

Dec. 6, 1938.

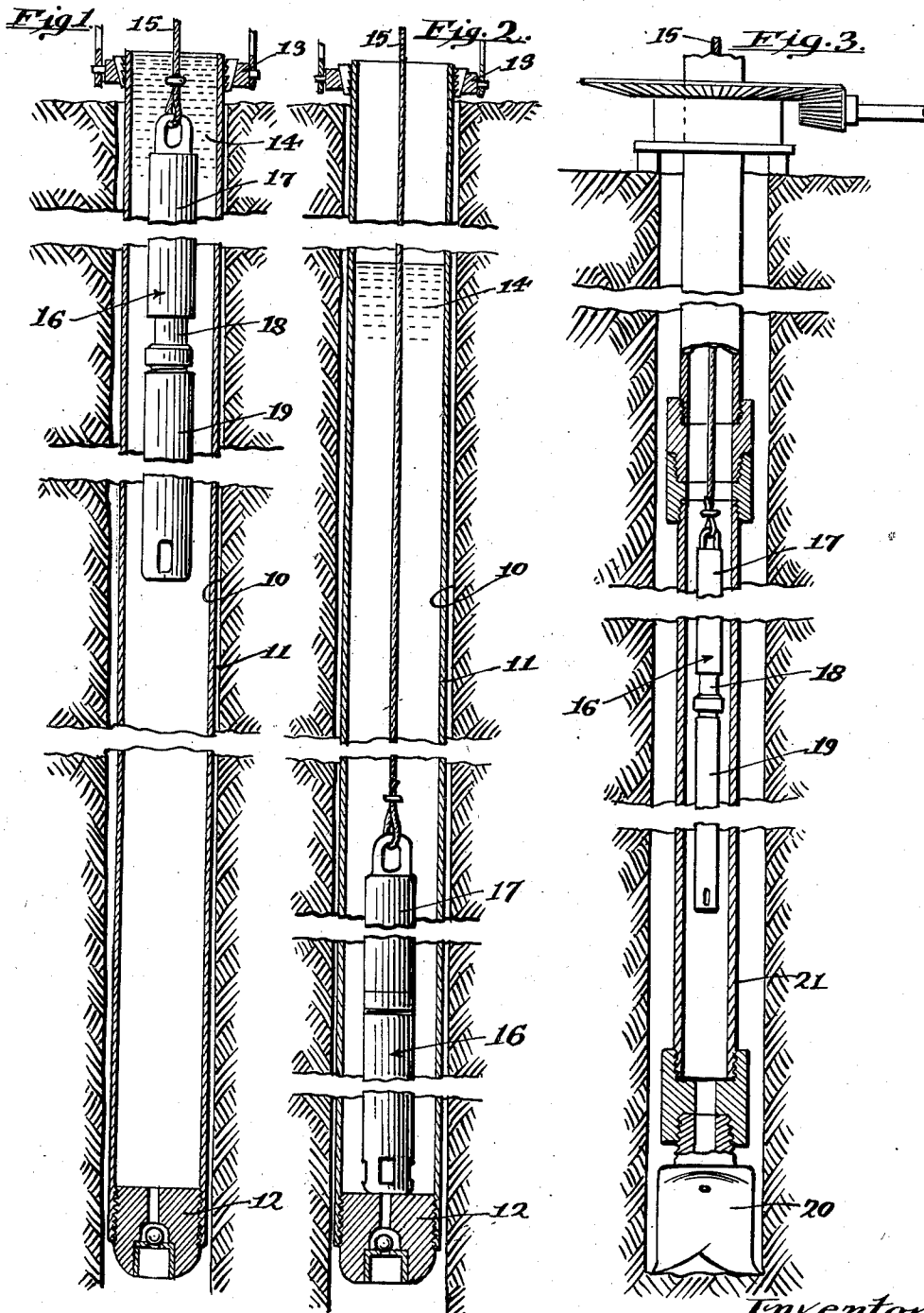
P. G. GATES

2,139,076

METHOD OF FREEING AND RECOVERING PIPE FROM WELLS

Filed April 13, 1937

2 Sheets-Sheet 1



Inventor:
Paul G. Gates.
by Hazard and Miller
Attorneys.

Dec. 6, 1938.

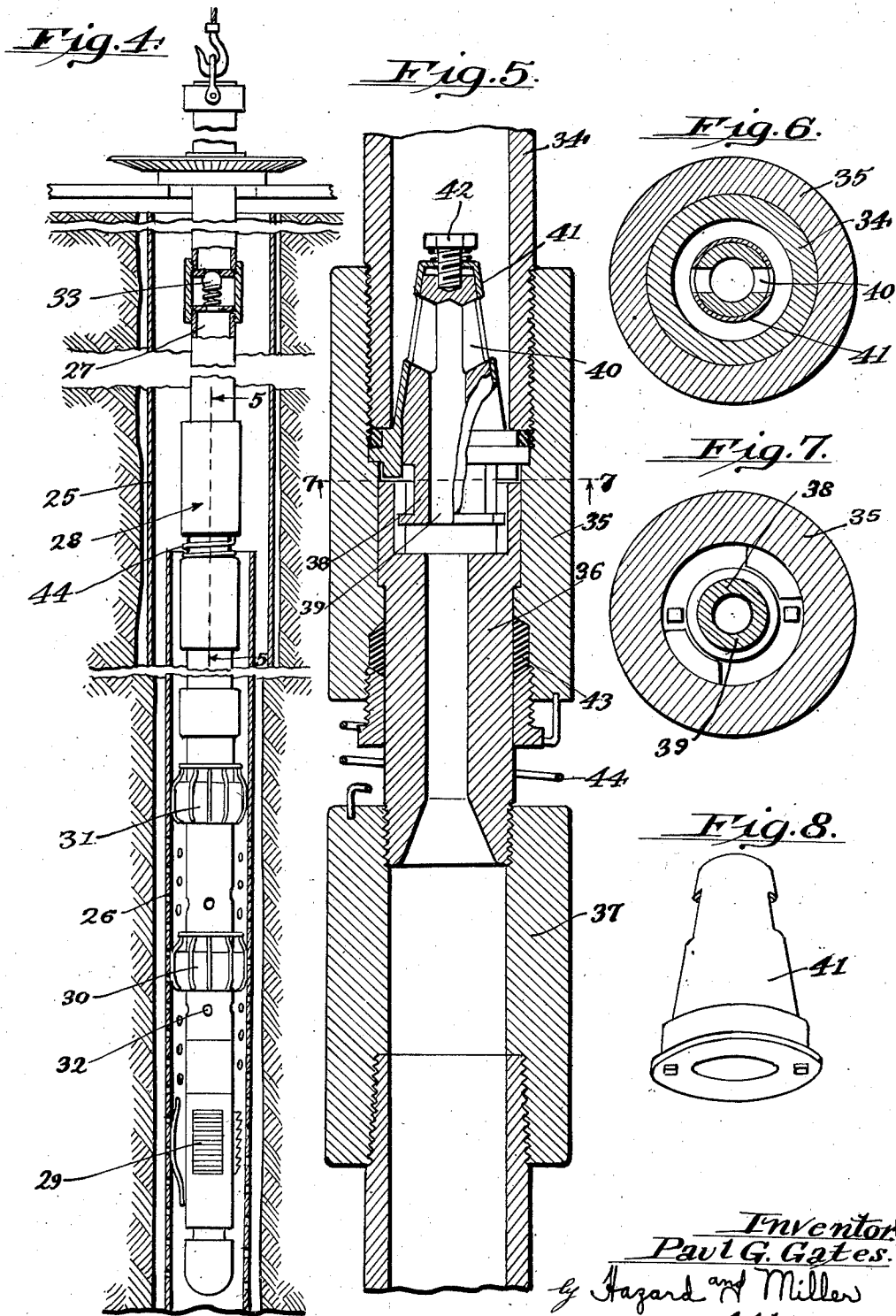
P. G. GATES

2,139,076

METHOD OF FREEING AND RECOVERING PIPE FROM WELLS

Filed April 13, 1937

2 Sheets-Sheet 2



Inventor
Paul G. Gates.
by Hazard and Miller
Attorneys

UNITED STATES PATENT OFFICE

2,139,076

METHOD OF FREEING AND RECOVERING PIPE FROM WELLS

Paul G. Gates, Long Beach, Calif.

Application April 13, 1937, Serial No. 136,543

7 Claims. (Cl. 255-1)

This invention relates to a means and method for freeing and recovering pipe from wells.

In well drilling operations, such as in oil well drilling, it frequently occurs that casing, liners, and drill pipe and sometimes tubing becomes stuck or caught in the well so as to prevent their being moved or withdrawn from a well or being lowered to the desired depth. Thus, when casing or liners, or sometimes tubing and drill pipe have been allowed to remain at rest in a well for a considerable length of time, the settling of the formation and of the mud in the circulation fluid, as the case may be, may cause such pipe to become firmly stuck. Also, when casing is being run into the well it sometimes happens that it becomes stuck before it has reached the desired depth to which it is intended to lower the casing.

It is an object of the present invention to provide a simple and efficient means and method by which such pipe can be freed in the well to enable its removal and recovery or continued lowering as circumstances may require.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for a schematically illustrative embodiment of the invention, wherein:

Figure 1 is a vertical section through a well illustrating a stuck or frozen casing therein which it is desired to remove and recover, the apparatus employed for facilitating loosening being shown in that position in which it is about to be lowered into the well;

Fig. 2 is a view similar to Fig. 1 illustrating the apparatus in the position in which it is operative to free or loosen the casing;

Fig. 3 is a vertical section through a well illustrating the means and method as being applied to the recovery of stuck drill pipe and the like;

Fig. 4 is a vertical section through a well illustrating a modified form of apparatus that may be advantageously employed in loosening and recovering liners;

Fig. 5 is a sectional view taken substantially upon the line 5-5 upon Fig. 4 in the direction indicated;

Fig. 6 is a horizontal section taken substantially upon the line 6-6 upon Fig. 5;

Fig. 7 is a horizontal section taken substantially upon the line 7-7 upon Fig. 5; and

Fig. 8 is a perspective view of a part of the valve structure.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, and particularly to Figs. 1 and 2, 10 designates a well hole in which is disposed a casing 11 which may or may not be provided with a casing plug 12. Assuming that this casing has become stuck or frozen in the well and it is desired to loosen it and withdraw it, the method in which it is freed or recovered is as follows:

Elevators or equivalent lifting means indicated at 13 are attached to the casing and an upward strain taken thereon by means of the blocks and drawworks on the derrick (not shown). Any equivalent means may be employed for applying this upward strain on the casing, the primary purpose being to place the casing under tension and to exert a continuous upward force on it capable of lifting the casing when it is free. In most well drilling operations the well hole is filled with circulation fluid; such fluid is indicated at 14. Into this fluid there is lowered, by means of a sand line or the equivalent indicated at 15, a device commonly known as an "explosion type" bailer indicated at 16. A typical "explosion type" bailer that may be employed for this purpose may have substantially the same construction as that disclosed in my prior United States Patent No. 2,000,750. Any equivalent "explosion type" bailer may be employed, or for that matter, any device which has an air chamber within which air may be confined and maintained at substantially atmospheric pressure while it is being lowered into the fluid 14 and then suddenly opened near the bottom of the casing to allow a sudden inrush of liquid 14.

The mechanism illustrated is very similar to that disclosed in my prior patent above mentioned, consisting of an upper air chamber 17 having a hollow stem 18 in the sides of which there are ports (not shown). This hollow stem slidably extends into the top of an entrapping chamber 19 and the construction is such that while the bailer remains suspended, the ports in stem 18 are closed, thus closing the entrance to the air chamber 17. When the bailer reaches the bottom of the casing as shown on Fig. 2, the downward movement of the entrapping chamber 19 is arrested and stem 18 on the air chamber telescopes therein so as to open the ports in the sides of the stem to allow a sudden inrush of liquid 14 under high hydrostatic pressure into the air chamber which has contained air at substantially atmospheric pressure.

In the present invention, it is not essential to

have the entrapping chamber 19 equipped with an entrapping valve, nor is it essential to have any long entrapping chamber. I merely disclose the use of this type of apparatus for the reason that "explosion type" bailers having air chambers in which the air is maintained at approximately atmospheric pressure and which are opened suddenly near the bottom of the well, are now becoming quite well known and generally used. Any "explosion type" bailer or any device having such an air chamber may be advantageously employed without alteration or modification to perform the present method.

When the bailer reaches the casing plug 12 or any equivalent obstruction which will set off the bailer to open the air chamber, the effect is to allow the liquid at the bottom of the liquid column and which is under high hydrostatic pressure to suddenly enter the air chamber. This, in effect, suddenly withdraws some of the supporting liquid near the bottom of the well that supports the hydrostatic column, allowing the hydrostatic column to suddenly fall. This sudden drop of the hydrostatic column creates a very severe vibration which vibration alone may be sufficient to loosen the casing and allow it to be moved under the influence of the upward strain. I have observed however, that when an "explosion type" bailer is set off in a well that the level of the liquid in the well drops to a greater extent than that which would compensate for the volume of liquid entering the air chamber. Not only is this true, but the liquid after having initially dropped, soon rises to a point above its original level and then oscillates back and forth finally reaching a state of equilibrium. I attribute this unusual drop of the liquid level which is more than that which would compensate for the volume of liquid entering the air chamber, to the casing expanding slightly. That is, when the column of liquid has its support suddenly withdrawn by liquid entering the air chamber, its sudden drop creates a very high pressure in the casing and expands it. This would account for the liquid level dropping to an extent greater than that which would compensate for the volume of liquid entering the air chamber. Thereafter, the casing in attempting to spring back to a normal position in contracting on the liquid, squeezes the liquid so that its level rises higher than its initial level. Therefore, in addition to mere vibration of the casing, there is an expansion and contraction of the casing against settled mud, wall cavens, and the like, tending to free the casing so that it may be elevated. Once having been freed, it is usually relatively easy to withdraw the casing.

When lowering casing into a well in the event that it has become stuck before reaching the desired depth, the method of freeing the casing is substantially the same except that, instead of applying forward strain on the casing, the driller "sets the casing down". That is, he allows the casing to be supported by itself in the well either wholly or partially rather than be mainly suspended from the derrick. The weight of the casing then becomes effective to move the casing downwardly and thus free it at the time that the "explosion type" bailer is set off.

In this construction as illustrated in Fig. 3, the method and apparatus is substantially the same as that previously described, except that it is illustrated as being applied to a stuck drill pipe. In this form of construction and operation, an upward strain may be taken on the drill pipe while

the "explosion type" bailer is being lowered therein and set off. The surging of the liquid in the drill pipe created by the operation of the bailer vibrates the drill pipe severely and causes it to expand and contract, thus freeing itself and enabling the upward pull thereon to become effective.

Where the bottom of the pipe has an entrance such as for example, through the casing plug 12, or through the circulation ports in bit 20 on the drill pipe 21, the bailer not only creates a vertical surging of the liquid but is also apt to create a small sudden inrush of liquid into the bottom of the pipe. This sudden inrush of liquid from around the bottom of the pipe into the pipe has a tendency to create a sudden and severe movement of circulation fluid around the pipe that is effective to wash the pipe free.

On Fig. 4 I have illustrated a modified form of apparatus that may be advantageously employed in recovering liners and the like. In this form, the casing is indicated at 25 and the liner that it is desired to recover is indicated at 26. A pipe is lowered into the well which provides an air chamber 27 at the bottom of which there is a rotary valve, generally indicated at 28. Below this valve there is mounted a casing spear 29 or any equivalent construction that may be attached to the liner 26 so that an upward strain may be applied thereto. One or more packers or obstructions indicated at 30 and 31, may be mounted on the pipe or incorporated therein above ports 32 which form the entrance to the pipe. The top of the air chamber 27 may be either closed or left entirely open or it may be provided with an upwardly closing check valve 33. While any suitable valve may be employed for valve 28, to enable opening of the bottom of the air chamber, the preferred construction is illustrated in detail in Fig. 5, wherein the pipe forming the air chamber indicated at 34 is provided with a sub 35 rotatable on a hollow stem 36 which is attached to a sub 37 connected to the pipe on which packers 30 and 31 and the casing spear 29 are mounted. The stem has splined thereto a plug 38 which has a central passage 39 and lateral ports 40. The seat for the plug which forms the cap for the valve is indicated at 41. This seat or cap is rigidly attached to sub 35 and has ports therein which can be moved into or out of registration with ports 40. Screw 42 is used to tighten the plug within the seat or cap. A stuffing box indicated at 43 prevents leakage around stem 36 and a spring 44 is connected to subs 35 and 37 and urges these parts into such position that the ports in the plug and cap will be out of registration.

In use of this apparatus the pipe thus assembled is lowered into the well and into the liner and the casing spear is caused to engage and grip the liner. It is not necessary to set the packers as these packers merely form obstructions in the liner causing most of the fluid flow in the well to take place on the outside of the liner on entering ports 32. When the casing spear has been set, an upward strain is taken on the drill pipe as indicated on Fig. 4, and at the same time the drill pipe is rotated. Rotation of the top of the pipe serves to rotate the cap or seat 41 relative to plug 38. This opens the bottom of air chamber 27 wherein the air has been maintained at atmospheric pressure and allows the liquid in the well to enter the air chamber. The liquid enters the air chamber through ports 32, through the hollow stem 36, and through the hollow plug 38, 76

compressing the air therein. The presence of the packers 30 and 31 causes most of the flow to take place around the liner rather than inside of the liner with the result that the liner is effectively washed free in addition to being severely vibrated by the surging liquid. When it is free the upward strain becomes effective to remove it.

Should occasion require that circulation be maintained in the well, this can be accomplished by pumping circulation liquid downwardly through the pipe, this being permitted by check valve 33.

From the above-described means and method, it will be appreciated that stuck casing, drill pipe, liners, and the like can be easily freed in the well so as to be removed and recovered or lowered to a greater depth. In many instances, conventional apparatus in the form of "explosion type" bailers can be employed without modification and in their use a vertical surging of the column of liquid is created to vibrate the pipe and to cause it to expand and contract and thus free itself. While in most instances it is convenient either to apply an upward strain to the pipe while this surging of the liquid column takes place or to apply additional weight to the pipe by setting it down, there may be instances where it may be desirable to apply a torque tending to rotate the pipe. This can be easily accomplished by means of a rotary table, particularly where a drill pipe having a kelly is present. When a torque is applied, the freeing of the pipe enables it to be rotated and thus kept loose after it has been freed. It will, therefore, be understood that in applying a strain to the pipe as defined in the following claims any force tending to move the pipe from its stuck position is intended which may be either a forward pull or a torque or setting the pipe down wherein gravity acting on the mass of pipe tends to move it.

Various changes may be made in the details of the construction and of the method without departing from the spirit and scope of the appended claims.

I claim:

1. The method of recovering or moving pipe in wells which includes, applying a strain to the

pipe tending to move it and suddenly allowing liquid in the well under high hydrostatic pressure to enter an air chamber so as to create a vertical surging of the liquid column.

2. The method of recovering or moving pipe in wells which includes, applying a strain to the pipe tending to move it, lowering an "explosion type" bailer into the liquid in the pipe and operating the bailer while the strain is applied.

3. The method of recovering or moving pipe in wells which includes, taking an upward strain on the pipe and suddenly allowing liquid in the pipe near the bottom thereof to enter a low pressure chamber thereby creating a vertical surging of the liquid column in the pipe and enabling the pipe to be pulled while being vibrated by the liquid.

4. The method of recovering or moving pipe in wells which includes, imposing a strain on the pipe tending to move it, suddenly allowing liquid in the pipe near the bottom thereof to enter a low pressure chamber and directing the liquid so that the major portion of the fluid flow created by the liquid entering the low pressure chamber takes place around the exterior of the pipe.

5. The method of recovering or moving pipe or liners in wells, which includes applying strain to the pipe or liner tending to move it in the well and suddenly allowing liquid in the well near the bottom thereof to enter a low pressure chamber to bring about a movement of the liquid column in the well and incidental vibrations enabling the pipe or liner to be pulled.

6. The method of freeing a liner in a well comprising positioning obstructions one spaced above the other in the liner so as to isolate a portion of the perforated liner, and suddenly admitting the hydrostatic pressure between the obstructions to enter a chamber of low pressure.

7. The method of freeing liners in wells which consists of positioning an obstruction in the liner and suddenly admitting the hydrostatic pressure that is within the liner below the obstruction to a chamber of low pressure.

PAUL G. GATES.