Aug. 5, 1952 C. J. McCOY 2,605,847

WET PLUG FOR WELL PIPES

Filed June 24, 1949 2 SHEETS—SHEET 1

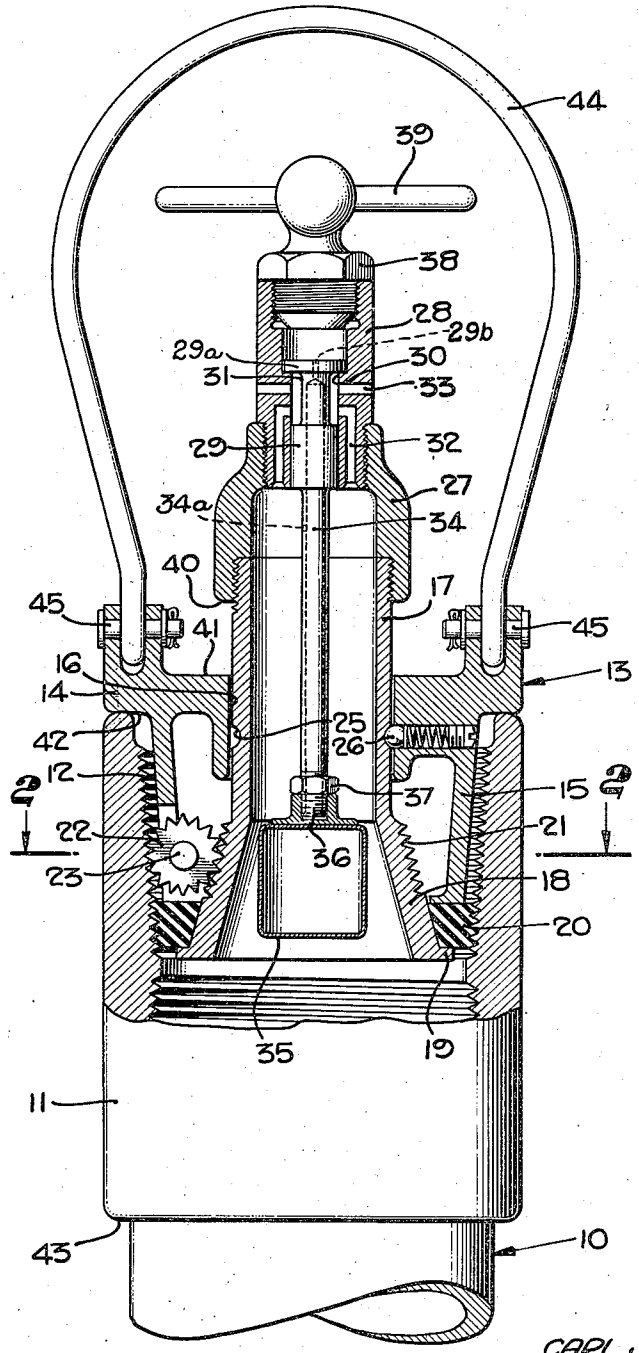


Fig. 1.

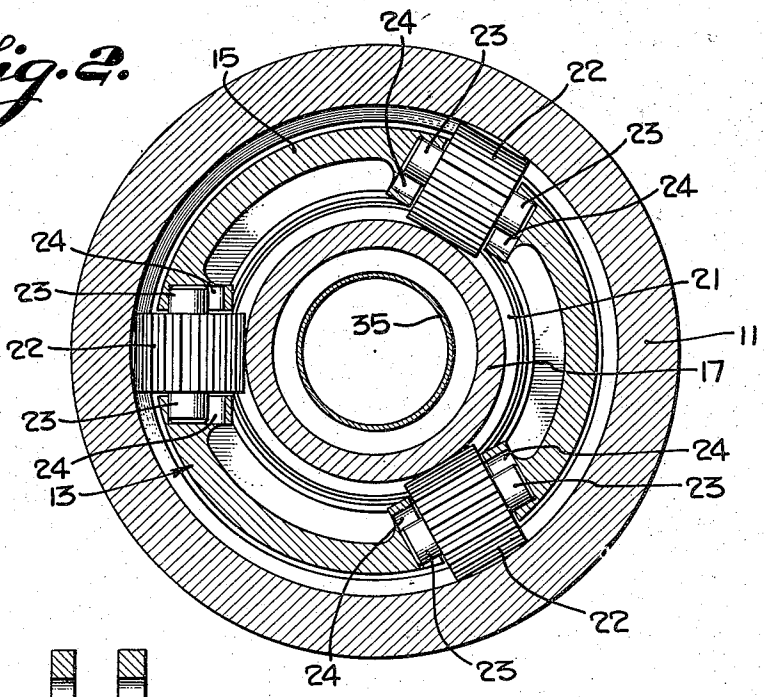
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Filed June 24, 1949 2 SHEETS—SHEET 2

Fig. 2.



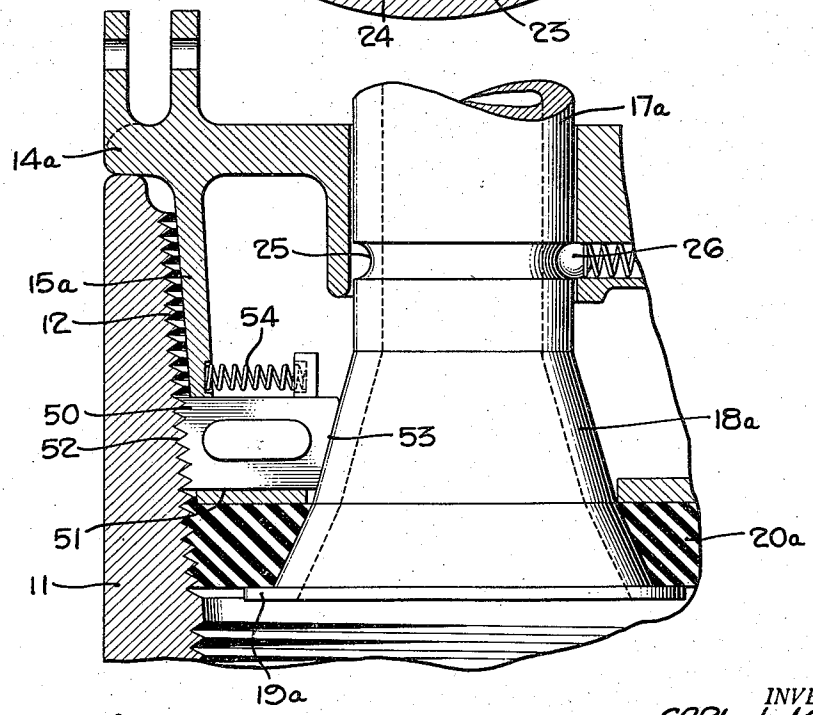


Fig. 3.

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WET PLUG FOR WELL PIPES

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13 Claims. (Cl. 166—14)

1

This invention relates to the art of producing petroleum from wells and is particularly directed to improvements in apparatus employed for removing eduction tubing from the well hole while the tubing is full of well fluid.

Conventional pumping apparatus for petroleum wells includes a pump at the lower end of the eduction tubing and a sucker rod which extends through the eduction tubing to the surface. The sucker rod is reciprocated within the tubing to actuate the pump for lifting the well fluid to the surface. It is necessary from time to time to withdraw the eduction tubing from the well for the purpose of servicing or replacing the pump. If the pump has become "sanded up" during use or has been rendered inoperative for any reason the well fluid may remain in the eduction tubing as it is withdrawn upwardly from the well hole. As the eduction tubing is withdrawn lengths thereof are disconnected section by section and stacked on end within the derrick. When the threaded connection between adjacent sections is broken oil within the lower part of the tubing may be forced out by gas and spread over the derrick floor and the working crew, thereby creating a fire hazard and making the task of withdrawing the eduction tubing difficult and unpleasant.

Even after an upper section of the eduction tubing has been disconnected and set aside, gas formerly dissolved within the well fluid may be released by the reduction in pressure on the well fluid and cause the well fluid within the lower portion of the eduction tubing to surge by "heads." To avoid undesirable surging and consequent drenching of the derrick floor with petroleum it has been the conventional practice to screw a conventional plug in the uppermost coupling of the lower portion of the eduction tubing as soon as an upper section is disconnected and removed. The operation of placing the plug in position and screwing it into the threads must be accomplished rapidly and effectively before a surge or "head" occurs. If the plug is cross-threaded or otherwise insecurely attached before a surge occurs the force of the well fluid against the plug may disengage it and the operator may be injured if the plug should strike him. This hazard connected with the operation of screwing the plug into position often causes the operator to attempt to hurry the operation unduly with the results that the plug is cross-threaded or is jammed in the coupling.

In accordance with my invention I provide a new and improved wet plug device which may readily be installed without careful alignment

2

of threads and which requires only a minimum of time to place in position. Furthermore, I provide means for venting the gas pressure away while retaining the oil within the eduction tubing. The danger of spraying petroleum over the derrick floor and working crew occasioned by surging within the lower part of the eduction tubing is therefore largely eliminated. The wet plug embodying my invention is attached to the upper end of each eduction tube section in turn forming a seal against escape of well fluid but permitting escape of gas. A vent valve is incorporated into the device which is moved to closed position by the action of liquid moving upwardly within the eduction tubing but is uneffected by gas pressure. Accordingly, the gas within the upper portion of the eduction tubing is vented away but when oil approaches the wet plug at the upper end of the tubing the gas venting valve is automatically closed to prevent escape of oil.

Accordingly, it is the principal object of my invention to provide a new and improved form of wet plug for use in connection with the withdrawal of eduction tubing from a well hole.

Another object is to provide a device of this type which automatically vents off gas within the tubing but which prevents escape of oil.

Another object is to provide such a device which may be readily and rapidly secured to the upper open end of the eduction tubing with a minimum of care in alignment.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

Figure 1 is a side elevation principally in longitudinal section showing a preferred embodiment of my invention in operative sealing relation within the upper end of the coupling of an eduction tube for a well.

Figure 2 is a sectional plan view taken substantially on the lines 2—2 as shown in Figure 1.

Figure 3 is a partial sectional view showing a modified form of my invention.

Referring to the drawings the eduction tubing generally designated 10 extends into a well bore (not shown). The tubing may be formed of a plurality of tubular sections connected by threaded couplings 11. Each of the couplings is provided with the usual internal pipe threads 12. As the eduction tubing 10 is raised from the well it is unjointed section by section and the couplings 11 commonly remain on the upper ends of the sections rather than the lower ends as the sections are set aside.

In accordance with my invention a wet plug

assembly generally designated 13 is adapted to be inserted into the upper open end of the coupling 11. The assembly 13 includes a body 14 having a downwardly extending conical skirt 15. The body is provided with a central opening 16 for slidable reception of the sleeve 17. The lower end of the sleeve 17 is provided with a flared portion 18 having a flange 19 at its extreme end. A resilient packing ring 20 is mounted on the flared portion 18 between the flange 19 and the lower end of the skirt 15. A series of annular serrated rings 21 is provided on the flared portion 18 above the position of the sealing ring 20 and a plurality of toothed rollers are rotatably mounted on the body 14 and arranged to mesh with the serrations 21. The teeth of these rollers 22 engage the threads 12 within the upper end of the coupling 11 and the action of the serrations 21 is to prevent rotation of the toothed rollers 22. The rollers 22 may each be provided with integral laterally extending trunnions 23 received within horizontal recesses 24 provided on the skirt 15 of the body 14. Each of the toothed rollers 22 is therefore capable of rotating about the axis of the trunnions 23 and also may have limited radial movement as the trunnions slide within the transverse recesses 24. If desired, spring means (not shown) may be employed for normally urging the rollers 22 to move in a radially outward direction.

A detent ring 25 may be provided on the sleeve 17 if desired, and one or more spring urged balls 26 may enter the detent ring 25 to maintain the sleeve 17 in its raised position. A coupling collar 27 connects the upper end of the sleeve 17 to the valve body 28. A valve member 29 is slidably mounted within the central axial opening 30 in the valve body 28. The valve member 29 is provided with a reduced portion 31 between its opposed ends so that in one position of the valve member 29 the body ports 32 and 33 are placed in communication, and in another position of the valve member 29 the ports are isolated. Thus when the valve member 29 is in the position shown in Figure 1, gas within the sleeve 17 may pass upwardly through the port 32 into the bore 30 of the valve body 28. The gas may then escape through vent ports 33 to the atmosphere. If the valve member 29 is raised so that the lower cylindrical portion thereof closes the inner ends of the ports 32, gas within the sleeve 17 cannot reach the central bore 30 and hence cannot escape through the vent ports 33.

The valve member 29 or valve head may be secured by any convenient means to an actuating rod or tube 34 which extends axially into the interior of the sleeve 17. A hollow float 35 is secured to the lower end of the tube 34 by any convenient means such as, for example, the threads 36 and lock nut 37. From this description it will be understood that vertical movement of the float 35 within the sleeve 17 acts to open and close the means for venting the space within the sleeve 17. A closure plug 38 having a suitable handle 39 may be provided for closing the upper end of the body 28.

The upper extremity of the valve member 29 forms a flange 29a which engages but does not seal against a shoulder formed in the bore 32. The valve member is preferably a balanced valve unaffected by gas pressure. This is accomplished by affording communication between the chamber above the valve member and the region below; for example, the tubular stem 34 may have a side port 34a and the valve member may have a bore 29b therethrough.

In the operation of the device the wet plug assembly 13 is inserted into the upper end of the coupling 11 as soon as the pipe section formerly threaded into the threads 12 has been disconnected and set aside. When the assembly 13 is installed in position the sleeve 17 is in its lower position with the shoulder 40 on the coupling collar 27 in engagement with the shoulder 41 defined by the upper surface of the body 14. In this position the flared portion 18 at the lower end of the sleeve 17 extends downwardly below the lower end of the skirt 15 so that the resilient sealing ring 20 contracts radially. The assembly 13 may be inserted quickly and easily into the upper end of the coupling 11 without any alignment of threads or careful manipulation. When the shoulder 42 on the underside of the body 14 engages the upper end of the coupling 11, the operator grasps the handle 39 and raises the sleeve 17 upwardly. This action forces the toothed rollers 22 into engagement with the threads 12 and into engagement with the annular serrations 21, abruptly locking the assembly 13 in position within the coupling 11. Formation gas formerly dissolved in the well fluid and released therefrom by relaxation of pressure on the well fluid is vented out through the ports 32 and 33 so long as the float 35 remains in its lower position. In the event of a surge or "head" of oil within the eduction tubing 10, the liquid oil raises the float 35 against the action of gravity and moves the valve head 29 to shut off the vent ports before any appreciable quantity of oil can escape through port 33. Flooding of the derrick floor and crew with oil is thereby prevented. When the surge or head subsides the float 35 descends by gravity and again acts to vent gas to the atmosphere. The assembly 13 is not blown out of position by the pressure of the oil and gas since the toothed rollers 22 prevent upward movement of the assembly 13. The seal ring 20 prevents escape of well fluid upwardly along the threads 12 in any appreciable quantity.

After the wet plug assembly 13 has been placed in operative position, and after the sleeve 17 has been raised to lock it against displacement, the well crew raises the eduction tubing 10 in the normal conventional manner. This ordinarily entails the use of an elevator which engages under the lower shoulder 43 of the coupling 11. The wet plug assembly remains in the coupling 11 as it is raised upwardly within the derrick and until the next succeeding joint in the eduction tubing is disconnected. At the time of such subsequent disconnection the float 35 acts to vent the space within the sleeve 17 and within the upper section of the eduction tubing so that well fluid is not retained within the upper section by suction pressure. As soon as the lower threaded coupling is disconnected, another wet plug assembly which is a duplicate of that shown and described is inserted into the lower coupling. The assembly 13 on the upper end of the pipe section just disconnected is then removed from its operative position and lowered to the derrick floor by means of a line attached to the bail 44. The bail 44 may conveniently be attached to the body by means of the pivot pins 45.

As the eduction tubing is raised and disconnected section by section the two wet plug assemblies 13 are used alternately so that the upper end of the eduction tubing is kept closed

except for the very short interval after the threaded connection is broken and before the wet plug assembly 13 is installed in position. The construction of the vent valve assembly including the parts 28 and 29 is such that the valve is substantially balanced and the pressure of the gas within the sleeve 17 has no effect on the opening and closing of the valve.

In the modified form of my invention shown in Figure 3 a plurality of radially slidable dogs 50 replace the toothed wheels 22. Each of these dogs is received within a recess 51 provided on the skirt 15*a*. The extending end 52 of each of the dogs is serrated to engage the teeth 12 in the coupling 11 and the inner end 53 of each dog is tapered to rest against the flared portion 18*a* of the sleeve 17*a*. The sealing ring 20*a* is positioned on the lower end of the flared portion 18*a* and is supported by the annular flange 19*a*. Retracting springs 54 may be provided for each of the dogs 50 so that the serrated face of the dog is moved out of engagement with the threads 12 when the sleeve 17*a* is lowered with respect to the body 14*a*. The operation of this form of my invention is substantially the same as that previously described in connection with Figures 1 and 2. In both of these forms of my invention the pressure of the gas and well fluid within the eduction tube tends to hold the wet plug device in position, and therefore the greater the pressure the tighter is the plug secured.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a wet plug assembly for insertion into a threaded coupling on the upper end of an eduction pipe in a well, the combination of a body having a skirt thereof adapted to extend into the threaded coupling, a sleeve slidably mounted within the body and provided with a flared portion projecting below said body, rotary locking elements cooperating with the flared portion and adapted upon relative axial movement of the skirt and sleeve to engage the threads of the coupling, a resilient sealing ring encircling a portion of the sleeve, said sealing ring being expandible into engagement with said threads upon relative movement of the body and sleeve in a direction to actuate the locking elements.

2. A plug structure for temporary placement in the internally threaded upper end of eduction tubing, involving: a body member adapted to engage the upper end of an eduction tube and including a skirt depending into the internally threaded end thereof; a sleeve slidably mounted within said body member and terminating in a flared end projecting below the skirt of said body member; an annular seal ring interposed between the lower extremities of said skirt and sleeve and adapted to expand radially on upward movement of said sleeve in said body member to seal against said internal threads; and toothed radially movable locking members carried by said body member and engageable by the flared portion of said sleeve to interlock with said internal threads of the eduction tube on upward movement of said sleeve in said body member.

3. A plug structure for temporary placement in the internally threaded upper end of eduction tubing, involving: a body member adapted to engage the upper end of an eduction tube and including a skirt depending into the internally threaded end thereof; a sleeve slidably mounted within said body member and terminating in a flared end projecting below the skirt of said body member; an annular seal ring interposed between the lower extremities of said skirt and sleeve and adapted to expand radially on upward movement of said sleeve in said body member to seal against said internal threads; toothed radially movable locking members carried by said body member and engageable by the flared portion of said sleeve to interlock with said internal threads of the eduction tube on upward movement of said sleeve in said body member; said sleeve projecting above said body member; a normally open balanced valve in the upper extremity of said sleeve for venting gas from said eduction tubing; and a float member suspended within said sleeve for closing said valve on rise of liquid into said sleeve.

4. A plug structure as set forth in claim 2 wherein said locking members are toothed wheels and the flared portion of said sleeve is equipped with teeth to engage said wheels.

5. A plug structure as set forth in claim 2, wherein: said locking members are radially guided and slidable dogs having teeth in their radially outer ends, and their radially inner ends being engageable by the flared portion of said sleeve.

6. A plug structure as set forth in claim 3 wherein: said locking members are toothed wheels and the flared portion of said sleeve is equipped with teeth to engage said wheels.

7. A plug structure as set forth in claim 3 wherein: said locking members are radially guided and slidable dogs having teeth in their radially outer ends, and their radially inner ends being engageable by the flared portion of said sleeve.

8. In a device of the class described for closing the upper internally threaded end of an eduction pipe in a well, the combination of a body member, a sleeve member slidably mounted with respect to the body member, locking elements carried on the body member and movable into engagement with the internally threaded element at the upper end of the eduction pipe, a seal ring on the sleeve member adapted to engage within the internally threaded element, operating means on said sleeve member for moving said locking elements radially and expanding said seal ring into operative position upon relative axial movement of said sleeve and body members, a vent valve on one of said members, and a float operatively connected to close the valve in the event that well fluid should rise in the eduction pipe.

9. In a device of the class described for closing the upper internally threaded end of an eduction pipe in a well, the combination of a body member, a sleeve member slidably mounted with respect to the body member, locking elements carried on the body member and movable into engagement with the internally threaded element at the upper end of the eduction pipe, a seal ring on the sleeve member adapted to engage within the internally threaded element, operating means on said sleeve member moving said locking elements radially and expanding said seal ring into operative position upon relative axial movement of said sleeve and body members.

10. A device as set forth in claim 8, wherein:

said locking elements are equally spaced, toothed wheels capable of radial displacement, and said operating means includes a tapered section with annular teeth meshing with said wheels and adapted to force said wheels to intermesh with the internal screw threads of said eduction pipe.

11. A device as set forth in claim 9, wherein: said locking elements are equally spaced, toothed wheels capable of radial displacement, and said operating means includes a tapered section with annular teeth meshing with said wheels and adapted to force said wheels to intermesh with the internal screw threads of said eduction pipe.

12. A device as set forth in claim 8, wherein: said locking elements are dogs supported for radially slidable movement by said body member, said dogs having teeth at their radially outer ends for meshing with the internal screw threads of said eduction pipe, and whereby said operating means includes a tapered portion engaging the radially inner ends of said dogs.

13. A device as set forth in claim 9, wherein: said locking elements are dogs supported for radially slidable movement by said body member, said dogs having teeth at their radially outer ends for meshing with the internal screw threads of said eduction pipe, and whereby said operating means includes a tapered portion engaging the radially inner ends of said dogs.

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