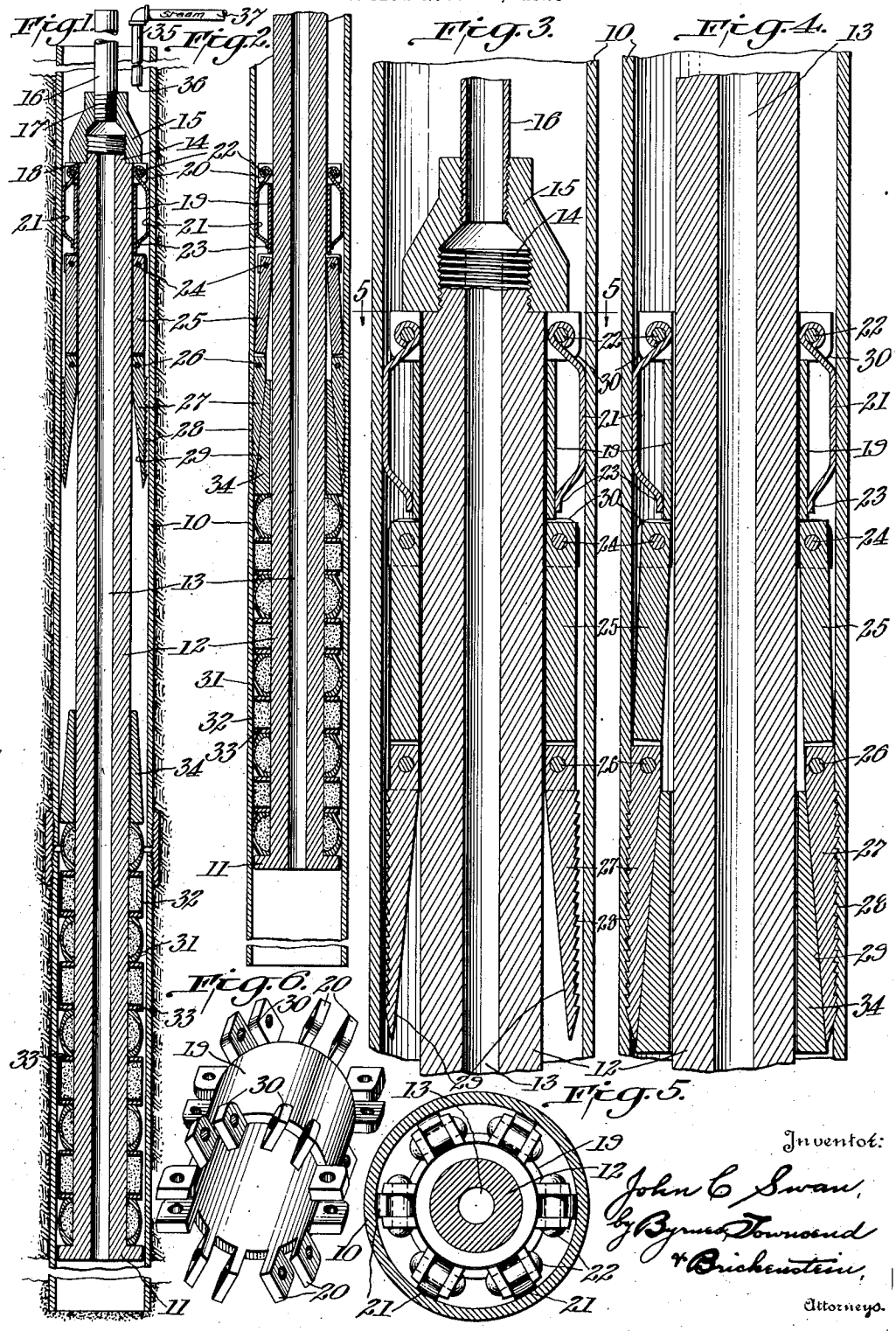
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J. C. SWAN

METHOD OF AND MEANS FOR RELEASING AND RECOVERING FAST CASING FROM WELLS

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JOHN C. SWAN, OF MARIETTA, OHIO.

METHOD OF AND MEANS FOR RELEASING AND RECOVERING FAST CASING FROM WELLS.

Application filed November 27, 1923. Serial No. 677,351.

To all whom it may concern:

Be it known that I, JOHN C. SWAN, a citizen of the United States, residing at Marietta, in the county of Washington and State of Ohio, have invented certain new and useful Improvements in Methods of and Means for Releasing and Recovering Fast Casing from Wells, of which the following is a specification.

The invention relates to a method of and means for releasing, starting and recovering a string of casing from the bottom of a well or from such other point in the well at which the casing may be lodged, either by accident, unknown conditions or by design.

By virtue of the use of the present improvements casings may be salvaged under conditions which heretofore precluded the same, or which permitted of salvaging only in part.

It is common practice in the cable tool fields of this country to drill completely through water strata if possible before inserting a string of casing to exclude it from the well. To make certain of the exclusion resort is made frequently to the introduction of clay in the form of compressed balls which are thrown into the well and allowed to settle to the bottom of the well before the casing is finally landed.

In addition to this many drillers do not attempt to remove a very large part of the drilling sediment that is in suspension in the well water and this sediment after the water has been shut off finally settles around the lower sections of the casing. When the time comes to remove that casing this condition offers great resistance to starting the casing by the ordinary pulling methods and very frequently defeats the purpose altogether, calling for the use of casing splitters, collar busters and casing pulling tripping devices and sometimes for the use of casing spears for the purpose of jarring up, while the traction is made on the casing at the surface with hydraulic jacks and pulling rings.

By the application of the method and means hereinafter described the foregoing and other difficulties attending the present practice are avoided and it is possible to apply at the point of the well where the obstruction to the movement of the casing is located the degree of force necessary to release the casing. This heretofore has been unavailable and unknown.

A special application of the improvements is in the starting of casing from wells which have been sealed by means of a non-aqueous, non-hygroscopic, viscid, congealable liquid, in accordance with my prior Patent No. 1,455,010, dated May 15, 1923. The wells which have been sealed in accordance with the method of the aforesaid patent are clear of sand, sediment, etc., but the casing is "frozen" to the viscid medium and is held so fast thereby that the ordinary hoisting method is not sufficient to release the casing. By supplying a heating medium however to the inside of the casing where it is thus held fast the film of viscous material in contact with the casing may be softened or liquefied and the casing thereby made free at the moment when the lifting force employed in accordance with this invention is applied.

The desired results are accomplished by the application, upwardly and through suitable mechanical agencies, of fluid pressure on the casing at or near the lower end thereof; this lifting force being assisted by the usual casing handling device on the surface of the ground. The casing is thus raised by a simultaneous pushing and pulling operation. Once released, the casing may be removed from the well by the usual pulling methods. In employing fluid pressure, I may take advantage of the hydrostatic head due to the depth of the well, which head of course increases in ratio with the length of the casing to be withdrawn and therefore with its weight; and the fluid pressure may be augmented as desired by a suitable pump at the top of the well. Either oil, gas or water may be used as the fluid, but if oil is available and permissible for the purpose I prefer to use this medium.

The invention will better be understood by reference to the accompanying drawing, wherein:

Fig. 1 is a broken sectional view of a well equipped with means for carrying out the invention;

Fig. 2 is a similar view showing the relation of the elements after initial movement

of certain of the parts upwardly, and with the gripping means in engagement with the casing;

Figs. 3 and 4 are views similar in general to Figs. 1 and 2 but enlarged and showing only certain of the parts;

Fig. 5 is a horizontal sectional view on the line 5—5, looking downwardly; and

Fig. 6 is a perspective view of the suspending sleeve.

In the drawing, the numeral 10 indicates a lower portion of the casing to be removed, shown in Fig. 1 in position in the well. It need not be the lowermost section, and in deep wells may be a portion several hundred feet above the bottom of the well. However, the portion referred to usually will be so far down the string that the bulk of the weight of the casing will be above the same.

Within the casing is a piston-like member having a head 11 and an stem 12. The member is provided with a bore 13 which extends longitudinally through the stem 12 and head 11 to the lower surface of the member. The head 11 occupies substantially the entire inside cross-sectional area of the casing 10 but it has a sliding fit with the casing.

The upper end of the stem is reduced and left-hand screw threads are provided on the reduced portion 14. By means of a coupling 15 the internal left-hand thread of which engages the thread of the portion 14 of the stem, the piston-like member is supported upon and made directly movable with a string of tubing 16 which extends to the top of the well. The tubing 16 and the coupling 15 may be joined by a right-hand thread connection 17. The piston-like member and its coupling constitute a frame which is comparable to a packer frame.

Around the upper portion of the stem 12 and abutting against the lower shoulder 18 of the coupling 15 is a cylindrical sleeve 19. As best shown in Figs. 5 and 6 the sleeve is provided at its opposite ends with a series of aligned pairs of lateral lugs or ears 20. These lugs may be welded on to the body of the sleeve 19 or they may be formed by suitable milling operations, such as are well known in the art of metal working. A series of leaf springs 21, preferably but not necessarily six in number, are supported in the respective pairs of ears 20 at the upper end of the sleeve, by means of rivets or the like 22. The lower ends 23 of the springs fall a little short of the lower series of lugs and rest on the external surface of the sleeve. Suspended from the respective pairs of lower lugs, by means of rivets or pivot rods 24, are a plurality of links 25. To the lower ends of the links are suspended by pivotal connections 26 a corresponding number of slips 27 having external wickers 28 adapted under proper conditions to bite into the inner wall of the casing 10. The inner portions 29 of the wicker slips are cut away at an acute angle with the axis of the casing. This reduction of the inner portions of the wicker slips is necessary in order to permit the wicker slips to pass freely downward into the casing; but the more acute the angle between the inner portion of the wicker slip and the axis of the casing, the longer will be the available surface of gripping by the wickers. With a view to economy and lightness the rear edges 30 of the ears 20 are rounded off. By the means described above the wicker slips 27 are suspended by and from the pairs of lugs 20, through the medium of the links 25 and the springs 21 which are at all times in frictional contact with the inner wall of the casing. It will be readily understood that downward movement of the tubing 16, and consequently the coupling 15, will be followed by the sleeve 19, the links 25 and the wicker slips 27. Upon upward movement however of the tubing and coupling and the stem 12 of the piston-like member, the wicker slips will be held against such upward movement by the frictional contact of the springs 21 with the casing.

Around the stem of the piston-like member and above the head 11 thereof is suitable packing means intended to be of such efficiency as to seal the space within the casing 10 above the piston head 11 against fluid under pressure introduced below the head 11. In a genera' way the packing shown resembles the well packing means disclosed in my copending application filed February 6, 1923, Serial No. 617,354. As illustrated, the packer comprises a series of annuli 31 composed of a metal such as lead which is flowable under pressure the annuli or rings being of arch shape in cross section, with the wall of the arch thicker along the sides and at the spring than at the periphery or crown. The annuli are spaced apart by shallow cylindrical hollow rings 32 which are made of any compressible material which is strong enough to be self-supporting under the conditions of use to be described but which may be easily deformed and made to expand or flow toward the casing 10 upon the application of axial pressure on the side walls. Between the annuli 31 and the cylindrical bodies 32 are preferably interposed steel rings or washers 33. The annuli 31 and the cylindrical members 32 are filled with a plastic sealing agent which may be rubber or hard coal tar pitch or wood tar pitch, or it may be a composition of rosin, paraffin and linseed oil.

Slidably mounted on the stem 12, above and resting upon the uppermost annulus 31, is a wedge ring 34 tapering inwardly along the direction of the top of the well. At the proper time this wedge member is moved

along the stem to engage the rear faces of the wicker slips 27 and force the wickers 28 into anchoring engagement with the inner wall of the casing 10.

For the purpose of introducing steam, which preferably is superheated, a pipe or other conduit 35 is supported within the casing 10 and its lower end 36 may terminate in proximity to the coupling 15. At the top of the well a source of steam supply is indicated at 37.

In the use of the apparatus described, the piston-like member comprising the packer frame is lowered into the well by means of the tubing 16 to which it is coupled, until the member reaches the region where the casing is held fast. This may be at or near the bottom of the well or it may be some distance above the bottom of the well. For the purpose of illustration it will be assumed that it is the object of the operation to release the casing from a well wall which has been sealed in accordance with the process described in my patent heretofore referred to, and that the resistance to the removal of the casing from the well is due to the freezing of the sealing agent to the casing. Proceeding under these conditions, the piston-like member with the sealing means 31, 32, wedge ring 34, wicker slips 27, links 25, springs 21, etc. thereon, is lowered into the well by means of the tubing 16 and coupling 15 until the assembly described arrives at a position as near as possible to the lowermost section of the string. Thereupon the tubing 16 is raised by the same means at the top of the well which has supported the apparatus and lowered it into the well. By this upward movement the piston-like member is also raised of course but the wicker slips 27 remain in fixed position due to the frictional engagement of the spring members 21 with the inner wall of the casing 10. With the piston-like member are also raised the sealing means 31 and 32 and the wedge ring 34. After a predetermined interval depending upon the distance between the wedge ring and the wicker slips, the wedge ring moves upwardly behind the slips as shown in Figs. 2 and 4 and causes the wickers of the slips to bite firmly into the casing. By making the entering angle of the wedge relatively small, as previously mentioned, and by suspending the wicker slips from the sleeve 19 by the pivoted links 25 which, as clearly shown in Fig. 4, have considerable radial play in the casing at their lower ends where the wicker slips are pivoted, the wickers may be of considerable length and their full range of bite made effective. The swing of the links 25 outwardly, as shown in Figs. 2 and 4, permits the wedge ring 34 to ride behind substantially the entire length of the wicker slips and thereby to cause the engagement of the wickers with the casing along substantially the full length of the slips. The operation so far described effects the gripping of the casing by means which is then movable with the piston-like member in any further travel upward. Further upward movement of the piston-like member causes axial compression upon the annuli 31 and the rings 32 and this in turn causes the annuli and rings and the plastic filling contained therein to flow radially outward to make a firm sealing engagement with the inner wall of the casing. In this manner the space within the casing above the head of the piston-like member is effectively sealed against the passage thereinto of fluid under pressure from the space in the casing or well below the head.

The casing being thus firmly gripped and therefore now substantially immovably connected with the piston like member, and the casing being effectively sealed against the upward passage of fluid past the piston head 11, a fluid under very high pressure is admitted to the space below the head 11 through the bore 13. The fluid may be gaseous but preferably it is a liquid. As previously mentioned the liquid may be water, oil or tar, but where available and permissible I prefer to use oil. By using a liquid for the pressure medium advantage may be taken of the hydrostatic head resulting from the depth of the well which obviously will be considerable in the present day deep wells where the difficulty in salvaging casing is the greatest and yet, because of the many tons of metal represented by the casing, is highly desirable. The pressure of the fluid may be augmented by a suitable pump at the surface.

Simultaneously with the introduction of the fluid under pressure through the tubing 16 and the bore 13, superheated steam is introduced into the well onto the casing through the pipe 35. The heat thereof through the casing causes the congealed sealing agent contiguous to the exterior surface of the casing to become softened or liquefied, so that the casing no longer remains stuck but may readily be removed from the well. By the simultaneous introduction of the heating medium and the liquid under pressure, and at the same time exerting an upward pull through the tubing 16 by the commonly employed hoisting means, casing may readily be released however tightly the sealing agent may have been frozen onto the casing.

Referring to the starting of fast casings under the conditions previously described where a viscous sealing agent is not employed, it will be understood that the pressure of the fluid may be raised to such a point that a circulation will be established through the binding sediment referred to,

to such degree that the sediment again will be distributed in the water behind the casing, which always lies above this body of sediment under the conditions stated; in which case the casing not only will be started upwardly but completely freed to the surface of the ground if desired, making effective the ordinarily used pulling methods for the purpose of casing recovery. Failing in this by the cold application of the method described, the casing may first be heated to expand it against the well wall and then suddenly cooled to contract it by dumping cold water into the casing, in the meantime maintaining the maximum pressure.

Obviously many details of the means illustrated may be modified, and it is to be understood that such changes may be made without departing from the scope of the invention, which scope is restricted only by the limitations in the appended claims.

I claim:

1. The method of releasing well casings which comprises establishing a fluid-tight abutment with a lower portion of the casing, and introducing through the abutment a fluid under pressure and thereby applying a head of hydrostatic pressure beneath the abutment.

2. The method of releasing well casings which comprises introducing a piston-like element into the casing, anchoring it substantially immovably to the inner wall of the casing, and passing a fluid under pressure through the piston-like element to exert pressure upon the lower surfaces thereof.

3. The method of releasing well casings which comprises introducing a piston-like element into the casing, anchoring it substantially immovably to the inner wall of the casing and providing a fluid-tight seal, and passing a fluid under pressure through the seal and the piston-like element to exert pressure upon the lower surface of the latter.

4. The method of releasing casing from wells which have been sealed with viscid, congealable liquids, which comprises applying fluid under pressure to a lower portion of the casing under conditions causing the pressure to be exerted upwardly on substantially the full cross sectional area of the casing as an abutment, and simultaneously applying heat to the casing in the region of sealing.

5. The method of releasing casing from wells which have been sealed with viscid, congealable liquids, which comprises applying a head of hydrostatic pressure to a lower portion of the casing under conditions causing the hydrostatic head to exert its pressure upwardly on substantially the full cross sectional area of the casing as an abutment, and simultaneously introducing steam into the casing in the region of sealing.

6. Apparatus for releasing the casings of wells which have been sealed with viscid, congealable liquids, comprising a piston-like member provided with means affording a sliding fit in the casing and having a bore therethrough, means constructed and arranged to be forced into frictional contact with the inner wall of the casing in response to upward movement of the piston-like member for anchoring the latter substantially immovably to the wall of the casing, means for introducing a heating fluid against the casing to soften or liquefy the congealed sealing agent in contact with the casing, and means for applying fluid pressure on the lower end of the piston-like member.

In testimony whereof, I affix my signature.

JOHN C. SWAN.