

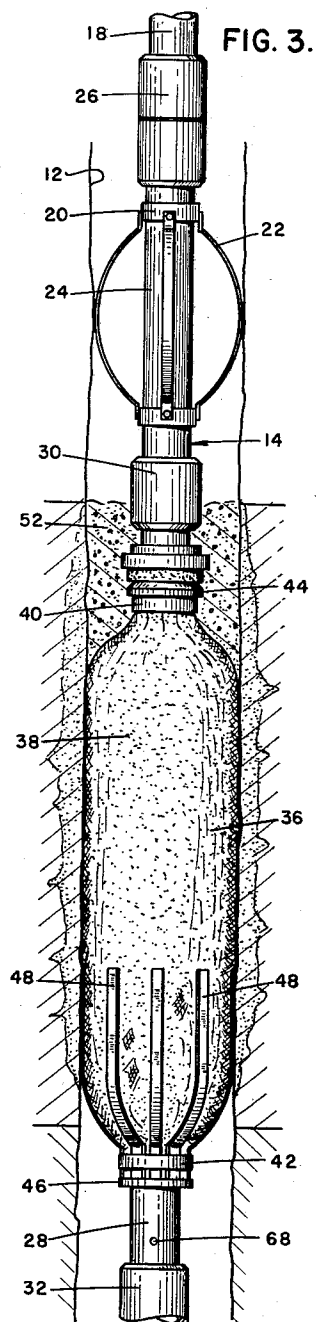
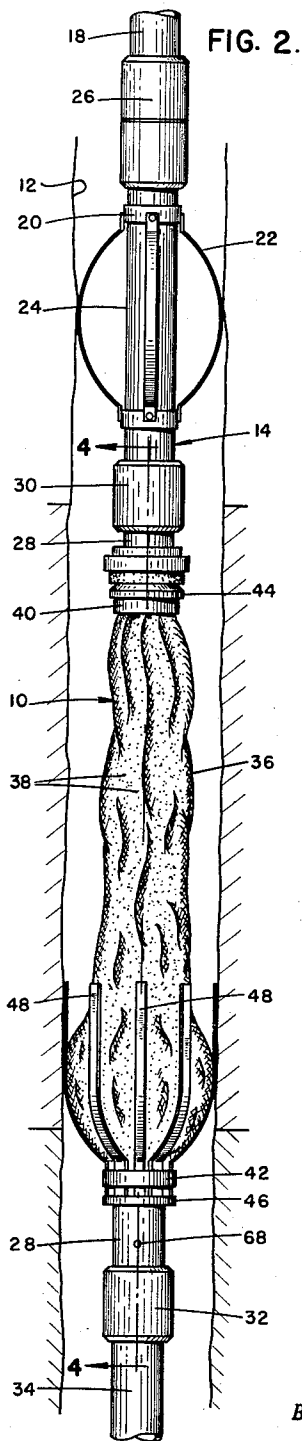
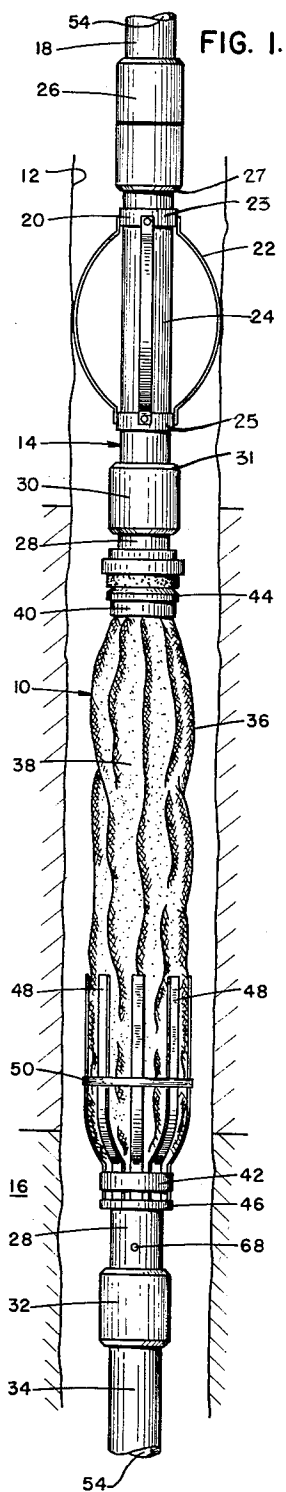
Jan. 26, 1960

J. W. MALY
WELL PACKER

2,922,478

Filed July 30, 1956

2 Sheets-Sheet 1



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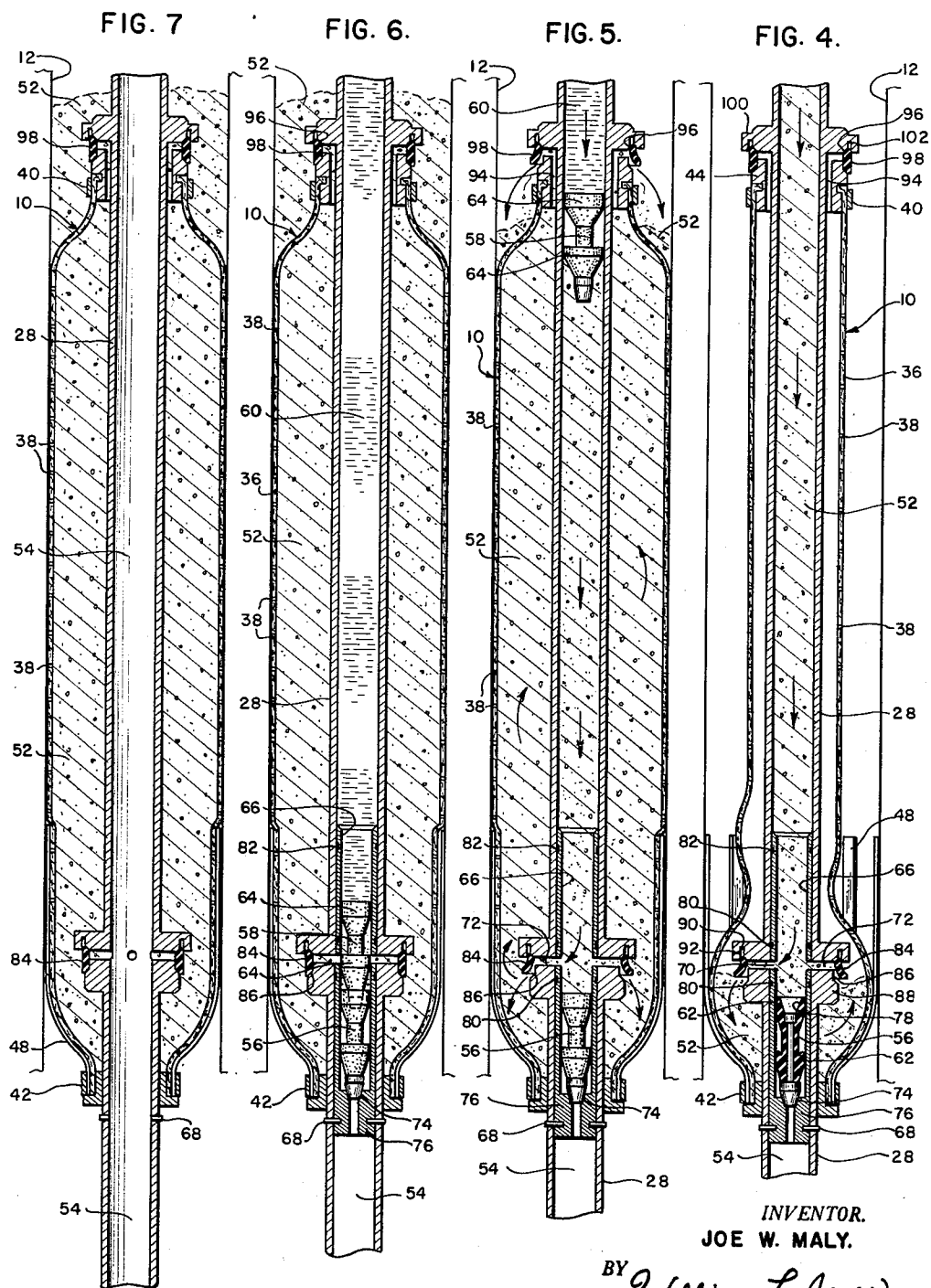
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2,922,478

WELL PACKER

Joe W. Maly, Oklahoma City, Okla., assignor to Halliburton Oil Well Cementing Company, Duncan, Okla.

Application July 30, 1956, Serial No. 601,002

9 Claims. (Cl. 166—154)

This invention relates to packers for use in oil and gas wells or the like to effect a seal with a wall surface therein. More particularly, the invention relates to a packer useful for sealing off the annular space in a well below a pipe or conduit on which the packer is lowered into the well.

The invention provides particular advantages in connection with operations performed in an uncased or open bore hole, such as when it is desired to effect a seal with the wall of the bore hole at or near the upper limit of a zone or formation upon which a treating, testing, or other well operation is to be performed. It is understood, however, that the invention may be applied elsewhere.

It is a general object of the invention to provide an improved well packer.

It is another object of the invention to provide an improved well packer capable of effecting a superior seal with a wall surface in an oil and gas well or the like.

It is another object of the invention to provide an improved well packer capable of effecting a superior fluid-tight seal with the wall of an uncased or open bore hole.

It is a further object of the invention to provide an improved well packer which may be expanded into engagement with a rough or uneven surface to effect a superior fluid-tight seal therewith, whereupon the packer is adapted to withstand the effects of high pressures and forces without being displaced from sealing engagement with such surface.

In general, the invention involves the concept of a well packer including a flexible packing element which is adapted to inflate or expand upon cementitious fluid being supplied to an interior space provided therein. Means is provided for permitting a portion of the cementitious fluid to escape from such interior space as the packing element inflates or expands and to contact a wall surface in the well in which the packer is used. The arrangement is such that the cementitious fluid sets or hardens both within the packing element and exteriorly thereof between the packer and the wall surface in the well. As a result, the packer becomes cemented in place and in rigid engagement with the wall surface, effecting a superior seal therewith.

The invention involves the further concept of providing means for controlling or directing the cementitious fluid in order to obtain an efficient utilization thereof in inflating or expanding the packing element and in setting or hardening to cement the packer in place. Also, means is provided for controlling the cementitious fluid so that portions thereof setting or hardening in the passageway through which the fluid is introduced into the well may be thereafter readily removed to permit subsequent use of the passageway to conduct other fluids into or out of the portion of the well below the set or expanded packer.

The foregoing and other objects and advantages of the invention will become more apparent from the following description of one embodiment thereof when read

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in connection with the accompanying drawing in which similar reference characters designate similar parts and wherein:

Figure 1 is a side elevational view of a portion of a string of well equipment positioned within an open or uncased bore hole, the string including a well packer which is constructed in accordance with the invention and is shown in an unexpanded position such as during and immediately after the lowering thereof to a desired location in the well;

Figure 2 is a view similar to that of Figure 1, but showing the packer during an early stage in the expansion thereof;

Figure 3 is a view similar to that of Figures 1 and 2, but showing the packer fully expanded in the well;

Figure 4 is a longitudinal cross-sectional view taken along the line 4—4 of Figure 2;

Figure 5 is a view similar to that of Figure 4, but showing the position of the packer and its parts during a later stage in the operation thereof;

Figure 6 is a view similar to that of Figures 4 and 5, but showing the position of the packer and its parts immediately after the final stage in the expansion thereof; and

Figure 7 is a view similar to that of Figures 4, 5, and 6, but showing the packer and its parts at an even later stage of operation, occurring after the full expansion thereof in the well.

Referring to the drawing in detail and first to Figure 1 thereof, the invention is there illustrated and is herein-after described, by way of example, as being incorporated in a well packer 10 which is shown positioned in an uncased or open bore hole 12 after having been lowered as part of an equipment string 14 to a desired location therein, such as to a location in the vicinity of the upper limit of a zone or formation 16 upon which a treating, testing, or other well operation is to be performed.

In addition to the packer 10, the string 14 is shown as including a hollow drill pipe 18 which extends upwardly to the surface of the ground (not shown) and as further including a centralizer in the form of a drag spring assembly 20 which is connected between the drill pipe 18 and the packer 10.

The drag spring assembly 20 may be of conventional design and is shown as including a plurality of outwardly bowed spring members 22 which are angularly spaced about and mounted for limited sliding movement along a short section of hollow pipe 24. Each of the members 22 is shown connected at its upper end to an upper collar 23 and at its lower end to a lower collar 25. The collars 23 and 25 encircle and are slidable along the pipe 24 between upper and lower limits, as will appear more fully hereinafter.

The hollow pipe 24 has its upper end shown coupled to the adjacent lower end of the hollow drill pipe 18 by means of a releasable connection or safety joint 26 which may be of conventional design and, accordingly, will not be described in detail. The safety joint 26 at its lower end provides a downwardly facing abutment 27 for engaging the upper collar 23 to limit relative upward movement of the drag spring members 22 along the pipe 24.

As illustrated, the well packer 10 includes an elongated central member or mandrel 28 which is hollow and has its upper end threadedly or otherwise coupled to the adjacent lower end of the hollow pipe 24 by means of a coupling or joint member 30. The joint member 30 at its upper end provides an upwardly facing abutment 31 for engaging the lower collar 25 to limit relative downward movement of the drag spring members 22 along the pipe 24.

The lower end of the hollow mandrel 28 is shown threadedly or otherwise coupled by means of a joint

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member 32 to the upper end of a section of hollow pipe 34, which forms a downward extension of the packer 10. Depending upon the particular well operation involved, the downwardly extending pipe 34 may or may not reach to the bottom (not shown) of the bore hole 12. If desired, the pipe 34 may be provided with lateral perforations (not shown) throughout all or a portion of its length.

In accordance with the invention, the packer 10 is shown as including an elongated packing element in the form of a flexible sleeve 36 having a multiplicity of small openings or pores 38 which extend through the wall thereof and are preferably disposed generally throughout the packing material. The sleeve 36 may be made of a fabric containing woven or intermeshed strands or fibers of a natural or artificial substance, such as a woven cotton, nylon or glass fabric, or it may be made of other suitably porous or permeable material.

Throughout a major portion of its length the sleeve 36 loosely encircles the mandrel 28 to which both the opposite end portions of the packing material are preferably securely fastened, such as by means of metal clamps or bands 40 and 42. As illustrated, the band 40 encircles the upper end portion of the sleeve 36 and is tightened about an upper raised portion 44 of the mandrel 28. The band 42 is shown encircling the lower end portion of the sleeve 36 and is tightened about a lower raised portion 46 of the mandrel 28.

A plurality of finger-like support members 48 are shown angularly spaced about the lower portion of the sleeve 36. The support members 48 are preferably made of a resilient material, such as spring metal or the like. The lower end portion of each member 48 is disposed between the lower band 42 and the sleeve 36 and is thus securely clamped to the lower raised portion 46 of the mandrel 28.

The upstanding portions of the support members 48 are normally retained in an inward or unexpanded position close to the mandrel 28, such as by means of a frangible band or tape 50 which is shown encircling the members 48 intermediate the ends thereof. Upon the tape 50 being parted or broken, the resilient members 48 quickly move or expand radially outward (see Figure 2).

When unexpanded, the support members 48 together with the tape 50 add lateral support to the loose packing material and, in particular, to the lower portion thereof. Additional lateral support for the loose packing material may be provided by utilizing one or more additional bands or tapes similar to the tape 50 at other points throughout the length of the sleeve 36. As will appear more fully hereinafter, the frangible tape 50 is adapted to part or break upon sufficient force being applied thereto due to the inflation or expansion of the sleeve 36.

Referring now to Figure 4, the packer 10 is adapted to be inflated or expanded by supplying a quantity of cementitious fluid 52 to the interior space between the mandrel 28 and the loose portion of the sleeve 36. The fluid 52 is introduced into the well from a source (not shown) at the surface by pumping or otherwise forcing it downwardly through a passageway 54 which extends generally lengthwise through the entire equipment string 14 (see Figure 1). A suitable separator such as a bottom plug 56 is inserted in the passageway 54 ahead of the fluid 52 and another separator such as a top plug 58 (see Figure 5, for example) is inserted therein behind the fluid 52. The top plug 58 is followed by a quantity of displacing fluid 60 (see Figure 5, for example) which may be water, oil, drilling mud, or other suitable fluid.

The plugs 56 and 58 may be of similar construction and may be designed as conventional cementing plugs of the type having a solid body portion made of metal or hard rubber or the like with one or more flexible annular wipers extending upwardly and outwardly therefrom. The bottom plug 56 is shown provided with a plurality of wipers 62 which engage the walls of the pas-

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sageway 54 so that the cementitious fluid 52 is isolated from any other fluids which are present ahead of the plug 56 as it moves downwardly into the well. Similar wipers 64 (see Figure 5) are shown provided on the top plug 58.

Ordinarily, it is desirable for the passageway 54 to be available for use in conducting or circulating fluids other than the cementitious fluid 52 into or out of the well after the packer 10 has been set or expanded. While various arrangements may be employed whereby the passageway 54 may be subsequently cleared of obstructions, such as by removing the plugs 56 and 58 and any excess or unused cementitious fluid 52 therebetween, one advantage of the present invention arises from the provision of means whereby such clearance or removal may be readily accomplished after the fluid 52 has already set or hardened.

To this end, yieldably mounted container means such as a hollow cylindrical container 66 is provided within the passageway 54 for receiving first the bottom plug 56 and later the top plug 58 and holding any excess or unused cementitious fluid 52 therebetween out of contact with the wall of the portion of the passageway 54 in which the container 66 is located.

As illustrated, the container 66 is an inner sleeve-like member which is closely but slidably fitted within the mandrel 28 and is normally supported therein by one or more frangible pins 68. The pins 68 are shown extending through the wall of the mandrel 28 and into the wall of the lower end portion of the container 66.

One or more lateral openings or ports 70 are provided in the wall of the container 66 intermediate the ends thereof. Each port 70 is aligned with a lateral opening or passageway 72 which extends through the wall of the mandrel 28 and admits the fluid 52 into the sleeve 36, as will appear more fully hereinafter.

An upwardly facing surface or seat 74 for the bottom plug 56 is provided within the container 66 a suitable distance below the ports 70. As illustrated, the plug seat 74 is a tapered surface on the upper end of an annular abutment 76 which is provided on the inner surface of the wall of the container 66 near the lower end thereof.

A tapered surface on the upper end of the bottom plug 56 provides a seat 78 for the top plug 58 which comes to rest thereon (see Figure 6) after substantially all of the cementitious fluid 52 has been admitted to the space between the mandrel 28 and the sleeve 36, as will appear more fully hereinafter.

Sealing means such as O-rings 80 are preferably provided between the walls of the container 66 and the mandrel 28 above and below the aligned ports 70 and passageways 72. Additional sealing means such as O-ring 82 may be provided between the wall of the mandrel 28 and the upper end portion of the wall of the container 66. The O-rings 80 and 82 prevent the cementitious fluid 52 from entering and setting or hardening in the space between the container 66 and mandrel 28.

One-way valve means is preferably provided for controlling the flow of the cementitious fluid 52 through the passageways 72. As illustrated, such valve means includes a flexible sealing ring 84 mounted in an annular recess 86 which is provided on an intermediate raised portion 88 of the mandrel 28 and communicates with each of the passageways 72 at the respective outer ends thereof. The ring 84 may be made of rubber or the like and is mounted so that it functions as a one-way check valve. The check valve opens upon the force applied to the inner surface of the ring 84 by the pressure of the fluid 52 in the passageway 72 becoming sufficient to move the ring 84 outwardly in the recess 86, whereupon the fluid 52 is permitted to enter and fill the space between the mandrel 28 and the sleeve 36. Upon the fluid pressure in the passageways 72 being subsequently relieved, the ring 84 returns to its inward position within the recess 86 (see

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Figure 6) and the check valve is closed, preventing return flow of the fluid 52 into the hollow mandrel 28.

The intermediate raised portion 88 of the mandrel 28 is preferably disposed thereon opposite the lower loose portion of the sleeve 36 so that the passageways 72 admit the fluid 52 into such lower loose portion. Also, deflecting means is preferably provided within the sleeve 36 for controlling the fluid 52 so as to direct it downwardly therein.

In the arrangement shown, an annular flange 90 is provided on the intermediate raised portion 88 above the annular recess 86 thereon and the flange 90 is provided with a downwardly extending lip 92 which overlaps and is preferably disposed closely adjacent the upper end of the ring 84 so as to prevent substantial outward movement thereof in the recess 86. As a result, the cementitious fluid 52 is caused to enter the sleeve 36 by flowing past the lower end of the ring 84, which assumes a suitable shape to function as a deflector which directs the fluid 52 in a generally downward direction within the sleeve 36.

A portion of the cementitious fluid 52 supplied, as aforesaid, to the interior of the sleeve 36 is permitted to escape therefrom through the pores 38 of the packing material. Also, escape or by-pass means is provided near the top of the packer 10 for permitting another portion of the fluid 52 to pass from the interior of the sleeve 36 into the annular space between the wall of the bore hole 12 and the upper end portion of the packer 10.

In the arrangement shown, such escape or by-pass means includes an interior passageway 94 which is provided in the upper raised portion 44 of the mandrel 28. The passageway 94 extends upwardly from the lower surface of the raised portion 44 and has a lateral branch terminating at an annular recess 96 which is provided on the portion 44 above the upper end of the sleeve 36.

One-way valve means is preferably provided for controlling the flow of fluid through the passageway 94. As illustrated, such valve means includes a flexible sealing ring 98 which is mounted in the annular recess 96 and may be similar to the ring 84 mounted, as aforesaid, on the intermediate raised portion 88 of the mandrel 28. The ring 98 functions as a one-way check valve which opens upon the force applied to the inner surface thereof by the pressure of fluid 52 in the passageway 94 becoming sufficient to move the ring 98 outwardly in the recess 96, whereupon the fluid 52 is permitted to escape and contact the wall surface of the bore hole 12 (see Figures 3 and 5). Upon the fluid pressure being relieved, the ring 98 returns to its inward position within the recess 96 (see Figure 6) and the check valve is then closed. Also, the check valve is in its closed position during the lowering of the packer 10 into the well (see Figure 4) and thereafter until the sleeve 36 begins to overflow.

Deflecting means is preferably provided exteriorly of the sleeve 36 for controlling the overflowing fluid 52 so as to direct it in a generally downward direction. In the arrangement shown, an annular flange 100 is provided on the upper raised portion 44 of the mandrel 28 above the annular recess 96 thereon and the flange 100 is provided with a downwardly extending lip 102 which overlaps and is preferably disposed closely adjacent the upper end of the ring 98 so as to prevent substantial outward movement thereof in the recess 96. As a result, the cementitious fluid 52 overflowing from the sleeve 36 through the passageway 94 is caused to flow past the lower end of the ring 98, which assumes a suitable shape to function as a deflector which directs the overflowing fluid 52 downwardly onto the exterior surface of the sleeve 36 and into contact with the wall of the bore hole 12 (see Figure 5).

In carrying out a well operation using the arrangement illustrated in the drawing, the equipment string 14 is lowered into the bore hole 12 with the parts of the packer 10 occupying the respective positions shown in Figure 1. That is, the packing sleeve 36 is unexpanded and the sup-

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port members 48 are retained by the tape 50 in their inward positions close to the mandrel 28. Support is thus provided for the loose portion of the sleeve 36 during the lowering thereof, reducing the likelihood of the packing material becoming caught or damaged by protruding surfaces or objects in the well. The outwardly bowed spring members 22, by engaging the walls of the bore hole 12 during the lowering of the string 14, tend to maintain the packer 10 in more or less centrally spaced relation therein and thereby further reduce the likelihood of the loose packing material becoming caught or damaged.

The string 14 is lowered sufficiently to position the packer 10 at or near the upper limit of the zone or formation 16, as shown in Figure 1, this being assumed to be the desired location at which a seal is to be effected with the wall surface of the bore hole 12. Then the bottom plug 56 is inserted into the upper end of the hollow drill pipe 18 and is moved downwardly therein by pumping the cementitious fluid 52 into the upper portion of the passageway 54 behind it.

Upon the desired quantity of cementitious fluid 52 being introduced, the top plug 58 is then inserted into the upper end of the drill pipe 18 and the plugs 56 and 58 together with the interposed fluid 52 are moved downwardly by pumping the displacing fluid 60 into the upper portion of the passageway 54 behind the top plug 58.

As the bottom plug 56 moves downwardly, it displaces ahead of it any fluids such as well fluids or drilling mud which are present in the passageway 54, these fluids being permitted to escape through the lower end of the pipe 34, or other openings therein, and thus being permitted to flow upwardly around the string 14 to the mouth of the bore hole 12 and into a nearby slush pit or other suitable receptacle (not shown).

Upon the plug 56 reaching the container 66, it is received therein and comes to rest on the plug seat 74, as shown in Figure 4, effecting a seal which closes the passageway 54 at a point below the aligned ports 70 and passageways 72 into which the cementitious fluid 52 is permitted to enter. Thereafter, as the pumping of the displacing fluid 60 continues, the pressure of the fluid 52 in the passageways 72 applies a force to move the ring 84 to its open position, as shown in Figure 4, whereupon the fluid 52 is admitted into the sleeve 36. As hereinbefore described, the ring 84 assumes a suitable position to deflect or direct the fluid 52 downwardly within the sleeve 36, filling it from the bottom upwardly.

As the sleeve 36 begins to fill, the inflation or outward expansion of the lower loose portion thereof applies a force which overcomes or breaks the tape 50, thereby permitting the support members 48 to spring outwardly into engagement with the wall of the bore hole 12, as shown best in Figure 2. When thus expanded, the support members 48 tend to prevent undesirable sagging and downward extrusion of the loose portion of the sleeve 36 as the cementitious fluid 52 fills the interior thereof and thereafter continue to provide such support as the fluid 52 sets or hardens.

There are several reasons why it is desirable for the sleeve 36 to be filled from the bottom upwardly. Under actual field conditions, the fluid 52 will ordinarily enter the sleeve 36 under considerable pressure and there will be a tendency for the entering stream to exert considerable force against the portion of the sleeve surface it first strikes. Also, there will be a tendency for the fluid 52 to be sprayed as fine particles moving under considerable force toward the sleeve pores 38, and after deflection, perhaps toward the escape passageway 94 near the upper end of the sleeve 36.

It has been found that where the fluid 52 is caused to enter the lower portion of the sleeve 36 and is directed or deflected downwardly therein, as in the illustrated arrangement, the first entering portion of the fluid 52 tends to baffle the stream thereof continuing to enter the

sleeve 36 as it fills. This baffling action reduces the likelihood of the force of the fluid stream applied at a given location on the sleeve surface becoming sufficient to rupture or tear the sleeve material. Also, the likelihood of undue spraying of the fluid 52 is reduced, particularly since the fluid level in the sleeve 36 rises relatively quickly to a point above the lower end of the ring 84 past which the entering stream is flowing. Thus, there is less likelihood of the entering stream of fluid 52 being conducted in undue amounts as a fine spray through certain of the sleeve pores 38, or through the escape passageway 94, such as might allow an excess amount of the fluid 52 to escape from the sleeve 36 prior to the full inflation or expansion thereof.

It is further believed that the feature of filling the sleeve 36 from the bottom upwardly facilitates the displacement from the sleeve 36 of any fluid, such as drilling mud or fluid from the well formations, which may have entered through the sleeve pores 38 during the lowering of the equipment string 14 into the well. Thus, there is less likelihood of the cementitious fluid 52 becoming contaminated by fluids containing substances which might interfere with its setting or hardening characteristics and, also, there is less likelihood of "pockets" of other or non-cementitious fluids forming or remaining in the sleeve 36 during the inflation or expansion thereof.

During the inflation or expansion of the sleeve 36, a portion of the cementitious fluid 52 enters the pores 38 and thus is permitted to escape to the exterior surface of the packing material and contact the wall of the bore hole 12. It should be noted that while the pump pressure required to be applied to the displacing fluid 60 to cause inflation or expansion of the sleeve 36 may not itself be large, the pressure existing within the sleeve 36 will ordinarily be much larger due to the weight of the fluid column in the passageway 54. This pressure within the sleeve 36 tends to squeeze the cementitious fluid 52 through the pores 38 and into the pores or other openings of the adjacent well strata.

The quantity of cementitious fluid 52 introduced into the well should be selected so that there is more than enough to completely fill the sleeve 36. Thus, the passageway 54 is shown in Figure 5 as still containing some fluid 52 after the sleeve 36 has been substantially fully inflated or expanded in the well. Upon the sleeve 36 being thus substantially filled, a portion of the fluid 52 enters the escape passageway 94 near the top of the packer 10 and the pressure thereof applies a force moving the ring 98 to its open position, as shown in Figure 5, permitting a portion of the fluid 52 to overflow into the annular space about the upper end of the sleeve 36. As hereinbefore described, the ring 98 assumes a suitable position to deflect or direct the overflowing fluid 52 in a generally downward direction. The overflowing fluid 52 is shown contacting both the exterior surface of the upper end portion of the sleeve 36 and the wall surface of the bore hole 12 adjacent and above the portion of the sleeve 36 which is in contact therewith.

It will be noted that the continued application of pump pressure required to cause a portion of the cementitious fluid 52 to overflow through the passageway 94, as aforesaid, tends to move the sleeve 36 into tighter engagement with the wall surface of the bore hole 62 and also tends to cause squeezing of fluid 52 through the pores 38 and into the accessible openings and pore spaces of the well strata.

As the overflowing of fluid 52 through the passageway 94 continues, the top plug 58 approaches the container 66, as shown in Figure 5, and then is received therein, coming to rest on the seat 78 provided therefor on the upper end of the bottom plug 56, as shown in Figure 6. The occasion of the top plug 58 engaging its seat 78 will be accompanied by a sudden rise in pressure which will ordinarily be noticeable immediately by the pump operator at the surface, whereupon the pumping is discontinued for a period of time while the cementitious fluid 52 is allowed to set or harden.

tinued for a period of time while the cementitious fluid 52 is allowed to set or harden.

In this connection, the fluid 52 is preferably selected from those cementitious fluids which have a controllable and relatively short setting or hardening time. Also, it is preferred that the fluid 52 include a cementitious fluid phase, such as a plastic or resinous fluid, which is adapted to set or harden after passing through the pores 38 in the wall of the sleeve 36 and entering the pore spaces or other openings of the well strata. In addition to its cementitious fluid phase, the fluid 52 may include a cementitious filler or solid phase which does not pass through the sleeve pores 38 in appreciable amounts but a portion of which nonetheless sets or hardens in contact with the well strata after overflowing through the passageway 94.

As particular examples, cementitious fluids of the type described in U.S. Patents No. 2,191,652 and No. 2,210,545, which were granted to Andrew C. Hamilton, Jr., are suited for use with the present invention. It is understood, however, that other cementitious fluids may also be used and the invention is not to be considered as limited to any specific ones of those which may be used.

As shown best in Figure 6, the container 66 is preferably of sufficient length to encircle the full length of both of the plugs 56 and 58 when seated therein. As hereinbefore indicated, the bottom plug 56 when seated closes off the portion of the passageway 54 therebelow. Also, the wipers 62 and 64 provided, respectively, on the plugs 56 and 58 engage the wall of the container 66 and, due to the weight of the displacing fluid 60 thereabove, are forced tightly thereagainst. Accordingly, any cementitious fluid 52 present in the container 66 in the spaces around the plugs 56 and 58 and between the wipers thereon, or in the aligned ports 70 and passageways 72, is retained in such spaces where it sets or hardens while the other portions of the fluid 52 are setting or hardening within the sleeve 36 and, exteriorly of the packer 10, in contact with the wall surface of the bore hole 12 and in the pores or other openings in the well strata.

It will be noted that, in the arrangement shown, the top plug 58 when seated has the lower of its wipers 64 disposed in the container 66 opposite the lateral port 70, thus effecting a seal which closes the inner end of what is in effect the inlet passageway leading to the interior of the sleeve 36. This is desirable in that a double seal is thus provided for closing such inlet passageway. The inner seal provided by the plug 58 will ordinarily be effective to prevent return flow of fluid 52 through such inlet passageway in the event that the outer seal provided by the sealing ring 84 is not effective for some reason, such as where for some reason the ring 84 fails to return to its closed position at the desired time or otherwise fails to effect a seal at the outer end of such passageway upon the fluid pressure being relieved when the plug 58 becomes seated.

Since the container 66 is yieldably supported in place in the hollow mandrel 28 by the frangible pins 68, it may be removed therefrom at any time after the plugs 56 and 58 are seated by applying sufficient pump pressure to fluid contained in the portion of the passageway 54 thereabove. The pins 68 should be selected so that they are not overcome by the forces applied thereto during the pumping which occurs as the cementitious fluid 52 is admitted into the sleeve 36 or otherwise prior to the fluid 52 setting or hardening in the well.

In some instances it may be desirable for the container 66 to remain in place, keeping the lower portion of the passageway 54 closed off, for a considerable length of time or even permanently after the fluid 52 has set or hardened, such as where the packer 10 is to be used as a bridging plug. In such event, the string 14 may, if desired, be separated by releasing the safety joint 26 after the fluid 52 is set or hardened, whereupon the drill pipe 18 may be withdrawn from the well.

Where it is desirable for the full length of the passageway 54 to be made available for conducting or circulating fluid into or out of the well after the cementitious fluid 52 has set or hardened, this may be readily accomplished without the necessity of performing a drilling or other time-consuming operation to remove the plugs 56 and 58 and the portion of the fluid 52 which has set or hardened within the container 66. Thus, by applying sufficient pump pressure to the displacing fluid 60 to cause the pins 68 to be broken or sheared, the container 66 together with the plugs 56 and 58 and the interposed set or hardened fluid 52 may be pumped downwardly through the passageway 54 and out of the lower end of the pipe 34, leaving the passageway 54 free of obstruction, as shown in Figure 7. Thereafter, a treating, testing, or other well operation may be carried out using well known procedures.

While only one embodiment of the invention has been described herein, various modifications thereof within the spirit of the invention will now suggest themselves to those skilled in the art. Accordingly, the invention is best defined by the scope of the appended claims.

I claim:

1. A well packer comprising an elongated hollow mandrel having a lateral passageway in the wall thereof, a flexible porous fabric sleeve loosely encircling said mandrel and secured thereto at points above and below said lateral passageway, an elongated hollow container mounted in said hollow mandrel for sliding downward movement therein, yieldable means for normally supporting said container in an upward position in said mandrel, said container having a lateral port therein normally aligned with the lateral passageway in said mandrel and having an upwardly facing seating surface therein disposed a suitable distance below said port, whereby cementitious fluid may be supplied to inflate or expand said sleeve by pumping said fluid downwardly through said hollow mandrel behind a lower plug adapted to enter said container and engage the seating surface therein to effect a seal below said aligned port and passageway and ahead of a top plug adapted to also enter said container, the arrangement being such that said container and the plugs and any excess cementitious fluid therein between said plugs may be subsequently removed by pumping additional fluid downwardly through said hollow mandrel under pressure sufficient to overcome said yieldable means and move said container downwardly through said mandrel.

2. A well packer as claimed in claim 1 including one-way valve means for controlling fluid flow through the lateral passageway in said mandrel, said valve means including means for directing the fluid supplied to said sleeve in a generally downward direction therein.

3. A well packer as claimed in claim 1 wherein said mandrel near the upper end thereof has a raised portion to which said sleeve is secured and through which extends an interior fluid escape passageway for permitting a portion of the cementitious fluid supplied to inflate or expand said sleeve to escape to the exterior of said packer above said sleeve, said packer including one-way valve means for controlling fluid flow through said escape passageway, said valve means including means for directing said escaping fluid in a generally downward direction.

4. A well packer comprising an elongated hollow central member forming a passageway for cementitious fluid supplied thereto, a flexible packing element mounted on said central member and forming therewith a substantially enclosed interior space, an elongated hollow container mounted within said central member for downward movement along said passageway, yieldable means

for normally supporting said container in an upward position within said central member, means including lateral openings formed in said central member and container for admitting cementitious fluid from said passageway into said interior space to inflate or expand said packing element when said container is in its upward position within said central member, fluid escape means including a multiplicity of small openings in said packing element for permitting a portion of the cementitious fluid supplied to said interior space to escape to the space outside the packer, and means responsive to the pressure fluid in said passageway for overcoming said yieldable means and moving said container downwardly therealong and out of said central member, said yieldable means being selected so as to be overcome after said packing element has been at least partially inflated or expanded.

5. A well packer as defined in claim 4 wherein said fluid escape means includes an interior passageway in the wall of said central member communicating at one end with the space between said member and said packing element and at its other end with the space outside and above said packing element.

6. A well packer as defined in claim 4 wherein said fluid escape means includes an escape passageway having its outlet end disposed on said central member above said packing element and including fluid flow directing means above said packing element for deflecting the cementitious fluid passing through the outlet end of said escape passageway in a generally downward direction.

7. A well packer as claimed in claim 4 including fluid flow directing means between said central member and said packing element for deflecting the cementitious fluid supplied to said interior space in a generally downward direction.

8. A well packer adapted to be lowered into an oil or gas well or the like and then inflated or expanded and cemented in place against a wall surface therein comprising an elongated hollow mandrel having a lateral opening in the lower portion thereof, a flexible packing element mounted on said mandrel and forming therewith a substantially enclosed interior space disposed opposite and extending upwardly from the lateral opening in said mandrel, a removable hollow container within said mandrel, means including a lateral opening in said container for admitting a slurry having a cementitious fluid phase into the lateral opening in said mandrel and thence into said interior space to fill the same and thereby inflate or expand said packing element into contact with a surrounding wall surface in said well, and means including a multiplicity of small openings in said packing element for permitting a portion of the cementitious fluid phase of said slurry to escape from said interior space onto the exterior surface of said element during the inflation or expansion thereof.

9. A well packer as claimed in claim 8 including means for directing the slurry admitted to said interior space in a generally downward direction therein, whereby said interior space is filled from the bottom upwardly.

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