June 1, 1948. P. B. CLARK 2,442,529

CONTROL PACKER

Filed Jan. 11, 1944 2 Sheets-Sheet 1

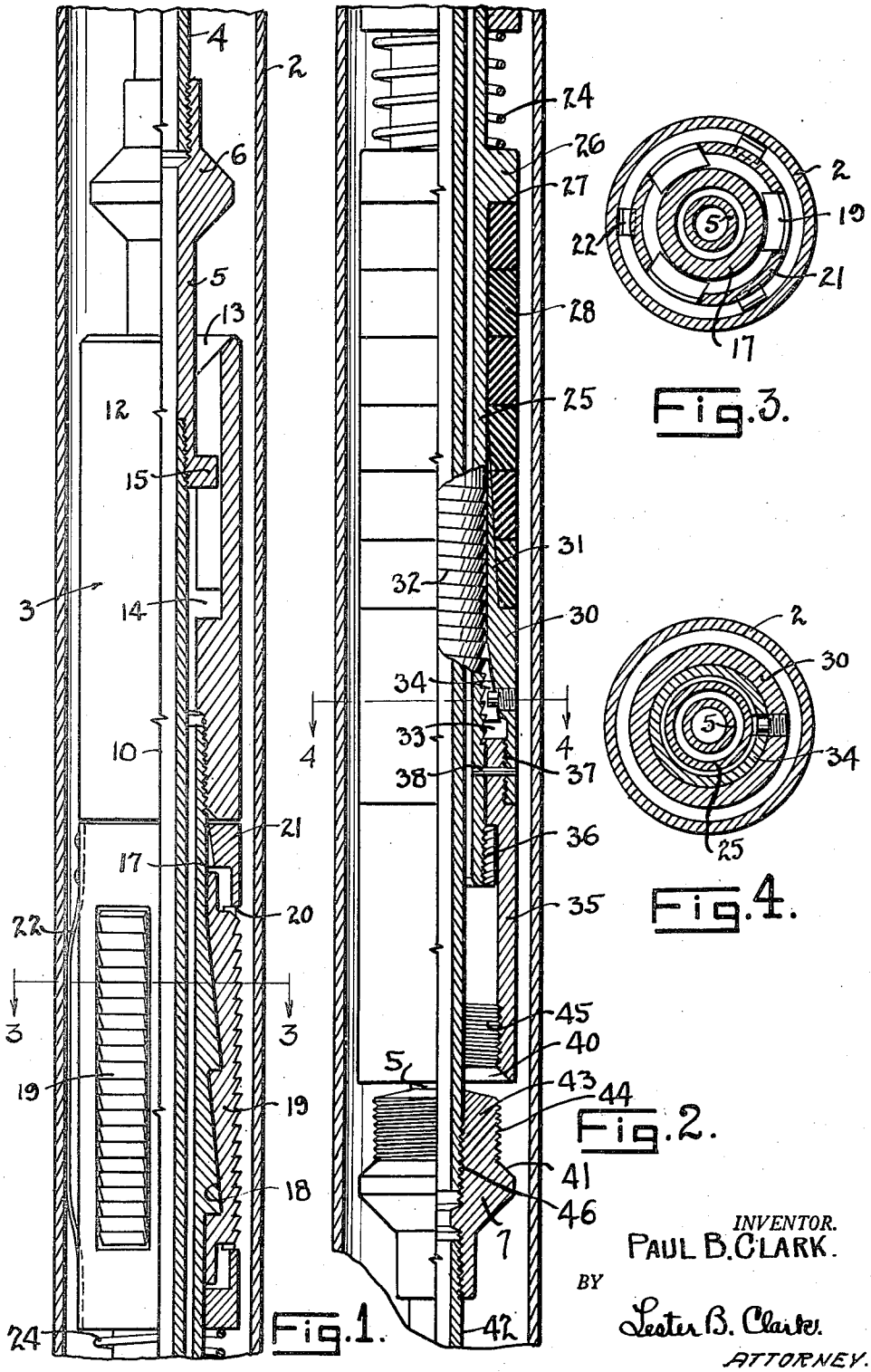


Fig. 1.

Fig. 3.

Fig. 4.

Fig. 2.

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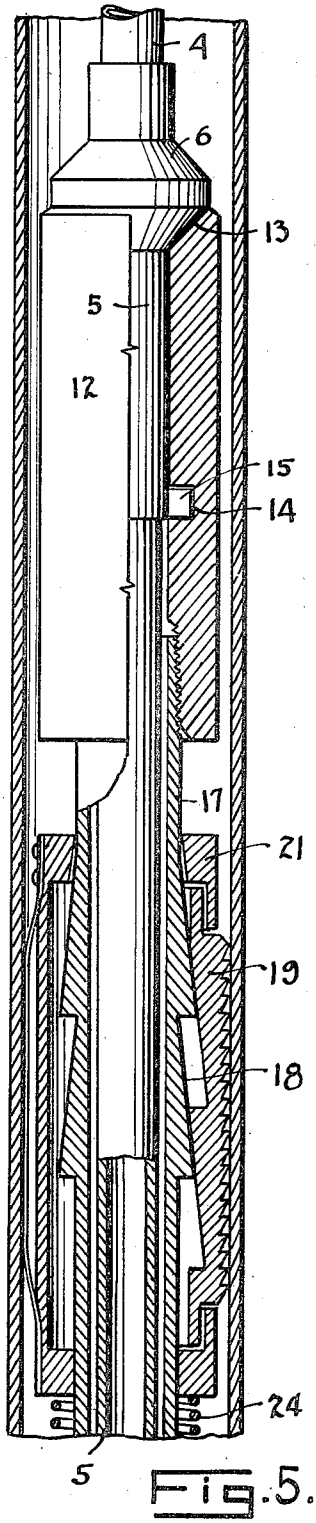


Fig. 5.

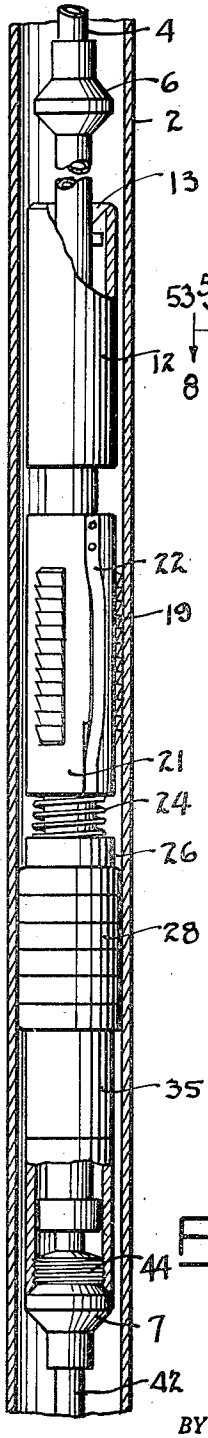


Fig. 6.

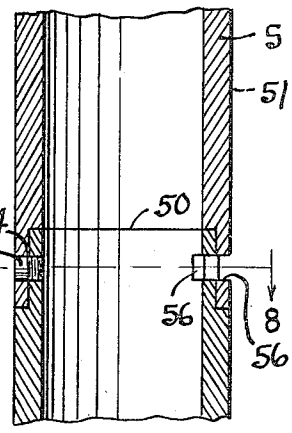


Fig. 7.

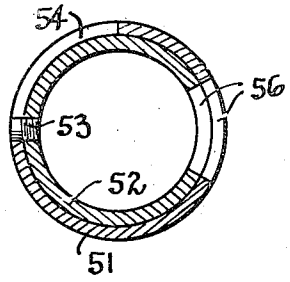


Fig. 8.

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CONTROL PACKER

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4 Claims. (Cl. 166—12)

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The invention relates to a control packer which adapts itself for a considerable variety of uses to accommodate the varying conditions which are usually encountered in the completion and production of fluid from wells.

In the drilling of wells by the rotary method where a heavy drilling fluid is circulated into and out of the well bore, the static head of the column of drilling fluid creates considerable pressure upon the porous formations and it is necessary to wash the well first to remove the drilling fluid and attempt to break down the filter cake which forms on the face of porous formations while replacing the heavy drilling fluid with a lighter liquid so as to encourage the entrance of fluids from the formation into the well. In some instances, however, the lighter liquid which it is desirable to use in washing the well does not maintain sufficient pressure against the formations to prevent blowing out and it is often necessary to quickly close the well and also necessary to effect the washing of the well bore before and after setting of the control packer so as to clean the well with a view of obtaining maximum production.

With the foregoing in mind, it is one of the objects of the present invention to provide a combination control packer and control valve assembly which may be lowered into a well bore, anchored, and manipulated to accomplish the operations desired.

Another object of the invention is to provide a control packer having a housing in combination with a valve mandrel so that the housing may be closed at the top, at the bottom, or flow permitted therethrough.

Another object of the invention is to provide a control packer which can be set in a well bore to provide a seal against the flow of fluid from the well except through a valve control passage.

Another object of the invention is to provide a control packer housing having a valve seat on each end thereof.

Another object of the invention is to provide a control packer mandrel having spaced valves adapted to seat on the packing housing.

Another object of the invention is to provide a control packer which may be manipulated to flow from one or more formations.

Another object of the invention is to provide a control packer wherein the weight of the flow tubing may be disposed upon the flow packer so as to support the tubing or wherein the tubing may be placed under tension to exert a pull against the control packer or where the packer

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may remain open to permit a flow therethrough around the outside of the flow tubing.

Another object of the invention is to provide a control packer which can be lowered into the well, set, sealed and closed or opened as desired.

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

Fig. 1 is a vertical sectional view illustrating an arrangement of the upper end of the structure of the invention.

Fig. 2 is a continuation of Fig. 1 illustrating the lower portion of the equipment.

Figs. 3 and 4 are sections taken on the lines 3—3 of Fig. 1 and 4—4 of Fig. 2 respectively.

Fig. 5 illustrates the tool as having been set and supporting the weight of the tubing flow string.

Fig. 6 illustrates the tool in elevation in a well with tension on the tubing to close the packer at the bottom.

Fig. 7 is a sectional view of a modified form of the mandrel inside of the control packer.

Fig. 8 is a section taken on the line 8—8 of Fig. 7.

In the drawings the well casing or liner 2 is disposed in the well and the control packer assembly 3 is lowered into the well by means of the flow tubing 4 to which is connected the valve mandrel 5.

This mandrel 5 is an elongated piece of pipe made up of a suitable number of sections so as to support the upper valve member 6 and the lower valve member 7 in spaced relation a distance apart somewhat greater than the length of the control packer housing assembly 10 as seen in the composite view of Figs. 1 and 2.

The housing 10 is made up of a coupling 12 which is provided with a tapered valve seat 13 on its upper end and arranged with a J slot or latch construction 14 which is arranged to receive the lug 15 on the valve mandrel 5 so that upon relative rotation of the mandrel and the housing the mandrel can be released for vertical sliding movement relative to the housing, but the two will be latched together when the lug 15 moves circumferentially into the recess 14.

Below the coupling 12 is a slip wedge section 17 which has one or more frusto conical surfaces 18 which tend to move the slips 19 through the openings 20 in a slip cage 21 which is slidable on the wedge section. Alternately arranged around this wedge section on the slip cage are the drag springs 22 and the slips 19 as best seen

in Fig. 3. A spring 24 normally urges the cage upwardly relative to the wedge sections so as to retain the slips in collapsed or retracted position.

The lower end of this slip section is formed as a packing receiving barrel 25 which has a flange 26 thereon upon which the spring 24 is seated. This flange forms a shoulder 27 against which a series of packings 28 may abut. These packings are supported on a collar 30 having a tapered portion 31 to fit inside of the packings and prevent the packings from engaging the ratchet teeth 32 on the barrel 25. This collar 30 is recessed at 33 to receive the dog 34 which is arranged to engage the ratchet teeth 32 to hold the packings compressed. The ratchet teeth 32 are helical so that rotation of the packer barrel relative to the packings and the collar 30 will effect release of the dogs and the packings.

A packer setting skirt or sleeve 35 is suspended by the support ring 36 on the lower end of the packer barrel and is threaded at 37 to the collar 30. A shear pin 38 is seen in Fig. 2 as projecting through the collar, skirt and packer barrel to retain the parts in the position of Fig. 2. When the tool is to be operated, however, this pin 38 will be sheared. The lower end of the packer skirt 35 is provided with a tapered seat 40 which is arranged to receive the valve surface 41 on the valve 7. The mandrel 5 continues beyond the valve 7 and may have a tail or flow pipe 42 thereon of any desired length.

The valve 7 has a shank 43 thereon which is threaded at 46 to engage in the complementary threads 45 on the lower inside of the skirt 35. Thus when the mandrel is raised to elevate the lug 15 out of the vertical portion of the J latch 14 so that the mandrel is then free to be rotated a desired amount so that the threads 44 and 45 will be engaged to retain the valve 7 in closed position. If desired the threads 46 connecting the mandrel 5 with the valve 7 can also be releasable by continued rotation of the mandrel so that the mandrel may be removed after the assembly has thus been locked in position.

Figs. 7 and 8 show a modified form of the mandrel 5 wherein a joint 50 has been arranged by connecting the portions 51 and 52 of the mandrel together by means of a support pin 53 which is carried by the pipe section 52 and projects into the slot 54 in the pipe 51. This pin and slot connection limit the relative turning movement of one section of the mandrel with respect to the other. The telescoped portions of the pipes 51 and 52 each have a slot 56 therein as seen in Figs. 7 and 8 and these slots will be aligned to form an inlet or outlet port when the parts are in the position of Fig. 8. This port may be desirable in event production is to be obtained from two separate formations or in event it is desired to pump fluid into or out of the formation or to otherwise permit flow for some particular purpose.

Broadly the invention has various uses, but it is particularly adapted for use in completing wells where a variety of conditions may be encountered.

In operation the parts will be assembled and the housing will be resting upon the lower valve member 7 as seen in Fig. 6 and the tool lowered into the well.

The assembly may be lowered into the well in another position with the lug 15 in the horizontal portion of the J-slot 14 supporting the weight of the housing as seen in Fig. 5.

In either event when the tool arrives at the

desired elevation where it is to be set the well will probably be washed to some extent by circulating a washing liquid down through the tubing 4 and upwardly through the well pipe 2.

When it is desired to set the tool the tubing 4 and mandrel 5 will be raised slightly to cause the slips 19 to move outwardly on the wedge faces 18. The drag springs 22 tend to hold the housing stationary sufficiently to effect this wedging action. Fig. 6 shows the slips as having been expanded against the pipe 2.

In order to prevent the packings 28 from being set while the tool was being lowered the shear pin 38 was provided and after the slips have been set it is next desirable to set the packings 28 and to accomplish this an upward pull is made upon the tubing 4 so that the valve 7 engages the skirt 35, shears the pin 38 and moves the skirt and collar 35 upwardly to expand the packings 28 radially against the pipe 2. The ratchet dog 34 clicks over the ratchet teeth 32 to latch the packings in expanded position. In event it is thereafter desired to release these packings the rotation of the packer barrel 25 relative to the collar 30 causes the dog 34 to travel on the ratchet teeth to effect release.

After the packer has been set it seems obvious that the flow through the pipe 2 can be very quickly controlled by closing either the valve 6 or 7 by longitudinal movement of the tubing and mandrel 5. The washing of the well to remove the heavy drilling fluid and reduce the pressure on the formation is now accomplished and this washing operation may be carried on until the wash liquid shows clear at the surface to indicate complete washing of the formation.

If the well begins to flow during this operation the flow, of course, will be upwardly through the pipe 2 to the surface. If it is desired that the production pass through the tubing 4 it is only necessary then to either lower the tubing to close the valve 6 or to raise the tubing to close the valve 7 as may be desired.

Some operators under some circumstances prefer to rest the tubing or a portion of the weight thereof on the top of the control packer in which instance the valve 6 will be closed. Other operators prefer to maintain a tension on the tubing by exerting an upward pull in which instance the valve 7 would be closed. It is thus apparent that the construction is capable of either operation.

In either event the flow would then be forced through the tubing 4 to the surface.

In some instances an operator may desire to remove the tubing completely and flow the well through the pipe 2 in which instance the threads 44 and 45 would be engaged and by continued rotation the threads 46 released and the tubing removed.

In some instances it might be desirable to retain both the valve 6 and 7 in open position to flow through the pipe 2 and in this situation the pipe 4 may be connected to a source of pressure fluid which could be introduced into the well to assist in elevating the well liquid.

If the equipment were positioned in a well having two producing formations it seems obvious that by suitable segregation one formation could flow through the tool and the pipe 2 while the other formation could flow through the tubing 4 or if desired the flow from both formations could be admitted to the tubing by opening the port 56 which is shown in Figs. 7 and 8 by suitable rotation of the tube to effect such

opening if this type of port were provided in the mandrel 5.

Broadly the invention contemplates a construction which is capable of completing and controlling a well for production.

What is claimed is:

1. A control packer housing for wells including an upper coupling having a beveled valve seat at its upper end, a slip wedge section connected to the lower end of said coupling, frusto-conical faces on said section, a slip cage containing slips slidable on said faces of said section to effect expansion or contraction of said slips upon relative sliding movement between the section and cage, a packer assembly connected to the lower portion of said section and including a packing, a packer setting sleeve, means to retain the packing in set position, and a valve seat on the lower end of said setting sleeve.

2. A control packer including a housing, means to anchor and seal said housing in a well bore, a valve mandrel movable in said housing, and cooperating valve and seat means on said housing and mandrel at the upper and lower ends of said housing so as to close the passage within said housing and around said mandrel at either the top or the bottom by movement of said mandrel relative to the housing, and interconnectable means on the mandrel and housing arranged to be connected to set said anchor and seal but releasable for movement of said mandrel to hold the mandrel with both valve means open.

3. A control packer and valve mandrel for wells including a packer housing, means to anchor and seal said housing in the well, a mandrel extending through said housing, a pair of spaced valves on said mandrel, a valve seat at each end of said housing, and tubing means to minpulate said mandrel to set said packer housing, a latch between said mandrel and housing engagable to lock said mandrel to said housing for setting said anchor and seal but releasable for movement of said mandrel to open or close either of said valves to control the washing and flowing of the well.

4. A control packer and valve mandrel for wells including a packer housing, means to anchor and seal said housing in the well, a mandrel extending through said housing, a pair of spaced valves on said mandrel, a valve seat at each end of said housing, and means to manipulate said mandrel to set said housing and to open or close either of said valves to control the washing and flowing of the well, and a flow port adapted to be opened or closed intermediate said valves in said mandrel to admit or discharge fluid.

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