March 2, 1954 R. E. DOBBS 2,670,799

COLLAPSIBLE PIPE PLUG

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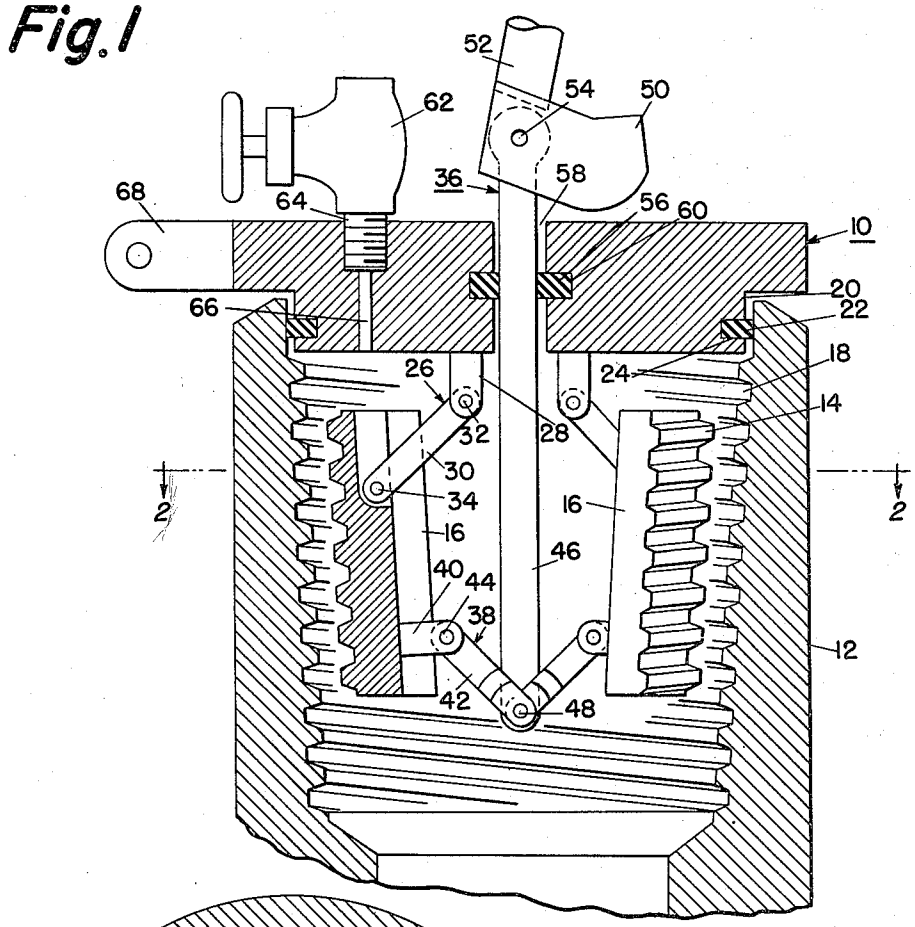
Fig. 1



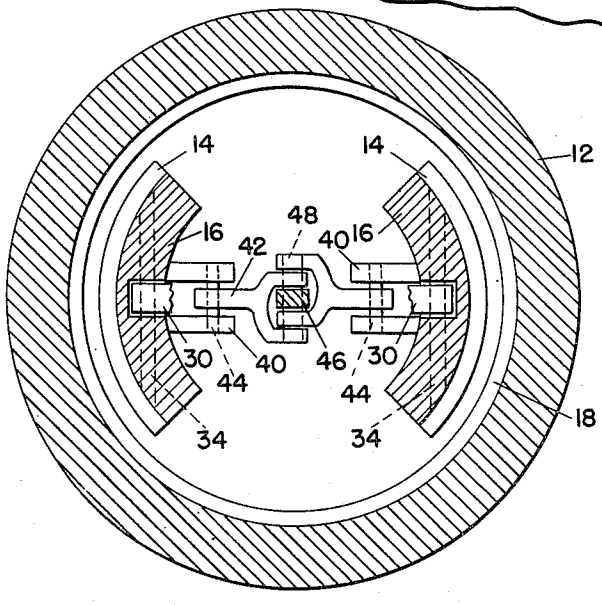


Fig. 2

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COLLAPSIBLE PIPE PLUG

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6 Claims. (Cl. 166—14)

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This invention relates in general to pipe plugs and more particularly to an improved form of quick operating pipe plug adapted for use in well drilling operations.

The rotary method of drilling wells for the production of oil or gas requires a fluid as a carrier of the drilling debris and as a lubricant and cooling medium for the drilling bit. This fluid commonly referred to as "drilling mud" is pumped through the well borehole during the drilling operation and completely fills the hole. From time to time as the work progresses, it is necessary to lower special equipment and tools into the well for which there is just sufficient clearance in the hole or casing for the operation. Consequently, the drill pipe used to suspend such equipment is filled with the displaced drilling mud as it is lowered into the well. This fluid flows out the end of the lowering drill pipe and is lost for further operation. In addition to the added cost for drilling fluid, an unpleasant and hazardous condition is created in which the working crews must operate.

It is a common practice to conserve the drilling mud and prevent the unpleasant and hazardous conditions by plugging the section of drill pipe which is being lowered into the well. As the drill pipe under consideration has an internal thread, it requires a threaded plug which must be inserted and removed for each length of drill pipe used. This is time consuming and must be transferred by the floor crew in the derrick to the derrick man, who works above the derrick floor, for each subsequent operation. It is, therefore, an object of this invention to provide a pipe plug which is simple in construction and reduces the time now consumed in using screw plugs.

Devices of this type have been designed and are usually very complex in structure involving many operating parts. The complexity of the known devices is increased because they are designed as stoppers for unthreaded pipe. This normally requires that a sealing section which is capable of expansion against a smooth surface be included as well as gripping elements designed to hold the stopper in place to resist high internal pressures. It is a further object of this invention to provide a pipe plug which will utilize the internal threads of pipe as a gripping area and requires no expanding sealing surfaces.

In accordance with the present invention, a pipe plug is disclosed in which the engaging slips are pivoted from a cap which fits on the end of

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the internally threaded pipe. The pivoted slips are segmented to fit readily into the threaded end section of the pipe and are chased with a duplicate thread on the engaging surface to fit tightly into the pipe thread. The pivoted arms which support the slips are attached to both the cap and to an operating lever which extends upwardly through the center of the cap. The operation of this lever forces the slips into engagement with the threaded surface of the pipe and simultaneously locks the cap in place over the end of the pipe. The reverse operation of the lever quickly releases the plug for further use.

In order that a better understanding of the invention may be had, reference is made to the following detailed description and the accompanying drawing in which:

Figure 1 is a section in elevation of the device in position, and

Figure 2 is a cross-section of Figure 1 along lines 2—2.

In the drawings, Figure 1 shows the pipe cap generally denoted by the numeral 10 as it fits on a section of internally threaded drill pipe 12 with threaded contact surface 14 of the slips 16 about to engage the threads 18 of the drill pipe. The cap 10, preferably made of metal but which may be made of any other satisfactory material, is reduced in diameter as at 20 to approximate the internal diameter of the pipe with which it is to be used. A sealing ring 22 is inserted in a groove 24 so as to engage the internal pipe periphery.

The slips 16 shown here as two in number diametrically opposite to each other, are suspended from the cap 10 by toggle mechanisms 26 which include an anchor arm 28 firmly fastened to cap 10 and a movable arm 30 pivoted to the anchor arm 28 by pin 32 and to the upper part of slip 16 by pin 34. It will be noted that both slips are suspended from the cap by similar toggle mechanisms. The lower part of the slips 16 is connected to an operating lever assembly 36 by like toggle devices generally denoted by the numeral 38. In the lower toggle mechanism 38, the anchor arm 40, in each case, is firmly fastened to the lower part of the slip 16 and the movable arm 42 is pinned to the anchor arm 40 by pin 44 and coupled to the plunger 46 of the operating lever assembly 36 by pin 48. As shown in Figure 2, the connection of the movable arms 42 to the plunger 46 by means of pin 48 shows the movable arms 42 to be bifurcated giving a balance and strength required for quick and proper operation.

The operating lever mechanism generally denoted by the numeral 36 includes the described plunger 46 and a cam 50 with a lever 52 fixed to the cam 50 and pivotally attached by pin 54 to the upper end of the plunger 46. The plunger 46 is concentrically arranged to extend through the cap 10 and is here shown enclosed by a seal 56 to prevent the escape of drilling mud through the opening 58 in the cap. An annular groove 60 is made in the center opening 58 of the cap through which the plunger 46 passes to position and holds the seal 56.

A valve 62, here shown as a manually operated vent valve but which may also be an automatically operated escape valve, is shown threaded into the cap as at 64 over a vent hole 66 placed to permit the escape of pressures which will be more fully understood after reading the discussion of the operation of the device.

The cap 10 has a projection 68 having an eye to receive the hook of an elevator which is standard equipment in the operating rigging of a derrick and is the means by which the cap, after release by the floor crew, is lifted to the derrick man for re-use on the next section of drill pipe.

The operation of this device will undoubtedly be clear from the description of the elements above, but to fully understand the advantages of this particular mechanism a specific example of its application will be described.

The derrick man, working above the upper end of the drill pipe, receives the plug assembly as it is lifted by an elevator in the derrick. With a minimum of effort the slips 16 are retracted by lifting the lever 52 to avoid burring the internal threads 18 in the drill pipe 12 and is positioned relative to the pipe as shown in Figure 1. With the slips 16 retracted and inserted and the cap 10 held in position with the sealing ring 22 pressed into the end of the pipe 12, as shown, the derrick man pushes the lever 52 down toward a horizontal position. This movement engages the cam 50 with the upper face of cap 10 and moves the plunger 46 upwardly through the aperture 58 in the cap 10. The upward movement of the plunger 46 raises the movable arms 42 of the lower toggle assembly 38 forcing the lower section of the slips 16 outwardly and engages the lower threaded contact surface 14 with the internal threads 18 of the drill pipe 12.

As the movable arms 42 of the lower toggle mechanism 38 are pivoted at pins 44 and 48, there is no appreciable upward movement of the slips 16 as they move outwardly to engage the threads 18 with their threaded contact surfaces 14.

With the lower threads of the threaded surfaces 14 of the slips 16 engaging the threads 18 of the drill pipe, the cam 50 forces downwardly on the upper surface of the cap 10 and moves the fixed arms 28 of the upper toggle assemblies 26 downwardly causing the movable arms 30 to pivot about the pins 32 and 34 thus forcing the upper parts of the slips 16 into locking engagement with the internal pipe threads. It will be evident that the rocking motion of the slips 16 starting from the bottom threads and progressively engaging the threads upwardly preserves the threaded area of the pipe and pulls the cap 10 into sealing engagement with the end of the pipe.

With the described pipe plug in place, the section of drill pipe may be lowered into the borehole without the drilling fluid escaping from the plugged end. Where entrapped air is held beneath the plug, it may be released by the valve 62 or a similar device without permitting the escape of the drilling mud. On reaching the derrick floor, the crew releases the plug, rapidly and without damage to the pipe thread, by lifting the lever 52 which reverses the motion of the slips 16 and withdraws them from engagement. Another opening of valve 62 will break any suction on the cap 10, and the hook of an elevator engaged in the eye in projection 68 will lift the plug free of the pipe and move it up to the derrick man for the next operation.

From the above description, it is apparent that a pipe plug is provided especially adapted for use with internally threaded pipes. It will be further noted that the slip engagement is made in a locking movement starting at the bottom of the slips and not completing the locking engagement until the lever mechanism is completely in the closed position. This permits the plug to be well seated, and as the slips move horizontally before engagement rather than in an upward direction, the lowermost depth is obtained for the slip which upon completion of the locking movement pulls the cap firmly into sealing engagement.

It is obvious that the construction and arrangement of the parts herein described may be varied in many ways without departing from the scope of the appended claims.

I claim:

1. A plug for use with internally threaded pipe comprising a cap for the pipe, a pair of diametrically opposed threaded slips, a toggle linkage suspending each slip from said cap, a plunger extending concentrically through said cap between said slips, a toggle linkage connecting the bottom of the plunger to each of said slips at a point spaced from the suspending toggle linkage, and lever means above the cap adapted to engage the cap and elevate the plunger, thereby through the action of said toggle linkages locking the slip in threaded engagement with the casing and clamping the cap on the pipe.

2. A plug for use with internally threaded pipe comprising a cap for the pipe, a plunger extending centrally through the cap, opposed arcuate slips having threads adapted for engagement with the pipe threads, toggle joint connections between the plunger and the lower parts of the slips, toggle joint connections between the cap and the upper parts of the slips to thereby suspend the slips from the cap, and cap engaging means to lift the plunger, thereby moving the slips into threaded engagement with the pipe and in such movement of the slips pulling the cap down into tight closing engagement with the end of the pipe.

3. A plug for use with internally threaded pipe comprising a cap for the pipe, a pair of diametrically opposed slips having the engaging face thereof threaded to fit the thread of said pipe, a suspending arm for each slip pivotally linked at each end thereof to the cap and slip respectively, a reciprocating plunger positioned between said slips and extending concentrically through the cap; operating arms pivotally connecting the lower part of said slips and the bottom of the plunger, a lever operated cam pin connected to the top of said plunger rotatably operable to engage the slips in the threaded portion of the pipe and press the cap into sealing engagement with the end thereof.

4. A plug for use with internally threaded pipe comprising a cap to cover the end of the

pipe, diametrically opposed arcuate slips adapted to cooperatively engage the threaded internal surfaces of said pipe, a suspending arm for each slip pivotally linked at each end thereof to the cap and slip respectively, reciprocable lever means adapted to engage the external surface of said cap and extending therethrough between the opposed arcuate slips, and a toggle joint connecting said lever and the slips in cooperative relation with said suspending arms.

5. A plug for use with internally threaded pipe comprising a cap for the pipe, a concentrically positioned plunger extending through the cap, a plurality of exteriorly threaded slips, toggles pivoted at opposite ends to the plunger and the lower parts of the slips, toggles pivotally connected to the upper parts of the slips and pivotally carried by the cap, and hand-actuated means adapted to lift the plunger and thereby swing the lower parts of the slips laterally into engagement with the pipe and then, by downward movement of the cap, swing the upper parts of the cap laterally into engagement with the pipe and thus effect a rolling engagement of the slips with the pipe from their lower ends upwardly and seal the cap to the pipe.

6. A plug for use with internally threaded pipe as defined in claim 5 in which said hand-actuated means comprises a lever pivoted to the plunger and turnable into abutting engagement with the cam to thereby successively lift the plunger and lower the cap.

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