

March 19, 1935.

E. GRAY ET AL

1,994,816

DEVICE FOR EQUIPPING WELLS

Filed May 26, 1931

2 Sheets-Sheet 1

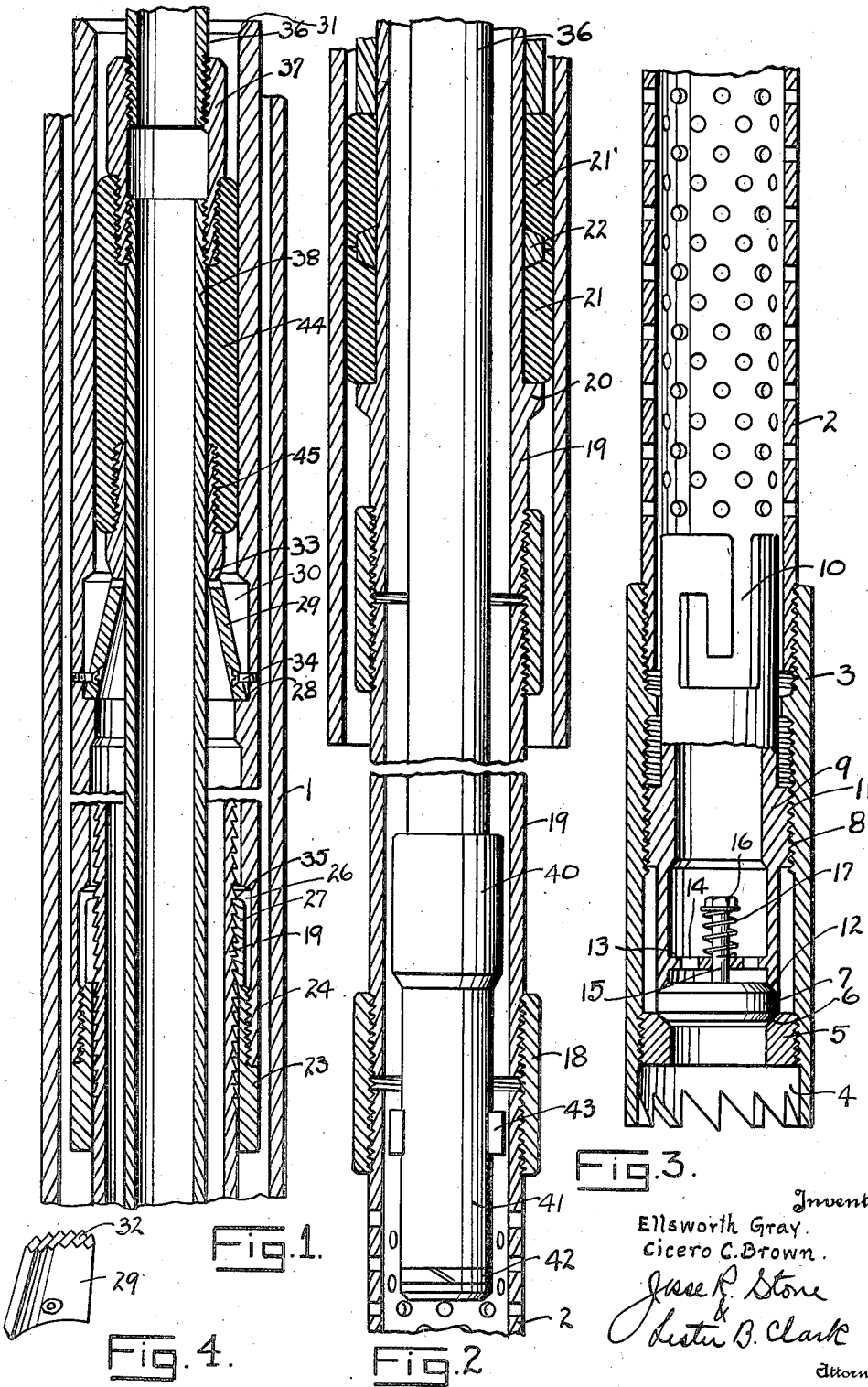


Fig. 3.

Inventors
Ellsworth Gray.
Cicero C. Brown.

Jose P. Stone
&
Arthur B. Clark

Attorney

March 19, 1935.

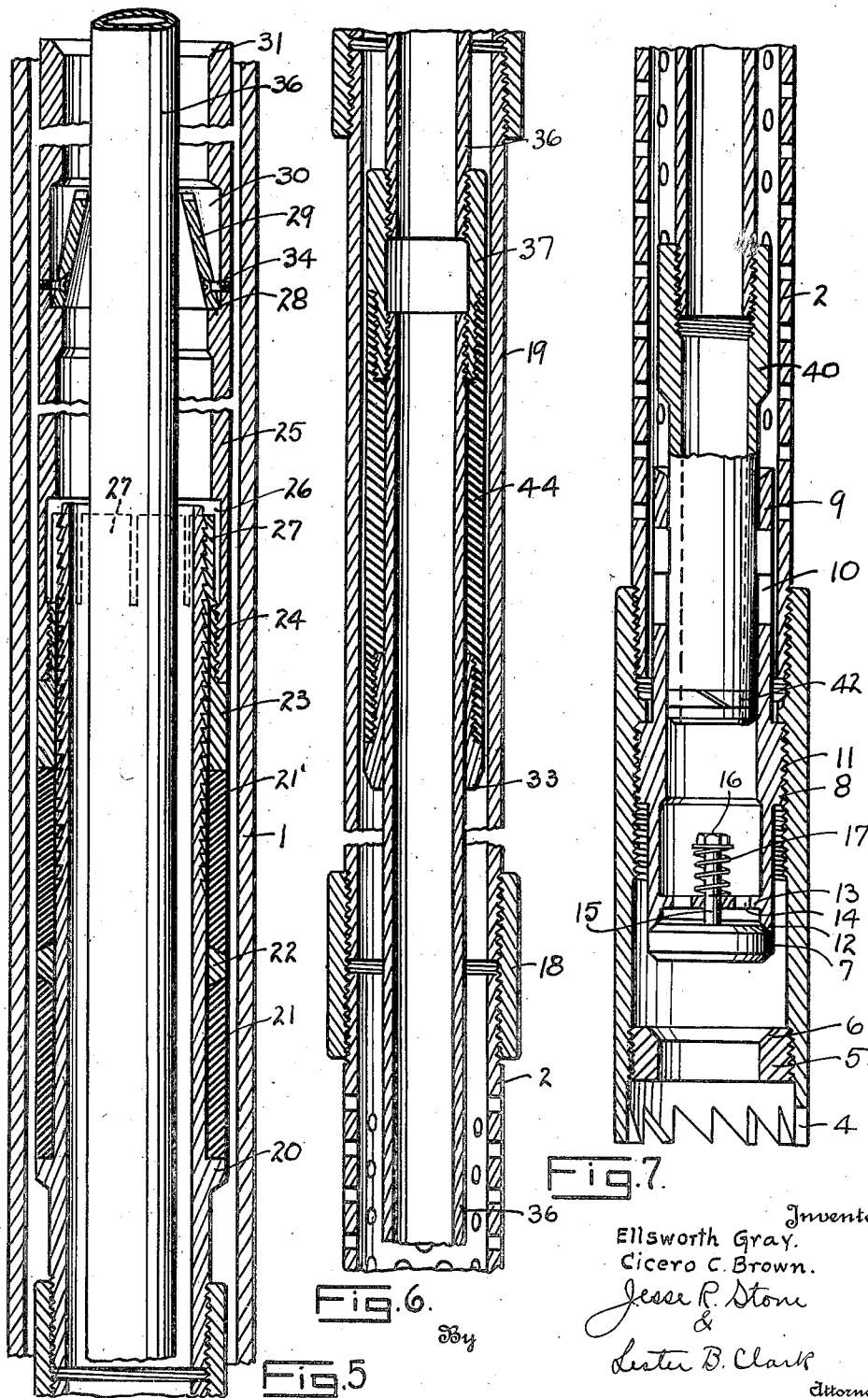
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UNITED STATES PATENT OFFICE

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DEVICE FOR EQUIPPING WELLS

Ellsworth Gray and Cicero C. Brown, Houston,
Tex.; said Gray assignor to said Brown

Application May 26, 1931, Serial No. 540,046

15 Claims. (Cl. 166—10)

Our invention relates to a device for equipping a well which has been drilled so that the fluid from the well may pass outwardly through a flow line employed with our equipment.

5 In bringing in a well producing oil or gas under pressure it is the usual custom to install at the lower end of the well, and connected with the lower end of the liner, a screen, and to wash first the outside of the screen and then the interior thereof so as to eliminate the mud and foreign matter about the screen so that the producing fluid may find entrance thereto. This washing of the screen is usually accomplished by inserting a wash pipe at the lower end of the drill stem and pumping the water down through the wash pipe and into and about the screen. This operation of washing a well requires a separate trip into the hole with the wash pipe to accomplish the washing of the well before a tubing or flow line can be introduced to provide an eduction tube through which the fluid can pass from the well. When the well has been washed and the wash pipe is withdrawn it is a frequent difficulty that the gas will force the oil upwardly following the drill stem and the wash pipe and provision must be made for preventing the well from blowing out.

It is an object of our invention to provide a tubing or flow line which may be employed for setting the screen, washing the well and providing also a flow line through which the production may pass from the well.

We desire to provide a flow line which may be connected with the back pressure valve for washing the exterior of the well but which may be disconnected therefrom to also wash the interior of the well and leave the tubing in position to act as a flow line for the oil or gas.

The invention also consists in the construction of the back pressure valve which is adapted for operation with our particular construction of eduction tube.

We also have as an object a provision in connection with our eduction tube for fixing the packer in position to close the space above the strainer and within the lower end of the liner as is now customary.

We desire to provide for closing the space between the eduction tube and the liner, and between the liner and the wall of the well and to be enabled to set both of these packers in one operation.

In the drawings herewith wherein a preferred embodiment of our invention is disclosed, Fig. 1 is a central longitudinal section through a well casing with our device therein, and showing the upper portion of said device in a set or expanded position.

Fig. 2 is a similar view showing the lower portion of said device after the back pressure valve has been closed.

Fig. 3 is a view of the lower end of the well strainer and illustrating the position of the closed valve.

Fig. 4 is a perspective view of one of the releasing dogs connected with the invention.

Fig. 5 is a view similar to Fig. 1 showing the parts in connected position as they are introduced into the well.

Fig. 6 is a view similar to that shown in Fig. 2 with the parts in connected position and Fig. 7 is a central longitudinal section through the lower end of the strainer and set shoe with the back pressure valve in position to open and the tube inserted.

With reference to Figs. 1, 2 and 3, we have shown the outer casing or liner 1 as extending downwardly into the well and having thereon adjacent the lower end a well screen and other equipment ordinarily placed in a producing well.

Within the casing is a screen 2 connected at its lower end to a set shoe 3. Said set shoe has a toothed lower end 4 which is used in cutting such material as may obstruct the well when the tool is introduced therein. Said shoe has adjacent its lower end a valve ring 5 secured therein and having a tapered seat 6 thereon to receive a back pressure valve 7. Spaced above the ring the shoe is threaded at 8 to engage with a valve housing 9.

The valve housing 9 is a tubular member, the upper end of which extends slightly into the screen 2 and has a J-slot 10 therein to receive the lower end of the tubing or setting tool whereby the adjusting of the valve housing may be accomplished. Said housing has an enlarged and threaded area 11 on its outer surface to engage with the threaded portion 8 of the set shoe. The lower end has a valve seat 12 thereon above which is a transverse wall or diaphragm 13 having openings 14 therein to allow the passage of fluid therethrough.

Centrally of the wall 13 is an opening through which the valve stem 15 extends, said valve stem being connected to the upper head of the valve 7. The valve stem extends through the wall 13 and has a nut 16 at its upper end. A spring 17 between said nut and the wall 13 tends to hold the valve 7 upwardly into the seat 12. It will be seen that the valve housing may be screwed upwardly to bring the valve away from the seat 6 or may be screwed downwardly into the position shown in Fig. 3.

The well screen 2 is shown as an ordinary perforated pipe, but any preferred form of well screen may be used. The upper end of the same is connected by means of a coupling 18 with the pipe 19 which may be of any desired length. An upper section of the pipe 19 has a radial flange 20 thereon upon which may be fitted the packing rings 21 which may be of soft metal such as lead or other compressible material such as is gener-

ally used in the formation of packers of this type. There are two of these rings 21 and 21' between which is a hard metal ring 22, the upper and lower ends of which are beveled outwardly to converge away from the pipe 19. This metal ring forms an expanding member assisting in the setting of the packer 21.

Above the packing member is a collar 23 having a threaded connection at 24 with a nipple 25. Said nipple is a tubular member recessed slightly at 26 to allow space for the operation of the ratchet jaws 27. Above the recessed portion a suitable distance, is a shoulder 28 formed on the inner side thereof to provide a support for a plurality of pipe engaging dogs 29, said jaws being allowed to move into a recess 30 above the shoulder 28. Above the dogs the nipple is extended for a suitable distance and is beveled slightly at 31 on the inner side thereof.

The dogs 29 are formed as shown in Fig. 4. They are arcuate in cross section as indicated in the drawings, and tapered slightly toward the upper end. Said upper end is formed with teeth 32 which are spiralled or inclined along the upper edge so as to engage beneath a collar 33 as is shown in Fig. 1. These dogs are held in position on the shoulder 28 by set screws 34 extending loosely through the dogs and allowing said dogs to swing inwardly at the upper ends. These spiral teeth 32 engaging the collar 33 enable the dogs to be moved outwardly by the screw action caused by the rotation of the nipple upon which they are mounted. This idea is well known in the art.

The collar 23 at the upper end of the packing member has at its upper end a plurality of ratchet dogs 27 previously referred to. These dogs have ratchet teeth 35 thereon presented inwardly to engage with similar teeth adjacent the upper end of the pipe 19. These ratchet dogs are formed by slotting the upper end of said collar 23 for a sufficient distance to allow a resilient action of the dogs when the pipe 19 is moved upwardly relative thereto.

Within the pipe 19 is a well tubing 36. Said tubing extends downwardly into the well from the surface and is connected by a special collar 37 with an intermediate section 38 of said tubing. The lower end of the tubing section 38 is connected at 40 with the setting mandrel 41 thereon. Said mandrel 41 has a packing ring 42 adjacent the lower end to fit within the upper end of the valve housing as shown in Fig. 7, making a fluid seal therewith. Above the packing ring are a plurality of radial lugs 43 which are adapted to engage within the J-slots 10 in the valve housing previously referred to.

Connected with the lower end of the special coupling 37 on the outer side thereof is a packing member 44 which is made in any preferred form. We have shown a packer of soft metal which may be screwed upon the lower end of said coupling. The packer fits about the tubing and its lower end is connected at 45 with a slidable collar 33. This packer is intended when expanded to close the space between the tubing and the inner wall of the screen or liner.

In the operation of our device the tool is assembled as shown in Figs. 5, 6, and 7. The screen with the setting shoe and back pressure valve thereon, is lowered into the well by means of the tubing 36. It will be seen that the screen assembly including the set shoe and the upwardly extending pipe 19 may be of sufficient length to connect with the lower end of the casing 1 in the well and will inter-fit therewith a sufficient dis-

tance to accomplish the purpose of packing between the two members.

When the set shoe engages the bottom of the well it may be raised slightly and water pumped downwardly through the tubing and past the back pressure valve 7 so as to wash around the outside of the screen and clear away the material in the well. When this is done there is danger of the gas pressure in the well escaping so as to blow up around the screen and tubing and care must be taken to avoid a blowout. Blowout preventers may be employed at the surface in the usual manner to guard against an inopportune blowout.

When the well has been properly washed the tubing 36 will be rotated to screw the valve housing 9 downwardly to bring the valve 7 against the seat 6. This will effectively prevent any leakage around the lower end of the screen from the well and the pumping of more liquid through the tubing will be prevented. The tubing will then be partially rotated to bring the lugs 43 into the channel in the J-slot 10 so that the tubing may be raised upwardly away from the valve housing. It will then assume an elevation about as shown in Fig. 2 and the pump may be again operated, indicating to the operator that the pipe has been disconnected from the housing. The water may be again circulated through the tubing to wash the interior of the screen and when this is done the packers may be set.

In setting the packers the tubing will be moved downwardly until the dogs 29 engage beneath the collar 33. The tube may then be forced downwardly upon the dogs so as to accomplish the simultaneous setting of both the packers. The upper packer 44 within the liner will be compressed longitudinally and expanded laterally by forcing the collar 33 against the lower end of the packer 44 in the usual manner.

The engagement of the dogs 29 with the collar will also tend to force the liner downwardly and move the latching dogs 27 downwardly along the pipe 19 and compress the packing members 21 and 21'. It will be seen from Fig. 2 that the effect of the beveled surfaces of the expanding ring 22 will be to assist in moving the packers outwardly to close the space against the inner wall of the casing. When the packers have both been expanded in this manner the tubing will be supported within the liner by means of the dogs 29 and the frictional engagement of the packers with the liners.

The advantages of our construction lies in the fact that the whole setting operation of introducing the screen into the well, washing both the outside and the inside of the screen, and adjusting the flow line in the well with the packers properly set in position for handling the production, may all be accomplished with one trip into the well. The tubing with the screen is inserted downwardly into the well and all of the necessary operations for cleaning the screen and properly setting the flow lines may all be done without withdrawing the tubing from the well. This has a great advantage not only in economy for time and expense, but also leads to greater safety in guarding against blowouts during the washing of the screen and bringing in of the well.

Having described our invention, what we claim as new is:

1. In a device of the character described, a set shoe, a valve housing longitudinally adjustable therein, a valve therein, a strainer above said shoe, a packer above said strainer, a tubing having releasable connection with said housing whereby said housing may be moved downward-

ly and means engaging said valve to clamp said valve in closed position in response to the downward adjustment of said housing.

2. In a device of the character described, a set shoe, a valve housing longitudinally adjustable therein, a downwardly opening valve therein, a strainer above said shoe, a tubing having releasable connection with said housing whereby said housing may be moved downwardly, a seat below said valve to receive and to clamp said valve in closed position in response to the downward adjustment of said housing.

3. In combination, a well strainer, a back pressure valve housing thereon at its lower end, a valve therein, a tubing releasably connected with said valve housing, said housing being adjustable by said tubing to clamp said valve in closed position, a packer on said strainer, and means on said tubing cooperating with means on said strainer to set said packer.

4. In combination, a strainer pipe, a well strainer thereon, a back pressure valve housing thereon at its lower end, a valve therein, a tubing releasably connected with said valve housing, said housing being adjustable by said tubing to clamp said valve in closed position, a packer on said tubing, dogs on said strainer pipe engageable with said packer, and means on said tubing to force said packer against said dogs to expand said packer.

5. In combination, a strainer pipe, a well strainer thereon, an outside packer on said strainer pipe inwardly extending dogs at the upper end of said packer, a well tubing in said strainer, a packer on said tubing automatically engageable with said dogs above said outside packer to set both said packers on the downward movement of said tubing.

6. A combined strainer, setting device, packer, and tubing, including a shoe, a valve housing adjustable therein, a valve in said housing, a strainer on said shoe, a strainer pipe on said strainer, a packer on said strainer pipe and a tubing in said strainer engageable in said housing to adjust the same to lock said valve and close said shoe, said tubing being movable upwardly away from said valve, and means thereon to engage and expand said packer.

7. A combined strainer, setting device, packer and tubing, including a shoe, a valve housing adjustable therein, a valve in said housing, a strainer on said shoe, a packer on said strainer, and a tubing in said strainer engageable in said housing to adjust the same to lock said valve and close said shoe, means on said strainer automatically engageable with said tubing to expand said packer and a packing member on said tubing to engage said means and expand said packer.

8. In a well, a casing, a liner, a strainer thereon, a tubing in said liner, a back pressure valve on said strainer, means operative by said tubing to clamp said valve in closed position, a strainer packer on said liner, a tubing packer on said tubing, and means on said liner engageable with said tubing packer to simultaneously radially expand and set said packers, thereby fixing said tubing in said liner.

9. A well strainer, a shoe at the lower end thereof, a tubing in said strainer, extending to the surface, a housing in said shoe, a releasable connection between said tubing and said shoe, a downwardly opening back pressure valve in said shoe, said housing being adjustable by said tubing

ing to cause said valve to close the lower end of said shoe thereby stopping circulation of liquid in either direction through said shoe, said tubing being releasable from said housing and adjustable to a different vertical position to allow circulation to said strainer, said tubing then acting as a flow line for fluid from the well.

10. A strainer, a downwardly opening back pressure valve at the lower end thereof, upper and lower seats for said valve, resilient means to hold said valve normally seated in said upper seat, a tubing in said strainer extending upwardly to the ground surface, and means actuated by said tubing to fix said valve in closed position in said lower seat.

11. In combination, a strainer, a set shoe at the lower end thereof, a back pressure valve in said shoe, a liner above said strainer, a packer on said liner, a combined tubing and strainer setting string extending through said liner, and strainer and having a releasable supporting engagement with said shoe below said strainer whereby said strainer may be lowered into the well by said string.

12. In combination, a strainer, a set shoe at the lower end thereof, a back pressure valve in said shoe, a liner above said strainer, a strainer setting string extending downwardly through said liner and strainer, and means releasably engaging said setting string with said shoe whereby said strainer and liner are supported and adjusted in the well.

13. The combination of a strainer assembly including a strainer, a set shoe at the lower end thereof, a back pressure valve in said shoe, a liner above said strainer, a packer on said liner, with a combined fluid conducting tubing and strainer-setting string extending from the ground surface and releasably engaging at a point below said strainer and forming a seal therewith, means adjustable by said string to close and set said valve from movement in either direction so as to seal off passage of fluid through said string, said string being detachable from said strainer assembly and movable upwardly to again allow passage of fluid therethrough.

14. The combination of a well strainer, a back pressure valve at the lower end thereof, an adjustable support for said valve, a combined tubing and setting string extending from the ground surface and releasably engaged in fluid tight relation with said adjustable support, said support being movable by said string to close said valve against movement in either direction to shut off the passage of fluid through said string, said string being releasable from said support and movable upwardly to again permit the flow of fluid through the same.

15. The combination of a strainer assembly including a strainer, a set shoe at the lower end thereof, a back pressure valve in said shoe, with a combined fluid conducting tubing and strainer-setting string extending from the ground surface and releasably engaging at a point below said strainer, and forming a seal therewith, means adjustable by said string to close and set said valve from movement in either direction so as to seal off passage of fluid through said string, said string being detachable from said strainer assembly and movable upwardly to again allow passage of fluid therethrough.

ELLSWORTH GRAY.
CICERO C. BROWN.