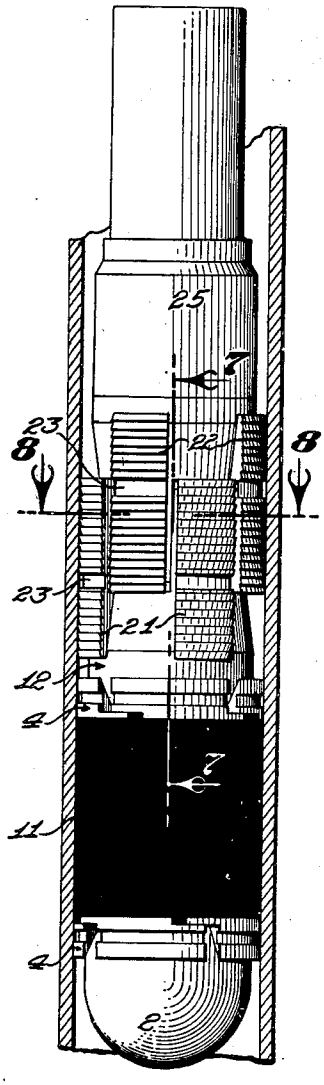


FIG. 6

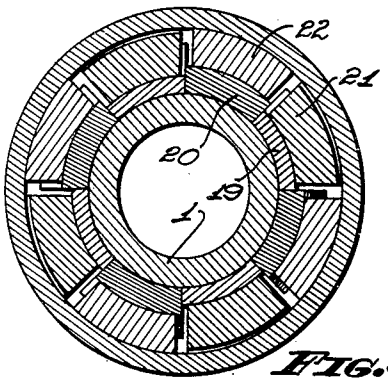


FIG. 8



FIG 10

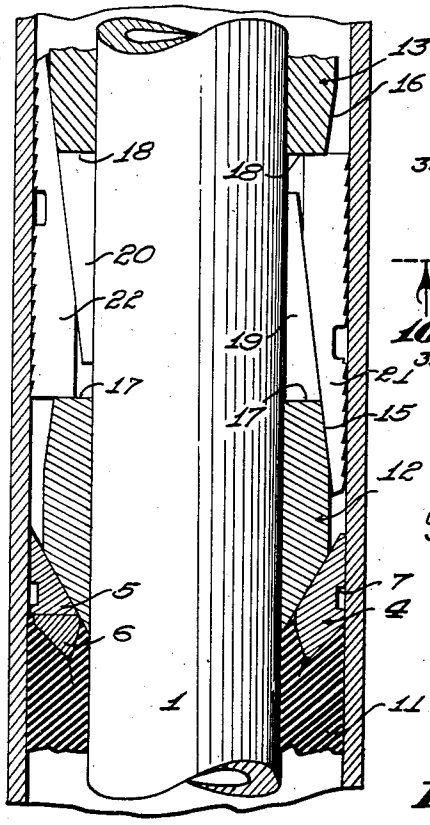


FIG. 7

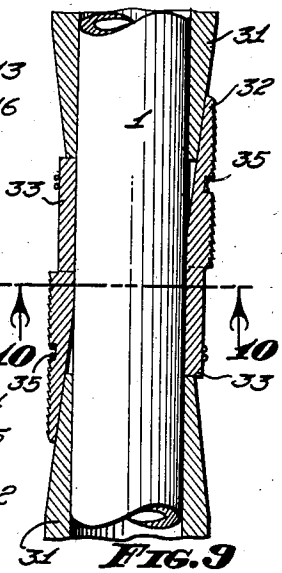


FIG. 9

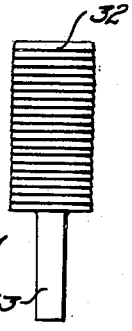


FIG 11

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BRIDGING PLUG

George F. Turechek, Los Angeles, Calif., assignor to Lane-Wells Company, Los Angeles, Calif., a corporation of Delaware

Application January 20, 1942, Serial No. 427,457

6 Claims. (Cl. 166—13)

My invention relates to bridging plugs; that is, to devices which are lowered into a well casing to plug or close the casing at some point above the bottom of the well. Among the objects of my invention are:

First, to provide a bridging plug which sets or locks against movement in either direction and which incorporates a packing element to completely close and seal the casing;

Second, to provide a bridging plug which includes a novel slip and cone or wedging arrangement employing two sets of slips wherein a minimum axial movement of the slips along the casing wall is required in order to move the slips from their initial or retracted position to their set or locked position, and virtually no axial movement of the slips is required after engaging the casing to bring both sets of slips into locking engagement;

Third, to provide a bridging plug having confronting wedge members so arranged that slips mounted on each of the wedge members are urged into operating position by abutment shoulders provided on the other wedge member, so that as the wedge members are moved axially toward each other the slips are expanded;

Fourth, to provide a bridging plug which is so designed that the parts may be made of easily drillable or friable material, so that it may be drilled up if it is desired to remove the bridging plug; and

Fifth, to provide a bridging plug which is particularly designed to be lowered on a wire line and set by a wire line operated setting tool such as disclosed in Patent No. 2,266,382 issued December 16, 1941.

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

Figure 1 is an elevational view of my bridging plug as it appears initially when being lowered into a well casing;

Figure 2 is an enlarged fragmentary longitudinal sectional view thereof taken through 2—2 of Figure 1;

Figure 3 is an enlarged transverse sectional view taken through 3—3 of Figure 2, showing particularly the clutch ring or locking ring;

Figure 4 is another transverse sectional view taken through 4—4 of Figure 1, showing particularly the slips and their expander wedges;

Figure 5 is an end elevational view of one of the segmental retainer rings for the packing sleeve with one of the segments removed;

Figure 6 is an elevational view similar to Figure 1, showing the bridging plug set within a casing, the casing being shown fragmentarily and in section;

Figure 7 is a fragmentary longitudinal sectional view thereof taken through 7—7 of Figure 6;

Figure 8 is a transverse sectional view thereof taken through 8—8 of Figure 6, showing particularly the arrangement of the slips and their wedging members;

Figure 9 is a fragmentary longitudinal sectional view similar to Figure 7 showing a modified form of slip and wedging means, the view being taken substantially through 9—9 of Figure 10;

Figure 10 is a transverse sectional view thereof taken through 10—10 of Figure 9; and

Figure 11 is an elevational view of one of the modified slip members.

My bridging plug includes a mandrel or body 1 which is tubular in form but is closed at its lower end by a head member 2. The mandrel 1 is connected by a shear pin A or other suitable means to a setting tool member B, indicated fragmentarily in Figure 2. The head member 2 may be provided with equalizing or circulating valves such as shown in Patent No. 2,249,172 issued July 15, 1941.

The upper end of the head member 2 forms a conical shoulder 3 around which fits a segmental retainer ring 4 comprising a series of segmental members having circumferentially overlapping tongues 5 and 6 which remain overlapped when the ring is expanded into contact with the casing, as shown in Figure 6. The retainer ring 4 is provided with an annular groove 7 which receives a tie wire 8 for initially holding the segments comprising the ring around the mandrel 1. One end of the ring is shaped to conform to the conical shoulder 3 while the other end of the ring is provided with an inner bevel 9 and an outer bevel 10 which coact with a similarly beveled end of a packing sleeve 11. The packing sleeve is more fully disclosed in Patent No. 2,249,171 issued July 15, 1941. The upper end of the packing sleeve coacts with a second segmental retainer ring 4.

Above the packing sleeve the mandrel receives a pair of slip expanders 12 and 13. The lowermost slip expander 12 forms at its lower end a conical shoulder 14 similar to the shoulder 3 which coacts with the upper segmental retainer ring 4.

The slip expanders 12 and 13 are provided with conical wedging portions 15 and 16, respectively, which converge toward each other. These portions are provided with axially directed slots 17 and 18, respectively, which form corresponding axially directed tongues 19 and 20. The tongues

19 of the lower slip expander fit into the slots 18 of the upper slip expander and, similarly, the tongues 20 of the upper slip expander fit into the slots 17 of the lower slip expander.

The lower slip expander 12 receives a set of slips 21 which ride upon the tongues 19 and fit into the slots 18 of the upper slip expander, abutting against the upper extermities of the slots. Similarly, a set of slips 22 ride upon the tongues 20 of the upper expander and fit into the slots 17 abutting the lower extremities thereof.

When the slip expanders are moved axially toward each other the lower slip expander urges the slips 22 of the upper slip expander upwardly and outwardly thereon and, similarly, the upper slip expander urges the slips of the lower slip expander along the tongues 19.

The slips 21 and 22 overlap axially when in their initial position and are provided with channels 23 which align circumferentially so that a single tie wire 24 may be wrapped around both sets of slips to hold them against their respective expanders.

As best shown in Figures 2 and 7, the slip 21 has saw-tooth shaped serrations facing in a direction away from the tapering surface 15 of the slip expander 12 and the slip 22 has similarly shaped serrations which face in a direction away from the tapered surface 16 of the slip expander 13. By this arrangement any tendency toward axial movement of the plug after setting of the slips will tend to cause further expansion of the slips.

A sleeve 25 is screw-threaded to the upper slip expander 13 and defines therewith an internal channel 26 which receives a clutch ring or locking ring 27. The clutch ring is provided with internal teeth which are adapted to coact with corresponding teeth 28 provided on the mandrel when the slip expander 13 is forced downwardly thereon in the course of expanding the slips and packing sleeve. In order to prevent accidental movement of the slip expanders 12 and 13 these may be initially secured to the mandrel by shear pins 29.

Operation of my bridging plug is as follows: The bridging plug is lowered by any suitable setting tool capable of pulling upwardly on the mandrel 1 and forcing downwardly on the sleeve 25. Upon being lowered to the desired position, the bridging plug is set by pulling upwardly on the mandrel and forcing downwardly on the sleeve 25. This compresses the packing sleeve until the shear pins 29 give way, thereupon the slip expanders move toward each other, breaking the tie wire 24.

The packing sleeve, in compressing, exerts sufficient force on the segmental retainer rings 4 to cause these rings to expand outwardly against the casing as shown in Figure 6. The retainer rings, when so expanded, serve to prevent axial flow of the material comprising the packing sleeve. In this connection, it should be noted that the packing sleeve is made of rubber or, more preferably, "neoprene," or similar rubber-like material unaffected by well fluids. However, it is known that these materials have a tendency to "cold flow" and it is desirable to close the space at the end of the packing sleeve as much as possible.

It will be noted that the slips are guided on both sides, as well as their ends, by the slots in which they fit, so that they remain substantially equally spaced around the bridging plug, as shown in Figure 8. It will also be noted that it is not necessary for either set of slips to slide along the casing before the other set of slips come into contact therewith, but both sets of slips come into contact with the casing virtually simultaneously. This assures adequate engagement by both sets of slips so that the bridging plug is securely locked against either upward or downward movement, and even though the forces against the bridging plug should alternate so that the pressure is first in one direction and then in the other there is no appreciable play or slack to cause the bridging plug to work loose.

Reference is now directed to Figures 9, 10 and 11: The structure here illustrated is essentially the same as the previously described structure, with the exception that the wedging cones 31 are not provided with tongues and slots; instead, the slips 32 are provided with tongues 33, as shown in Figure 11. The slips 32 are initially positioned so that the tongues of one set of slips fit between the tongues of the other set of slips. The upper cone engages the extremities of the tongues of the lower set of slips, which the lower cone engages the tongues of the upper set of slips. With this arrangement a greater slip area may be provided than is possible in the first described structure, for the slips being axially displaced may overlap circumferentially, as shown in Figure 10. The slips, as in the first described structure, are provided with channels 34 which receive tie wires 35.

Operation of the structure shown in Figures 9, 10 and 11 is the same as in the first described structure, that is, each cone performs two functions: it coacts with its own set of slips and at the same time urges the other set of slips upon the other cone. The slips preferably completely fill the circumference of the bridging plug so that they serve to hold each other in position; that is, the tongues of one set of slips are guided by the other set of slips.

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.

I claim:

1. A well tool comprising a mandrel, a pair of slip-expanding members mounted thereon, each including a plurality of spaced axially directed slip-expanding elements tapering toward the other slip-expanding member and defining therebetween a plurality of axially directed slots, said members positioned so that the elements of each slidably fit into the slots of the other, a tapered slip in each slot of each member and resting partially on the tapered element of the other expanding member extending into the slot, means for moving said members axially toward each other, each of said members engaging the slips riding upon the elements of the other of said members for urging said slips therealong into expanded position as said members are moved axially toward each other, and a tie-band for initially holding said slips in retracted position on the expanding members.

2. A well tool comprising: a mandrel; a pair of slip-expanding members mounted thereon, each including a plurality of axially directed slip-expanding elements defining therebetween a plurality of slots which terminate in abutment shoulders at their radially inner ends, said slip-expanding members positioned so that the elements of one slip-expanding member fit into the slots of the other; a slip complementary to each element and adapted to ride thereon, each slip fitting into

the corresponding slot of the other slip-expanding member restrained by the sides of its said slot against circumferential displacement and urged by its abutment shoulders axially along an element of said slip-expanding members as said members are moved axially toward each other; and means for holding said slips in contact with said elements.

3. A well tool comprising a mandrel, a first slip-expanding member and a second slip-expanding member mounted on said mandrel, said slip-expanding members each having a transverse abutting surface and an axially tapering surface, said tapering surface and abutting surface of one slip-expanding member facing the abutting surface and tapering surface of the other slip-expanding member, a pair of adjacent wedge-shaped slips positioned around said mandrel intermediate said slip-expanding members, one of said slips having a base portion in abutting relation to the abutting surface of said first slip-expanding member and having a single tapered portion complementary to and positioned to ride the tapered surface of said second slip-expanding member, the other of said slips having a base portion in abutting relation to the abutting surface of said second slip-expanding member and having a single tapered portion complementary to and positioned to ride the tapered surface of said first slip-expanding member whereby said slips are moved longitudinally in opposite directions and expanded when said slip-expanding members are moved axially toward each other, and yieldable means for initially holding said slips in a retracted position around said mandrel.

4. A well tool comprising a mandrel, a first slip-expanding member and a second slip expanding member mounted on said mandrel, each of said slip-expanding members having a transverse abutting surface and an axially tapering surface, said tapering surface and abutting surface respectively of one slip-expanding member facing the abutting surface and tapering surface respectively of the other slip-expanding member, a pair of sets of circumferentially spaced wedge-shaped slips positioned intermediate said slip-expanding members, each slip of one of said sets having a base portion in abutting relation to said abutting surface on said first slip-expanding member and having a single tapered portion complementary to and positioned to ride the tapering surface on said second slip-expanding member, and each slip of the other of said sets having a base portion in abutting relation to said abutting surface of said second slip-expanding member and having a single tapered portion complementary to and positioned to ride the tapering surface of said first slip-expanding member, means for moving said slip-expanding members axially toward each other for expanding said slips, and yieldable means for initially holding said slips in retracted position around said mandrel.

5. A well tool according to claim 3 in which said slips carry saw-tooth shaped serrations facing in a direction away from the tapering surface of the slip-expanding member upon which it rides, whereby axial reciprocation of said tool after expansion of said slips will tend further to expand said slips.

6. A well tool according to claim 4 in which said slips carry saw-tooth shaped serrations facing in a direction away from the tapering surface of the slip-expanding member upon which it rides, whereby axial reciprocation of said tool after expansion of said slips will tend further to expand said slips.

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