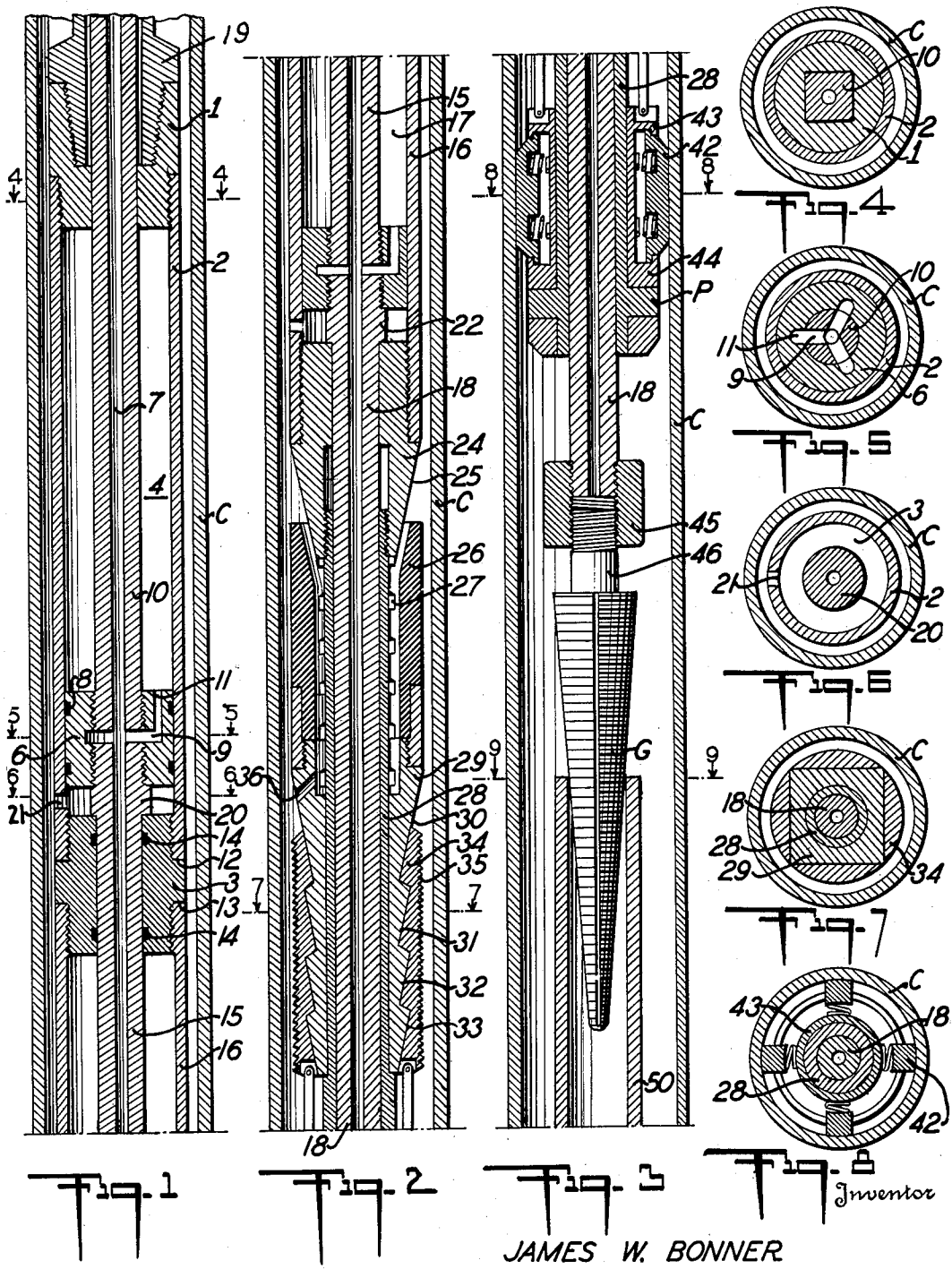
Feb. 14, 1956 J. W. BONNER 2,734,581

PULLING TOOL

Filed Feb. 4, 1952 2 Sheets-Sheet 1



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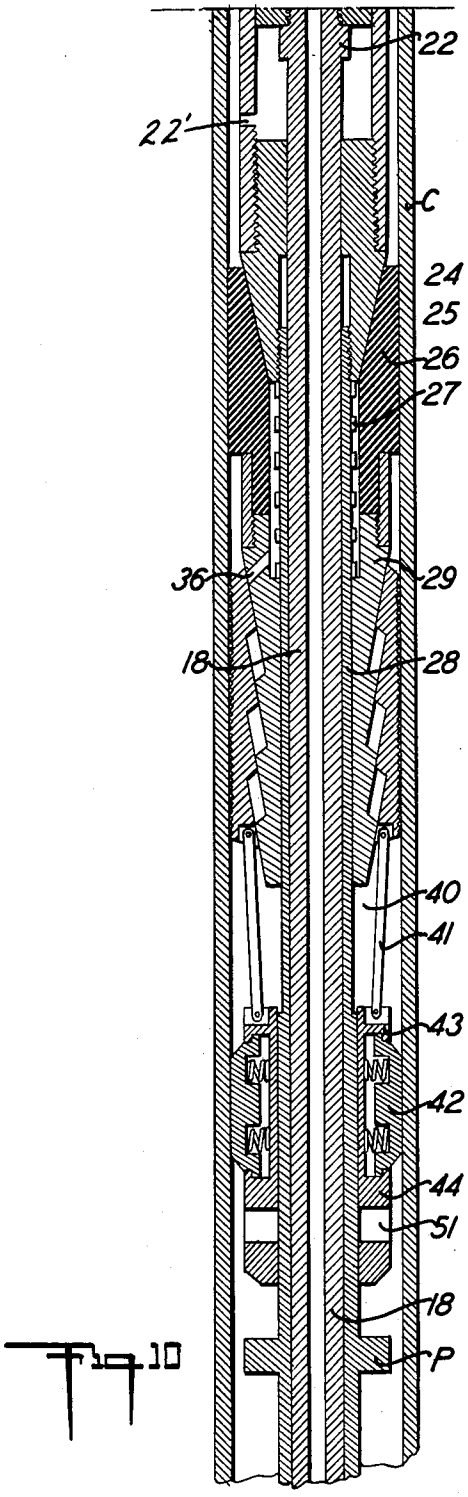


Fig. 10

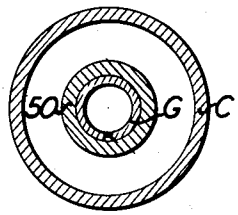


Fig. 9

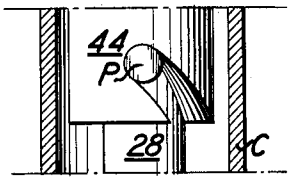


Fig. 11

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United States Patent Office 2,734,581 Patented Feb. 14, 1956

2,734,581

PULLING TOOL

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Application February 4, 1952, Serial No. 269,885

8 Claims. (Cl. 166—98)

This invention relates, as indicated, to a pulling tool adapted to be used in oil well operations wherein it is desired to remove a stuck object. Heretofore attempts have been made to provide hydraulic pulling tools, but as far as I am aware, these have not been successful.

It is a particular object of the invention to provide a combination of an operating string having a cylinder or series of cylinders located at its lower end and also having centrally disposed therein a piston and tubular piston rod. The piston rod is connected by means of a grapple of any desired sort to the "fish" or stuck object. Thereupon hydraulic pressure is employed and this invention differs from all other hydraulic tools in that the drilling fluid or other well fluid lying between the casing and the cylinder is used in order to force the piston, piston rod and "fish" upwardly.

Another specific object of the invenion is to provide a mechanically set packer which effectively seals the space between the aforesaid cylinder and the casing so that the fluid must follow one path; namely, into the cylinder and up against the piston.

Another object of the invention is to provide a means to retain the pressure on the cylinder without any loss thereof either through the piston rod or otherwise.

Still another object of the invention is to provide a joint between the piston rod and the cylinder and connected operating string so that the piston rod can be actuated to grapple or grasp the fish.

An outstanding object of the invention is to provide means for supplying pressure in any desired amount, this means comprising serially connected cylinders which can be added on in any desired number to surround the piston rod and wherein one or any number of desired pistons may be employed to produce the desired upward pressure. In other words, if it is found necessary to increase the lifting pressure, it is merely necessary to withdraw the operating string and add any desired number of cylinders that may be required.

A further broad object of the invention is to provide a pulling tool which may be effectively used in deep wells as well as shallow wells and, as a matter of fact, is more effective in deep wells due to pressure of the column of liquid lying between the casing and the connected cylinders and operating string.

A further object of the invention is to provide an exceedingly simple construction of very few parts which is capable of long wear and which may be easily replaced.

Other and further objects of the invention will become apparent as the description proceeds, reference being made to the accompanying drawing forming a part of the present disclosure, wherein:

Fig. 1 is a vertical section of the upper portion of the tool;

Fig. 2 is a vertical section of the intermediate portion of the tool;

Fig. 3 is a vertical section of the lower portion of the tool;

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 1;

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 1;

Fig. 6 is a horizontal section taken on line 6—6 of Fig. 1;

Fig. 7 is a horizontal section taken on line 7—7 of Fig. 2;

Fig. 8 is a horizontal section taken on line 8—8 of Fig. 3;

Fig. 9 is a horizontal section taken on line 9—9 of Fig. 3;

Fig. 10 is a vertical section similiar to Figs. 2 and 3 showing the packer in set position;

Fig. 11 is a detailed view of the slip releasing pin mechanism.

Referring now to the drawings and more particularly to Fig. 1, it will be seen that I have provided an operating string of pipe **19** which is screw threadedly received in the adapter **1** to which is attached the upper cylinder **2**. This cylinder is secured to a combined connecting and stop member **3** so that a space **4** is provided between what may be termed a piston rod **10** and the interior surface of the cylinder **2**.

The piston rod **10** has a tubular bore **7** and is threaded to a piston **6**, the piston being provided with packing **8** so as to seal the same during its travel up and down in the space **4**.

The piston **6** has a horizontal passageway **9** connected to a vertical passageway **11** so that as the piston ascends, air or fluid in the space **4** may drain downwardly and radially inward to the bore **7**. Since there is no pressure in the operating string there will be none in the bore **7**, so there is no resistance to such air or pressure.

In removing objects which are less difficult to dislodge, it may be possible to operate my pulling tool with a single cylinder tube, but I prefer to employ at least two cylinders as shown. The cylinders may be added at will due to the construction of the piston **6** and the sectional piston rods **10**, **15** and **18**. In order to accomplish this the upper piston rod **10** is screwed down into the piston **6** until its lower surface coincides with the upper part of the horizontal passage **9**, which passage may be duplicated, for example, as I have shown in Fig. 5, wherein three passages are utilized. This will provide for one cylinder in combination with the outer member **2**. Another piston rod **15** is then screwed into the threaded bore of the lower portion of piston **6**, the rod being screwed up until its upper surface coincides with the lower part of passage **9** and prevented from going further by the stop shoulder **20**. The lower horizontal surface of the stop shoulder functions to prevent the piston and the connected piston rod being descending to a position where port **21** would be blocked.

This combined connecting and stop member **3** serves as a stop for the piston rod as described, and also serves to connect the upper cylinder **2** into the assembly since the cylinder **2** is screwed down until it reaches the stop shoulder **12**. Similarly the lower cylinder **16** is screwed upwardly until it reaches the stop shoulder **13** and, of course, as many of the combined connecting and stop members **3** may be employed as desired along with additional sections of the piston rod and additional cylinders and pistons.

In the embodiment shown wherein two cylinders are provided, the lower cylinder **16** is connected to packer expanding member **24** having a conical surface **25**. The expander **24** screw threadedly receives the cylinder **16**.

The packer assembly consisting of the packer **26**, multiple cone member **29**, slips **34**, friction shoe retaining ring **43** is mounted externally of a mandrel **28** that surrounds the lowermost section **18** of the piston rod. The

parts are held with the slips in retracted position by means of a compression spring 27. The slip expander 29 is provided with a series of inclined or conical surfaces 30, 31, 32 and 33, which engage corresponding surfaces on the slips 34. The slips are connected to the friction shoe assembly by means of the links 41 and the tubular sleeve 43 has mounted therein three spring loaded friction shoes 42.

At the lowermost portion of the mandrel 28 the same is enlarged to provide recesses 51 for reception of the slip releasing pins P. The enlargement 44 provides ample space in which to locate the sockets 51 and the curved slots leading downwardly from such sockets to the lowermost edge of the mandrel 28.

A coupling sleeve 45 connects the grapple G to the piston rod 18 by means of interior threads therein which engage exterior threads on the neck of the grapple and piston rod. This grapple is one form of a fish-engaging means and is not the only form which may be used. There are many tools capable of grappling or gripping stuck objects in a well bore and the grapple G is merely shown for purposes of illustration.

It should be noted that the stop shoulder 22 on the upper part of lower piston rod 18 performs the same functions as set forth with respect to the stop shoulder 20. The ports 36 may be provided in any number, these being closed during the slip setting operation by movement of the member 29 downwardly into the slips. After the pull has been made, fluid may move down between the cone 25 and the packer 26 and out through the port or ports 36 in order to equalize the pressure. This is very important where the tool is used in a well having a formation which will not hold the fluid. In other words, if the fluid can pass into the formation it obviously can perform no useful function. However, with this tool the type of formation is immaterial.

In operation the operating string 19 with the attached cylinders 2 and 16 and packer assembly along with the grapple is lowered into the well until contact is made with the fish 50. The operator is, of course, aware of such contact because of the fact that the operating string ceases to travel downwardly.

In order to disconnect the piston rod 18 from the packer assembly, the operating string is turned slowly to the left so that the pin will ride down the inclined groove as shown in Fig. 11 and will move beneath the mandrel 28, as shown in Fig. 10. The packer setting mechanism is now ready to be operated.

The operating string is then rotated and due to the fact that the piston rod 10 may move longitudinally with respect to the adapter 1, as shown in section in Fig. 4, the grapple grips the fish 50.

After the fish has been gripped the packer is next set by lowering the operating string which compresses the spring 27 and, due to contact between the conical face 25 on the expander 24 expands the packer 26 while at the same time the spring 27 forces the slip expander 29 downwardly. At this time the slips are held in a stationary position due to contact of the friction shoes 42 with the interior surface of the casing C. It is believed that the packer may be set so that a tight seal is obtained merely by use of pressure upon the operating string, but it is to be noted that the seal between the packer and the casing may be made tighter when fluid is subsequently applied.

The sectional piston rod 10, 15 and more sections if desired along with their associated pistons 6 as an assembly, is free to move upwardly or downwardly restricted by the members 1 and 3. The upper piston rod 10 terminates slightly above the adapter 1, as shown in Fig. 1, when the piston is in its lowermost position.

The tool is now ready for the pulling operation and this is done by forcing the fluid between the operating string and the dependent cylinders and the casing through the ports 21 and 22'. Since the space between the tool and the casing is effectively sealed, as shown in Fig. 10, the pressure is effectively delivered to each of the pistons which in turn acts on the composite or connected piston rod, and this in turn subjects the fish 50 to an upward thrust through the medium of the grapple G. Thus it will be seen that all of the pressure imparted to the well fluid plus the weight of the well fluid may be effectively applied to the fish. If it be found that two cylinders, as shown, cannot move the fish, then additional cylinders may be added and the pressure increased enormously.

From the above description it will be apparent that I have provided a device which may be easily lowered into a well and which then can be attached to a fish, after which the packer is mechanically set and the fluid surrounding the tool is subjected to pressure to force the fish upwardly. Furthermore, it will be noted that the device is capable of imparting any desired pressure due to the fact the pressure cylinders may be added as desired. In addition, it will be observed that the space beneath the tool is effectively sealed off and that all of the pressure fluid is effectively employed to force the fish upwardly.

One particular feature of the invention is the ability to make multiple pulls where the fish happens to be securely stuck. For example, let it be assumed that the distance between bumper 45 and the lower end 44 of the mandrel 28 is five feet. After the first pull on the fish 50 the bumper 45 will be up against the lower end 44. At this time if it is impossible to lift the fish by the normal amount of force exerted by the tubing string, another pull can be made without taking the tool out of the well. This is accomplished by resetting the slips and going through the operation as described above, and it is to be noted that this operation can be repeated over and over again, thus eliminating the severe strain to which the string would otherwise be subjected.

Another very important feature of the invention is the fact that it is possible to pump either way at any time before the tool is set. For example, it may be desirable to pump downwardly outside of the tool and up through the central bore 7 which is generally referred to as "reverse circulation." On the other hand, pumping may be done downwardly through 7 and up outside of the tool with equal facility. This latter operation is particularly advantageous where sanding occurs since fluid can be pumped down through 7 and up between the casing and tool, thus removing the sand.

It will be obvious that modifications may be made by those skilled in the art without departing from the spirit of the invention, and it is my desire to cover all such modifications as come within the scope of the invention as defined by the following claims.

I claim:

1. A pulling tool, for use in a cased well, comprising an operating string, a cylinder mounted on the lower end of said operating string, a piston slidably mounted in said cylinder, a port in said cylinder located below said piston, a piston rod secured to said piston and extending above and below said cylinder, a mandrel secured to the lower end of said cylinder and slidable on said piston rod, a packer assembly slidably supported on said mandrel below said port, means on the lower end of said piston rod to attach said rod to a fish, means to set said packer assembly so as to seal off the space between the well casing and said cylinder whereby upon admission of fluid under pressure from said space through said port into said cylinder said position, piston rod, and fish receive an upward thrust.

2. The construction set forth in claim 1 wherein one or more cylinders and pistons may be attached to said cylinder and piston rod respectively.

3. A pulling tool, for use in a cased well, comprising an operating string, a cylinder mounted on the lower end of said operating string, a piston slidably mounted in said cylinder, a port in said cylinder located below said piston, a piston rod secured to said piston and extending above

and below said cylinder, a mandrel secured to the lower end of said cylinder and slidable on said piston rod, a packer assembly supported on said mandrel below said port, means on the lower end of said rod to attach said rod to a fish, means to set said packer assembly so as to seal off the space between the well casing and said cylinder whereby upon admission of fluid under pressure from said space through said port into said cylinder said piston, piston rod, and fish receive an upward thrust, said piston rod comprising a tubular member ported to the interior of said cylinder.

4. A pulling tool, for use in a cased well, comprising an operating string, a cylinder connected to the lower end of said string, a piston slidably mounted in said cylinder, a piston rod located centrally of said piston and extending below said cylinder, a grapple mounted on the lower end of said rod, an inlet port in said cylinder below said piston, a closure member at the lower end of said cylinder and a mandrel connected to said member and said member and mandrel slidably surrounding said rod, a packer slidably supported on said mandrel below said port, said closure member having a conical shaped surface adapted to engage and set said packer, slips, and slip setting mechanism slidably carried by said mandrel, a releasing pin on the lower end of said mandrel, said slip setting mechanism having a groove for the reception of said pin whereby after moving said pin out of the groove in said mandrel said packer may be mechanically set, and upon the introduction of fluid under pressure through said port and into said cylinder, said grapple is given an upward thrust.

5. A construction as set forth in claim 4 wherein said packer is secured to a sleeve having a series of conical shaped surfaces and said sleeve is surrounded by slips having interior surfaces corresponding to said conical surfaces and roughened exterior surfaces.

6. A pulling tool, for use in a cased well, comprising an operating string, a cylinder mounted on the lower end of said operating string, a piston slidably mounted in said cylinder, a port in said cylinder located below said piston, a piston rod secured to said piston and extending above and below said cylinder, a mandrel secured to the lower end of said cylinder, a packer assembly slidably supported on said mandrel below said port, means on the lower end of said rod to attach said rod to a fish, means to set said packer assembly so as to seal off the space between the well casing and said cylinder whereby upon admission of fluid under pressure from said space through said port

into said cylinder said piston, piston rod, and fish receive an upward thrust, said piston rod being enlarged immediately below said piston to provide a stop shoulder.

7. A pulling tool, for use in a cased well, comprising an operating string, a cylinder mounted on the lower end of said operating string, a piston slidably mounted in said cylinder, a port in said cylinder located below said piston, a piston rod secured to said piston and extending above and below said cylinder, a mandrel secured to the lower end of said cylinder, a packer assembly supported on said mandrel below said port, means on the lower end of said rod to attach said rod to a fish, means to set said packer assembly so as to seal off the space between the well casing and said cylinder whereby upon admission of fluid under pressure from said space through said port into said cylinder said piston, piston rod and fish receive an upward thrust, said piston rod being enlarged immediately below said piston to provide a stop shoulder, and said cylinder having a reduced portion extending to said piston rod to provide a lower stop for said piston rod, such reduced portion lying immediately below said port.

8. A pulling tool, for use in a cased well, comprising an operating string, a cylinder mounted on the lower end of said operating string, a piston slidably mounted in said cylinder, a port in said cylinder located below said piston, a piston rod secured to said piston and extending above and below said cylinder, a mandrel secured to the lower end of said cylinder, a packer assembly supported on said mandrel below said port, means on the lower end of said rod to attach said rod to a fish, means to set said packer assembly so as to seal off the space between the well casing and said cylinder whereby upon admission of fluid under pressure from said space through said port into said cylinder, said piston, piston rod, and fish receive an upward thrust, said piston rod being enlarged immediately below said piston to provide a stop shoulder, and said cylinder having a reduced portion extending to said piston rod to provide a lower stop for said piston rod, such reduced portion lying immediately below said port, and said cylinder having another reduced portion extending to the piston rod at the upper end thereof.

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