Jan. 7, 1941. J. LYNES 2,227,730

INFLATED PACKER TREATING TOOL FOR WELLS

Filed Oct. 13, 1939 2 Sheets-Sheet 1

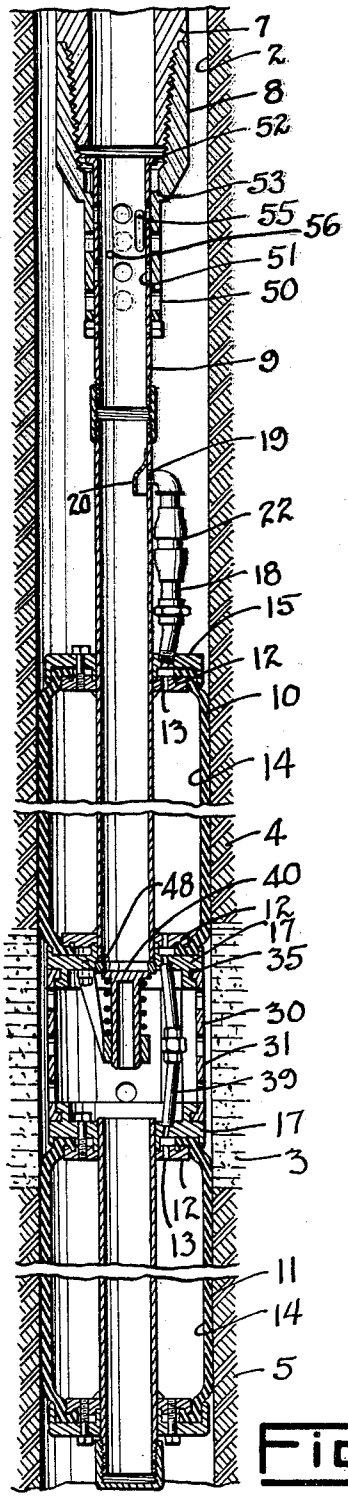

Fig. 1.

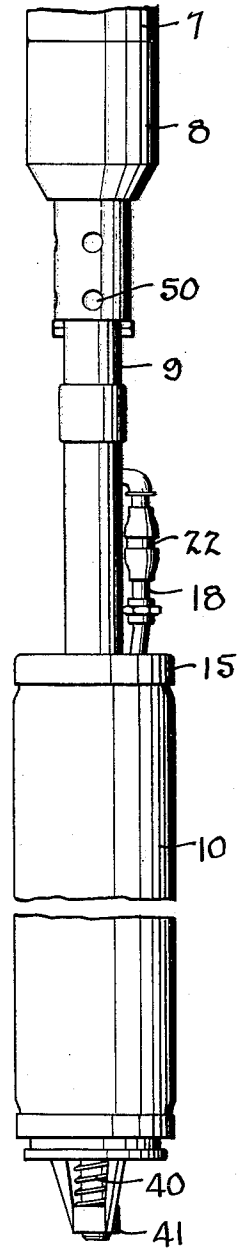

Fig. 2.

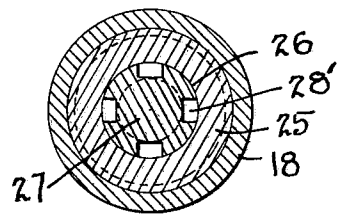

Fig. 4.

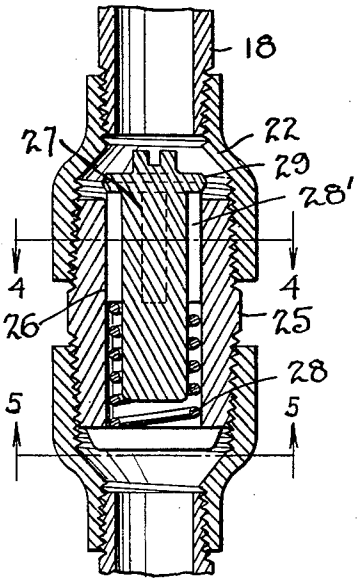

Fig. 3.

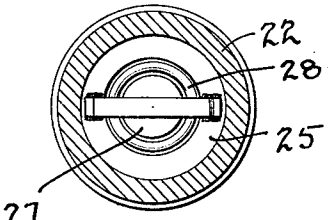

Fig. 5.

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INFLATED PACKER TREATING TOOL FOR WELLS

Filed Oct. 13, 1939 2 Sheets-Sheet 2

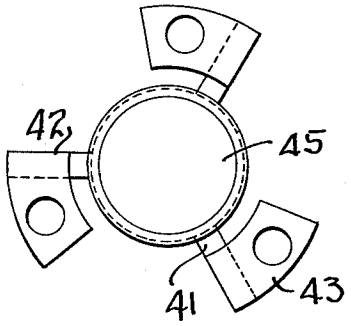

Fig. 7.

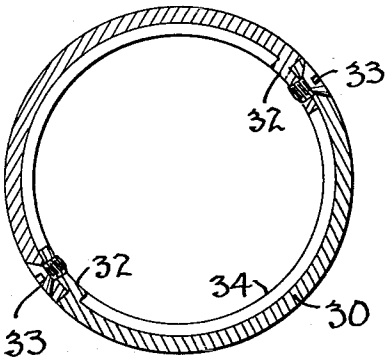

Fig. 9.

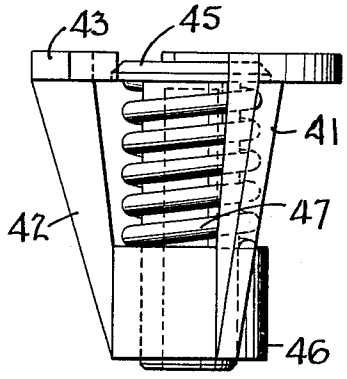

Fig. 6.

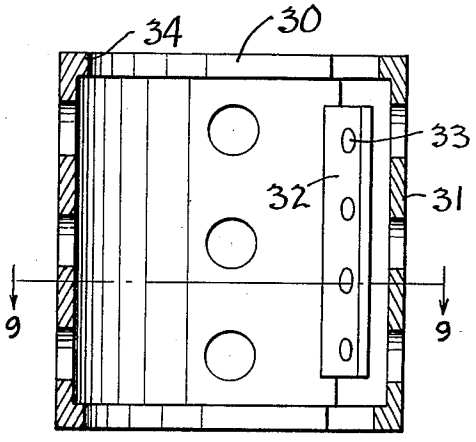

Fig. 8.

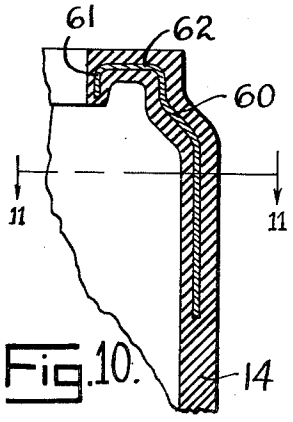

Fig. 10.

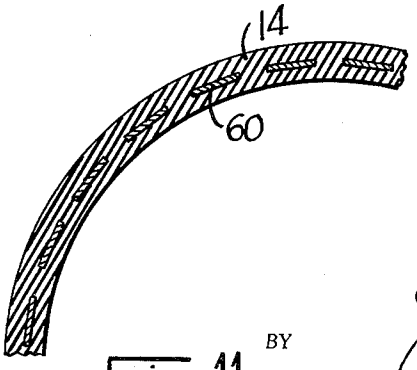

Fig. 11.

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UNITED STATES PATENT OFFICE

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INFLATED PACKER TREATING TOOL FOR WELLS

John Lynes, Houston, Tex.

Application October 13, 1939, Serial No. 299,236

10 Claims. (Cl. 166—11)

The invention relates to a treating tool for wells which embodies an inflatable packer so as to form a seal in the well bore by utilizing the liquid under pressure with which the well is being treated to also inflate the packer.

In completing a producing well it is often desirable to either close off an undesirable formation by applying cement under pressure thereto or in other instances it is desirable to treat a certain formation in order to increase the productiveness thereof or otherwise combat some detrimental feature which may be presented as to a certain increment of the formation. The present tool contemplates that this increment can be sealed off and liquid under pressure applied thereto in any desired amount so that cement or chemical may be forced into the formation to perform the desired result.

It is one of the objects of the present invention to provide a treating tool which can be set in the well bore by utilizing the pressure of the treating liquid to provide a seal in the well bore and to also discharge such liquid into the formation which is thus sealed.

Another object of the invention is to provide a treating tool wherein the treating liquid will be introduced under pressure so that some of said liquid will flow into the packers to maintain the packers at a predetermined pressure and that thereafter the treating liquid will discharge from the tool when the pressure thereon exceeds a predetermined amount so that the tool may be set to provide a seal and discharge the treating liquid into the formation at a single operation.

Another object of the invention is to provide a treating tool wherein the packer thereof will be set at one pressure as liquid is discharged from the tool at a pressure in excess of the pressure used to set the packer.

Still another object of the invention is to provide a treating tool which can be set in the well bore at a predetermined pressure, liquid discharged into the formation at a predetermined pressure and the liquid then diverted to obtain a circulation in the well bore above the tool and permit of its removal.

Other and further objects of the invention will be readily apparent when the full description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a vertical sectional view of the treating tool embodying a pair of spaced packers set in the well in operative position.

Fig. 2 is a side elevation of the tool which embodies only one packer.

Fig. 3 is a vertical sectional detailed view of the valve which controls the entry of pressure to the packers.

Figs. 4 and 5 are sections taken on the lines 4—4 and 5—5 of Fig. 3 respectively.

Fig. 6 is a side elevation of the packer pressure valve of the tool.

Fig. 7 is a top plan view of Fig. 6.

Fig. 8 is a sectional view of the discharge section in the center of the tool.

Fig. 9 is a section taken on the line 9—9 of Fig. 8.

Fig. 10 shows a fragmentary sectional view of a form of reenforcement for the packing sleeve.

Fig. 11 is a section taken on the line 11—11 of Fig. 10.

The present invention relates to somewhat the same subject matter as that disclosed in my copending application, Serial No. 297,257, filed Sept. 30, 1939, for a Packer and sampling assembly for wells, the general construction of the packers per se being claimed in such application.

Fig. 1 shows the well bore 2 as having been drilled into the earth formation and as having penetrated a porous formation 3 which is located between the impervious formations 4 and 5.

The tool is shown as having been lowered into the well bore by means of an operating pipe 7 which carries a coupling 8 on the lower end thereof by which the stem 9 of the tool is connected to the operating pipe 7.

The stem 9 extends downwardly to carry the packers 10 and 11 which are spaced on the stem or body 9.

The upper packer 10 is made up of a disc 12 which is affixed to the stem 9 and has the openings 13 therein to admit fluid under pressure to the interior of the resilient sleeve or packing 14. This packing sleeve is held upon the disc 12 which clamps the edge of the sleeve between the disc 12 and the cap 15. The lower end of the packer is similarly constructed except that the base plate 17 serves the same purpose as the cap 15.

In order to apply pressure to the interior of the packer an entry pipe or conduit 18 is connected into the stem 9 at the point 19. A baffle plate 20 may normally deflate the flow of liquid downwardly thru the pipe so that it will not cut out the entry 19.

This pipe 18 carries a valve 22 which is shown in detail in Figs. 3, 4 and 5. This valve is of a special construction in that it is arranged to close at a predetermined pressure so as to protect the

resilient sleeve 14 of the packer 21 against excessive pressures from the inside.

The detailed construction of the valve 22 includes a housing 25 which has a passage 26 therethru. This passage is arranged to be closed by the valve member 27 which is slidably mounted in the passage and has the grooves 28' therein to allow a flow of fluid past the valve member. This valve is normally in open position, as in Fig. 3, held by a spring 28 which is arranged to resist pressure below a predetermined pressure on the valve. The flange 29 on the valve seats on the upper end of the housing 25 so that when a predetermined pressure is exerted on the fluid the valve will move to closed position and be maintained in that position so long as the pressure is exerted thereon. The valve, however, will snap to open position as soon as the pressure falls below the predetermined pressure at which the valve is set to close. It seems obvious that the valve may be set to operate at any desired pressure.

With the foregoing construction it seems obvious that when pressure in the operating pipe 7 and the stem 9 reaches the predetermined pressure at which the valve 22 will close, that any further entry of liquid under pressure inside of the packers will be cut off and that when the pressure in the operating pipe and stem drops below this predetermined amount the pressure in the packer will be released. Thus, the packer will be inflated at a fixed pressure and can be deflated by reducing the pressure in the operating pipe.

Below the upper packer 10 is the discharge section 30 which is arranged to allow discharge of the liquid under pressure into the well bore. This section includes a perforate piece of pipe 31 which is seen in detail in Figs. 8 and 9 and is made up of at least two portions which will be fitted together to form a complete circular pipe. A lapped plate 32 may be fixedly connected to one of the pipe sections and has openings arranged to receive the screws 33 which are passed through the openings then screwed into the adjacent part of the other section in order to clamp the two halves together. These halves are clamped about the base plate 17 and have an inwardly directed lip 34 which is arranged to fit in the groove 35 in the base plate. In this manner the section will be secured in place and serves to support the lower packer 11 because the lower end of the section is clamped about the similar base plate 17.

This lower base plate 17 serves as a cap or upper end of the packer 11 which is constructed in the same manner as the packer 10 previously described.

A conduit 39 is connected between the upper and lower base plates 17 so as to conduct the pressure liquid into the interior of the lower packer 11 the same as described in connection with the packer 10. In this manner both of the packers will be inflated simultaneously and at the same pressure.

In order to apply the liquid under pressure from the pipe 7 and the stem 9 of the packers at the predetermined pressure and in order to cause the valve 22 to close, a back pressure valve 40 has been positioned in the stem 9 adjacent the discharge section 30. This valve is seen in detail in Figs. 6 and 7 and includes a frame 41 which has the side legs 42, each of which carries a flange 43 by which the valve is affixed to the upper base plate 17 with screws or bolts. The valve member 45 is slidably mounted in the guide ring 46 near the base of the frame and is normally urged upwardly by a spring 47 to engage against the seat ring 48 which is carried either by the base plate 17 or by the top of the frame 41. The spring 47 can be so designed that this valve will open at a pressure in excess of the pressure which serves to close the valve 22. As an illustration of this the valve 40 may be arranged to open at a pressure which is 500 pounds per square inch greater than the pressure at which the valve 22 will close. In this manner the operator will be aware of the pressure at which the packers have been set and only by increasing the pressure on the liquid will he observe that the liquid is discharging into the well bore. While the valve 40 has been shown as disposed below the end of the pipe 9 and in the discharge section, it is obvious that it can be arranged inside of the stem 9 and above the lower end of the packer 10 if desired.

The coupling 8 has the perforations 50 therein which are adapted to be aligned with the perforations 51 in the upper end of the stem 9 which also carries a flange 52 to abut against the seat 53 in the coupling 8 so that when the coupling 8 is moved upwardly the stem 9 will be opened to allow a flow of liquid into the well bore 2. The guide pin 55 in the coupling 8 is movable in a slot in the stem 9 to prevent relative rotation of the stem and the coupling. Suitable shear pins 56 prevent relative movement between the coupling and stem until the packers have been set and a sufficient pull exerted on the stem 7 to cause shearing of the pins. Thus, after the packers have been set and the liquid discharged into the formation, if it is desired to maintain a circulation in the well bore the pipe 7 will be pulled upwardly to shear the pins 56 and open the ports to divert the pressure liquid.

In operation the tool will be assembled at the surface and water, oil or any suitable liquid will be used to fill the stem 9 and the packers 10 and 11. As the tool is lowered into the well bore by the operating stem the stem will be filled with liquid so as to balance the static pressure on the column of liquid in the well bore 2. In this manner when the tool arrives at the elevation where it is to be set it will only be necessary to apply a suitable liquid pressure thru the operating stem 7 to cause the packers to be inflated by creating a greater pressure in the operating stem than is present in the well bore 2 outside of the tool. The valve 22 will have been set to close at a pressure somewhat in excess of the static pressure at the elevation where the tool is to be set. In this manner a predominant pressure is applied on the inside of the packers to maintain the seal with the well bore. When the pressure on the liquid exceeds the pressure at which the valve 22 will close the valve moves to closed position and maintains the packers inflated.

As the pressure on the liquid is increased the valve 40 will open and allow the liquid to discharge into the well bore. Any desired pressure may be applied to force this liquid into the porous formation 3 in accordance with the operation being performed and the circumstances encountered.

If the operation is the cementing of the formation 3 it seems obvious that enough water or oil could be placed in the pipe 9 and the packers 10 and 14 to fill them as the tool is assembled at the surface, then as the tool is lowered the cement will be introduced and in view of the

fact that the packers are already full of water, no cement could enter the packer. Therefore after the cement was discharged from the tool and introduced into the formation the packers could be deflated by reducing the pressure in the operating pipe 7. The batches of cement could be so proportioned and alternated with slugs of water or other liquid so that little or no cement would remain in the operating pipe or the stem 9. In this manner the tool could be released when desired.

In event it is desired to establish circulation in the well bore 2 above the tool, then the operating pipe 7 may be moved upwardly to open the ports in the coupling 8 and allow the liquid under pressure from the pipe 7 to be diverted into the well bore to maintain circulation.

The tool is adapted for use in introducing various types of chemicals, or other treating liquids which are to be applied to a formation in the well bore and while cement has been described as introduced by use of the tool it is obvious that chemicals for dissolving or impregnating the formation may be uttilized.

Fig. 2 shows a formation of the tool where the discharge section and the lower packer 11 have been omitted and in this form the valve 40 would discharge directly into the well bore below the packer 10. A tool of this sort is particularly adaptable as a cement retainer where a squeeze job is being performed. Jobs of this sort include the setting of the packer in the well bore to provide a seal and the introduction of cement under high pressures so as to force the cement into the formation of the well below the packer. The packer may remain expanded in sealing position until the cement sets, whereupon it is removed and the device of Fig. 2 would be particularly adaptable for this purpose because the packer could be deflated by merely reducing the pressure in the operating pipe.

If it is desired to maintain the packer inflated while diverting the liquid into the well bore thru the coupling 8, it seems obvious that casinghead which is usually present on the top of the well could be closed and the flow lines restricted by partially closing the flow valve so as to maintain a pack pressure on the well bore 2 which would be sufficient to keep the valve 22 closed while the circulation was being accomplished.

Figs. 10 and 11 show a form of the resilient packing sleeve such as 14 wherein a reenforcement is provided. Such a reenforcement is desirable where excessive pressure differentials are to be encountered between the inside and outside pressures or where there is to be any considerable pull upon the tool while the packer is inflated. The reenforcement is shown in the form of straps 60 which are embedded in the rubber or resilient material at the time it is molded. These straps have a finger 61 which extends downwardly in the lip of the packer so that it will be securely clamped between the plates 12 and 15. The strap then extends laterally at 62 so as to pass over the edge of the disc 12 and then follows the configuration of the packing sleeve downwardly for a sufficient distance so as to hold the packing sleeve in proper position and to prevent the internal pressure from distorting it or blowing it past the cap 15. Fig. 11 shows a plurality of these straps 60 which are spaced circumferentially in the resilient material.

What is claimed is:

1. A tool of the character described comprising an operating pipe, a body normally pinned thereto, a pair of spaced packers on said body, means to direct liquid under pressure from said pipe into said packers, means to limit the maximum pressure at which such liquid may enter the packers, a perforate section between said packers to discharge liquid from the tool, and means to open such discharge only when the pressure on the liquid exceeds that at which said first means for the packers operates so that an excessive pressure will not be exerted on said packers and the discharge from the tool will occur at not less than a predetermined pressure.

2. A tool of the character described comprising an operating pipe, a body normally pinned thereto, a pair of spaced packers on said body, means to direct liquid under pressure from said pipe into said packers, means to limit the maximum pressure at which such liquid may enter the packers, a perforate section between said packers to discharge liquid from the tool, and means to open such discharge only when the pressure on the liquid exceeds that at which said first means for the packers operates so that an excessive pressure will not be exerted on said packers and the discharge from the tool will occur at not less than a predetermined pressure, and additional means to divert the discharge of liquid above the packers upon release of said pinned connection.

3. A treating tool for wells including a body, a pair of spaced packers thereon, a discharge section between said packers, an operating pipe to manipulate said tool and to supply liquid under pressure to be discharged into the well from said section, and means operable so that the pressure liquid will first inflate said packers and thereafter discharge from the tool.

4. A treating tool for wells including a body, a pair of spaced packers thereon, a discharge section between said packers, an operating pipe to manipulate said tool and to supply liquid under pressure to be discharged into the well from said section, means operable so that the pressure liquid will first inflate said packers and thereafter discharge from the tool, and additional means operable by said pipe while said packers are set to divert the liquid into the bore above the tool.

5. A tool to apply liquid under pressure to an increment of a well bore including a body, a pair of spaced packers thereon, an operating pipe thru which liquid under pressure is supplied to said tool, means to first direct the liquid to inflate said packers and to thereafter effect discharge of the liquid between the packers into the well bore.

6. A tool to apply liquid under pressure to an increment of a well bore including a body, a pair of spaced packers thereon, an operating pipe thru which liquid under pressure is supplied to said tool, means to first direct the liquid to inflate said packers and to thereafter effect discharge of the liquid between the packers into the well bore, and additional means operable by relative movement of the pipe to divert the liquid into the well bore above the packers.

7. A tool of the character described comprising a stem, a packer thereon, a valve closing the lower end of said stem, an entry to the packer from said stem, and a valve operable and closable to control said entry and normally open so that liquid under pressure in said stem will first flow to the packer until a predetermined pressure is reached whereupon said entry valve will close and said bottom valve will open at a pressure

exceeding that at which the entry valve closed so as to discharge liquid into the well bore below the tool.

8. A tool of the character described comprising a stem, a packer thereon, a valve closing the lower end of said stem, an entry to the packer from said stem, and a valve operable and closable to control said entry and normally open so that liquid under pressure in said stem will first flow to the packer until a predetermined pressure is reached whereupon said entry valve will close and said bottom valve will open at a pressure exceeding that at which the entry valve closed so as to discharge liquid into the well bore below the tool, and means on the stem to divert the liquid into the well above said packer.

9. A treating tool for wells to force cement, chemicals or other treating liquids into the well bore, including a stem, a packer thereon, a back pressure valve in said stem arranged to open at a predetermined pressure, an operating pipe to provide liquid under pressure to said tool, a valve operable and closable to control the flow of such liquid to said packer and normally open until a predetermined pressure is reached whereupon said valve will close to protect the packer, said back pressure valve being set to open at a pressure exceeding that of the closing pressure for the packer valve.

10. A treating tool for wells to force cement, chemicals or other treating liquids into the well bore, including a stem, a packer thereon, a back pressure valve in said stem arranged to open at a predetermined pressure, an operating pipe to provide liquid under pressure to said tool, a valve operable and closable to control the flow of such liquid to said packer and normally open until a predetermined pressure is reached whereupon said valve will close to protect the packer, said back pressure valve being set to open at a pressure exceeding that of the closing pressure for the packer valve, and additional means to relieve the pressure in said stem so as to hold the pressure in the well below said packer or to reduce the pressure so that said packer may deflate when the pressure decreases to allow the packer valve to reopen.

JOHN LYNES.

DISCLAIMER

2,227,730.—*John Lynes*, Houston, Tex. INFLATED PACKER TREATING TOOL FOR WELLS. Patent dated Jan. 7, 1941. Disclaimer filed Aug. 6, 1946, by the inventor and the assignee, *Lynes, Inc.*

Hereby enter this disclaimer to that part of the claims 3, 4, 5, and 6 in said specification as follows:

From the scope of claim 3, all treating tools for wells except wherein the means operable so that the pressure liquid will first inflate said packers and thereafter discharge from the tool will also operate to close said packers;

From the scope of claim 4, all treating tools for wells excepting wherein said means operable so that the pressure liquid will first inflate said packers and thereafter will also operate to close said packers against more than a predetermined pressure;

From the scope of claim 5, all tools to apply liquid under pressure except wherein the means to first direct the liquid to inflate said packers and to thereafter effect discharge of liquid between the packers into the well bore will operate upon the closing of the packers against the entry of additional liquid;

From the scope of claim 6, all tools to apply liquid under pressure except wherein the means to first direct the liquid to inflate said packers and to thereafter effect discharge of the liquid between the packers into the well bore includes valves to close the packer.

[*Official Gazette September 10, 1946.*]