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DRILLING HOLE PACKER

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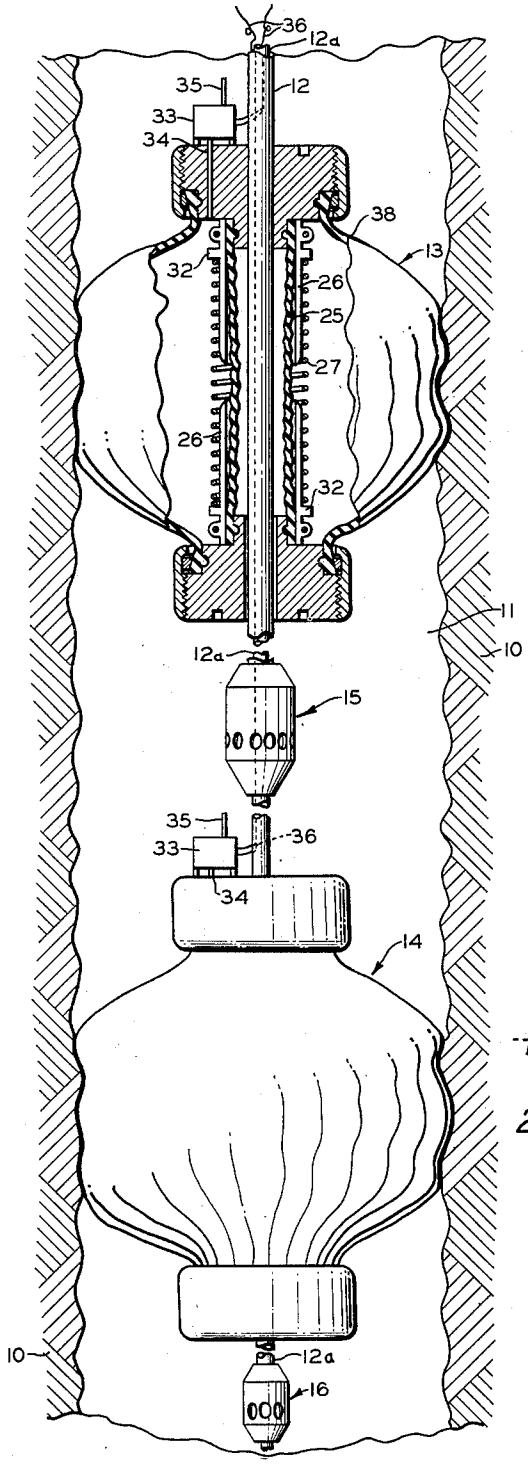
FIG. 1.



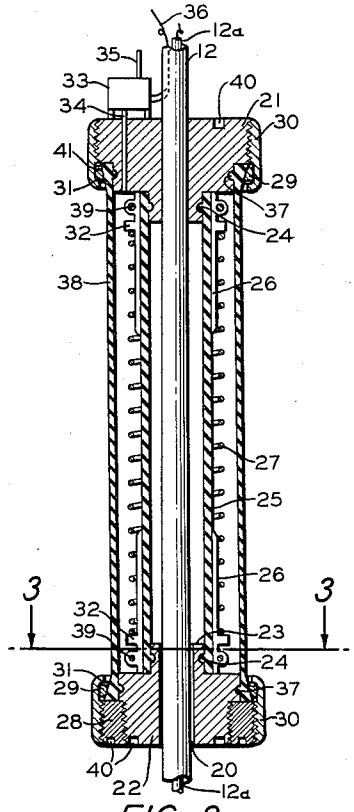


FIG. 2.

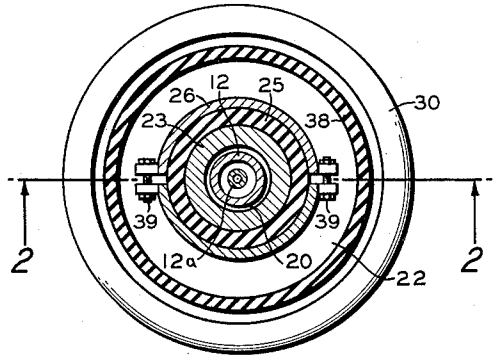


FIG. 3.

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DRILLING HOLE PACKER

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4 Claims. (Cl. 166—11)

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This invention relates to a packing device for sealing-off a drill hole. In another aspect, it relates to a novel packing device for use in combination with a dual down hole type flow meter unit in oil and/or gas wells.

Heretofore, considerable difficulty has been experienced in isolating one section of a drill hole from another in order that flow of fluid into or out of the strata adjoining such section may be independently measured. The use of packers in drill holes is old and many forms of such apparatus have been used. Many of the packers previously designed and used have failed to seal effectively one portion of the drill hole from another because of irregularity in the walls of the hole. The use of packers which have a resilient sealing sleeve is also old, but in the prior art effective means for collapsing the packer has not been provided and in many cases when a packer has been maintained in an expanded condition for long periods of time, the resilient sealing sleeve will adhere more or less tightly to the walls of the well, consequently the removal of the packer without injury to the resilient sealing sleeve has presented a serious problem.

This difficulty also increases operation costs because a packer with a damaged sealing sleeve cannot be reset in a well without removing the packer from the well. Our invention greatly reduces these problems and difficulties.

An object of our invention is to provide a packing device which effectively seals off a desired section of a drill hole.

Another object of our invention is to provide a packing device which effectively seals off a section of a drill hole and yet may be removed to another section of the same drill hole or to another drill hole without injury to the packer.

Still another object of our invention is to provide a dual flow meter assembly incorporating such packing devices.

Various other objects, advantages, and features of our invention will become apparent from the following description taken in conjunction with the accompanying drawing in which Figure 1 is a longitudinal sectional view of a drill hole and showing a dual flow meter-packer assembly in place in which one packer is shown partly in section. Figure 2 is a sectional elevational view of another embodiment of our packer in a collapsed condition. Figure 3 is a cross sectional view of the packer taken on the line 3—3 of Figure 2.

Referring to the drawing and specifically to Figure 1, reference numeral 11 identifies a drill

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hole penetrating earth formations 10. The flow meter-packer assembly is composed of a tube member 12 disposed from the surface of the ground to a point in the drill hole below the top packer 13. A second tubing member 12*a* of a smaller diameter than tubing 12 is disposed within tubing 12 and extends from a point below the bottom packer 14 to the surface of the ground. Disposed between the two packers is a flow meter 15 for measuring the flow of liquid into or out of the tube 12. Below the packer 14 is a flow meter 16 for measuring the flow of fluid into or out of the tubing 12*a*.

Although it is preferred to extend tubing 12*a* to the surface of the ground, since a better control of the fluid flow through meters 15 and 16 can be effected if tubes 12 and 12*a* are separate conduits, the upper end of tubing 12*a* may terminate at any reasonable point above meter 15.

The flow meters 15 and 16 preferably are of the same design, or if desired, may be of different design. The construction of such flow meters and their operation are set forth in a co-pending application, Serial No. 105,295, filed July 18, 1949, entitled "Flowmeter."

The packers identified by reference numerals 13 and 14 of Figure 1 are identical in construction and for purposes of simplicity, the construction of only one of the packers is shown in the drawing. The packer 13 of Figure 1 is shown in an expanded or inflated condition and under this condition the upper portion of the drill hole is sealed from the lower portion by this packer. The packer is composed of two resilient and expandable members 25 and 38. These two resilient members should be made of material which is resistant to deterioration under conditions of use. For example, when this packer is used in an oil well such resilient material must be resistant to the destructive effect of oil. Certain synthetic rubbers or synthetic elastomers are preferred for oil well use.

With reference to Figure 2, the two resilient members 25 and 38 in their undistorted form may be cylindrical in shape and define an inflatable elastic sealing member. The upper end of the outer resilient member 38 is provided with a raised portion 37 which fits in a groove in the upper plate member 21. Such a ring-groove assembly provides more surface of contact between the two members for providing a fluid-tight joint. The upper end of the member 38 may also be provided with a beveled outer surface 41. Surrounding this beveled surface 41 is a compression ring 29 which preferably is of

split ring construction. The compression ring 29 is tightened around this beveled surface upon rotation of a collar member 30. This collar member 30 is threaded to the upper plate member 21 in such a manner that upon rotating the collar member 30 the collar rises with respect to the plate member 21 and a shoulder 31 forces the compression ring 29 tightly against the upper end of the outer resilient member 38 to hold the resilient member 38 firmly in place. Holes 40 in the upper plate member 21 are for insertion of a tool for holding the plate 21 while tightening the collar member 30.

The lower end of the outer resilient member is constructed exactly like its upper end and its assembly is substantially the same as that just described. The lower collar member 30 also has an inner shoulder 31 for exerting pressure against the lower compression ring 29. The lower plate member 22 is illustrated somewhat different in form than the corresponding upper plate number 21. This difference in construction includes the use of a double threaded nut 28 for ease of assembly of the packer. The lower collar member 30 may be tightened by rotating this collar around the double threaded nut 28. Holes 40 in the double threaded nut in the lower plate member permit insertion of a tool for use in screwing the nut 28 on to the plate member 22 and for holding this nut-plate assembly while tightening the collar 30.

The inner resilient member 25 is also cylindrical in form and like the outer member 38, it is also provided with a raised section 24 at either end, as illustrated. The raised ends on this member 25 are fitted into a corresponding groove in the upper reduced portion of a lower plate member 22 and in the bottom reduced portion of the upper plate member 21. Split guide flanges 26 hold the ends of this inner resilient member tightly in place. Each pair of guide flanges is held firmly in position by a pair of bolts 39.

A flange 32 is provided on each of these split guide flanges 26. The flanges 32 are disposed on the outer surface of the split guide flanges in such a manner to serve as a base for a compression spring 27. This compression spring 27 is of such compressive strength that it maintains the packer in the collapsed position except when the packer is inflated.

The upper plate member 21 is drilled and carries a tube 34. On the upper end of this tube 34 is mounted a reversible type pump to which is attached a second tube 35. This pump 33 is preferably electrically driven and electrical energy is supplied through lead wires 36 extending from the pump through the tubing 12 to the surface of the ground. Although two wires are shown, one wire would suffice with the circuit being completed using tubing 12 as the ground.

For assembling our packer device we prefer to attach the upper end of the inner resilient member 25 to the upper plate member 21 by placing the split guide flanges 26 into place and inserting the bolts 39. The outer resilient member 38 may then be installed by slipping the raised portion 37 into the groove in the plate member 21 and turning the collar 30 to tighten the compression ring 29.

The next step in the procedure of assembly is to slip the lower compression ring 29, in case it is not a segmental ring, and the lower collar 30 over the outer resilient member 38. The compression spring 27 may then be slipped into place over the upper split guide flanges 26. The lower guide flanges 26 may be inserted and the lower plate member 22 is fitted into place with the lower flange 23 being inserted into the lower end of the inner resilient member 25. The raised section 24 assists in holding these two members in place tightly while the two lower split guide flanges 26 are positioned and bolts 39 inserted. The double threaded nut 28 may next be screwed around the lower plate member 22 until its upper surface tightly contacts the lower end of the outer resilient member 38. The lower compression ring 29 may then be slipped down into position and tightened by rotation of the lower collar member 30. When compression ring 29 is a segmental ring, its segments may be inserted just prior to positioning and tightening the lower collar 30.

It is to be noted that the upper plate member 21 is firmly attached to the tubing 12 while the lower plate member 22 is intended to fit loosely over the tubing 12 so that some space 20 exists between the plate member 22 and the tubing 12. This space 20 is provided so that the lower portion of the packer is able to move freely in a longitudinal direction along the tubing 12. When our device is fully assembled, each packer assembly appears as an elongated cylindrical apparatus, as indicated by Figure 2. The maximum diameter of the packer assembly, is the diameter of the collar member 30 and this diameter will need, of course, to be smaller than the diameter of the drill hole in which the packer is to be used. For sealing off large diameter drill holes, the packers will need to be of larger size than one for use in sealing a small diameter drill hole. However, since the packers are expansible, a packer of given size may be used for sealing of drill holes of various diameters, for example, a packer suitable for sealing off a 6" diameter drill hole may also be used for sealing off an 8" or even larger diameter hole.

In our packing apparatus, the use of the spring 27 provides a positive method for releasing a packer, i. e., for making certain that the expansible member 38 contracts on removal of the fluid from within the space between members 38 and 25 so that the packer may be removed to another position in the same well or removed from the well.

When the packer is inflated, the bottom end of the packer assembly rises up the tubing tending to compress longitudinally the inner resilient member 25. The diameter of the opening through element 22 is such that a space 20 is provided for ease of movement of the lower end of the packer during inflation and deflation. This compression of the resilient member is illustrated in Figure 1 of the drawing. In order to make certain that during the compression of this resilient member that pinching will not occur between the coils of the spirng, the split guide flanges 26 are provided. These flanges also serve several other purposes. The side flanges 32 serve as seats for the compression spring 27, and the split flanges are held together by bolts 39 to serve as the tightening and holding means for the ends of the inner resilient member 25. The length of these flanges is such that the ends do not touch during the time the packer is inflated.

The reversible fan pump 33, as mentioned hereinbefore, is of the type that fluid within the well is pumped through inlet tube 35 and discharged through tube 34 into the space between the two

resilient members **25** and **38**. During the entire time the packer is to be in an inflated condition, the pump **33** is operating to maintain fluid pressure in the packer. The pump is of such a type and design that slippage occurs when the pump is delivering fluid against a certain maximum pressure. When it is desired to deflate and release the packer, the operator may merely stop the pump and allow the pressure to equalize or he may reverse the pump so that the pump aids the withdrawal of fluid from the packer through tube **34** and discharges it into the well through tube **35**. The removal of this fluid from the packer coupled with the compressive force of the spring **27** fully deflates the packer and loosens it from the walls of the well so that the packer assembly may be raised or lowered to another position in the well or removed from the well.

The lower end of the packer of Figure 2 is illustrated as being slightly different in construction than the packer shown in Figure 1, the difference being that the lower plate section is composed of plate member **22** and the double threaded ring **28** in place of the single member in Figure 1. Both of these designs are satisfactory, the only difference being that the design illustrated in Figure 2 is a little easier to assemble. Both the embodiments are given for illustrative purposes.

Figure 3, a cross sectional view on an enlarged scale of the bottom end of our packer, shows the structural relationship of the apparatus parts. The relationship of the apparatus parts in the top of the packer are similar.

Materials of construction, in general, may be selected from among those available commercially. The resilient member should be made of such materials as will not swell or otherwise deteriorate when in contact with materials encountered in wells. Synthetic rubbers of several types are available for such use and are satisfactory. The metallic parts should be made of such material as will be free from corrosion. The pumps **33** should, of course, preferably be powered by electric motors contained in a fluid-tight case, and the lead wires for these motors, of course, should be well insulated.

Many member parts of our apparatus may have forms different from that illustrated and described. For example, the upper plate member **21** and the lower plate member in double-threaded nut **28** may possess different configurations. For example, the double-threaded nut member **28** and the lower plate member **22** may be made as one part in place of two parts, as illustrated. The use of two parts is merely an advantage useful during assembling of the packer. Any type of compression ring **29** and tightening collar **30** may be used, providing the assembly serves the purpose of holding the bottom end of the outer resilient member in rigid contact with the plate **22**.

The above-described packer apparatus is given for illustrative purposes and should not be regarded as limiting the invention, the scope of which is set forth in the following claims.

Having described our invention, we claim:

1. A packing device for sealing off a section of a drill hole comprising, in combination, a tubing adapted to be positioned in a drill hole, a resilient member surrounding and attached at its upper end to said tubing and its lower end free to move with respect to said tubing, a second resilient member within said first mentioned resilient member and surrounding and attached at its upper end to said tubing and its lower end attached to the movable lower end of said first mentioned resilient member, a compression spring disposed around said tubing and between said resilient members and operatively attached to said resilient members to maintain the top and the bottom ends thereof separated by a maximum distance, and means for introducing fluid to the space between said sealing members.

2. A packing device for sealing off a section of a drill hole comprising, in combination, a tubing adapted to be positioned in a drill hole, an inflatable cylindrical first member surrounding said tubing, a cylindrical resilient second member surrounding said tubing and within said first member, a first means attached to said tubing for holding the tops of said first and second members rigidly, a second means for attaching the bottom of said first member to the bottom of said second member, said second means being movable with respect to said tubing, a compression spring within said first member and surrounding said second member and operably attached to said first and second means, and means for inflating the space between said first and second members and for deflating said space.

3. The packing device of claim 2 including a spring guide means disposed between said compression spring and said second member.

4. The packing device of claim 1 including a spring guide means between said compression spring and said second resilient member within said first member.

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