

Feb. 16, 1960

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2,925,128

HYDRAULIC TUBING ANCHOR FOR WELLS

Filed July 6, 1954

3 Sheets-Sheet 1

FIG. 1.

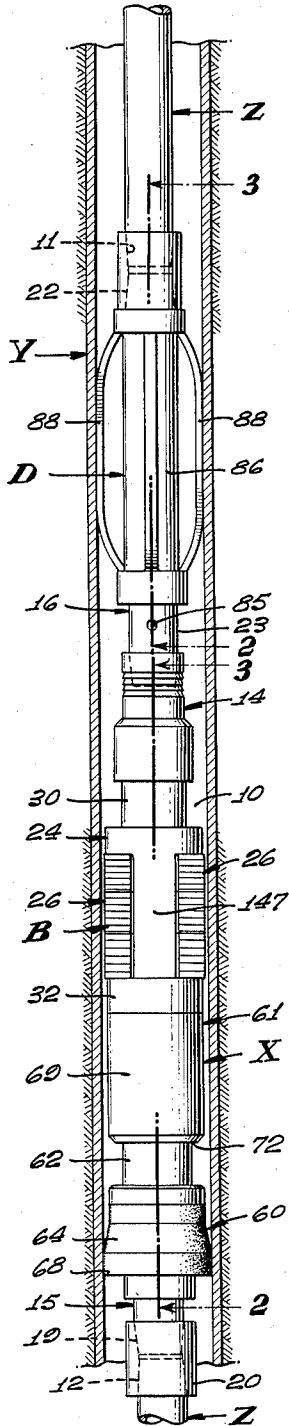
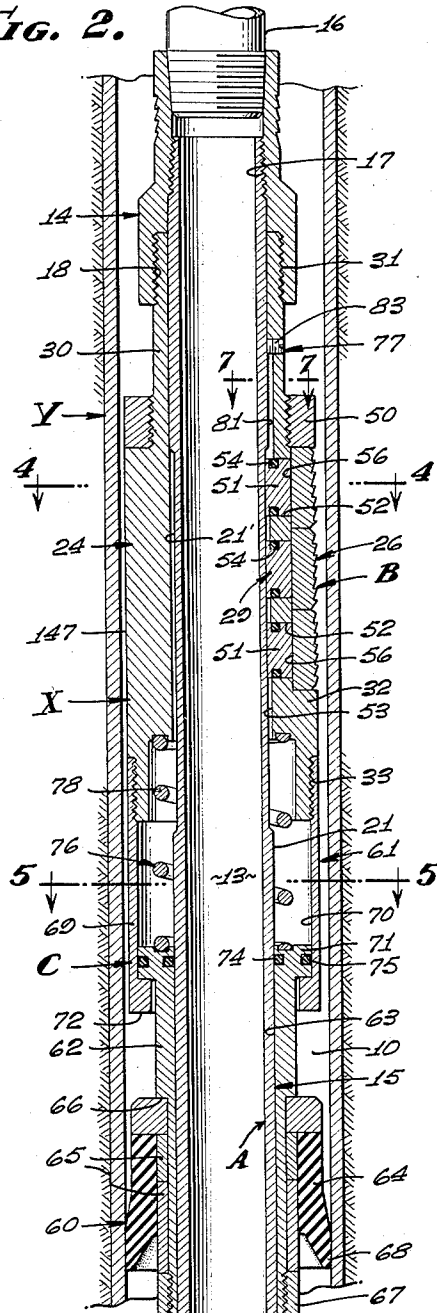


FIG. 2.



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Fig. 3.

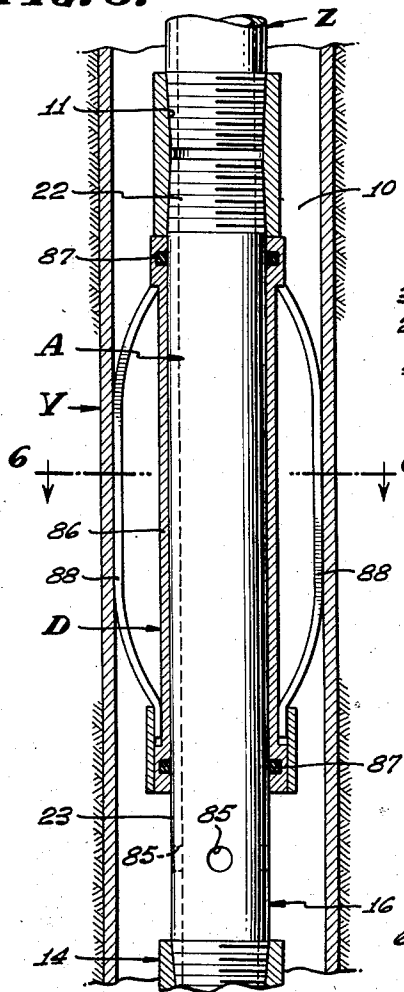


Fig. 4.

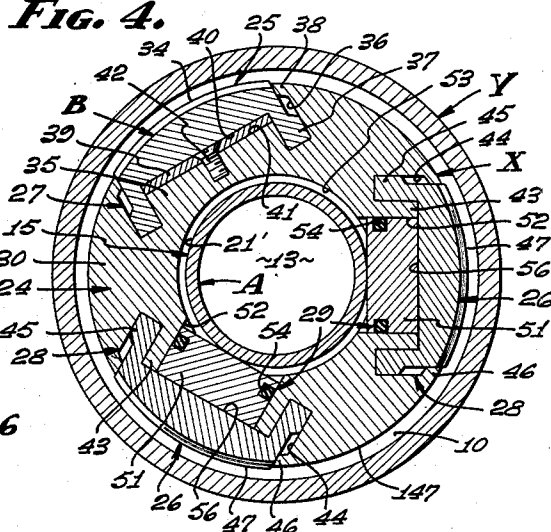


Fig. 5.

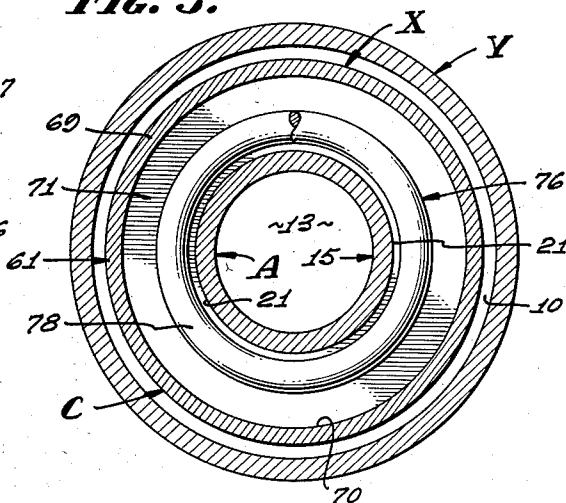


Fig. 6.

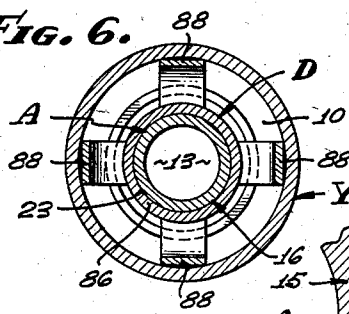
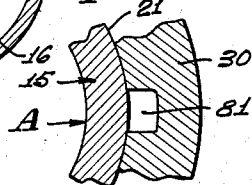


Fig. 7.



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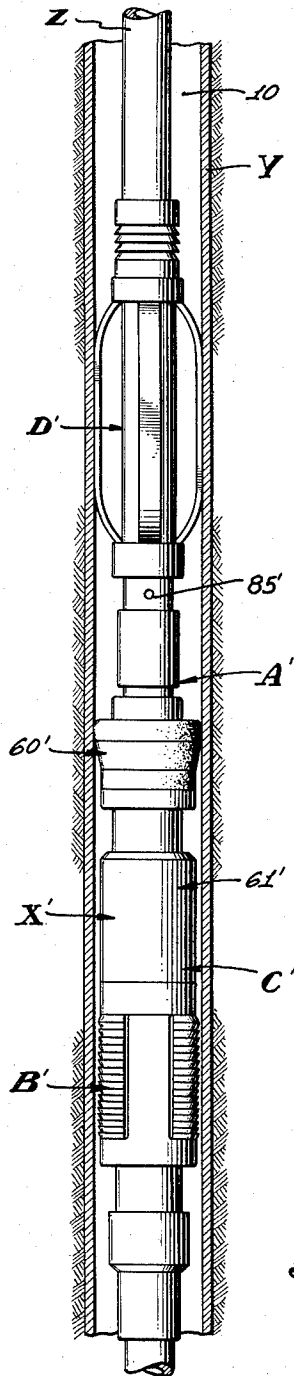
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HYDRAULIC TUBING ANCHOR FOR WELLS

Filed July 6, 1954

3 Sheets-Sheet 3

FIG. 8.



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2,925,128

HYDRAULIC TUBING ANCHOR FOR WELLS

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Application July 6, 1954, Serial No. 441,528

7 Claims. (Cl. 166—121)

This invention has to do with a well tool and is particularly concerned with a tubing anchor employed in a well casing to facilitate cementing, acidizing and pumping operations, or the like, which take place in the well. It is a general object of the invention to provide apparatus of this general character which is of simple, practical, economic construction and which is dependable and effective in action. This application is co-pending with my application entitled "Hydraulically Boosted Anchor For Wells," Serial No. 441,280, now Patent 2,881,841, filed on an even date herewith.

It is not uncommon to employ a string of tubing in a well, for instance, within a well casing to pump fluid from or into the well as, for instance, from or into the lower end portion of the casing. Such pumping or cementing operations involve the handling of fluids at high pressure and at variations in pressure, all of which make it highly advantageous that the lower end portion of the tubing employed in carrying out such an operation be anchored or secured in the casing against undesirable movement or shifting therein.

It is an object of this invention to provide an anchor for handling tubing in a well whereby the lower end portion of the tubing is established in gripping engagement with the casing of the well so that it does not move or shift therein.

It is another object of this invention to provide apparatus of the general character referred to wherein a gripping mechanism is provided in or carried by the tubing in combination with a fluid control valve and a piston or packer, which gripping mechanism is adapted to be actuated by increased fluid pressure to grip the casing in which the tubing is located.

It is another object of this invention to provide a tubing anchor of the general character referred to which is characterized by a simple, practical, improved means for operating a hydraulic gripping mechanism at a fluid pressure greater than the fluid pressure in the well surrounding or at the tool. With the construction of the present invention the affected area of the element operated upon by fluid within the well casing is greater than the effective area of the element supplying fluid under pressure to the gripping means of the tool.

The various objects and features of my invention will be fully understood from the following detailed description of the typical preferred forms and applications of my invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a vertical sectional view through a typical well, showing the casing and showing the anchor of the present invention in elevation and as it is when being lowered into the well. Fig. 2 is an enlarged detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged detailed sectional view taken as indicated by line 3—3 on Fig. 1. Fig. 4 is an enlarged detailed transverse sectional view taken as indicated by line 4—4 on Fig. 2. Fig. 5 is an enlarged detailed transverse sectional view taken as indicated by line 5—5 on

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Fig. 2. Fig. 6 is a transverse sectional view taken as indicated by line 6—6 on Fig. 3. Fig. 7 is an enlarged detailed portion of the structure taken as indicated by line 7—7 on Fig. 2, and Fig. 8 is a view similar to Fig. 1 showing how the tool of the present invention can be reversed to be responsive to a head of pressure above the tool.

The anchor X of the present invention is adapted to be operated in a well casing Y, which may be set or fixed in a well. A fluid handling tubing Z is provided within the casing and extends downwardly therein to the desired depth to establish open communication with the interior of the casing, or, if desired, with the bore of the well below the casing.

The tool that I provide is particularly adapted for use during cementing operations, wherein a slurry of cement is urged downwardly through the tubing and into the well structure, under pressure, and in which case the lower end of the tubing Z can be open and unobstructed to allow for the free flow of fluid upwardly and/or downwardly through the tubing, as circumstances require.

In accordance with the present invention the tubing Z is considerably smaller in size than the casing Y with the result that there is an open space or annulus 10 between the casing and the tubing. In practice, the anchor X is carried by the tubing Z and may be inserted in or connected to the tubing, intermediate its ends, as shown in Fig. 1 of the drawings. In accordance with well construction the upper end of the anchor X is internally threaded at 11 and is threaded onto the lower end of the upper section of the tubing Z, while the lower end of the anchor X is internally threaded at 12 and is threaded into the upper end of a section of the lower section of the tubing Z.

The hydraulic tubing anchor X of the present invention involves, generally, a frame A threaded at 11 and 12 as above described and adapted to be inserted in the string of tubing Z, a gripping means B carried on the frame A preferably at the center portion thereof and adapted to have anchoring engagement with the casing Y, pressure boosting means C carried on the frame A preferably at the lower end thereof and adapted to increase hydraulic pressure which is used to operate the gripping means B, and a valve D carried on the frame A preferably at the upper end thereof and adapted to pass fluid between the interior and exterior of the frame A when the valve is open and to stop flow of fluid when the valve is closed so that the means C is operated.

The frame A is an elongate tubular element that is round in cross section and is characterized by a flow passage 13 extending continuously therethrough from the top to the bottom thereof. As shown in the drawings, the frame A may be sectional and involves an upper valve section 16, coupling section 14 and a lower section 15. The valve section 16 is provided at the upper end of the frame A and carries the threaded portion 11 above referred to. Section 14 has a central bore 17 and is threadedly engaged to the lower end of section 16 and has a downwardly opening threaded counterbore 18. The bore 17 threadedly receives the upper end of the lower section 15, while the counterbore 18 threadedly receives the upper end of the means B hereinafter described.

It will be apparent that the flow passage 13 extending through the body A establishes open communication with the sections of the tubing Z at the upper and lower end of the anchor, with the result that the flow of fluid through the tubing is not interrupted by the presence of the anchor.

The upper portion of the lower section 15 is screw threaded into the bore 17 and is an elongate part that depends from the coupling section and connects with

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the gripping means B and the pressure boosting means C. As shown, the lower end portion of the section 15 is threaded at 19 and receives a coupling 20 which establishes the internal threads 12 referred to above and which joins the tool to the lower section of tubing Z. The section 15 is characterized by a smooth cylindrical outer wall 21 which extends between the threaded upper and lower end portions of the section. In the preferred form of the invention the wall 21 has a portion 21' of reduced diameter which receives or accommodates elements of the means B and provides for fluid passage.

The upper valve section 16 has a threaded upper end portion 22 screwed into a coupling in which the threads 11 are established and which joins the tool to the upper section of the tubing Z. The lower end portion of the section 16 threads into the coupling section 14. The section 16 is characterized by a smooth cylindrical outer wall 23 which extends continuously between the threaded upper and lower end portions of the section.

The gripping means B provided by the present invention involves, generally, an elongate tubular body 24, a plurality of circumferentially spaced shoes, preferably including an abutment shoe 25, and a plurality of working shoes 26. The means B further includes mounting means 27 mounting the abutment shoe in a fixed position on the body, mounting means 28 mounting the working shoes on the body for movement radially relative thereto, and operating means 29 acting to move the working shoes radially into engagement with the casing Y.

The body 24 of the means B is in the form of a sleeve 30 slidably engaged on the cylindrical outer wall 21 of the frame section 15. The body 24 has a threaded upper end portion 31 screw threaded into the counterbore 18, and an enlargement 32 at its lower end threaded at 33 and adapted to be joined or coupled to the means C hereinafter described.

The abutment shoe 25 is carried on the exterior of the body 24, that is, on the exterior of the sleeve 30 of the body, and, in accordance with the invention, it has a predetermined or fixed working position relative to the body so that it forms an abutment member engageable with the casing to provide a rigid or unyielding support establishing the body of the anchor in the casing against movement or shifting relative thereto. In the preferred form of the invention the outer face 34 of the abutment shoe 25 is convex and is preferably finished or provided with teeth to have effective gripping engagement with the wall of the casing Y. The abutment shoe may, in practice, be made as an integral part or projection on the body 24. However, it is preferred that it be joined to or mounted on the body by the mounting means 27 as shown in the drawings.

The particular mounting means 27 illustrated in the drawings, involves a longitudinally disposed portion 35 on the exterior of the sleeve 30, which is provided with a longitudinal guideway 36 with opposed walls. The abutment shoe is carried in the guideway and has a widened or enlarged base portion 37 engaged between the opposing walls of the guideway. Inwardly turned or projecting flanges 38 are provided at the outer part of the guideway to overhang or overlie the enlarged base portion 37 so that the shoe cannot become radially displaced from the guideway.

In accordance with the present invention it is preferred that the abutment shoe 25 have a fixed or predetermined working position relative to the body, that is, that it have a working position from which it will not move or shift when the anchor is in use. In the particular case illustrated, the structure is such that the abutment shoe may move radially outward but it cannot move inward of the body from the predetermined working position.

The invention provides means for adjusting or varying the working position of the abutment shoe so that the shoe can be set to operate at a predetermined distance from the center of the anchor. In the form of the

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invention illustrated, an insert or liner 39 is provided behind the shoe or between the back 40 of the shoe and the bottom 41 of the guideway. The liner is shown secured in position by screw fasteners 42. It will be apparent from the drawings how the liner or insert 39 positively determines the working position of the abutment shoe 25, and it will be apparent that by varying liners, that is, by using liners of different thicknesses the effective position of the shoe may be varied.

In the preferred form of the invention, I provide two working shoes 26 circumferentially spaced apart and from the abutment shoe 25. The several shoes 25 and 26 are preferably equally spaced around the body as illustrated in the drawings.

Each working shoe 26 is provided with a mounting means 28 by which it is mounted on the body 24 and, in the preferred form of the invention, each mounting means 28 involves a laterally disposed portion 43 on the exterior of the sleeve 30, which has a longitudinal guideway 44 with opposed guide faces. The shoe carried by the guideway has an enlarged base portion 45 that slides in the guideway 44 and inwardly projecting flanges 46 are provided at the outer part of the guideway to overlie the base portion 45 to positively prevent radial displacement of the shoe from the guideway. The shoe carried in the guideway has a convex outer face 47 preferably finished or provided with gripping teeth or the like, and the structure is such that when the shoe is retracted its outer face is substantially concentric with the outer face 147 of the portion 43, and when the shoe is extended its outer face is beyond the said portion and fits in or substantially conforms to the contour of the interior of the casing Y.

In accordance with the present invention there may be a plurality of shoes 25 and 26 carried in the guideways 36 and 44 respectively. As shown, the shoes are retained in the guideways by the enlargement 32 at the lower end of the body 24 and by a collar 50 threaded onto the upper end of the body 24. The enlargement and the collar are provided to close the ends of the guideways to retain the shoes therein.

The operating means 29 is actuated by fluid pressure from within the body 24 and acts to operate the working shoes radially of the body and into pressure engagement with the interior of the casing Y, while the abutment shoe 25 bears in the casing and forms a fixed point positioning the body in a predetermined manner in the casing. Where there is a plurality of working shoes or where the working shoes are sectional, as above described, it is preferred that there be a unit of the operating means 29 for actuating each shoe section. In the drawings a plunger 51 is shown for operating each shoe or section and is carried in a radial cylinder opening 52 provided in the body 24, the opening extending from the interior or bore 53 of the body to the exterior of the enlargement 32 at the bottom of the guideway carrying the shoe or section thereof. A suitable packing ring or seal 54 is provided to seal the plunger in the cylinder opening, while the outer end of the plunger seats against or bears on the inner or back face 56 of the shoe section. With this construction, which is clearly illustrated in the drawings, it will be apparent that fluid pressure in the body 24 actuates the plunger outwardly so that the sections of the working shoes are individually operated outward and into suitable pressure engagement with the casing.

The pressure boosting means C is a fluid pressure operated means that supplies increased fluid pressure to the gripping means B, above described, and involves, generally, a fluid pressure actuated element 60 of large effective cross sectional area and a fluid pressure generating element 61 of reduced effective cross sectional area.

In accordance with the present invention the element 60 operates in the annulus 10 and includes a tubular piston sleeve 62 with a smooth cylindrical bore 63 slidably carried on the lower end of the frame section

15, and a drive piston 64 on the sleeve. The drive piston 64 is in the nature of a packer or the like, such as is commonly employed in connection with well tools of the character under consideration, and is a downwardly faced flexible cup-shaped part of rubber or like material. The piston 64 is vulcanized to one or more suitable rings 65 that seat against a downwardly faced shoulder 66 on the sleeve 62. A nut 67 is screw threaded onto the lower end of the sleeve 62 to retain the drive piston 64 in working position. The piston 64 has an outer peripheral lip 68 adapted to have sliding sealed engagement with the interior of the casing Y.

The fluid pressure generating element 61 is essentially a cylinder and piston unit having a relatively small effective area so that an increased differential in pressure is created between the fluid pressure that acts upon the actuated element 60 and the fluid pressure which is delivered by the fluid pressure generating element 61. As shown, a cylinder 69 is threadedly engaged with the lower end of the gripping means B at 33 and has a smooth bore 70 that receives a piston head 71 at the upper end of sleeve 62. An end wall 72 closes the lower end of the cylinder 69 and is provided to retain the head 71 in the cylinder. Inner and outer seals 74 and 75, such as O-rings or the like, are carried by the piston head 71 to provide sealing engagement with the section 15 of the frame A and the cylinder 69. It is to be understood that suitable seals or the like, may be provided at various places throughout the structure as indicated throughout the drawings and as circumstances require.

In accordance with the present invention a suitable fluid handling means 77 and a return means 76 are provided for the pressure boosting means C. The return means 76 is in the form of a simple compression spring 78 acting between the enlargement 32 and the upper end of the piston head 71 to yieldingly urge the actuated element 60 to a down or unactuated position. The spring 76 is of sufficient strength to maintain the packer 64 in its lowermost position when the valve D is open and as the structure is lowered into the well. The fluid handling means 77 involves a charging passage 81 which is closed by a plug 83 or the like. The reduced portion 21' of wall 21 conducts fluid from the means C to the cylinders of the gripping means. The passage 81 provided for charging the means B with suitable hydraulic fluid opens at the exterior of the body 24 so that it is accessible from the exterior of the structure.

The valve D is shown connected to the tubing Z as by a suitable coupling and is preferably a sleeve type valve adapted to be operated, that is, opened or closed by manipulation of the tubing. In the particular case illustrated, the valve is adapted to be operated by vertical movement or reciprocation of the tubing.

The valve D involves one or more lateral ports or openings 85 provided in the frame section 16 at or near the lower end portion thereof, and further includes a sleeve 86 slidable relative to the tubular body to vary in position relative to the body between an up or open position where it is above the ports 85, and a down or closed position where it is over or covers the ports 85. In actual operation the sleeve remains relatively stationary in the well casing Y and the body of the valve or frame of the tool moves vertically to effect opening and closing of the valve.

Suitable packing means, such as annular packings 87, are carried by the sleeve at the end portion thereof and provide sealing engagement between the ends of the sleeve and the exterior of the body frame section 16. A suitable control means is provided and includes one or more casing engaging elements 88 which normally resist movement of the sleeve in the well casing. In the particular case illustrated, the members 88 are circumferentially spaced, outwardly bowed leaf springs carried by and extending between the end portions of the sleeve

86 and adapted to bear outwardly against the interior of the well casing.

With the construction just described the sleeve 86 will assume a position, such as shown in Fig. 1 of the drawings, in the course of lowering the tubing into the well casing, the upper end of the sleeve 86 being stopped against the upper coupling that connects the frame section 16 to the string of tubing. As the tubing is lowered the valve is moved downwardly in the casing against the resistance offered by the engagement of the leaf springs 88 due to their frictional engagement with the casing. When the construction has been lowered to the desired position or whenever it is desired to close the valve, upward movement of the tubing will result in relative movement between the valve body and the frame section 16 with the result that the ports 85 will be covered by the valve sleeve.

From the foregoing, it will be apparent that when the construction is lowered into the well casing, as during a cementing operation, and the valve means D is open, the fluid in the casing, below the packer 60 is displaced thereby and is caused to flow upwardly through the tubing Z. The fluid in the tubing flows through the ports 85 of the means D and into the casing above the packer and seeks its own level in the casing, thereby placing the packer 60 in equilibrium in the well fluid and so the means C is not actuated to set the means B. Upon limited upward movement of the tubing, the valve means is closed.

Upon subsequent introduction of a slurry of cement downwardly through the tubing, into the well, below the packer, and under pressure, balanced condition of the packer is upset and the means C is actuated to set the means B.

When the tool is thus actuated and set, the tubing is suitably anchored in the casing and is not subject to being elevated in the well structure upon continued introduction of cement into the well.

In the form of the invention illustrated in Fig. 8 of the drawings, the tubing anchor X' is upwardly faced so that it is responsive to hydraulic pressure in the well occurring above the tool. The anchor X' includes a frame A' threaded as above described in connection with the first form of the invention and adapted to be inserted in a string of tubing Z, a gripping means B' carried on the frame A' to have anchoring engagement with the casing Y, a pressure boosting means C' carried at the center portion of the frame A' and adapted to operate the gripping means B', and a valve D' carried on the frame A' at the upper end thereof. This form of the invention differs from the form first described in that the means B' and C' are oppositely disposed so as to face upwardly. That is, the element 60 of the boosting means C' faces upwardly and the gripping means B' and pressure generating element 61' of the means C' are below the element 60' to be operated thereby when a head of pressure occurs above the tool. The boosting means C' and gripping means B' may be identical with and may be related to each other the same as set forth above in describing the first form of the invention. It will be readily understood how this form of the invention will operate to secure the tubing Z in the well casing Y when desired.

In the form of the invention illustrated in Fig. 8, when it is desired to pull the tubing, the valve D' must be shifted upwardly to its open position to allow the fluid in the casing above the packer to drain through the ports 85' and into the tubing. The above opening of the valve means can be advantageously accomplished by the use of a suitable fishing tool (not shown), which tool is engaged in the casing from the top of the well, lowered into gripping or hooked engagement with the casing engaging elements of the valve D' and then elevated the necessary amount to open the valve. The fishing tool

is employed to maintain the valve D open during the entire pulling operation.

From the foregoing, it will be apparent that I have provided an extremely simple and dependable anchor for use in a well casing or the like, which anchor grips the casing with increased pressure engagement. When it is desired to set or anchor the tubing Z in the casing Y, the valve D is operated to close the ports 85, whereupon fluid is prevented from flowing into the annulus 10, above the anchor and pressure builds up in the annulus 10, below the anchor. Upon increase of pressure in the annulus below the anchor, the piston packer 64 is urged upwardly and the piston head 71 is shifted upwardly in the cylinder 69. Because the head 71 has a smaller effective area than the affected area of the piston 64, there is a differential in pressure which results in increased fluid pressure being delivered to the plungers 51 of the means B. It is to be observed that the pressure boosting means is charged with clean fluid so that there is no harmful effect upon the plungers 51 and cylinder openings 52. As set forth above, the tool can be faced upwardly or downwardly as circumstances require.

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

Having described my invention, I claim:

1. A hydraulically operated tubing anchor adapted to anchor a fluid conducting tubing string in a well casing including, an elongate, tubular fluid conducting frame engaged in a string of tubing, a fluid operated gripping means carried by the frame and including a tubular body fixed to the frame intermediate its ends and surrounding the frame, casing engaging shoes carried by the body for radial outward shifting relative thereto, cylinder openings in the body formed radially inward of the shoes and plungers in the cylinder openings and engageable with the shoes; and fluid pressure boosting means adapted to deliver operating fluid under pressure to the cylinder openings to shift the plungers and the shoes radially outwardly including, a cylinder at the lower end of the body, a fluid passage establishing open communication between the cylinder and the cylinder openings, said cylinder and fluid passage being charged with operating fluid, a tubular sleeve slidably carried on the frame adjacent the lower end of the body, an annular casing engaging drive piston on the lower end of the sleeve to be acted upon by fluid pressure in the well casing below the anchor, a piston head of less effective cross-sectional area than the drive piston at the upper end of the sleeve and engaged in the cylinder, and spring means adapted to normally yieldingly maintain the sleeve and the piston thereon in a down or unactuated position, said drive piston adapted to be shifted upwardly against the resistance of the spring means and to shift the piston head upwardly in the cylinder to actuate the plungers and shift the shoes into gripping engagement with the casing upon the introduction of fluid under pressure, through the tubing string and into the casing below the anchor.

2. A hydraulically operated tubing anchor adapted to anchor a fluid conducting tubing string in a well casing including, an elongate, tubular fluid conducting frame engaged in a string of tubing, a fluid operated gripping means carried by the frame and including a tubular body fixed to the frame intermediate its ends and surrounding the frame, casing engaging shoes carried by the body for radial outward shifting relative thereto, cylinder openings in the body formed radially inward of the shoes and plungers in the cylinder openings and engageable with the shoes; fluid pressure boosting means adapted to deliver operating fluid under pressure to the cylinder openings to shift the plungers and the shoes radially outwardly including, a cylinder at the lower end of the body, a fluid

passage establishing opening communication between the cylinder and the cylinder openings, said cylinder and fluid passage being charged with the operating fluid, a tubular sleeve slidably carried on the frame adjacent the lower end of the body, an annular casing engaging drive piston on the lower end of the sleeve to be acted upon by fluid pressure in the well casing below the anchor, a piston head of less effective cross-sectional area than the drive piston at the upper end of the sleeve end engaged in the cylinder, and spring means adapted to normally yieldingly maintain the sleeve and the pistons thereon in a down or unactuated position, and valve means operable to direct fluid in the tubing string into the casing above the anchor, when the anchor is being lowered into the casing and including a port in the frame above the body, a valve sleeve slidably engaged on the frame to normally occur above the port thereon and elements carried by the valve sleeve and frictionally engaging the casing to maintain the sleeve engaged above the port when the anchor is shifted downwardly in the casing and to cause the sleeve to shift downwardly on the frame and to engage over and close the port upon limited upward shifting of the anchor in the casing, said drive piston adapted to be shifted upwardly against the resistance of the spring means and to shift the piston head upwardly in the cylinder to actuate the plungers and shift the shoes into gripping engagement with the casing when the port in the frame is closed and upon the introduction of fluid under pressure, through the tubing string and into the casing below the anchor.

3. A hydraulically operated tubing anchor adapted to anchor a fluid conducting tubing string in a well casing including, an elongate, tubular, fluid conducting frame engaged in a string of tubing, a fluid operated gripping means carried by the frame and including, a tubular body fixed to the frame intermediate its ends and surrounding the frame, a plurality of circumferentially spaced casing engaging shoes carried by the body, one of said shoes being fixed to the body and the other mounted on the body for radial outward shifting relative thereto, cylinder openings in the body formed radially inwardly of the shiftable shoes and plungers in the cylinder openings and engageable with the shoes; and fluid pressure boosting means adapted to deliver operating fluid under pressure to the cylinder openings to shift the plungers and the shoes radially outwardly including, an elongate cylinder at the lower end of the body concentric with and surrounding the frame, a fluid passage establishing opening communication between the cylinder and the cylinder openings, said cylinder and fluid passage being charged with operating fluid, an elongate, tubular sleeve slidably carried on the frame adjacent the lower end of the body, an annular, downwardly disposed, cup-shaped drive piston on the lower end of the sleeve to engage the interior of the casing and to be acted upon by fluid pressure in the casing below the anchor, an annular piston head of less effective cross-sectional area than the drive piston at the upper end of the sleeve and engaged in the cylinder, and spring means adapted to normally yieldingly maintain the sleeve and the pistons thereon in a down or unactuated position, said drive piston adapted to be shifted upwardly against the resistance of the spring means and to shift the piston head upwardly in the cylinder to actuate the plungers and shift the shoes into gripping engagement with the casing upon the introduction of fluid under pressure, through the tubing string and into the casing below the anchor.

4. A hydraulically operated tubing anchor adapted to anchor a fluid conducting tubing string in a well casing including, an elongate, tubular, fluid conducting frame engaged in a string of tubing, a fluid operated gripping means carried by the frame and including a tubular body fixed to the frame intermediate its ends and surrounding the frame, a plurality of circumferentially spaced casing engaging shoes carried by the body, one of said shoes being fixed to the body and the others mounted on the

body for radial outward shifting relative thereto, cylinder openings in the body formed radially inward of the shiftable shoes and plungers in the cylinder openings and engageable with the shoes; fluid pressure boosting means adapted to deliver operating fluid under pressure to the cylinder openings to shift the plungers and the shoes radially outwardly including, an elongate cylinder at the lower end of the body concentric with and surrounding the frame, a fluid passage establishing opening communication between the cylinder and the cylinder openings, said cylinder and fluid passage being charged with operating fluid, an elongate, tubular sleeve slidably carried on the frame adjacent the lower end of the body, an annular, downwardly disposed, cup-shaped drive piston on the lower end of the sleeve to engage the interior of the casing and to be acted upon by fluid pressure in the casing below the anchor, an annular piston head of less effective cross-sectional area than the drive piston at the upper end of the sleeve and engaged in the cylinder, and spring means adapted to normally yieldingly maintain the sleeve and the pistons thereon in a down or unactuated position, and valve means operable to direct fluid in the tubing string into the casing above the anchor, when the anchor is being lowered into the casing and including, a port in the frame above the body, a valve sleeve slidably engaged on the frame to normally occur above the port thereon and elements carried by the valve sleeve and frictionally engaging the casing to maintain the sleeve engaged above the port when the anchor is shifted downwardly in the casing and to cause the sleeve to shift downwardly on the frame and to engage over and close the port upon limited upward shifting of the anchor in the casing, said drive piston adapted to be shifted upwardly against the resistance of the spring means and to shift the piston head upwardly in the cylinder to actuate the plungers and shift the shoes into gripping engagement with the casing when the port in the frame is closed and upon the introduction of fluid under pressure, through the tubing string and into the casing below the anchor.

5. A hydraulically operated tubing anchor adapted to anchor a fluid conducting tubing string in a well casing including, an elongate, tubular fluid conducting frame engaged in a string of tubing, a fluid operated gripping means carried by the frame and including a tubular body fixed to the frame intermediate its ends and surrounding the frame, a plurality of circumferentially spaced casing engaging shoes carried by the body, one of said shoes being fixed to the body and the others mounted on the body for radial outward shifting relative thereto, cylinder openings in the body formed radially inward of the shiftable shoes and plungers in the cylinder openings and engageable with the shoes; fluid pressure boosting means adapted to deliver operating fluid under pressure to the cylinder openings to shift the plungers and the shoes radially outwardly including, an elongate cylinder fixed to and depending from the lower end of the body concentric with and surrounding the frame, a fluid passage establishing opening communication between the cylinder and the cylinder openings, said cylinder and fluid passage being charged with operating fluid, an elongate, tubular sleeve slidably carried on the frame adjacent the lower end of the body, an annular downwardly disposed, cup-shaped drive piston on the lower end of the sleeve to engage the interior of the casing and to be acted upon by fluid pressure in the casing below the anchor, an annular piston head of less effective cross-sectional area than the drive piston at the upper end of the sleeve and engaged in the cylinder, and spring means including a compression spring in the cylinder to occur above the piston head and adapted to normally yieldingly maintain the sleeve and the pistons thereon in a down or unactuated position, and valve means operable to direct fluid in the tubing string into the casing above the anchor, when the anchor is being lowered into the casing and including a stop member at the upper end of the frame, a port in the

frame below the stop and above the body, an elongate, tubular valve sleeve slidably engaged about the frame to normally occur above the port thereon and against the stop and circumferentially spaced, radially outwardly projecting spring elements carried by the valve sleeve and frictionally engaging the casing to maintain the sleeve engaged with the stop and above the port when the anchor is shifted downwardly in the casing and to cause the sleeve to shift downwardly on the frame and to engage over and close the port upon limited upward shifting of the anchor in the casing, said drive piston adapted to be shifted upwardly against the resistance of the spring means and to shift the piston head upwardly in the cylinder to actuate the plungers and shift the shoes into gripping engagement with the casing when the port in the frame is closed and upon the introduction of fluid under pressure, through the tubing string and into the casing below the anchor.

6. A hydraulically operated tubing anchor adapted to anchor a fluid conducting tubing string in a well casing including, an elongate, tubular, fluid conducting frame engaged in a string of tubing, a fluid operated gripping means carried by the frame and including a tubular body fixed to the frame intermediate its ends and surrounding the frame, a plurality of circumferentially spaced, longitudinally disposed rows of casing engaging shoes carried by the body, one row of said shoes being fixed to the body and the other rows of said shoes being mounted on the body for radial outward shifting relative thereto, cylinder openings in the body formed radially inwardly of each of said shiftable shoes and plungers in the cylinder openings and engageable with the shoes; and fluid pressure boosting means adapted to deliver operating fluid under pressure to the cylinder openings to shift the plungers and the shoes radially outwardly including, an elongate cylinder at the lower end of the body concentric with and surrounding the frame, a fluid passage establishing opening communication between the cylinder and the cylinder openings, said cylinder and fluid passage being charged with operating fluid, an elongate, tubular sleeve slidably carried on the frame adjacent the lower end of the body, an annular, downwardly disposed, cup-shaped drive piston on the lower end of the sleeve to engage the interior of the casing and to be acted upon by fluid pressure in the casing below the anchor, an annular piston head of less effective cross-sectional area than the drive piston at the upper end of the sleeve and engaged in the cylinder, and spring means adapted to normally yieldingly maintain the sleeve and the pistons thereon in a down or unactuated position, said drive piston adapted to be shifted upwardly against the resistance of the spring means and to shift the piston head upwardly in the cylinder to actuate the plungers and shift the shoes into gripping engagement with the casing upon the introduction of fluid under pressure, through the tubing string and into the casing below the anchor.

7. A hydraulically operated tubing anchor adapted to anchor a fluid conducting tubing string in a well casing including, an elongate, tubular, fluid conducting frame engaged in a string of tubing, a fluid operated gripping means carried by the frame and including a tubular body fixed to the frame intermediate its ends and surround the frame, a plurality of circumferentially spaced, longitudinally disposed rows of casing engaging shoes carried by the body, one row of said shoes being fixed to the body and the other rows of shoes being mounted on the body for radial outward shifting relative thereto, cylinder openings in the body formed radially inward of each of said shiftable shoes and plungers in the cylinder openings and engageable with the shoes; fluid pressure boosting means adapted to deliver operating fluid under pressure to the cylinder openings to shift the plungers and the shoes radially outwardly including, an elongate cylinder at the lower end of the body concentric with and surrounding the frame, a fluid passage establishing opening communi-

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cation between the cylinder and the cylinder openings, said cylinder and fluid passage being charged with operating fluid, an elongate, tubular sleeve slidably carried on the frame adjacent the lower end of the body, an annular, downwardly disposed, cup-shaped drive piston on the lower end of the sleeve to engage the interior of the casing and to be acted upon by fluid pressure in the casing below the anchor, an annular piston head of less effective cross-sectional area than the drive piston at the upper end of the sleeve and engaged in the cylinder, and spring means adapted to normally yieldingly maintain the sleeve and the pistons thereon in a down or unactuated position, and valve means operable to direct fluid in the tubing string into the casing above the anchor, when the anchor is being lowered into the casing and including a port in the frame above the body, a valve sleeve slidably engaged on the frame to normally occur above the port therein and elements carried by the valve sleeve and frictionally engaging the casing to maintain the sleeve engaged above the port when the anchor is shifted downwardly in the casing and to cause the sleeve to shift downwardly on the

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frame and to engage over and close the port upon limited upward shifting of the anchor in the casing, said drive piston adapted to be shifted upwardly against the resistance of the spring means and to shift the piston head upwardly in the cylinder to actuate the plungers and shift the shoes into gripping engagement with the casing when the port in the frame is closed and upon the introduction of fluid under pressure, through the tubing string and into the casing below the anchor.

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