

Feb. 4, 1941.

W. BENDELER ET AL

2,230,712

WELL BRIDGING PLUG

Filed April 11, 1940

2 Sheets-Sheet 1

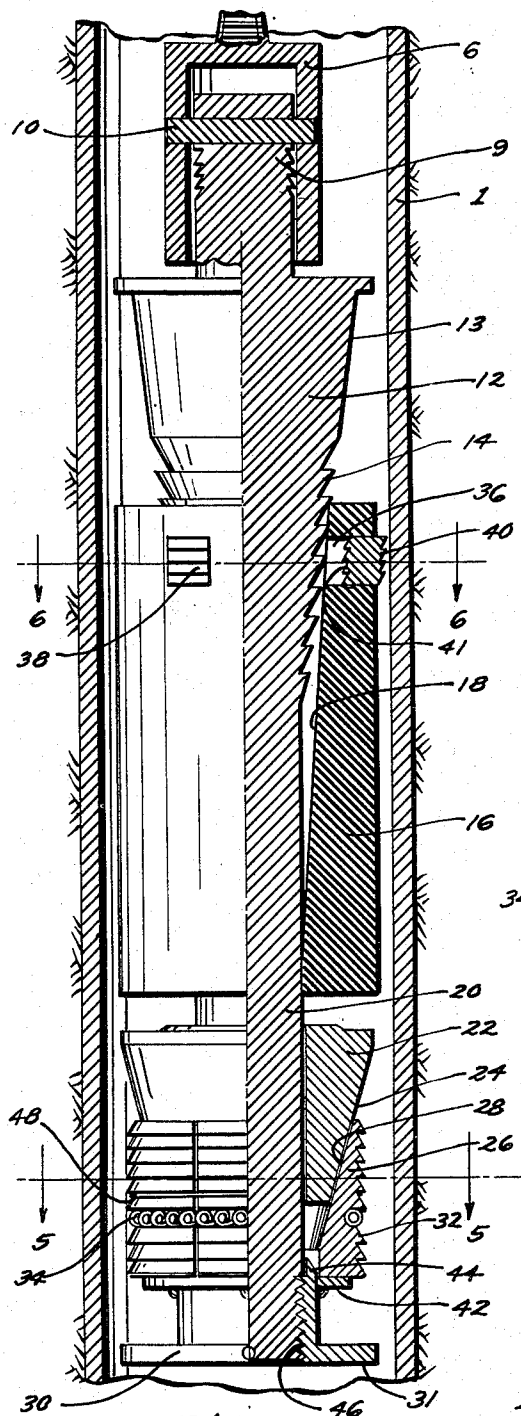


Fig. 1

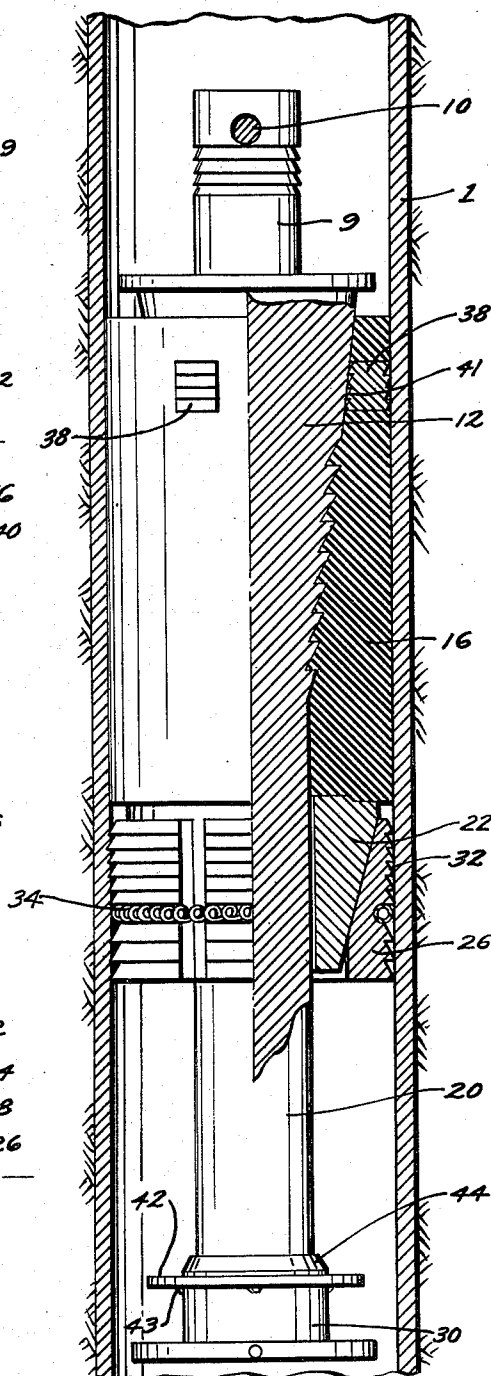


Fig. 2

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2 Sheets-Sheet 2

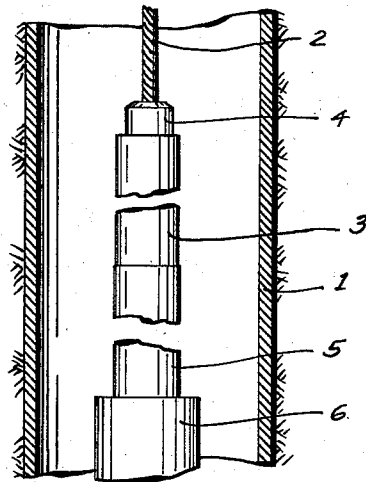
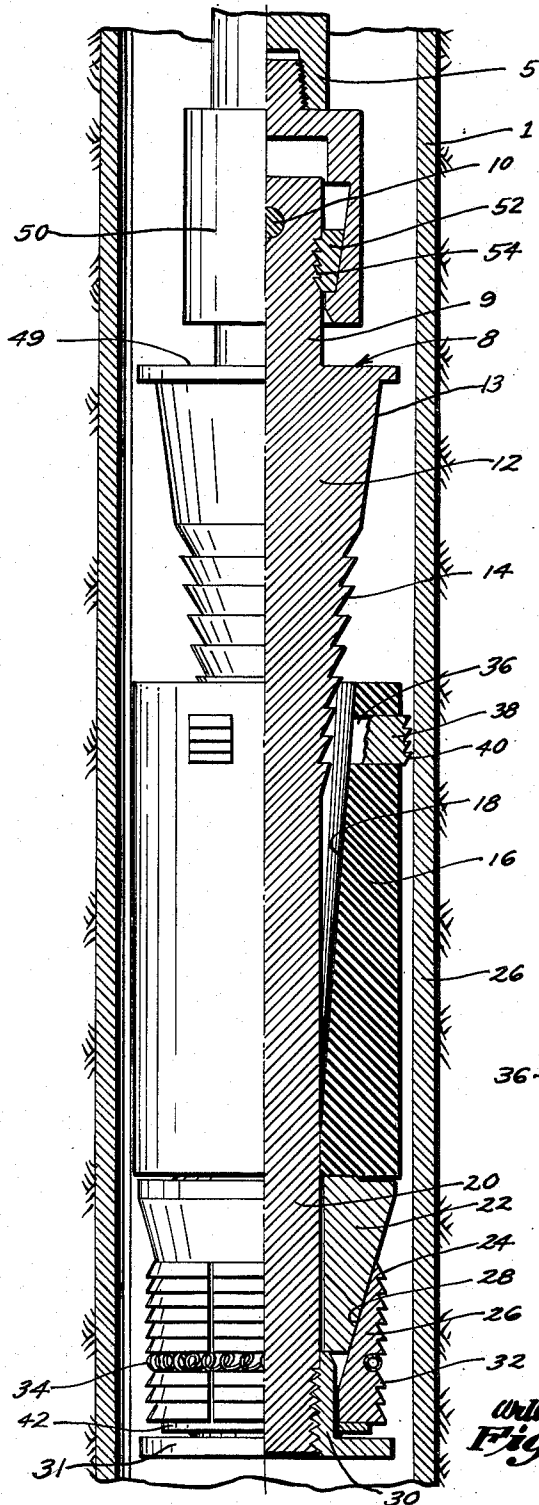


Fig. 4

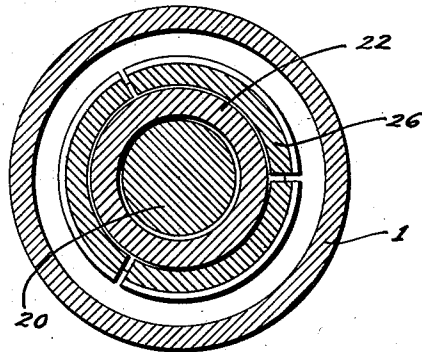


Fig. 5

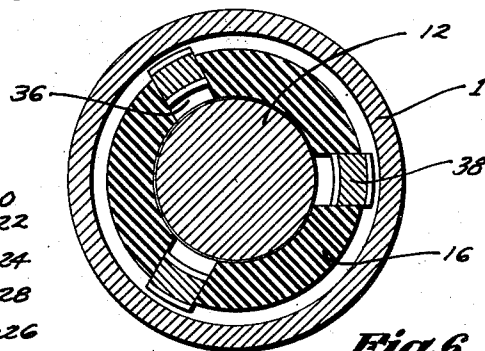


Fig. 6

William
Fig. 3

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UNITED STATES PATENT OFFICE

2,230,712

WELL BRIDGING PLUG

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Application April 11, 1940, Serial No. 329,183

11 Claims. (Cl. 166—13)

This invention relates to a well plug, and more particularly, but not by way of limitation to an oil well bridging plug adapted to be positioned in an oil well or the like for the purpose of sealing or plugging off a lower section of the well bore.

When a lower oil strata has been exhausted or ceases to be productive, rather than abandon the well, it is often desired to exhaust oil from an upper producing strata. This is done by tapping the upper stratas, but prior to the tapping operation it is necessary to position or set a bridging plug in the well hole to pack off or seal water and fluid that may be present in the original lower strata. Heretofore, bridging plugs once positioned in the well bore could only be removed by drilling out the plug from the well casing, which operation in most instances consumes considerable time. Furthermore, this drilling out lends the possibility of fracturing or drilling through the well casing, thus ruining the well.

It is therefore an important object of this invention to provide a bridging plug which can be set in a well hole, removed from the well hole and re-set in a comparatively short time.

A further object of this invention is to provide a bridging plug which may be lowered and positioned in the well hole by means of a wire rope or cable which is releasable when the plug is in set position.

Another object of this invention is to provide a removable bridging plug which when set forms a fluid tight seal in the well hole and resists pressure thrusts from either above or below the plug.

A further object of this invention is to provide a removable bridging plug which is so constructed that in lowering or removing the plug all possibility of drag against the well casing is eliminated.

And still a further object of this invention is to provide a removable bridging plug having a rubber sealing member cooperating with the well casing and including a series of small slip members assisting the rubber sealing member in holding said member in an engaging position against the casing regardless of bottom hole pressure.

And an additional object of this invention is to provide a removable bridging plug which is positioned in a well hole by means of a wire line whereby said wire line may be disconnected from the plug by a jarring action, said plug so constructed with a wickered or serrated neck portion at the upper end for receiving a special sock-

et carried by the wire line in removing the plug from the well hole.

And still a further object of this invention is to provide a removable bridging plug of novel construction which is durable, efficient in its action and will not independently release or slip once it is positioned in the well hole.

Other objects and advantages of the invention will be evident from the following detailed description read in conjunction with the accompanying drawings which illustrate one form of my invention.

Fig. 1 is an elevational view partly in section showing the bridging plug being lowered into the casing of a well hole.

Fig. 2 is a similar view showing the bridging plug in set position in the well hole.

Fig. 3 is a similar view showing the bridging plug being removed from the well hole.

Fig. 4 is an elevational view showing the cable tools connected to the plug.

Fig. 5 is a view taken on lines 5—5 of Fig. 1.

Fig. 6 is a view taken on lines 6—6 of Fig. 1.

Referring to the drawings in detail and more particularly to Figs. 1, 2 and 4, the bridging plug herein illustrated is adapted to be lowered into the well casing 1 on a cable or wire rope 2 secured at the top of the well to a reciprocating walking beam or like device capable of producing a quick stopping action (not shown). The lower end of the wire or cable 2 is connected to a straight bar or stem 3 providing weight and adapted to receive a threaded socket 4 securing the wire. The lower end of the bar 3 is secured to a jarring tool 5 which in turn is threaded to a drive collar 6 secured to the bridging plug. It will be apparent that the jarring tool can be of any conventional type to provide a jarring action in assisting the cable in setting or releasing the bridging plug in the well casing 1.

The bridging plug comprises a body portion or mandrel 8 having a reduced upper neck 9 for receiving the drive collar 6. The drive collar 6 is secured to the neck portion 9 by a stud or pin 10 disposed in aligned apertures of the neck and collar. The body portion has a central portion 12 of increased diameter provided with an outer taper or frusto-conical external surface 13 provided with serrations or projections 14. A collar 16 preferably composed of durable rubber or the like surrounds the portion 12 and is provided with tapered aperture or socket 18 complementary to the taper of the portion 12.

The lower portion 20 of the mandrel 8 is substantially cylindrical and is adapted to receive

an apertured slip head 22 having a frusto-conical or tapered outer periphery 24 cooperating with a plurality of slips 26 (preferably 3), each having a complementary tapered internal surface 28. A nut 30 is threaded to the lower end of the portion 20 and is provided with an outwardly projecting flange 31 to prevent disassembly of the various elements of the plug. The outer periphery of slips 26 is provided with serrations or projections 32. The slips 26 are held in assembled relation on the portion 20 by a small helical spring 34 disposed in one of the grooves provided by the serrations.

Alluding further to the rubber collar 16, said collar is provided with a plurality of bores or cavities 36 (preferably three) adapted to receive small metal blocks or slips 38 having serrations 40 and 41 provided on the outer and inner side faces respectively and disposed in an opposite direction to each other for a purpose as will be hereinafter set forth.

An annular flange or ring 42 is adapted to be spot welded at the upper end 43 of the nut 30 for a purpose as will be hereinafter set forth. Furthermore, it will be noted that the upper end of the nut is provided with a tapered extension 44 extending axially from the threads 46 for a purpose to be hereinafter described.

Operation

Prior to lowering the bridging plug in the well casing 1, a piece of bailing or small wire 48 is disposed around the slips 26 for holding them in the position shown in Fig. 1. The bailing wire 48 holds the slips in a retracted position to allow only a limited protrusion of the slip head 16 into portions 28, thus preventing any drag of the slips against the casing during the lowering operation. Furthermore, the welded ring 42 supports the slips 26 in proper position during the lowering operation. With the plug lowered into position to be set, a jerk on the wire line causes a reciprocation of the plug and slips, fracturing the bailing wire to allow further axial movement of the slip head 22 to move the slip radially outward against the tension of spring 34 and into biting engagement with the interior of the casing, thus anchoring the bridging plug in the well hole. A continued jarring movement by the cable tools causes the drive collar 6 to shear the pin 10 whereupon the collar 6 jars against the top 49 of portion 12 to move the mandrel axially downward and radially expanding the collar 16 into frictional and seal tight engagement with the casing 1. From Fig. 2 it will be noted that the lower face of collar 16 contacts slip head 22 to assure efficient anchoring of the slips 26. It will be apparent that engagement of the collar 16 with the casing likewise provides engagement of the small slips 38 and their teeth 40 and 41 with the casing 1 and mandrel portion 12 respectively. The engagement of slips 38 assists the sealing of collar 16 by resisting any bottom hole pressure. The serrations 14 of the mandrel are adapted to indent the tapered inner periphery 18 of the collar 16 to prevent slippage between the mandrel and collar. It will be apparent that the shearing of the pin 10 releases the drive collar 6 from the neck portion 9 to allow the removal of the wire line and jarring tool when the bridging plug is in set position in the well casing. (Fig. 2.)

When it is desired to remove the bridging plug from the well hole, the wire line 2, stem 3 and jarring tool 5 are lowered into the well casing,

but as shown in Fig. 3, in lieu of the drive collar 6, a special releasing collar 50 is connected to the lower end of jarring tool 5. A set of small slips 52 are disposed in the collar 50 and are adapted to engage the serrations 54 on the neck portion 9 of the plug. In this manner the collar 50 is connected to the mandrel, and an upward jarring action by the cable tools pulls the mandrel axially upward against the bite of the small slips 38 and the indentions of the serrations 14 in the rubber collar 16. The upward pull and jarring action causes a shearing of the small teeth 41 against the outer periphery 13 of the mandrel 8 which releases the slips 38 from their frictional engagement with the casing 1, simultaneous with a release of the collar 16. Furthermore, in the upward jarring action the serrations 14 merely slip out of the indentions in the upper collar 16 due to the flexibility of the rubber collar.

A particular feature to be noted is that on the upward axial movement of the mandrel 8 and portion 20, the welded ring 42 contacts the under face of slips 26 breaking the weld and allowing the ring and slips 26 to move axially downward and rest on the nut flange 31 out of contact with the casing 1. The spring 34 retracts the slips 26, and in order to prevent any possibility of the slips dragging against the casing during removal of the plug, the tapered portion 44 of the nut 30 acts as a stop for the axial movement of the slip head 22 to limit the downward movement of the head 22 to prevent any radial expansion of slips 26. Upon removal of the plug from the well hole, it will be apparent that the various parts can be re-assembled for a re-setting operation. Obviously, it will be necessary to re-place the small slips 38, shear pin 10 connecting the drive collar 6, as well as re-weld the annular ring 42.

From the foregoing it will be apparent that this invention provides a well bridging plug capable of being set and released from a well hole by a wire cable, and when in set position forms a fluid tight seal for resisting hydrostatic pressure either above or below the plug. Furthermore, the invention contemplates the elimination of all drag of the plug in lowering it into the well hole, as well as removing it from the well hole.

Changes may be made in the combination and arrangement of parts as heretofore set forth in the specification and shown in the drawings, it being understood that any modification in the precise embodiment of the invention may be made within the scope of the following claims without departing from the spirit of the invention.

What I claim is:

1. In combination with a bridging plug adapted to be positioned in the casing of a well hole by a wire line and comprising a mandrel having resilient sealing means disposed thereon, a jarring tool secured to the wire line, a collar carried by the jarring tool, a pin connecting the collar to an upper neck portion of the mandrel, said pin adapted to be fractured by a jarring action of the tool to release the collar from the mandrel whereby said mandrel may be moved axially downward by the jarring tool to radially expand the resilient means into seal tight engagement with the casing.

2. In combination with a bridging plug adapted to be lowered into a well hole by a wire line and comprising a tapered mandrel having a resilient sleeve disposed thereon, a jarring tool se-

cured to the wire line, a collar carried by the jarring tool, means connecting the collar to the upper portion of the mandrel, said mandrel being actuatable by the tool to move axially, means on the mandrel for radially expanding the resilient sleeve into seal tight engagement with the well wall upon axial movement, and means disposed in the resilient sleeve for gripping the well wall and assisting the engagement of the resilient sleeve with the well wall.

3. In combination with a bridging plug adapted to be lowered into a well hole by a wire line and comprising a mandrel having a frusto-conical outer periphery with a resilient collar disposed thereon, a jarring tool secured to the wire line, a collar carried by the jarring tool, means connecting the collar to the upper portion of the mandrel, said mandrel actuatable by the tool to move axially to radially expand the resilient collar into seal tight engagement with the walls of the well hole, a plurality of slip means disposed in the resilient collar for gripping the well wall and assisting the engagement of the resilient collar with the well wall.

4. In combination with a bridging plug adapted to be positioned in a well hole and comprising a mandrel having resilient means disposed thereon, a jarring tool, a collar carried by the jarring tool, means connecting the collar to an upper neck portion of the mandrel, a slip head mounted on the mandrel below the resilient means, slips disposed on the mandrel below the head, means restricting radial movement of the slips during the lowering operation, said restricting means being rendered inoperative by a reciprocable thrust of the jarring tool to allow radial expansion of the slips by axial movement of the slip head for anchoring the plug in the well hole.

5. In combination with a bridging plug adapted to be lowered into a well hole and comprising a mandrel having a rubber sleeve disposed thereon, of a jarring tool, a collar carried by the jarring tool, means connecting the collar to the upper portion of the mandrel, said means adapted to be rendered inoperative by a jarring action of the tool for disconnecting the collar from the mandrel, said jarring tool upon disconnection being adapted to force the mandrel axially downward for radially expanding the rubber sleeve into seal tight engagement with the walls of the well hole.

6. In combination with a bridging plug comprising a mandrel adapted to be positioned in a well hole and having slips disposed thereon for anchoring the plug against downward movement, an expansible sleeve disposed on the mandrel for securing the plug against upward movement, and operating elements for said mandrel accessible from the upper end of the plug including, a jarring tool having a drive collar secured to the upper end of the mandrel, means securing the collar to the mandrel and responsive to a jarring action of the tool for releasing the drive collar to allow removal of the tool and collar from the hole, a retrieving tool adapted to be carried by the jarring tool and lowered into engagement with the upper end of the mandrel, said retrieving tool cooperating with the jarring tool for moving the mandrel axially upward to remove the plug from the hole.

7. In combination with a bridging plug comprising a mandrel adapted to be positioned in a well hole and having slips disposed thereon for anchoring the plug against downward move-

ment, an expansible sleeve disposed on the mandrel for securing the plug against upward movement, and operating elements for said mandrel accessible from the upper end of the plug including, a jarring tool having a drive collar secured to the upper end of the mandrel, means securing the collar to the mandrel and responsive to a jarring action of the tool for releasing the drive collar to allow removal of the tool and collar from the hole, a retrieving tool adapted to be carried by the jarring tool and lowered into engagement with the upper end of the mandrel, said retrieving tool cooperating with the jarring tool for moving the mandrel axially upward to remove the plug from the hole, and means preventing drag of the slips during the removal of the plug.

8. In combination with a bridging plug lowered in a well hole by a wire line and comprising a mandrel having resilient means expanded in seal tight engagement in the well hole, a jarring tool secured to the wire line, a retrieving collar carried by the jarring tool, slip means disposed in the collar for connecting the collar to an upper neck portion of the mandrel, a slip head slidably mounted on the mandrel below the resilient means, anchoring slips disposed on the mandrel below the head, a flanged nut threaded to the lower end of the mandrel and having an axially projecting portion, means carried by the nut for supporting the slips, said means actuatable responsive to a jarring action of the retrieving tool to allow the slips to move axially downwardly and inwardly out of contact with the well hole, said nut projecting portion limiting downward movement of the slip head to prevent radial expansion of the slips in the removing operation.

9. In combination with a bridging plug adapted to be positioned in a well hole by a wire line and comprising a mandrel having a frusto-conical outer periphery with resilient sealing means disposed thereon, a jarring tool secured to the wire line, a collar carried by the jarring tool, means connecting the collar to a serrated neck portion of the mandrel, a slip head slidably mounted on the mandrel below the resilient means, slips disposed on the mandrel below the head, means restricting radial movement of the slips during the lowering operation, said restricting means actuatable responsive to a jarring action to allow radial expansion of the slips by the slip head for anchoring the plug in the well hole, and said connecting means releasable responsive to a continued jarring action by the tool to disconnect the collar from the mandrel to allow axial movement of the mandrel for radially expanding the resilient means.

10. In a bridging plug comprising a mandrel, a resilient collar disposed on the mandrel, a slip head freely slidable on the mandrel below the collar, slips disposed on the mandrel below the slip head, a flanged nut secured to the lower end of the mandrel, a slip supporting ring secured to the nut, said nut provided with an axially projecting portion extending above the ring, said supporting ring adapted to be moved downward upon a release of the slips whereby said slips are moved out of contact with the well hole, said nut projecting portion limiting downward movement of the slip head to prevent expansion of the slips during removal of the plug.

11. In combination with a plug adapted to be lowered into a well hole on a wire line, a mandrel having a rubber collar disposed thereon, a jar-

ring tool secured to the wire line, and releasable means connecting the mandrel to the jarring tool, a slip head slidably mounted on the mandrel below the rubber collar, slips disposed on the mandrel below the head, means restraining axial movement of the slip head for preventing radial movement of the slips during the lowering operation, said restraining means being rendered inoperative by a jarring action of the tool

to allow radial expansion of the slips by the head to anchor the plug in the well hole, and means responsive to further jarring action by the jarring tool to move the mandrel axially to radially expand the collar into seal tight engagement with the walls of the hole.

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