May 26, 1959 H. F. CYPHER 2,888,079

PLUGGING TOOL FOR A WELL PIPE

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Fig. 1

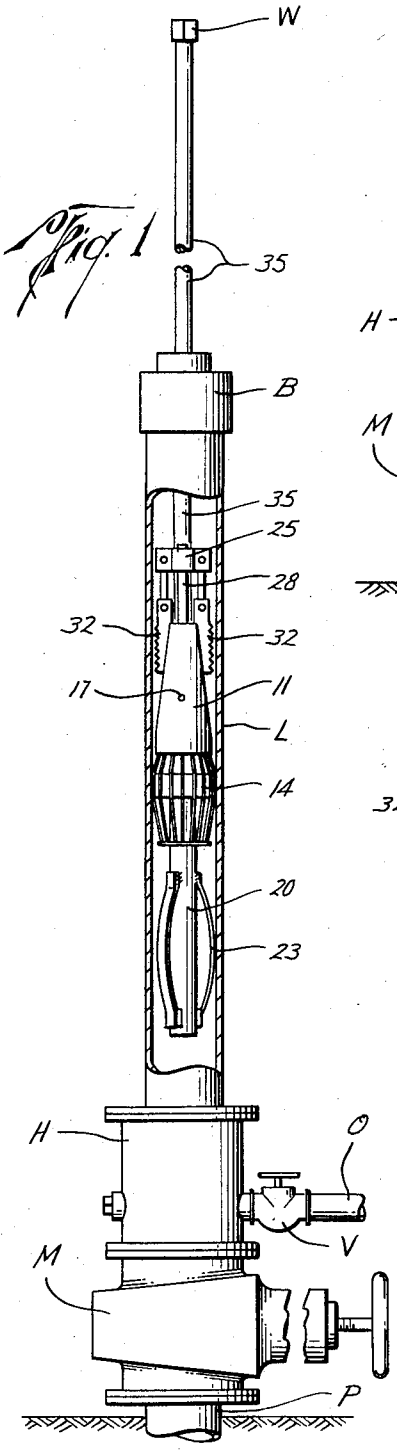


Fig. 2

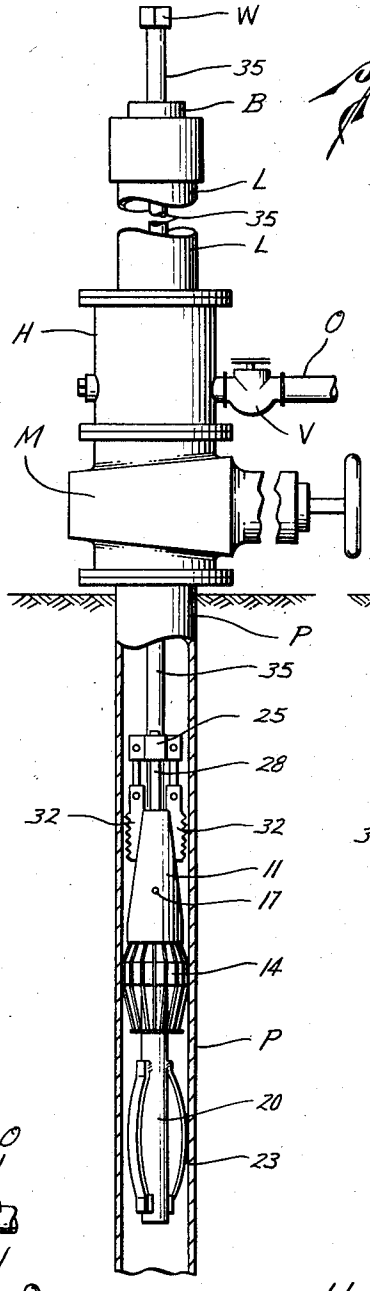
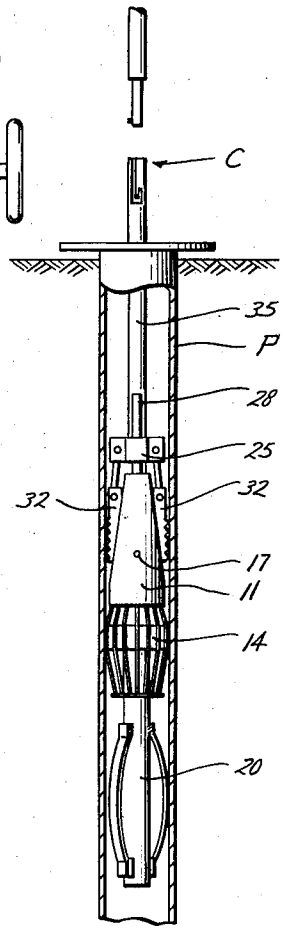


Fig. 3



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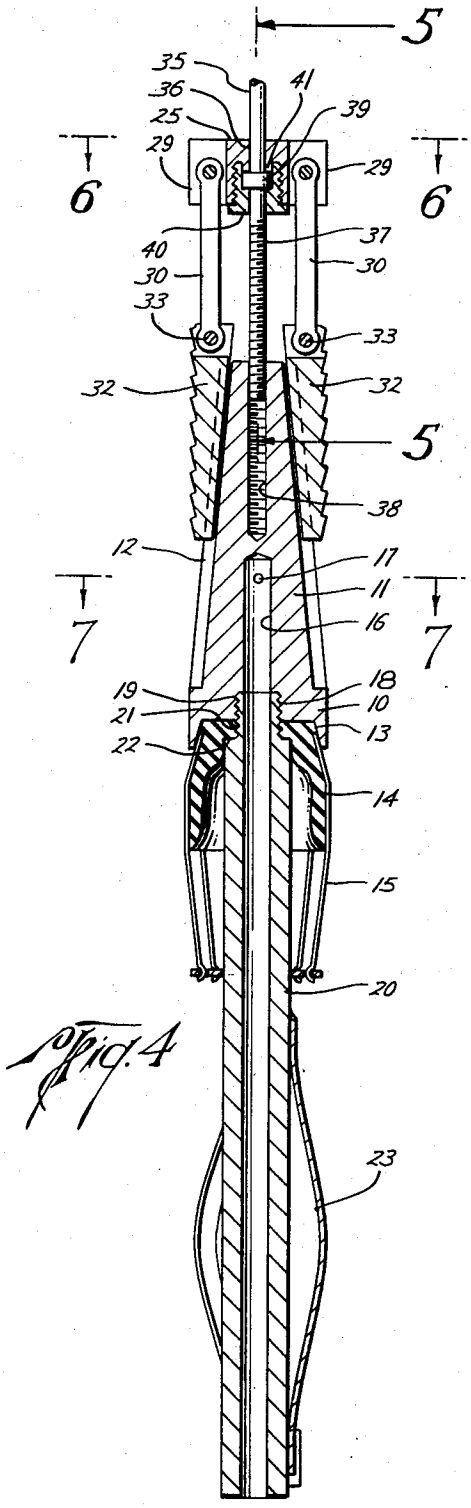


Fig. 4

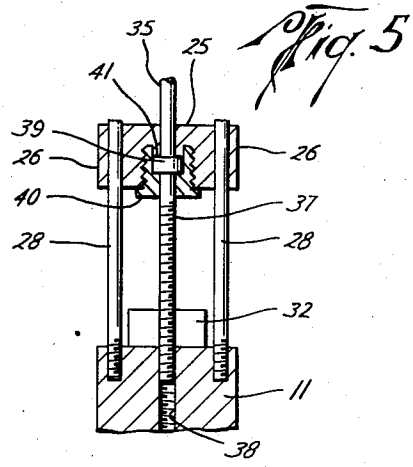


Fig. 5

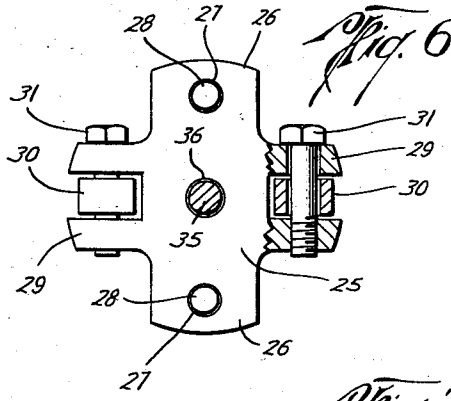


Fig. 6

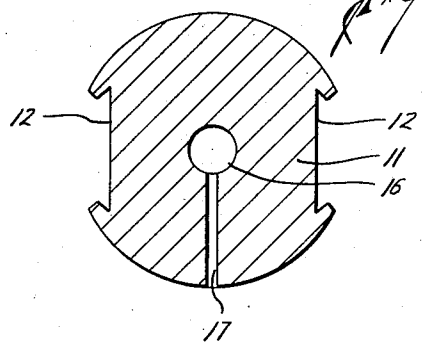


Fig. 7

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PLUGGING TOOL FOR A WELL PIPE

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Application October 9, 1957, Serial No. 689,074

3 Claims. (Cl. 166—139)

This invention relates to plugging tools for use in well pipes, and particularly for an improved form of removable plug for plugging high pressure gas wells.

In operation of oil and gas wells, particularly high pressure gas wells, it is often necessary, because of wear, erosion and other damage, to replace the wellhead fittings and the master valve, in particular. Ordinarily, the well must be killed by filling it with heavy mud in order to permit removal of the defective equipment and replacement with new equipment. The introduction of mud into the well very often is seriously damaging to the producing formations and it is highly desirable to avoid such a method of killing a well for repair or replacement of wellhead equipment.

Accordingly, it is a primary object of the present invention to provide a plugging device which may be inserted through the wellhead into the well pipe and anchored therein to effectively plug the well below the fittings, which it is desired to remove.

Another object is to provide a retrievable plugging device for plugging off a well.

A further object is to provide a plugging device which can be inserted through a lubricator mounted on top of a well and positioned in the well casing below the wellhead, and which may be actuated from the surface to anchor, and release, the plug in the well pipe by means of a rotatable drive stem which extends through the lubricator to the exterior thereof.

Still another object is the provision of a retrievable plugging device which can be inserted in a well pipe to plug the same, and which is provided with a pressure equalizing passage therethrough so that the device may be readily inserted into a well under high pressure.

Other and more specific objects and advantages of this invention will become apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with the present invention.

In the drawing:

Figs. 1, 2 and 3 illustrate several stages in the operations of inserting and setting the plugging device in a well pipe;

Fig. 4 is a longitudinal sectional view of the plugging device;

Fig. 5 is a detail of the upper portion of the device taken along line 5—5 of Fig. 4;

Fig. 6 is a plan view, partly in section, of the upper end of the device; and

Fig. 7 is a cross-sectional view taken generally along line 7—7 of Fig. 4.

Referring to the drawing and initially to Figs. 4 to 7, the plugging device comprises the generally cylindrical body 10 having its upper portion shaped to form an upwardly tapered slip mandrel 11 having slip-receiving dove-tail grooves 12 on opposite sides thereof. At its lower end, body 10 is provided with a generally circular socket 13 adapted to receive the upper end of a flexible, resilient cup seal 14, such as a conventional swab cup,

which opens downwardly and is provided with a reenforcing wire cage 15 of generally conventional design. An axial passage 16 communicates with socket 13 and extends part-way upwardly of body 10 and opens to the exterior thereof through a passageway 17 of relatively restricted area. The lower end of passage 16 is internally threaded at 18 to receive the threaded pin member 19 of a tubular nipple 20 which extends through a central opening 21 in swab cup 14. A shoulder 22, at the base of pin member 19, serves to clamp swab cup 14 in socket 13 when pin member 19 is screwed into the lower end of body 10. Nipple 20 carries outwardly bent bow springs 23 which are adapted to frictionally engage the wall of the well pipe P (Figs. 1, 2 and 3) to constrain body 10 against rotation in pipe P while permitting longitudinal movement in the pipe.

Mounted vertically above the upper end of mandrel 11 is a collar member 25 provided with a pair of oppositely extending ears 26—26, having openings 27—27 therein to slidably receive a pair of upstanding guide rods 28—28 mounted on the upper end of mandrel 11. Rods 28 serve to constrain collar member 25 against rotation while permitting axial movement of the collar member relative to the upper end of the mandrel. Collar member 25 is provided on diametrically opposite sides thereof at right angles to ears 26—26, with bifurcated ears 29—29 which receive the upper ends of links 30—30, which are pivotally secured to the ears for radial movement relative thereto by means of the removable pivot pins 31—31. The lower ends of links 30 are pivotally connected, by means of pivot pins 33—33, to the upper ends of wedge-shaped pipe-gripping slips 32—32 which are slidably disposed in dove-tail grooves 12—12 of the mandrel. Thus, the slips are pendently secured to collar member 25 for longitudinal movement along the tapering surfaces of mandrel 11 in response to axial movement of the collar member. The pivoted connections between the slips and the collar member permits radial movement of the slips in response to their longitudinal movement in grooves 12. Thus as collar member is moved downwardly, the slips will be radially projected into pipe-gripping engagement, and when collar member 25 is retracted the slips will be withdrawn from engagement with the well pipe.

In order to move the collar member axially relative to the mandrel for actuating the anchor slips, an elongate stem member 35 is inserted through an axial journal 36 in collar member 25 and is provided at its lower end with a section of external threads 37 receivable in a threaded socket 38 extending axially downwardly into the upper end portion of mandrel 11. The portion of stem 35 which extends through collar member 25 is provided with an annular shoulder 39 which is confined in journal 36 against axial movement therein by means of a tubular bushing 40 which is screwed into the lower end of journal 36 of the collar member and bears against annular shoulder 39, the latter being prevented from moving upwardly through journal 36 by a downwardly facing shoulder 41 provided in journal 36.

Stem 35 thus provides a drive connection between the collar member and the mandrel which, when rotated in one direction by screwing thread section 37 into socket 38, will move collar member 25 and its attached slips downwardly relative to mandrel 11, thereby moving the slips into pipe-gripping engagement and which, when rotated in the opposite direction, will raise collar member 25 relative to the mandrel and will retract the slips upwardly along the mandrel and thereby withdraw them from engagement with the well pipe.

The device above described is operated in the following manner, reference being had to Figs. 1, 2 and 3 in connection with the description of the operation: The

device is inserted into a conventional tubular lubricator L which is mounted on the top of a wellhead fitting H having an outlet pipe O fitted with a control valve V. Wellhead H is connected to the master valve M, which is mounted in a generally conventional manner on the well pipe P, master valve M being designed to open to the full diameter of pipe P, as is generally conventional. With master valve M closed, the plugging tool will be inserted in lubricator L, and stem 35 will be made sufficiently long to project upwardly through the usual stuffing box B which closes the upper end of lubricator L. Stem 35 will preferably be made up of two or more sections and the joint nearest the plugging tool will be of a suitable and generally conventional releasable construction, such as a bayonet-type connection C (Fig. 3), which will permit the stem to be rotated as a whole, but may be separable, when desired, in order to disconnect the upper sections of the stem from the section connected directly to the plugging device. The upper end of the stem may be provided with a square section W for application of a wrench or similar tool, for turning the stem. When the device has been inserted in the lubricator, as shown in Fig. 1, the master valve will be opened and by a downward force applied in any suitable manner to stem 35, the entire device will be forced downwardly through the wellhead and the master valve into pipe P to a point below the master valve, as best seen in Fig. 2. When the plugging device has thus attained the desired position below the master valve, stem 35 will be rotated in a direction to advance slips 32 downwardly along mandrel 11 in order to urge them into wedging engagement with pipe P to thereby anchor the plug in the pipe. Swab cup 14 will form a seal with the pipe by reason of the pressure in pipe P which will enter the interior of the cup and expand the cup into tight engagement with the pipe wall. Some gas will escape upwardly through the bore of nipple 20 and passages 16 and 17 into the bore of pipe P above the cup seal 14. This will serve to equalize the pressures, thereby allowing the device to move downwardly in the pipe while, at the same time, the restricted area of passage 17 will act as a choke to cause the pressure to be exerted against the interior of cup 14 and effect the tight sealing desired. The small amount of gas which will escape through passage 17, will not be sufficient to interfere with the subsequent operations.

When the plug has been set in pipe P, as described, the releasable connection between the stem sections will be broken and the upper portion of the stem withdrawn from lubricator L, thereupon the lubricator L, wellhead H and master valve M will be removed from the top of pipe P, as best seen in Fig. 3, and a new master valve or other fittings substituted therefor. When the new master valve and wellhead fittings are in place, the lubricator is reconnected and the upper portions of stem 35 are reinserted and re-engaged with the lower portion of stem 35, whereupon the stem is rotated in the direction to retract slips 32 and release the same from its engagement with pipe P. Thereafter, an upward pull on stem 35 will be employed to withdraw the tool upwardly through the master valve and wellhead fittings into lubricator L, whereupon master valve M will be closed and pressure bled off from the lubricator through outlet pipe O by opening valve V. When the pressure is thus relieved in the lubricator, the latter may be disconnected from the wellhead and the plugging tool withdrawn therefrom for re-use in a subsequent operation.

It will be understood that various changes and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims, but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. A plugging device for a well pipe, comprising, a body insertible in a well pipe and including an upwardly tapered slip mandrel, a downwardly opening flexible cup seal secured to the body below the mandrel, an elongate stem extending axially into the upper end of the body and having a screw connection thereto for effecting axial movement of the stem relative to the body by rotation of the stem, a collar member secured to the stem for axial movement therewith relative to the upper end of the mandrel, a plurality of radially movable pipe-gripping slips pendent from the collar member and slidable on the mandrel in response to axial movement of the collar member, means carried by the body frictionally engageable with the well pipe to restrain said body against rotation in the pipe, and a pressure equalizing passage of restricted area through said body.

2. A plugging device for a well pipe, comprising, a body insertible in a well pipe and including an upwardly tapered slip mandrel, a downwardly opening flexible cup seal secured to the body below the mandrel, an elongate stem extending axially into the upper end of the body and having a screw connection thereto for effecting axial movement of the stem relative to the body by rotation of the stem, a collar member secured to the stem for axial movement therewith relative to the upper end of the mandrel, guide means projecting upwardly from the mandrel and slidably engaging the collar member to restrain rotation thereof, a plurality of radially movable pipe-gripping slips pendent from the collar member and slidable on the mandrel in response to axial movement of the collar member, means carried by the body frictionally engageable with the well pipe to restrain said body against rotation in the pipe, and a pressure equalizing passage of restricted area through said body.

3. A plugging device for a well pipe, comprising, a body insertible in a well pipe and including an upwardly tapered slip mandrel, a downwardly opening flexible cup seal secured to the body below the mandrel, a threaded socket in the upper end portion of the mandrel, a cylindrical stem threadedly inserted in said socket, a collar member disposed about the stem above the mandrel, said collar member having an axial opening to rotatably receive the stem, an annular shoulder on the stem cooperable with abutting upper and lower shoulders in said opening to prevent relative longitudinal movement between the stem and the collar member whereby the collar member will be axially movable relative to the mandrel in accordance with the movements of the stem, a plurality of pipe-gripping slips slidably disposed on the mandrel, radially pivotable links pendently connecting said slips to the collar member, guide means on the mandrel slidably engaging the collar member to restrain rotation thereof, means carried by the body frictionally engageable with the well pipe to restrain rotation of the body in the pipe, and a pressure equalizing passage of restricted area through the body.

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