Oct. 10, 1939. F. E. O'NEILL 2,175,540

SELF-CLEANING ANCHOR

Filed Aug. 16, 1937

Fig. 1.

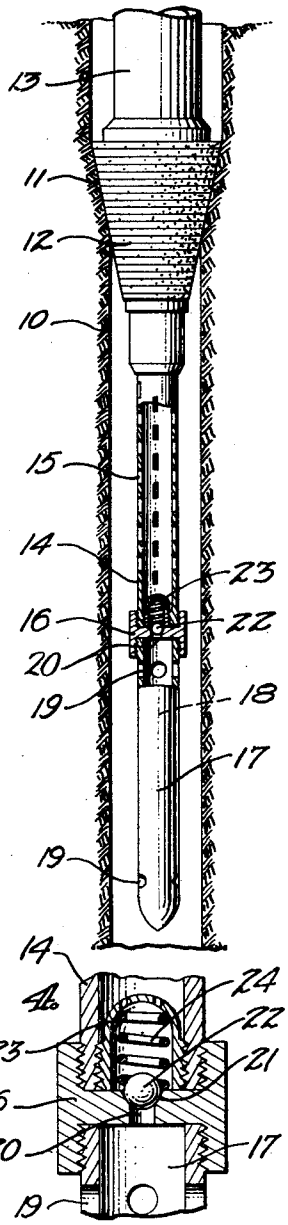


Fig. 2.

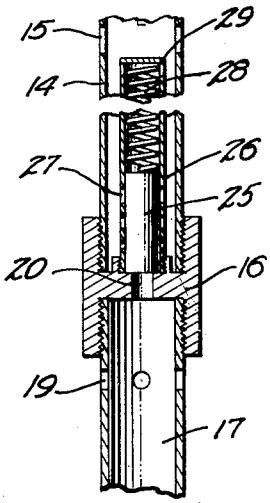


Fig. 3.

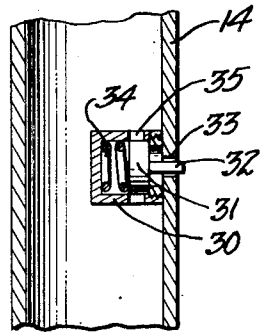
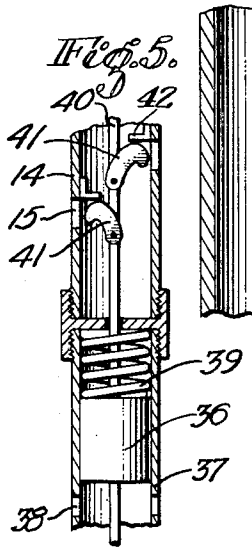


Fig. 4.

Fig. 5.



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SELF-CLEANING ANCHOR

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Application August 16, 1937, Serial No. 159,342

4 Claims. (Cl. 166—1)

This invention relates to well equipment, especially the type used in oil well production work, and particularly pertains to a self-cleaning anchor.

In connection with various types of oil well equipment, pipe having perforated walls is lowered into the well. A commonly used structure of this kind is a perforated anchor which is lowered into the well below a packer for production or testing purposes. In many instances this anchor is lowered into an open hole of the well bore so that there is not only the possibility of clogging due to the perforations, but there is also a great probability that the formation will cave and that debris will fill the anchor perforations. In some instances such a resulting condition is highly objectionable, such for example in connection with formation testing apparatus, and particularly formation testing apparatus which includes a pressure bomb for recording the fluid pressure existing in an area of a well bore which has been closed off at the bottom of the well by the use of a packer. When formation tests are made it is common to lower the testing device to the bottom of a well on a drill string. This testing device includes a packer above which a valve is mounted to admit and entrap fluid within the drill string. The packer is formed with a central passageway therethrough and a length of perforated pipe is carried beneath the packer and communicates with the central passageway. At a point within or below the perforated pipe a fluid pressure recording device is placed. In the event that the perforations become clogged fluid will not flow through the perforations and upwardly in the drill string, but pressure will be built up within the sealed area so that a false reading will be made by the pressure recording device. It is the particular object of the present invention therefor to provide means whereby the perforations within a pipe submerged in the fluid of a well will be automatically cleaned in the event that an accumulation of dirt and debris tends to clog them.

The present invention contemplates the provision of valve means acting to relieve an excessive built up pressure within a sealed area of well bore and cooperating to hydraulically or mechanically clean the perforations if they are clogged.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in vertical section and elevation showing a portion of a well testing tool seated within a well bore and disclosing one form of the present invention.

Fig. 2 is a fragmentary view showing a form of relief valve suitable for use in carrying out the present invention.

Fig. 3 is a fragmentary view of another form of relief valve which may be used.

Fig. 4 is an enlarged view of the type of valve shown in Fig. 1.

Fig. 5 is a fragmentary view showing a fluid operated mechanical perforation cleaner.

Referring more particularly to the drawing, 10 indicates a well bore having a seat 11 against which a rathole packer 12 is seated. Disposed above the packer is a tubular body 13 of a well testing tool or of a drill string. It is understood that this particular structure is shown by way of example only in order to demonstrate the application and value of the present invention, and that various other applications of the invention might be made without departing from the spirit of the invention as claimed. Mounted beneath the packer 12 is a pipe 14 formed with perforations 15, the pipe being usually called a perforated anchor. A coupling 16 is secured at the lower end of the pipe 14 and receives the upper threaded end of a housing 17 within which a fluid pressure recording device 18 is mounted. It is understood that the fluid pressure recording device is shown diagrammatically since its construction is not essential to the present invention. Perforations 19 may be formed through the wall of the housing 17 to permit the fluid within the well bore to gain access to the pressure responsive means of the fluid pressure recording device. As previously stated it sometimes occurs that due to the thickness of mud, silt, debris, and cavings occurring in the well bore, the perforations 15 of the pipe 14 may become clogged. It will be evident by reference to Fig. 1 that if this condition prevails the native fluid pressure of the formation may be blocked since liquid will not flow to the testing tool and the fluid pressure will not be relieved. The result will be that the liquid sample obtained in the formation testing device will be small and will give an incorrect indication of the condition of the liquid and the pressure within the formation, while at the same time the fluid pressure measuring device will respond to an excessive pressure in the area below the packer and will give a false high pressure reading. In order to overcome this and like conditions various means are here shown. The structures shown in Figs. 1 and 4 provide for an opening 20 through the partition wall of the coupling 16, the upper end of the opening forming a valve seat 21 to receive a valve element 22 here indicated as a ball.

This valve ball is confined within a cage 23 and is yieldably held upon its seat by a spring 24 also within the cage. The cage 23 is here indicated as being threaded into lower end of the pipe 14. In this particular form of device it is contemplated that when the perforations 15 in the pipe 14 become completely clogged or partially obstructed so that an excessive pressure will build up within the confined area of the well bore, this pressure will act through the relatively large opening 19 of the housing 17 or through the supplemental pipe 17 to lift the valve ball 22 from its seat and establish circulation of flow of fluid through the passageway 20 and the pipe 14 and upwardly into the drill string. This will equalize the pressure around the pipe 14 and within the pipe 14, under which conditions there would be a tendency for the accumulation of material which clog the perforations to become loosened and to pass from the perforations. If that occurs pressure acting to lift the valve ball 22 will be relieved immediately and the valve ball will seat since circulation of fluid will then take place through the perforations 15 normally intended.

In the form of the invention shown in Fig. 2 a different type of valve is provided. This valve comprises a plunger 25 slidably mounted within a valve sleeve 26. The valve sleeve 26 is here shown as attached to the coupling 16 and to be in communication with the opening 20 formed through the partition wall of the coupling. The valve plunger 25 is of the piston type and when acted upon by the fluid pressure bearing against its lower face will move and uncover one or more perforations 27 formed through the wall of the sleeve 26. This movement will be opposed by the spring 28 mounted within the sleeve. This spring may be adjustably set in position by a threaded thimble 29 mounted upon the upper end of the sleeve and making it possible for a different pressure to be established before the valve plunger 25 begins to move. The perforations 27 in the sleeve are preferably arranged in progressive diameter from the lower end of the sleeve, thus as the valve plunger is forced to raise by fluid pressure thereby indicating an excessive fluid pressure, the plunger will successively uncover the perforations 27 until its pressure is relieved and equalized inside and outside of the pipe 14.

In the form of the invention shown in Fig. 3 of the drawing, a valve thimble 30 is provided to receive a plunger valve 31 carrying an outwardly extending pin 32. The pin 32 projects through the perforation 33 and is yieldably held in this position by a spring 34. When pressure becomes excessive in the well bore the pin 32 is forced inwardly and at the same time the plunger 31 uncovers relief slots 35, thereby increasing the area of opening through which the fluid may flow. When the pressure is relieved exteriorly of the well bore the spring 34 will force the pin 32 outwardly and this will tend to clean the perforation 33 by mechanical movement. It is undertsood that in connection with this type of device a plurality of perforations in the pipe 14 may be equipped with these valves.

In the form of the invention shown in Fig. 5 of the drawing, a piston 36 is mounted within a cylinder 37. Fluid pressure is exerted against the piston through openings 38 in the cylinder which is of much larger area than the perforations to be cleaned, and the piston is forced to rise by differential pressure against the response of a spring 39. Mounted on the piston is a rod 40 and pivotally mounted on the rod is a plurality of knives 41 which act when the rod is moved upwardly to be forced outwardly through the side walls of the pipe 14 to open the perforations and to positively clean the accumulated material from them. A plurality of guide plates 42 are secured to the inner wall of pipe 14 contiguous to the openings 15 and serve to guide the knives into and out of the perforations 15. When the perforations have been opened the exterior pressure will have been relieved and the piston 36 will be restored to its lowermost position by the action of the spring 39. This will retract the blades 41 and leave the slots 15 clear. It will be seen that in the use of the present invention the devices provided act to establish equilibrium of fluid through the interior of the pipe whereby the accumulated material within the perforations will be disturbed and will tend to be dislodged. This insures that the perforations may be maintained clean at substantially all times, and it will further result that when the structure is used with a pressure bomb that a definite indication will be made in the pressure bomb reading to show the true condition within the test area.

While I have shown the preferred form of my invention, and means of practicing the same, it will be understood that various changes might be made in the construction of the devices used therewith, by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A self cleaning anchor comprising a primary tubular section and a secondary tubular section, said secondary tubular section being substantially closed at its lower end, said sections having openings in their wall to permit fluid to flow thereinto from a body of fluid within which said anchor is submerged, a coupling connecting between said sections and having an opening in a wall thereof, a rod element extending from said secondary section through said coupling opening and into said primary section, a piston connected to the lower end of said rod and operable within said secondary section, a plurality of knife members carried by the upper end of said rod element and adapted to move through the openings in said primary section to clean the same, and means responsive to a predetermined fluid pressure for actuating said knife members.

2. A self cleaning anchor comprising a primary tubular section, a secondary tubular section closed at its lower end, a coupling member connecting between said primary and said secondary sections, the wall of said primary section being formed with perforations whereby a fluid within which the sections are submerged may pass inwardly through the perforations and outwardly through the open end of said primary section, the wall of said secondary section having openings through which the fluid may pass into said section, walls providing an opening in said coupling, a rod adapted for reciprocation in said coupling opening and having portions extending within said primary and said secondary sections, a piston carried by said rod for movement in said secondary tubular section, a plurality of knife members carried by said rod and adapted to move through the perforations in said primary sections to clean the same, means for moving said knife members through said perforations, and

means for withdrawing said knife members from said perforations.

3. A self cleaning anchor comprising a primary tubular section, a secondary tubular section closed at its lower end, a coupling member connecting between said primary and said secondary sections, the wall of said primary section being formed with perforations whereby a fluid within which the sections are submerged may pass inwardly through the perforations and outwardly through the open end of said primary section, the wall of said secondary section having openings through which the fluid may pass into said section, walls providing an opening in said coupling, a rod adapted for reciprocation in said coupling opening and having portions extending within said primary and said secondary sections, a piston carried by said rod for movement in said secondary tubular section, a plurality of knife members carried by said rod and adapted to move through the perforations in said primary section to clean the same, means for moving said knife members through said perforations, means for withdrawing said knife members from said perforations, and means for guiding said knife members in their movement relative to said perforations.

4. A self cleaning anchor comprising a primary tubular section, a secondary tubular section closed at its lower end, a coupling member connecting between said primary, and secondary sections, the wall of said primary section being formed with perforations whereby a fluid within which the sections are submerged may pass inwardly through the perforations and outwardly through the open end of said primary section, the wall of said secondary section having openings through which the fluid may pass into said section, walls providing an opening in said coupling, a rod adapted for reciprocation in said coupling opening and having portions extending within said primary and said secondary sections, a piston carried by said rod for movement in said secondary tubular section, a plurality of knife members carried by said rod and adapted to move through the perforations in said primary section to clean the same, means for moving said knife members through said perforations, and guide elements on said primary section acting to control the movement of said knife members relative to said perforations.

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