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RETRIEVABLE BRIDGE PLUG

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2 Sheets-Sheet 1

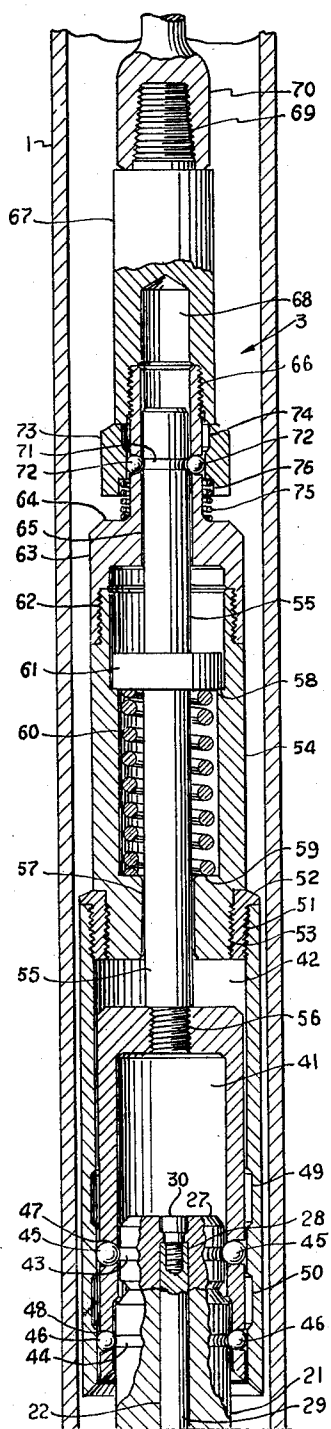


Fig. 1

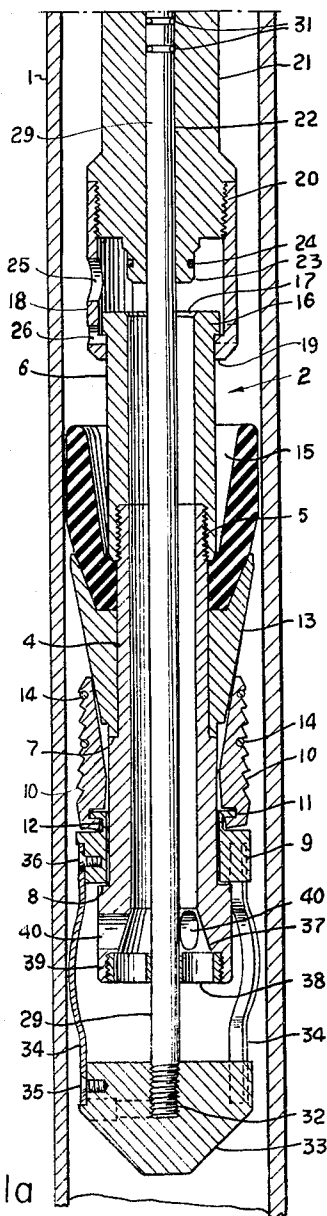


Fig. 1a

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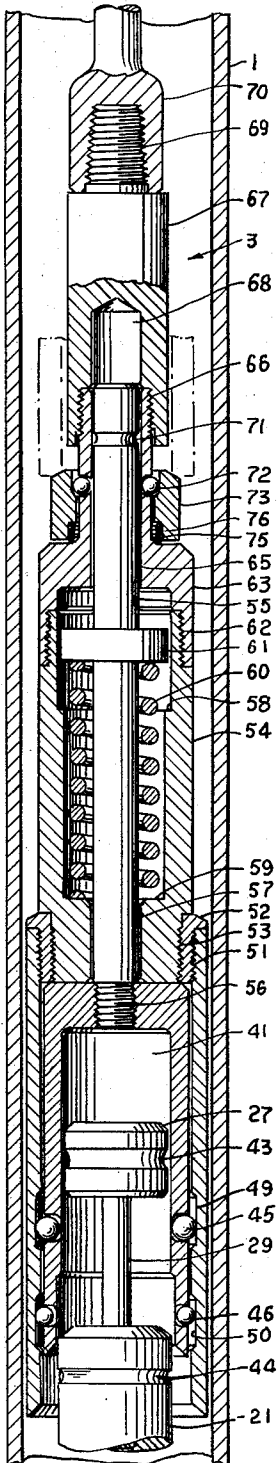


Fig. 2

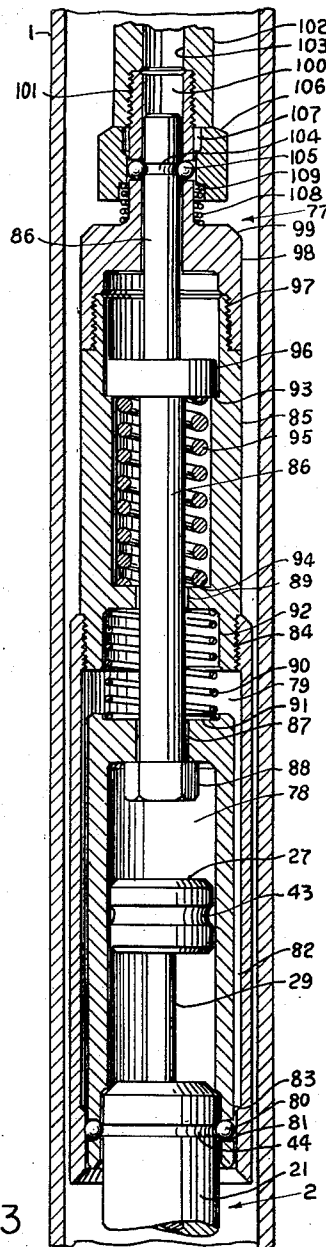


Fig. 3

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1

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RETRIEVABLE BRIDGE PLUG

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This invention relates to a retrievable bridge plug, and it concerns more particularly a well pipe or casing plug which is capable of being released and withdrawn from the well pipe after it has served its purpose.

The invention relates generally to a well pipe or casing plug of the type adapted to be lowered into a well on a suspension means and set at any desired depth within the well pipe for sealing off fluid pressures above and below the plug, as in sand fracturing operations at different levels.

The plug herein described is of the retrievable type, which after once being set may be released and withdrawn from the well pipe, as distinguished from plugs of the non-retrievable type which either are left in place permanently or are drilled out and thus destroyed in the event it is desired to unplug the well.

A retrievable plug is used primarily as a temporary plugging means to enable the operator to change surface fittings or to carry on other operations which require the shutting off of pressures at some lower point in the well pipe. Such plugs are seldom made of readily drillable material. Moreover, they are used mostly in well producing operations after all drilling equipment has been dismantled or removed from the well.

It is important that the retrievable type of plug be readily and surely releasable from the well pipe after it has served its purpose. Failure to retrieve the plug may result in loss of time and money due to the expense of setting up and operating heavy drilling or well pulling equipment and the loss of production which results from tying up the well.

An object of the invention is to provide a retrievable plug which is efficient in use and which can be readily and surely released and withdrawn from the well pipe.

Another object of the invention is to provide a plug which not only is retrievable but also is capable of being drilled out, whereby the plug is destroyed, if necessary.

The invention will be readily understood by referring to the following description and the accompanying drawing, in which:

FIGS. 1 and 1A together comprise a sectional elevational view of a retrievable bridge plug embodying the invention, and a setting tool therefor, showing the plug in its normal position while lowering it in a well casing, before expanding the slips whereby the plug is secured in fixed position relative to the casing;

FIG. 2 is a fragmentary sectional elevational view, similar to the view shown in FIGS. 1 and 1A, showing the setting tool in its released position whereby the plug is disengaged therefrom; and

FIG. 3 is a fragmentary sectional elevational view of the plug, and a retrieving tool therefor, showing the plug connected to the retrieving tool whereby it may be withdrawn from the well or reset at a different elevation, as desired.

Referring to FIGS. 1 and 1A of the drawing, the numeral 1 designates a well casing. A retrievable bridge plug embodying the invention, and a setting tool therefor, are indicated generally by the numerals 2 and 3, respectively.

The plug 2 includes a tubular mandrel 4, which is externally threaded at 5, adjacent its upper end, for engagement by the internally threaded lower end of a tubular member 6. The outside diameter of the mandrel

2

4 is reduced intermediate its ends to form a pair of longitudinally spaced, upwardly facing external shoulders, numbered 7 and 8, respectively.

An annular member 9, which supports a plurality of circumferentially spaced slip jaws 10, surrounds the mandrel 4 and is supported upon the lowermost external shoulder 8. The annular member 9 has a peripheral flange 11 and a peripheral groove 12 formed on its upper end for engagement by corresponding surfaces of the slip jaws 10, whereby the lower ends of the slip jaws 10 are anchored to the annular member 9 and are movable radially relative thereto.

A frusto-conical tubular expanding member 13, the tapered peripheral surface of which is capable of engaging corresponding surfaces of the slip jaws 10 to expand them, upon movement of the expanding member 13 longitudinally relative to the slip jaws 10, surrounds the mandrel 4 and is supported upon the uppermost external shoulder 7.

A pair of elastic rings 14 surround the slip jaws 10, and are received in arcuate grooves provided therefor in the outer surfaces of the slip jaws 10, whereby the slip jaws 10 are yieldably restrained against radial displacement thereof.

The upper end of the expanding member 13 is cup shaped, and the inner wall thereof is inclined downwardly and radially inwardly. A cup shaped annular packer member 15, which is formed of resilient material, and the adjacent surfaces of which conform to the shape of the expanding member 13, is received in the upper end of the expanding member 13. The packer member 15 surrounds the mandrel 4, and extends upwardly and radially outwardly from the expanding member 13 for engagement with the inner wall of the casing 1.

The outside diameter of the tubular member 6 is greater than the outside diameter of the mandrel 4 adjacent its upper end, and the lower end of the tubular member 6 forms a downwardly facing external shoulder for engagement with the inside of the packer member 15 whereby the packer member 15 and the expanding member 13 are secured to the mandrel 4.

The upper end of the tubular member 6 is externally flanged, as at 16, and has an annular valve seat formed therein, as at 17. A cylindrical valve housing 18 surrounds and slidably engages the tubular member 6. The lower end of the valve housing 18 is internally flanged, as at 19, for engagement with the under side of the flange 16 of the tubular member 6.

The upper end of the valve housing 18 is internally threaded, as at 20, for engagement with the lower end of an elongated stem 21, which is circular in transverse section and has a central bore 22 formed therein.

An annular valve plug 23, which is of smaller diameter than the elongated stem 21 and comprises a downward extension thereof, extends downwardly into the valve housing 18 for telescoping engagement with the upper end of the tubular member 6. A resilient O ring 24 is received in a peripheral groove provided therefor in the valve 23 for engagement with the inner wall of the tubular member 6.

One or more side ports 25 are formed in the valve housing 18 intermediate its ends. The arrangement is such that fluid may flow through the side ports 25, the valve housing 18, the tubular member 6 and the mandrel 4 when the valve housing 18 is in its uppermost position relative to the tubular member 6. The elongated stem 21 and the valve housing 18 are capable of supporting the tubular member 6 and the mandrel 4.

A plurality of circumferentially spaced openings 26 are formed in the valve housing 18 adjacent its lower end. The openings 26 communicate with the under side

of the flange 16 of the tubular member 6, whereby the pressure above and below the flange 16 is equalized.

A circular member 27, which is of slightly smaller diameter than the elongated stem 21 and is positioned above it, has a central bore 28 formed therein, beginning at its under side, for engagement by the upper end of an elongated rod 29, to which it is connected by a screw 30. The rod 29 is reciprocable in the bore 22 of the elongated stem 21, which acts as a guide therefor, and extends downwardly through the tubular member 6 and below the mandrel 4. A pair of resilient O rings 31 are received in peripheral grooves provided therefor in the rod 29 for engagement with the bore 22 of the elongated stem 21.

The lower end of the rod 29 is threaded, as at 32, for engagement by a shoe 33, which is circular in transverse section and has a threaded central bore formed therein, beginning at its upper side. The shoe 33 is additionally secured to the rod 29 by a set screw, shown in dotted lines.

A plurality of elongated metal strips 34, which advantageously may be made of spring steel and are arched intermediate their ends, are spaced circumferentially about the shoe 33. Each of the strips 34 is connected at its lower end to the peripheral surface of the shoe 33, as by a screw 35, and is connected at its upper end to the peripheral surface of the annular member 9, below the slip jaws 10, as by a screw 36. The intermediate portions of the strips 34 yieldably and frictionally engage the inner wall of the casing 1, and act as guides for use in centering the tool. The strips 34 also resist downward movement of the annular member 9, which carries the slip jaws 10, and coact with the expanding member 13 to expand the slip jaws 10.

The mandrel 4 is internally enlarged adjacent its lower end, as at 37, below the external shoulder 8. A spider 38, which surrounds the rod 29 and serves as a guide therefor, is externally threaded, as at 39, for engagement with the internally threaded lower end of the mandrel 4. A plurality of circumferentially spaced side ports 40 are formed in the internally enlarged portion 37 of the mandrel 4, above the threads connecting it to the spider 38.

The setting tool 3 includes an inner cylinder 41 and an outer cylinder 42, each of which is open at its lower end, the inner cylinder 41 being reciprocable in the outer cylinder 42. The circular member 27 and the upper end of the elongated stem 21 are receivable in the inner cylinder 41. Peripheral grooves 43 and 44 are formed in the circular member 27 and the upper end of the elongated stem 21, respectively. Two sets each comprising a plurality of balls, numbered 45 and 46, are received in circumferentially spaced openings 47 and 48 formed in the inner cylinder 41 for engagement, respectively, with the grooves 43 and 44, as shown in FIG. 1, whereby the plug 2 is secured to the setting tool 3.

Annular grooves 49 and 50 are formed in the inner wall of the outer cylinder 42 for engagement with the balls 45 and 46, upon moving the inner cylinder 41 upwardly relative to the outer cylinder 42, whereby the balls 45 and 46 are disengaged from the grooves 43 and 44, as shown in FIG. 2, and the plug 2 is released from the setting tool 3 and may be withdrawn therefrom. The spacing of the grooves 49 and 50 is such that the elongated stem 21 is released before the circular member 27 is released, whereby the expanding member 13 is advanced downwardly relative to the slip jaws 10, to expand the slip jaws 10.

The upper end of the outer cylinder 42 is internally threaded, as at 51, for engagement with an externally threaded collar 52, which is also internally threaded, as at 53, for engagement with the lower end of a cylindrical member 54.

An elongated rod 55 is threaded at its lower end,

as at 56, for engagement with a threaded bore formed in the upper end of the inner cylinder 41. The rod 55 supports the inner cylinder 41 and the plug 2, as shown in FIGS. 1 and 1A, and is reciprocable in a central bore 57 formed in the cylindrical member 54 beginning at its lower end.

The cylindrical member 54 is internally enlarged to form a pair of longitudinally spaced, upwardly facing internal shoulders 58 and 59. A compression spring 60 is received in the cylindrical member 54, above the lowermost internal shoulder 59, and surrounds the rod 55. A cylindrical enlargement 61, which is formed on the rod 55 intermediate its ends, is positioned in the cylindrical member 54 above the uppermost internal shoulder 58, and is acted on by the spring 60 whereby it is urged upwardly therein. The shoulder 58 limits the downward movement of the rod 55 relative to the cylindrical member 54.

The upper end of the cylindrical member 54 is externally threaded, as at 62, for engagement with the internally threaded lower end of a swaged member 63, the outside diameter of which is reduced intermediate its ends to form an upwardly facing external shoulder 64. The upper end of the rod 55 is reciprocable in a central bore 65 formed in the upper end of the swaged member 63.

The upper end of the swaged member 63 is externally threaded, as at 66, for engagement with the internally threaded lower end of a connecting member 67. The connecting member 67 has a counter bore 68 which is aligned with the bore 65 of the swaged member 63, and in which the upper end of the rod 55 is reciprocable. The upper end of the connecting member 67 is externally threaded, as at 69, for engagement with a suspension means 70, which advantageously may be a wire line or cable.

A peripheral groove 71 is formed in the upper end of the rod 55 for engagement by a plurality of balls 72, which are received in circumferentially spaced openings provided therefor in the upper end of the swaged member 63, above the external shoulder 64. A collar 73, which surrounds the upper end of the swaged member 63, normally acts upon the balls 72 to retain them in engagement with the groove 71, whereby the rod 55 is restrained against longitudinal movement relative to the swaged member 63.

The collar 73 has an annular groove 74 formed in its inner wall, adjacent its upper side. As shown in FIG. 2, upon movement of the collar 73 downwardly relative to the swaged member 63, the balls 72 are receivable in the annular groove 74 of the collar 73, whereby the rod 55 is disengaged from the swaged member 63 and is urged upwardly relative thereto, by the action of the spring 60, to release the plug 2 from the setting tool 3 as above described. This is accomplished by dropping a "go devil" shown in dotted lines, from the surface for engagement with the collar 73.

A compression spring 75, which surrounds the upper end of the swaged member 63 and is received in an annular groove 76 formed in the under side of the collar 73, acts upon the external shoulder 64 and the under side of the collar 73 whereby the collar 73 is normally urged upwardly in engagement with a downwardly facing external shoulder formed by the lower end of the connecting member 67.

Referring to FIG. 3 of the drawing, a retrieving tool for use in withdrawing the plug 2 from the well casing 1, and for resetting it at different elevations, is indicated generally by the numeral 77.

The retrieving tool 77 includes an inner cylinder 78 and an outer cylinder 79, each of which is open at its lower end, the inner cylinder 78 being reciprocable in the outer cylinder 79. The circular member 27 and the upper end of the elongated stem 21 are receivable in the inner cylinder 78. A plurality of balls 80 are received

in circumferentially spaced openings 81 formed in the inner cylinder 78 for engagement with a peripheral groove 44 formed in the upper end of the elongated stem 21, whereby the plug 2 is secured to the retrieving tool 77.

The outer cylinder 79 is internally enlarged at 82, above its lower end, to form an upwardly facing internal shoulder 83. The inner wall of the outer cylinder 79 normally engages the balls 80 to retain them in engagement with the peripheral groove 44 formed in the upper end of the elongated stem 21. The arrangement is such that the balls 80 are disengaged from the groove 44, upon moving the inner cylinder 78 upwardly relative to the outer cylinder 79, whereby the plug 2 may be snapped on the retrieving tool 77, or alternatively, may be released and withdrawn therefrom.

The upper end of the outer cylinder 79 is internally threaded, as at 84, for engagement with the externally threaded lower end of a cylindrical member 85.

The lower end of an elongated rod 86 is passed through a central bore 87 formed in the upper end of the inner cylinder 78, and is threaded for engagement by a nut 88 positioned below the lower end of the bore 87. The rod 86 supports the inner cylinder 78 and the plug 2, as shown in FIG. 3, and is reciprocable in a central bore 89 formed in the lower end of the cylindrical member 85.

A compression spring 90, which is received in depressions 91 and 92 formed in the upper end of the inner cylinder 78 and the lower end of the cylindrical member 85, yieldably restrains the inner cylinder 78 against upward movement relative to the outer cylinder 79, whereby the plug 2 may be snapped on the retrieving tool 77.

The cylindrical member 85 is internally enlarged to form a pair of longitudinally spaced, upwardly facing internal shoulders 93 and 94. A compression spring 95, which is substantially stronger than the spring 90, is received in the cylindrical member 85, above the lowermost internal shoulder 94, and surrounds the rod 86. A cylindrical enlargement 96, which is formed on the rod 86 intermediate its ends, is positioned in the cylindrical member 85 above the uppermost internal shoulder 93, and is acted upon by the spring 95 whereby it is urged upwardly therein. The shoulder 93 limits the downward movement of the rod 86 relative to the cylindrical member 85.

The upper end of the cylindrical member 85 is externally threaded, as at 97, for engagement with the internally threaded lower end of a swaged member 98, the outside diameter of which is reduced intermediate its ends to form an upwardly facing external shoulder 99. The upper end of the rod 86 is reciprocable in a central bore 100 formed in the upper end of the swaged member 98.

The upper end of the swaged member 98 is externally threaded, as at 101, for engagement with the internally threaded lower end of a connecting member 102. The connecting member 102 has a counter bore 103 which is aligned with the bore 100 of the swaged member 98, and in which the upper end of the rod 86 is reciprocable. The upper end of the connecting member 102 is connected to a suspension means (not shown), which advantageously may be a wire line or cable.

A peripheral groove 104 is formed in the upper end of the rod 86 for engagement by a plurality of balls 105, which are received in circumferentially spaced openings provided therefor in the upper end of the swaged member 98, above the external shoulder 99. A collar 106, which surrounds the upper end of the swaged member 98, normally acts upon the balls 105 to retain them in engagement with the groove 104, whereby the rod 86 is restrained against longitudinal movement relative to the swaged member 98.

The collar 106 has an annular groove 107 formed in its inner wall, adjacent its upper side. Upon movement of the collar 106 downwardly relative to the swaged member 98, the balls 105 are receivable in the annular groove 107 of the collar 106, whereby the rod 86 is dis-

engaged from the swaged member 98 and is urged upwardly relative thereto, by the action of the spring 95, to release the plug 2 from the retrieving tool 77 as above described. This is accomplished by dropping a "go devil" (not shown) from the surface for engagement with the collar 106.

A compression spring 108, which surrounds the upper end of the swaged member 98 and is received in an annular groove 109 formed in the under side of the collar 106, acts upon the external shoulder 99 and the under side of the collar 106 whereby the collar 106 is normally urged upwardly in engagement with a downwardly facing external shoulder formed by the lower end of the connecting member 102.

The operation of the apparatus above described is as follows:

The relative positions of the parts, upon lowering the bridge plug 2 in the casing 1 on the setting tool 3, is as shown in FIGS. 1 and 1A. The valve 23 is open, and well fluids pass upwardly through the ports 25 as the apparatus is lowered in the well bore.

The function of the slip jaws 10 is to support the bridge plug 2 at the desired elevation in the casing 1. The weight of the elongated member 21, and the parts depending therefrom, as shown in FIGS. 1 and 1A, is relied on to prevent upward displacement of the expanding member 13 relative to the slip jaws 10, due to fluid pressure from below, after the slip jaws 10 have been set. The weight of the elongated member 21 also prevents opening of the valve 23.

Upward displacement of the expanding member 13 and the packer member 15 in response to fluid pressure from below, to thereby disengage the slip jaws 10 from the casing 1, is prevented by expansion of the packer member 15, due to the static head of well fluids above it, whereby the packer member 15 frictionally engages the casing 1, and prevents withdrawal of the bridge plug 2 therefrom, until the valve 23 is opened.

The static head of well fluids in the casing 1 not only acts on the packer member 15 to expand it, and to resist upward displacement thereof in response to fluid pressure from below, but also acts on the elongated member 21 and the circular member 27 alike to prevent upward displacement of the bridge plug 2.

The static head of well fluids in the casing 1, acting on the elongated member 21, resists opening of the valve 23.

Upward displacement of the expanding member 13 and the packer member 15 in response to fluid pressure from below is also prevented by reason of the fact that the same upward pressure which acts on the expanding member 13 and the packer member 15 also acts on the under side of the shoe 33, to which the slip jaws 10 are connected, as above described.

The cross sectional area of the valve 23 is comparatively small, relative to the cross sectional area of the elongated member 21, so that the weight of the elongated member 21, together with the static head of well fluids acting thereon, ordinarily is sufficient to prevent the valve 23 from being unseated by upward fluid pressure in the well.

The packer member 15 is not collapsed due to fluid pressure from below for the reason that it is of substantially the same diameter as the expanding member 13 below it, and for the further reason that the packer member 15 is expanded, whereby it frictionally engages the casing 1, by the static head of well fluids above it.

FIG. 3 shows the relative positions of the parts upon attaching the bridge plug 2 to the retrieving tool 77. The relative positions of the parts upon withdrawing the bridge plug 2 from the casing 1 is the same as shown in FIGS. 1 and 1A, above referred to. The valve 23 is opened and the slip jaws 10 are disengaged from the casing 1 upon upward movement of the bridge plug 2 and the retrieving tool 77.

The invention may be modified in various ways without departing from the spirit and scope thereof.

The strips 34, which yieldably and frictionally engage the inner wall of the casing 1, resist downward movement of the annular member 9, which carries the slip jaws 10, and coact with the expanding member 13 to expand the slip jaws, as above described.

The weight of the setting tool 3, acting on the rod 29 and the shoe 33, to which the strips 34 are attached, is sufficient to overcome the frictional resistance of the strips 34 to downward movement of the bridge plug 2, whereby the bridge plug 2 may be lowered in the casing 1.

FIG. 2 shows the relative movement of parts whereby the bridge plug 2 is disengaged from the setting tool 3. The spacing of the grooves 49 and 50 is such that the elongated member 21 is released before the circular member 27 is released, whereby the expanding member 13 is advanced downwardly relative to the slip jaws 10, to expand the slip jaws 10, as above described.

The weight of the elongated member 21 is sufficient to overcome any frictional resistance of the O rings 31 to relative movement between the rod 29, to which the circular member 27 is attached, and the elongated member 21.

The valve 23 is closed upon downward movement of the elongated member 21 and the valve housing 18 relative to the tubular member 6, upon expanding the slip jaws 10 as above described.

What is claimed is:

1. A retrievable bridge plug, adapted to be set in a well pipe to seal off pressures from below, comprising a tubular mandrel, a tubular member connected by threads to the upper end of the mandrel, the lower end of the tubular member forming a downwardly facing external shoulder and the outside diameter of the mandrel being reduced intermediate its ends to form a pair of longitudinally spaced, upwardly facing external shoulders, an annular member surrounding the mandrel and supported upon the lowermost external shoulder, a plurality of circumferentially spaced slip jaws supported for radial movement upon the annular member, a tubular expanding member surrounding the mandrel and supported upon the uppermost external shoulder, the expanding member having a tapered peripheral surface for engagement with corresponding surfaces of the slip jaws to expand them, upon movement of the expanding member downwardly relative to the slip jaws, a cup shaped annular packer member, formed of resilient material, surrounding the mandrel and clamped between the upper end of the expanding member and the lower end of the tubular member, the packer member extending upwardly and radially outwardly from the mandrel for engagement with the well pipe, a cylindrical valve housing surrounding the tubular member, the tubular member being externally flanged at its upper end and the lower end of the valve housing being internally flanged for sliding engagement with the tubular member below its flanged upper end, an elongated member, circular in transverse section and having a central bore formed therein, connected by threads to the upper end of the valve housing, an annular valve plug, of smaller diameter than the elongated member and comprising a downward extension thereof, extending downwardly into the valve housing for telescoping engagement with the upper end of the tubular member, one or more side ports being formed in the valve housing intermediate its ends whereby fluid may flow through the valve housing, the tubular member and the mandrel when the valve housing is in its uppermost position relative to the tubular member, a circular member, of smaller diameter than the elongated member, positioned above the elongated member, the circular member and the upper end of the elongated member each having a peripheral groove formed therein for engagement by a setting tool, an elongated rod connected at its upper end to the circular member and reciprocable in the bore of the elongated member,

the rod extending downwardly through the tubular member and below the mandrel, a circular shoe connected to the lower end of the rod, and a plurality of circumferentially spaced resilient metal strips each connected at their ends to the annular member and the shoe, the metal strips being bowed radially outwardly intermediate their ends for yieldable, frictional engagement with the well pipe.

2. In combination with a retrievable bridge plug as described in claim 1, a setting tool comprising an inner cylinder and an outer cylinder, each open at its lower end, the inner cylinder being reciprocable in the outer cylinder, the circular member and the upper end of the elongated member being receivable in the inner cylinder, two sets each comprising a plurality of balls received in circumferentially spaced openings formed in the inner cylinder for engagement with the peripheral grooves formed in the circular member and the upper end of the elongated member, respectively, whereby the plug is secured to the setting tool, annular grooves being formed in the inner wall of the outer cylinder for engagement with the two sets of balls upon moving the inner cylinder upwardly relative to the outer cylinder, whereby the balls are disengaged from the peripheral grooves of the circular member and the upper end of the elongated member and the plug is released from the setting tool, the spacing of the annular grooves being such that the elongated member is released before the circular member is released, whereby the expanding member is advanced downwardly relative to the slip jaws, to expand them, a cylindrical member removably connected at its lower end to the upper end of the outer cylinder, an elongated rod connected at its lower end to the upper end of the inner cylinder and reciprocable in a central bore formed in the cylindrical member beginning at its lower end, the cylindrical member being internally enlarged to form a pair of longitudinally spaced, upwardly facing internal shoulders, a compression spring received in the cylindrical member, above the lowermost internal shoulder and surrounding the rod, a cylindrical enlargement, formed on the rod intermediate its ends, positioned in the cylindrical member above the uppermost internal shoulder, and acted on by the spring whereby it is urged upwardly therein, a swaged member removably connected at its lower end to the upper end of the cylindrical member, the outside diameter of the swaged member being reduced intermediate its ends to form an upwardly facing external shoulder, the upper end of the rod being reciprocable in a central bore formed in the upper end of the swaged member, a connecting member adapted to be suspended from the surface and removably connected at its lower end to the upper end of the swaged member, the connecting member having a bore aligned with the bore of the swaged member and in which the upper end of the rod is reciprocable, a peripheral groove being formed in the upper end of the rod, a plurality of balls received in circumferentially spaced openings provided therefor in the upper end of the swaged member, a collar surrounding the upper end of the swaged member and normally acting upon the balls to urge them in engagement with the peripheral groove of the rod, whereby the rod is restrained against longitudinal movement relative to the swaged member, the collar having an annular groove formed in its inner wall, adjacent its upper side, the balls being receivable in the annular groove of the collar, upon movement of the collar downwardly relative to the swaged member, whereby the rod is disengaged from the swaged member and is urged upwardly relative thereto, by the action of the compression spring, to release the plug from the setting tool, and a compression spring surrounding the upper end of the swaged member and acting upon the external shoulder and the under side of the collar whereby the collar is yieldably retained in its uppermost position relative to the swaged member.

3. In combination with a removable bridge plug having a stem comprising an elongated member having a rod

9

reciprocally arranged therethrough and slips in said plug adapted to be actuated by said rod, and a plurality of circumferential grooves in the upper end of said stem and said rod, a retrieving tool for said bridge plug, comprising, an outer cylinder, and an inner cylinder reciprocal in said outer cylinder, and adapted to receive said stem and said rod, a plurality of balls in circumferentially spaced openings in the lower end of said inner cylinder and engageable with the grooves in said stem and said rod whereby said plug is secured to said inner cylinder, annular grooves in the inner wall of said outer cylinder adapted to receive said balls and release the same from the grooves in said stem and said rod when said outer cylinder is moved longitudinally of said inner cylinder, a cylindrical member connected to the upper end of said outer cylinder, a second rod connected to the upper end of said inner cylinder and extending concentrically through said cylindrical member, annular shoulders formed in the upper and lower portions of said cylindrical member, an

10

enlargement formed on said second rod intermediate its ends engageable with said upper shoulder, a compression spring embracing said second rod in said cylindrical member below said enlargement and engaging the under surface thereof and said lower shoulder, whereby the inner cylinder is biased upwardly in said outer cylinder when the stem of said bridge plug is released therefrom, means for suspending said retrieving tool in a well, and releasable means for connecting said suspending means to the upper end of said second rod.

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