

April 27, 1937.

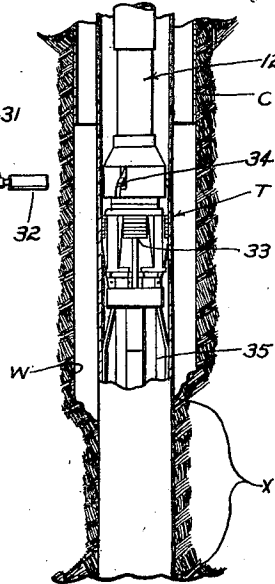
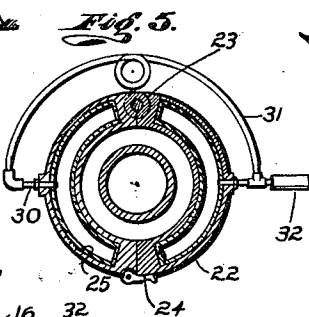
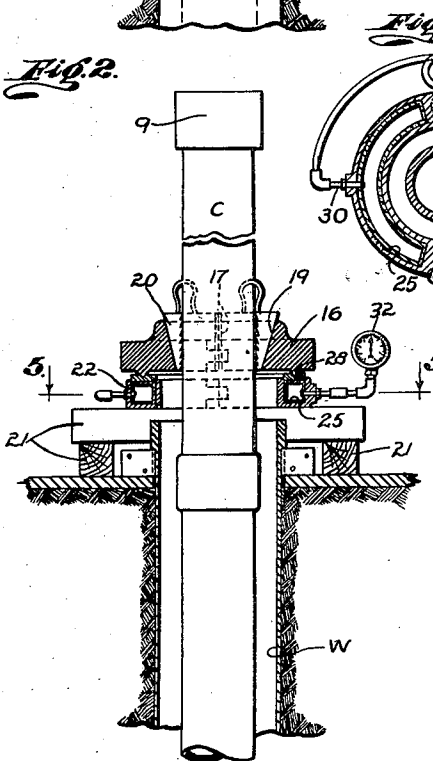
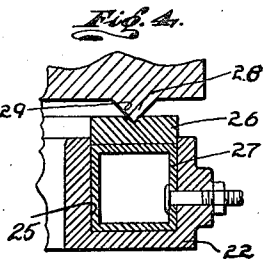
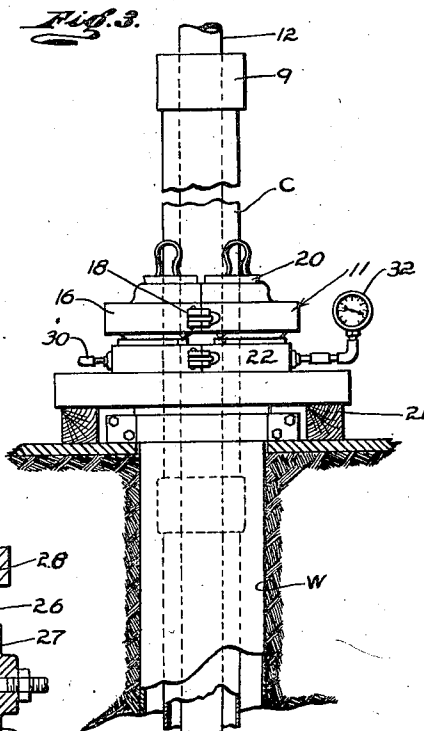
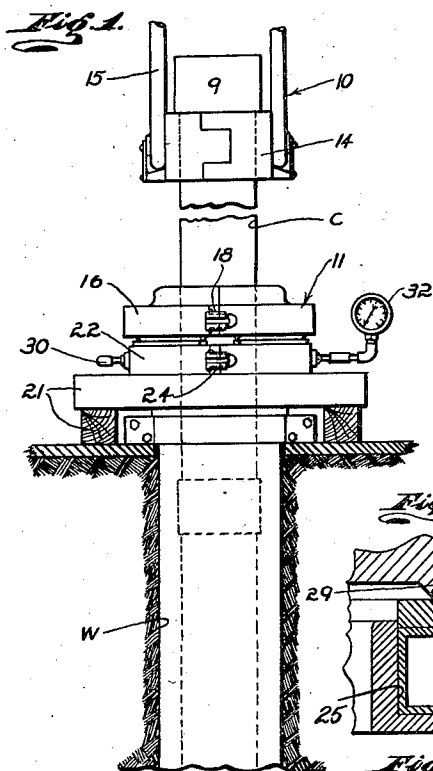
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2,078,426

METHOD FOR RECOVERING CASING FROM WELLS

Filed July 11, 1934

2 Sheets-Sheet 1



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METHOD FOR RECOVERING CASING FROM WELLS

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Fig. 6.

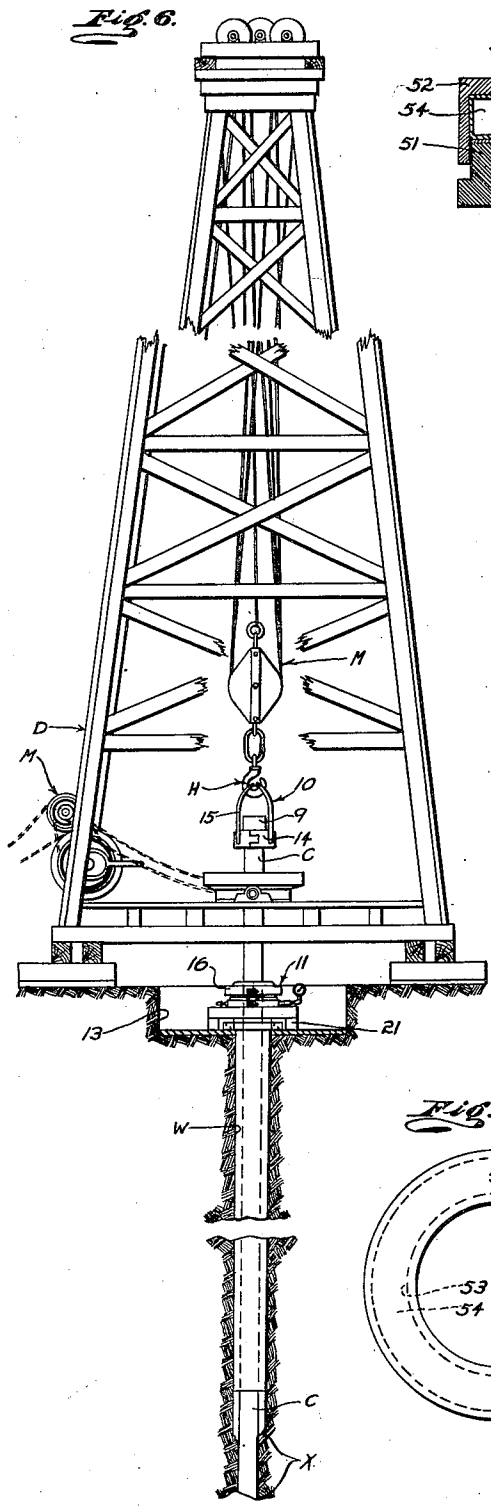


Fig. 8.

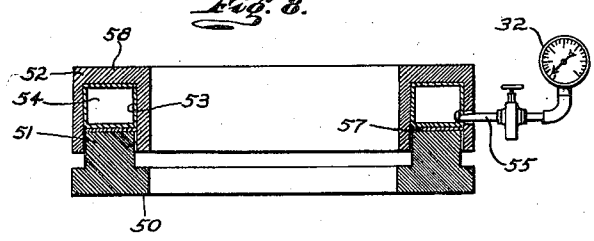


Fig. 7.

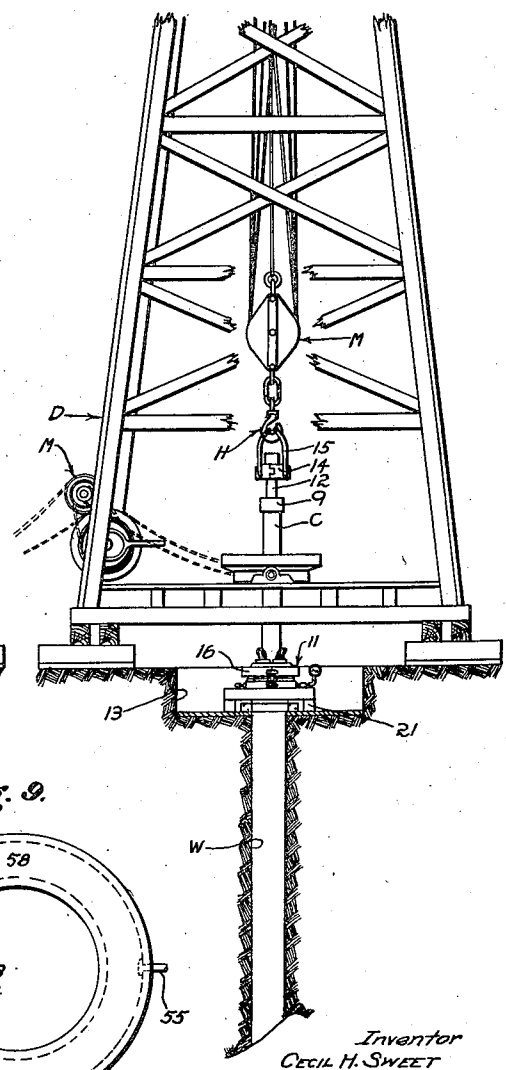
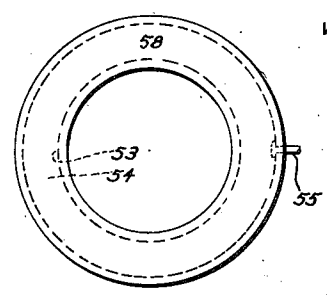


Fig. 9.



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UNITED STATES PATENT OFFICE

2,078,426

METHOD FOR RECOVERING CASING FROM
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to Weldon C. Erwin, Brea, Calif.

Application July 11, 1934, Serial No. 734,592

12 Claims. (Cl. 294—96)

This invention relates to a method useful in connection with the drilling and reconditioning of wells and relates more particularly to a method for recovering or removing casing and the like from oil wells, gas wells, etc. A general object of the invention is to provide a rapid economical and commercially practical method for recovering casing from wells.

In the drilling, repairing and reconditioning of wells such as oil and gas wells, it often becomes necessary to remove the well casing. In many instances well casings become caught or stuck in the well due to caving or the packing of sand or earth formation about the casing. When it is desired to remove a well casing that is cemented or stuck in the well it becomes necessary to cut or otherwise part the casing above the point at which it is caught. It is, of course, highly desirable to determine as accurately as possible the point at which the casing is caught or fixed in the well and to cut or part the casing immediately above that point so that a maximum amount of casing may be recovered following the first cut. The methods heretofore employed for locating the point at which a casing is cemented or stuck in a well have been very inaccurate and unsuccessful. One method that has been used involves the striking of the upper portion of the casing and attempting to determine the point at which the casing is stuck from the resultant sounds and echoes. Another method that is sometimes used includes putting the casing under a tensile strain, noting or recording the extent of stretching or elongation of the casing and then attempting to determine the point at which the casing is stuck by relating the intensity of the strain applied to the casing and the amount of elongation of the casing. The crudeness of the force measuring equipment employed in wells and other factors make the latter method very inaccurate.

An object of this invention is to provide a method for accurately determining the point at which a well casing is fixed or stuck in a well.

Another object of the invention is to provide a simple practical method for accurately determining the highest point at which a casing is fixed or caught in a well that does not depend upon the skill or experience of the operator or the accuracy of the equipment employed.

Another object of the invention is to provide an improved method for recovering caught or fixed casing from a well that may involve the employment of a casing cutting tool in locating the point at which the casing is caught in the well whereby said tool is automatically positioned ad-

jacent the point of fixation of the casing upon the location of said point, so that it may be operated to free or cut loose the entire portion of the casing above the said point.

Another object of the invention is to provide a method for recovering caught casing from a well that includes the placing of a tensile strain on the casing, lowering a string of pipe into the well carrying a tool capable of gripping the interior of the casing to connect the pipe therewith, the tripping or actuating of the tool, applying a longitudinal force to the casing through the medium of the pipe and gripping tool, noting whether or not the force thus applied varies the tensile strain on the casing to determine if the said tool is above or below the point at which the casing is caught, locating the point of fixation of the casing by actuating said tool and applying the longitudinal force at different vertically spaced points, cutting or parting the casing immediately above the point of fixation of the casing, and then removing the freed portion of casing from the well.

The various other objects and features of the invention will be best and more fully understood from the following detailed description of typical manners of carrying out the method of the invention, throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a side elevation of the portion of the apparatus at the upper end of the well illustrating the elevator in engagement with the casing for the purpose of putting a tensile strain thereon. Fig. 2 is a longitudinal detailed sectional view of the equipment at the upper end of the well showing the slips in holding or supporting engagement with the casing to maintain the tensile strain thereon. Fig. 3 is a side elevation of the equipment and a longitudinal cross section of the well with a portion of the casing broken away to show the casing cutter in position in the casing. Fig. 4 is an enlarged fragmentary transverse detailed sectional view showing the plunger supporting the spider and cooperating with the fluid containing member. Fig. 5 is a transverse detailed sectional view taken substantially as indicated by line 5—5 on Fig. 2. Figs. 6 and 7 are side elevations of a well derrick illustrating two steps or phases of the method. Fig. 8 is a horizontal cross section of another type of means for suspending and measuring the force on the casing, and Fig. 9 is a reduced plan view of the device shown in Fig. 8.

It is believed that the method of the present

invention will be better understood following a description of the apparatus, and I will proceed with a detailed description of the apparatus and follow such description by a detailed disclosure of the method.

The apparatus employed in carrying out the invention includes, generally, means 10 for putting a tensile strain on the casing C, means 11 for supporting the upper end of the casing C to maintain the tension thereon and operatable to indicate the tensile strain, and a string of pipe 12 adapted to be lowered through the casing C and having a tool T on its lower end for gripping the casing whereby a longitudinal strain may be imposed on the casing.

The casing C is shown in the drawings stuck or caught in the well W at the point X. The point X at which the casing is caught may be any location in the well, for example, it may be near the lower end of the casing or in the lower portion of the well bore. The upper end portion of the casing C projects above the surface of the ground or into the cellar 13 of the well. A typical or usual collar 9 is provided on the upper end of the casing C. The means 10 may be any suitable or practical means for putting an up-strain or tensile strain on the casing to be recovered from the well. In the drawings I have shown the means 10 as including an elevator 14 suspended and operated by the hoist mechanism M of the derrick and adapted to removably surround the projecting upper portion of the casing. The elevator 14 is adapted to engage the lower end of the collar 9 and is provided with bails 15. The bails 15 are adapted to be connected with the hook H of the hoist means M of the well derrick D whereby the hoist means or mechanism may be employed to place the casing C under the desired tensile strain.

The means 11 is provided to hold or support the casing C from its upper end to maintain the tensile strain thereon and, in accordance with the invention the means 11 is operatable to indicate the tension on the casing. In the form of apparatus illustrated in the drawings the means 11 includes a spider comprising two sections 16 hinged together at 17. The spider sections 16 are substantially semi-circular and are adapted to be swung together around the casing C. A latch 18 is provided for releasably connecting the free ends of the spider sections 16. The inner sides or walls 19 of the spider sections are inclined downwardly and inwardly. Slips 20 may be arranged in the spider to grip and support the casing C. The slips 20 have inclined outer sides for engaging the walls 19 and have toothed inner sides for engaging the casing C. After the desired tensile strain has been put on the casing C by means of the elevator 14 and the hoist mechanism of the derrick the spider sections are swung together about the casing C and are latched by the latch 18. The slips 20 are then positioned in the spider to grip the casing C whereby the casing is maintained under the desired tension when the elevator 14 is disengaged from its upper end.

The means 11 includes tension indicating means for mounting or supporting the spider sections 16. A suitable assembly of beams 21 is provided in the cellar 13 and two substantially semi-circular sections 22 are adapted to be arranged on the beams 21 to support the spider. A hinge 23 connects adjacent ends of the sections 22 so that the sections may be readily swung together about the casing C. A latch 24 may be

provided for releasably connecting the free ends of the sections 22 to hold them assembled about the casing. The sections 22 are preferably sufficiently large to pass the casing C with substantial clearance. A curved or arcuate channel 25 is provided in the upper end of each section 22. An arcuate plunger or piston 26 operates in each channel 25 and projects from the upper end of its respective section 22.

The particular form or apparatus disclosed in the drawings includes hollow or tubular members 27 arranged in the channels 25 and adapted to hold or contain fluid. The tubular members 27 may be shaped to fit the channels 25 and are preferably flexible and resilient. The spider sections 16 are supported on the two plungers 26. Ridges 28 may be provided on the under sides of the spider sections 16 to cooperate with grooves 29 in the upper ends of the plungers 26. The ridges 28 and grooves 29 may be substantially V-shaped in cross section. The cooperation of the ridges 28 with the grooves 29 centers the spider sections 16 on the pistons 26 and prevents lateral shifting of the spider.

The members 27 are adapted to contain a suitable fluid such as oil, water, or the like, which fluid is put under pressure when the casing C is supported or maintained under tension by the means 11. Pressure indicating means is provided in connection with the members 27 for visibly indicating the tension on the casing C. Conduits 30 communicate with the interiors of the members 25 and project from the sections 22. A flexible manifold or pipe 31 connects the two conduits 30. The pipe 31 may have a loop or convolution adjacent the hinge 23 to render it more flexible and permit the easy swinging of the sections 22. A pressure gauge 32 is connected with the pipe 31 to indicate the pressure on the fluid in the members 27. It will be seen that when the slips 20 are in engagement with the casing C to maintain the tension on the casing the fluid in the members 27 is under pressure directly proportional to the tension on the casing. The gauge 32 may be suitably graduated to indicate the desired range of tensile strains that may be put on the casing C.

The string 12 may be in the nature of a string of typical drill pipe or tubing and in accordance with the invention is adapted to be run in the casing C when the casing is suspended or supported from its upper end by the means 11. The string 12 may be composed of a plurality of stands of drill pipe assembled in the well known manner and may be suspended and operated by the hoist mechanism M of the well derrick. In employing the invention the string may act as a weight and is adapted to be connected with the casing C at various vertically spaced points along the casing. If the weight of the string 12 thus connected or attached to the casing increases the reading of the gauge 32 it is clear that the string is connected with the casing C above the point X while if the weight of the string 12 has no effect upon the reading of the gauge 32 the string is connected with the casing at a point below the point X.

The tool T is provided on the string 12 to facilitate the connection of the string with the casing whereby the weight of the string or an up strain on the string may be applied to the casing. In accordance with the broader aspects of the invention any suitable device or tool may be employed for connecting the string 12 with the casing. A spear or similar gripping or fishing tool may be

attached to the lower end of the string 12 for the purpose of gripping the interior of the casing C whereby the longitudinal strain or force may be put on the casing. In the drawings I have shown a casing cutter T on the lower end of the string 12 having means 33 for gripping the interior of the casing C. The casing cutter T includes cutters 34 capable of cutting through the casing C and a tail piece 35 for governing the actuation of the cutters, etc. The present invention is not primarily concerned with the specific details of the tool or casing cutter T, and I have omitted a detailed description of these details. When the casing cutter T is employed as a means for connecting the lower end of the string 12 with the casing C it may be utilized to cut the casing after the locating of the point X, thereby eliminating the necessity of withdrawing the string 12 from the casing and running a casing cutting device into the well.

In operating the apparatus and in carrying out the method of the invention with the apparatus illustrated in the drawings the elevator 14 is arranged around the upper portion of the casing C to engage the collar 9. The elevator 14 is suspended by the hoist mechanism M of the derrick and the mechanism is operated to put an up strain or tensile strain on the casing C. With the casing C under the tensile strain the sections 22 and the spider sections 16 are assembled around the casing and latched together. If desired the sections 22 and the spider sections 16 may be assembled around the casing prior to the engagement of the casing by the elevator 14. The slips 20 are arranged in the spider to grip the casing C so that the elevator 14 may be disengaged from the casing C to leave the upper end of the casing free and unobstructed. The means 11 suspends the casing from its upper end portion to maintain the tensile strain on the casing, the magnitude of said strain being indicated by the gauge 32.

The string 12 is then run into the casing C being assembled and handled by the hoist mechanism M in the well known manner. The tool T is connected with the string 12 to be run into the casing. When the tool T has reached a depth which is believed to be adjacent the point X at which the casing is caught the tool is tripped or actuated to grip the interior of the casing. The manner of actuating the tool T of course depends upon the character of the tool. A tool of the general character shown in the drawings is usually tripped or actuated by manipulation of the string to which it is connected. After the actuation of the tool T to grip the interior of the casing the weight or a portion of the weight of the string 12 may be allowed to settle so that it is imposed on the casing C or an up strain may be put on the string 12 to be transferred to the casing. With the tool T engaging or gripping the casing C above the point X the weight of the string 12 imposed on the casing C of course increases the tensile strain on the casing, and the up strain decreases the tensile strain on the casing, such variations being indicated by the gauge 32. If the tool T is at first actuated to connect the string 12 with the casing C above the point X as just described it is released and the string 12 is lowered and the tool T again actuated to connect the string with the casing. The weight or a portion of the weight of the string 12 or an upward strain is again imposed on the casing and the reading of the gauge 32 observed to ascertain if the tensile strain on the casing has varied.

If the reading of the gauge 32 is again changed it indicates that the tool T has again been set above the point X and the tool must be released and lowered to a greater depth in the casing. If, on the other hand, the weight of the string 12 or the upward strain imposed on the casing has not affected the reading of the gauge 32 the tool has been set or actuated to grip the casing C below the point X. If the tool T is set or actuated below the point X as determined by the unchanged reading of the gauge 32 the tool may be raised and again actuated and the operation repeated until the exact location or depth of the point X is determined. From the above it is believed that it will be understood how the point X may be located by imposing a longitudinal strain on the casing C at various vertical points.

Following the location of the point X the string 12 may be raised to bring the tool T above the point X and the tool may be actuated to part or cut the casing. By definitely locating the point X the tool T may be actuated to cut the casing X immediately above the point X. Following the actuation of the tool T to cut the casing C the string 12 is withdrawn and the freed or parted upper portion of the casing is removed from the well in the usual manner.

From the above detailed description of the apparatus and its mode of operation it is apparent that the method of the present invention includes, generally, engaging the casing C adjacent its upper end and putting the casing under a tensile strain, maintaining the tensile strain on the casing C, gauging or measuring this tensile strain, putting a longitudinal strain on the casing C at vertically spaced points while observing the reading of the gauge 32 and thus locate the point X at which the casing is caught, then parting or cutting the casing C above the point X and then removing the freed upper portion of the casing from the well.

The act or operation of putting the casing C under a tensile strain may be accomplished by means of the elevator 14 and the hoisting mechanism M or by other equivalent means. The intensity of the tensile strain imposed on the casing C of course depends upon various factors but must be sufficient to provide a reading on a force measuring device such as the gauge 32. The tensile strain on the casing C may be maintained by means of the hoist mechanism M. However, it is preferred to maintain the tensile strain on the casing by a means or device similar to the spider 16 which leaves the upper end of the casing clear and unobstructed for the insertion of the pipe string 12. Where the spider means 11 is employed to suspend the casing from its upper end, a force measuring or gauging device of the character described above may be embodied in or associated with the casing holding spider.

In most instances it is convenient to employ a string of pipe as the element 12 for applying the longitudinal strain to the casing. However, it is to be understood that a string of rods or the like may be employed for this purpose if desired. The string 12 is assembled and run into the casing C in the well known manner, being handled by the hoist mechanism M. To facilitate the connection of the weight element or string 12 with the casing C a casing gripping tool is provided on the string that may be actuated at will from the surface of the ground. The tool used for this purpose may vary under different circumstances. For example, where the

casing C is to be shot or parted by means of explosives a spear or like tool may be provided on the string 12 for connecting it with the casing. In the specific manner of carrying out the invention illustrated in the drawings the tool T is in the nature of a casing cutter adapted to be employed to connect and support the string 12 on the casing during the locating of the point X and to cut or part the casing when the point X has been located.

While the tensile strain is maintained on the casing C the weight element or string 12 is connected with the casing C at various points spaced vertically thereof and its weight or a portion of its weight or an upward strain is applied to the casing at these points. This successive application of the longitudinal strain to the casing C at spaced points is continued until the lowest point on the casing at which the application of the strain varies the tensile strain on the casing is ascertained, which point is the point or zone X. In practice the weight element or string 12 may be successively connected with the casing C and the weight or force applied thereto at progressively lower points to locate the lowest point on the casing at which the application of the weight of the string to the casing varies the tensile strain thereon. Another manner of locating the point X is to run the string 12 into the well to position the tool T at a point believed to be below the point X and then actuate the tool T to connect the string 12 with the casing C at progressively higher points until the application of the longitudinal strain on the casing varies the tensile strain on the upper portion of the casing. The point of fixation X of the casing C is immediately below the point at which the application of the strain to the casing C causes an increase or decrease in the tensile strain on the string. The initial tensile strain is, of course, maintained on the casing C and the readings of the gauge 32 are observed during the determination of the point X as just described. If desired, the exact depth of the point X may be determined in any suitable manner. For example, this may be accomplished by measuring or ascertaining the length of the string 12 and its tool T.

After the point X of fixation of the casing C has been located the casing C is cut or parted above the point X and the freed portion of the casing is withdrawn from the well. Where a spear or similar tool is provided on the string 12 to grip the casing to support the string on the casing for the purpose of locating the point X, the string 12 is withdrawn from the well following the location of the point X. Where the tool T is in the form of a casing cutter it is positioned immediately above the point X and is actuated to cause its cutters 34 to cut the casing. The cutting or parting of the casing results in a reduced reading on the gauge 32, the method thus indicating when the casing is fully parted. Following the cutting of the casing the string 12 and the casing C are withdrawn from the well by the hoisting mechanism M in the well known manner. It is to be noted that the method of the present invention accurately or definitely locates the highest point at which the casing is fixed or caught in the well, whereby a maximum amount of the casing may be recovered from the well following the first cut of the casing. The method may be employed to locate the point at which a casing is cemented in a well so that the casing may be perforated at the desired place. The method may be carried on with the usual hoist-

ing mechanism and other apparatus of the well derrick and the accuracy in locating the point at which the casing is caught does not depend upon the skill or experience of the operator.

While I have described the method as including the maintaining of a tensile strain on the casing C it is to be understood that the invention contemplates the maintaining of a compression strain on the casing while applying a longitudinal strain to the casing at longitudinally spaced points to locate the point of fixation. In other words a longitudinal strain in either direction may be maintained on the casing during the locating of the point.

Figs. 8 and 9 of the drawings illustrate another form of device for suspending the casing C from its upper end and for indicating the tensile strain on the casing. The device shown in Figs. 8 and 9 of the drawings may be mounted or arranged in the same location as the means 11 previously described. The device includes an annular member comprising a base 50 and a plunger 51 projecting upwardly from the base. The base surrounds the projecting upper portion of the casing C with suitable clearance. A cylinder member 52 is provided with an annular recess 53 in its underside for receiving the plunger 51. A tubular member or cell 54 of suitable flexible material is arranged in the cylinder member 52 between the top of the plunger 51 and the upper wall of the recess 53. The cell 54 is adapted to contain a suitable fluid and is constructed to withstand comparatively high pressures. A pipe 55 communicates with the interior of the cell 54 and carries a suitable gauge 56 for indicating the pressure on the fluid in the cell. A diaphragm or plate 57 is arranged in the recess 53 between the cell 54 and the upper end of the plunger 51. The plate 57 is preferably formed of metal and has a suitable degree of flexibility. The top or upper side 58 of the cylinder member 52 may be flat and horizontal as illustrated.

In employing the device illustrated in Figs. 8 and 9 of the drawings the base 50 is mounted to properly surround the projecting portion of the casing and the casing engaging means may rest on the upper side 58 of the cylinder member. In practice a casing spider or a casing elevator may be employed to engage the casing to suspend it on the cylinder 52 under the desired tensile strain. Where an elevator is employed it engages under a collar on the casing and its lower side rests or seats on the cylinder member 52. The weight of the casing C or the tensile strain on the casing C is imposed on the member 52 and transmitted through the cell 54. The fluid in the cell is thus placed under a pressure directly proportionate to the strain on the casing C. The gauge 32 may be suitably marked or calibrated to indicate the tensile strains on the casing.

Having described only a typical preferred form, application and manner of carrying out the method of the invention I do not wish to be limited or restricted to the specific details set forth but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. The method of locating the point at which an object is fixed in a well which includes maintaining a longitudinal strain on the object, and applying a longitudinal strain to the object at vertically spaced points to locate the lowest point on the object at which the application of the

longitudinal strain varies the strain maintained on the object.

2. The method of locating the point at which an object is fixed in a well which includes maintaining a longitudinal strain on the object, and applying a longitudinal strain to the object at progressively lower points to locate the lowest point on the object at which the application of the longitudinal strain to the object varies the strain thereon.

3. The method of locating the point at which an object is fixed in a well which includes maintaining a longitudinal strain on the object, and applying a longitudinal strain to the object at progressively higher points to locate the lowest point on the object at which the application of the longitudinal strain varies the strain maintained on the object.

4. The method of locating the point at which an object is fixed in a well which includes maintaining a longitudinal strain on the object from the upper end of the well, running an element into the well, connecting the element with the object at various points vertically thereof, applying a longitudinal strain to the object through the element while it is connected with the object to locate the lowest point at which the application of the longitudinal strain varies the strain maintained on the object, and then determining the depth of said point.

5. The method of locating the point at which an object is fixed in a well which includes, maintaining a longitudinal strain on the object, and applying a longitudinal strain to the object at various points thereon to locate the lowest point at which the application of the longitudinal strain varies the maintained strain on the object.

6. The method of locating the point at which an object is fixed in a well which includes placing a tensile strain on the object, and connecting a weight element with the object at various points vertically thereof to locate the lowest point at which the weight of the element increases the tensile strain on the object.

7. The method of recovering a tubular object fixed in a well which includes applying a tensile strain to the object, lowering a weight and cutting element into the object, successively connecting the element with the object at vertically spaced points to locate the lowest point at which the weight of the element increases the tensile strain on the object, parting the object above said point by operating said element, and then removing the freed upper portion of the object.

8. The method of recovering a tubular object fixed in a well which includes applying a tensile strain to the object, lowering a weight and cut-

ting element into the object, successively connecting the element with the object at vertically spaced points, measuring the tensile strain on the object during said successive connecting of the element with the object to determine the lowest point at which the weight of the element increases the strain on the object, parting the object above said point by operating the element, and then removing the freed portion of the object from the well.

9. The method of recovering a fixed casing from a well including, placing the casing under a tensile strain, running a casing gripping and cutting device into the casing on a string, actuating the device to support the string on the casing at vertically spaced points to determine the lowest point at which the weight of the string increases the tensile strain on the casing, parting the casing above said point by means of said device, and then removing the freed portion of the casing from the well.

10. The method of recovering a fixed casing from a well including, placing the casing under a tensile strain, running a casing cutter having a casing gripping means into the casing on a string, actuating the gripping means of the cutter to support the string on the casing at various vertically spaced points to determine the lowest point at which the weight of the string increases the tensile strain on the casing, actuating the cutter to part the casing above said point, withdrawing the string from the casing, and withdrawing the casing from the well.

11. The method of locating the point at which a tubing is fixed in a well which includes successively transferring the weight of an object to the tubing at longitudinally spaced points, associating a force measuring device with the tubing which is responsive to such transference of weight to the tubing, and observing the reading of said device at each successive application of the weight to the tubing to determine the lowest point on the tubing at which the application of the weight to the tubing increases the reading of the device.

12. The method of locating the point at which an object is fixed in a well, which includes suspending the object from its upper end, associating an indicating device with the object which is responsive to longitudinal strains on the object, applying a longitudinal strain to the object at longitudinally spaced points, and observing the reading of said device at each successive application of strain to the object to determine the lowest point on the object at which the application of a strain changes the reading of the said device.

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