

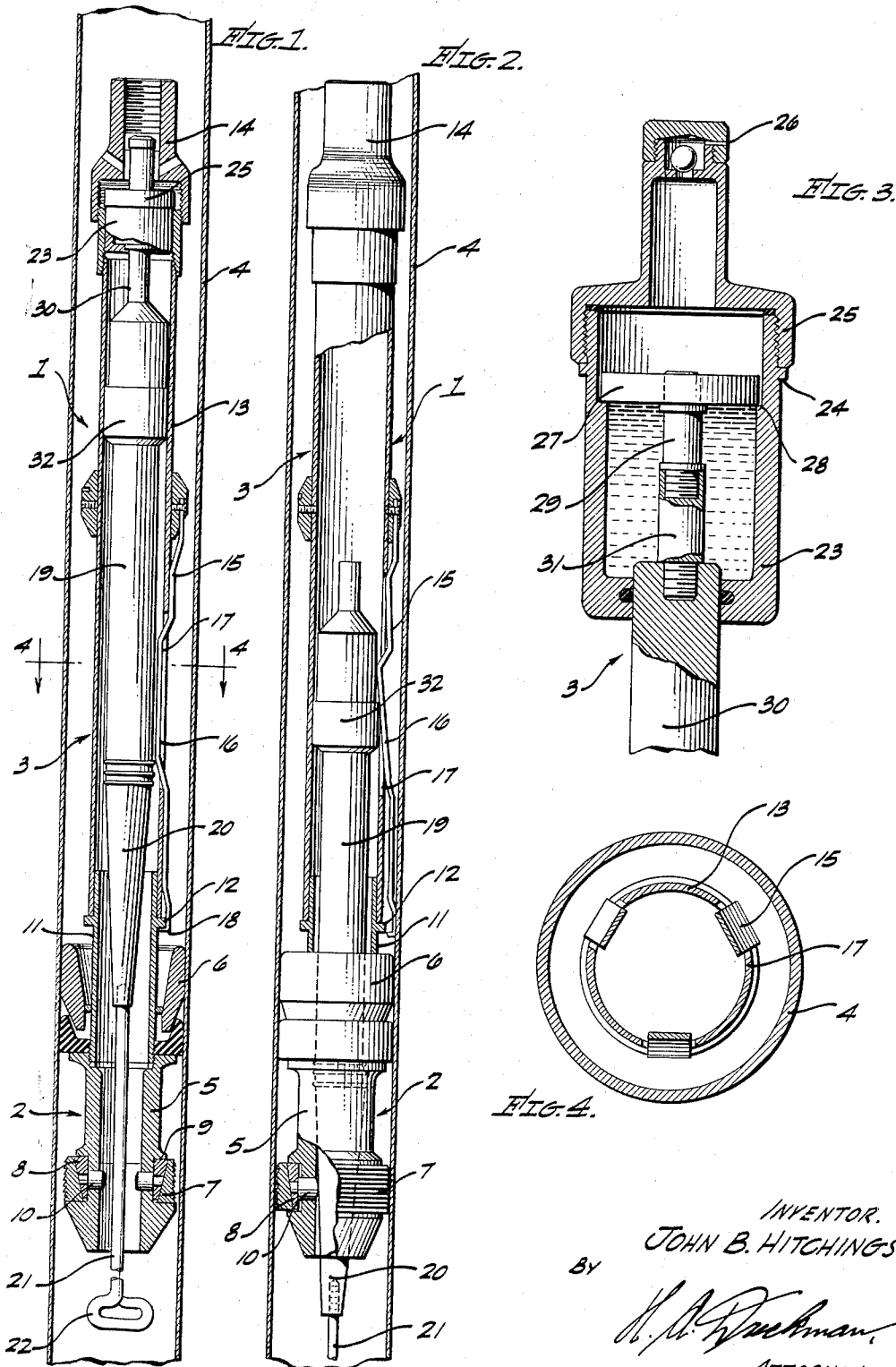
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RETRIEVABLE BRIDGING PLUG FOR OIL WELLS

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RETRIEVABLE BRIDGING PLUG FOR OIL WELLS

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This invention relates to a retrievable bridging plug whereby a plug may be set in an oil well in either the casing or open hole for the purpose of closing off the well bore at some point, so that the well may be tested, worked upon or cemented above the plug, or for other purposes.

An object of my invention is to provide a novel bridging plug which can be effectively set in the bore of a well and may be subsequently retrieved after the required work in the well has been completed.

Another object of my invention is to provide a novel retrievable bridging plug in which the setting tool is automatically released after the tool has been run into the well.

Another object of my invention is to provide a novel retrievable bridging plug in which a setting tool will set slips to hold the plug in position, and this same tool will also release the upper portion of the plug assembly so that this upper portion may be removed from the well before other work is done on the well.

A feature of my invention resides in a novel setting tool construction in which the setting tool may be used to subsequently release and retrieve the bridging plug.

Another feature of my invention resides in the novel means of releasing the setting tool with an acid bottle, wherein the contained acid chemically unites with a metallic part of the setting tool to dissolve a part of the setting tool and thus release the same.

Other objects, advantages and features of invention may appear from the accompanying drawing, the subjoined detailed description and the appended claims.

In the drawing:

Figure 1 is a longitudinal sectional view of my retrievable bridging plug showing the parts in position as they are run into the well.

Figure 2 is a longitudinal sectional view of my retrievable bridging plug in setting position.

Figure 3 is an enlarged fragmentary sectional view of the upper part of the plug assembly and showing the acid bottle.

Figure 4 is an enlarged transverse sectional view taken on line 4—4 of Figure 1.

Referring more particularly to the drawing, the numeral 1 indicates the retrievable bridging plug assembly which includes the bridging plug 2 at the lower end and the engaging tool assembly 3 at the upper end. The entire bridging plug assembly is run into the bore of the well, which may include the casing 4, or under certain instances may be set in a so-called open hole in which casing has not as yet been set. The bridging plug assembly 2 includes a tubular body 5 on the upper end of which a cup packer 6 is mounted. The mounting and construction of the cup packer 6 is usual and well known in the art. That is, the packer consists of an expansible rubber cup 6^a and a tapered plunger 6^b which enters the cup to expand the same. A plurality of slips 7 are mounted adjacent the lower end of the tubular body 5 and each of the slips bears against a tapered setting block 8 which fits in an appropriate groove 9 in the

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body 5. An inwardly projecting pin 10 extends inwardly from each of the setting blocks 8, and these pins extend entirely through the wall of the tubular body 5 and thus project into the central bore of the body 5 for a purpose which will be further described. A pipe 11 extends upwardly from the body 5 and is preferably threaded into the top of the body. The pipe 11 includes an annular ring or shoulder 12 which is engaged by certain parts of the grapple or tool engaging assembly 3.

The tool engaging assembly or grapple 3 consists of a length of tubing 13 at the upper end of which a coupling 14 is mounted. This coupling can attach to either a stand of pipe or tubing or a cable fitting, as may be desired. A plurality of spring arms 15 are fixedly mounted on the outside of the tube 13 and each of these spring arms are bent inwardly, as shown at 16, so as to project through slots 17 in the tube 13. A finger 18 at the lower end of each of the arms 15 engages the shoulder 12 for the purpose of releasably coupling the grapple portion 3 and the bridging plug portion 2 of the tool. A setting tool or mandrel 19 is mounted within the tube 13 and the lower end of this mandrel is tapered, as shown at 20. The purpose of the tapered portion 20 is to strike or engage the pins 10 and force the pins 10, the blocks 8 and the slips 7 outwardly when the setting tool or mandrel 19 is permitted to drop downwardly to the position shown in Figure 2.

A rod 21 of considerable length extends downwardly from the bottom of the mandrel 19 and is formed with a ring 22 at its lower end, which ring engages the bottom of the body 5 when the bridging plug assembly is to be removed, as will be subsequently described. An acid cup 23 is removably mounted at the upper end of the tube 13, the acid bottle being formed with a shoulder 24 which rests on the top of the tube. A screw cap 25 closes the top of the acid bottle and a vent 26 in the cap permits gases to escape from the inside of the acid bottle. A spider 27 rests on the shoulder 28 in the acid bottle 23 and a fitting 29 screws into the spider 27. A coupling 30 on the upper end of the setting tool 19 extends into the bottom of the acid bottle 23 and a metal connector 31 screws into the top of the member 30 and also onto the bottom of the coupling 29. The metal connector 31 is of a suitable metal such as a lead or tin alloy which will chemically unite with the acid (such as sulphuric acid) or base within the bottle 23, and the rate of chemical action being known, the time can be determined before the connector 31 is completely dissolved, permitting the setting tool 19 to drop downwardly by gravity. For example—at a known temperature the rate with which the sulphuric acid unites with the lead in the connector 31 is known. Therefore, by varying the thickness of the connector 31, or the strength of the acid, the time when the connector is dissolved is determined.

In operation the parts are assembled, as shown in Figure 1, with the spring arms 15 engaging the shoulder 12 on the pipe 11. Also the mandrel 19 is in its raised position with the coupling 30 extending into the acid cup 23 and with the connector 31 threaded onto the fitting 29. As the tool is lowered into the well the acid in the cup 23 is chemically uniting with the metallic connector 31. When the proper point in the well is reached, the tool is stopped in its movement, and very shortly thereafter the metal connector 31 would fail since its cross sectional area is reduced, due to the action of the acid, and thereupon the mandrel 19 will drop downwardly. The tapered portion 20 engages the pins 10 thus camming the slips 7 outwardly to engage the casing 4 or the open hole, as may be desired. The packer 6 is tightly engaging the casing 4, and thus the bridging plug portion is held tightly in position. When the mandrel 19 drops down-

wardly the enlarged upper portion 32 thereof will engage the bent portion 16 of the spring arms 15, thus springing the arms outwardly, as shown in Figure 2, and thereby releasing the engaging tool assembly 3 so that it can be returned to the surface.

When it is desired to remove the bridging plug 2, a suitable fishing tool is inserted into the well to engage the coupling 30, whereupon the mandrel 19 is pulled upwardly until the ring 22 engages the bottom of the body 5, whereupon the bridging plug assembly can be pulled upwardly to the surface. The slips 7 have been released, due to the fact that the taper 20 of the mandrel 19 has been pulled upwardly, as previously described.

Having described my invention, I claim:

1. A retrievable bridging plug, including a bridging portion and a tubular engaging tool portion above the bridging portion, said bridging portion including a packer means and slip means mounted thereon, spring means on said engaging tool portion releasably engaging the bridging portion, a setting mandrel slidably mounted for vertical movement in the engaging tool portion, releasable means in the engaging tool portion engaging and holding the setting mandrel in raised position in the engaging tool portion, said setting mandrel engaging and expanding the slip means in the released and lowered position thereof.

2. A retrievable bridging plug, including a bridging portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, spring means on said engaging tool portion releasably engaging the bridging portion, a setting mandrel slidably mounted for vertical movement in the engaging tool portion, automatically releasable means comprising a metal connector immersed in a reacting chemical in the engaging tool portion and holding the setting mandrel in raised position in the engaging tool portion, said setting mandrel engaging and expanding the slip means in the released and lowered position thereof.

3. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, spring means on said engaging tool portion releasably engaging the bridging portion, a setting mandrel slidably mounted for vertical movement in the engaging tool portion, an acid cup mounted in the engaging tool portion adjacent the upper end thereof, the upper end of said mandrel extending into the acid cup, a connector on the mandrel, means in the acid cup to which the connector is secured and whereby said mandrel is held in raised position, said setting mandrel engaging and expanding the slip means in the released and lowered position thereof.

4. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, said bridging plug portion including a hollow body, said slip means including a pin extending through the wall of the hollow body and projecting inwardly, spring means on said engaging tool portion releasably engaging the bridging plug, a setting mandrel in the engaging tool portion, releasable means in the engaging tool portion holding the setting mandrel in raised position in the engaging tool portion, said setting mandrel engaging and expanding the slip means in the released and lowered position thereof, and also engaging said spring means to release the spring means from the bridging plug.

5. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, said bridging plug portion including a hollow body, said slip means including a pin extending through the wall

of the hollow body and projecting inwardly, spring means on said engaging tool portion releasably engaging the bridging plug, a setting mandrel in the engaging tool portion, an acid cup mounted in the engaging tool portion adjacent the upper end thereof, the upper end of said mandrel extending into the acid cup, a connector on the mandrel, means in the acid cup to which the connector is secured and whereby said mandrel is held in raised position, said setting mandrel engaging and expanding the slip means in the lowered and released position thereof.

6. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, said bridging plug portion including a hollow body, said slip means including a pin extending through the wall of the hollow body and projecting inwardly, spring means on said engaging tool portion releasably engaging the bridging plug, a setting mandrel in the engaging tool portion, an acid cup mounted in the engaging tool portion adjacent the upper end thereof, the upper end of said mandrel extending into the acid cup, a connector on the mandrel, means in the acid cup to which the connector is secured and whereby said mandrel is held in raised position, said setting mandrel engaging and expanding the slip means in the lowered and released position thereof, and said setting mandrel engaging the spring means in the lowered position thereof and releasing said spring means from the bridging plug.

7. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, said bridging plug portion including a hollow body, spring arms on the outside of the engaging tool portion releasably engaging the bridging plug, a setting mandrel in the engaging tool portion, automatically releasable means in the engaging tool portion holding the setting mandrel in raised position, a conical lower end on the mandrel engaging and expanding the slip means in the lowered and released position of the mandrel, a rod depending from the mandrel and extending through the body of the bridging plug, and a ring on the lower end of the rod engageable with the body of the bridging plug to retrieve said bridging plug.

8. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, said bridging plug portion including a hollow body, spring arms on the outside of the engaging tool portion releasably engaging the bridging plug, a setting mandrel in the engaging tool portion, an acid cup mounted in the engaging tool portion adjacent the upper end thereof, the upper end of said mandrel extending into the acid cup, a connector on the mandrel, means in the acid cup to which the connector is secured and whereby said mandrel is held in raised position, a cone on the lower end of the setting mandrel engageable with the slip means to expand the same, a rod depending from the mandrel and extending through the body of the bridging plug, and a ring on the lower end of the rod engageable with the body of the bridging plug to remove the same.

9. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, said bridging plug portion including a hollow body, spring arms on the outside of the engaging tool portion releasably engaging the bridging plug, a setting mandrel in the engaging tool portion, automatically releasable means in the engaging tool portion holding the setting mandrel in raised position, a conical lower end on the mandrel engaging and expanding the slip means in the lowered position thereof.

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tion of the mandrel, a rod depending from the mandrel and extending through the body of the bridging plug, and a ring on the lower end of the rod engageable with the body of the bridging plug to retrieve said bridging plug, said mandrel engaging the spring arms in the lowered position of the mandrel to disengage the spring arms from said bridging plug.

10. A retrievable bridging plug, including a bridging plug portion and a tubular engaging tool portion above the bridging portion, said bridging plug portion including a packer means and slip means mounted thereon, said bridging plug portion including a hollow body, spring arms on the outside of the engaging tool portion releasably engaging the bridging plug, a setting mandrel in the engaging tool portion, an acid cup mounted in the engaging tool portion adjacent the upper end thereof, the upper end of said mandrel extending into the acid cup, a con-

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5 nector on the mandrel, means in the acid cup to which the connector is secured and whereby said mandrel is held in raised position, a cone on the lower end of the setting mandrel engageable with the slip means to expand the same, a rod depending from the mandrel and extending through the body of the bridging plug, and a ring on the lower end of the rod engageable with the body of the bridging plug to remove the same, said mandrel engaging the spring arms in the lowered position of the mandrel to disengage the spring arms from said bridging plug.

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