July 20, 1937. H. C. OTIS 2,087,528

WELL SEAL

Filed Sept. 3, 1935 5 Sheets-Sheet 1

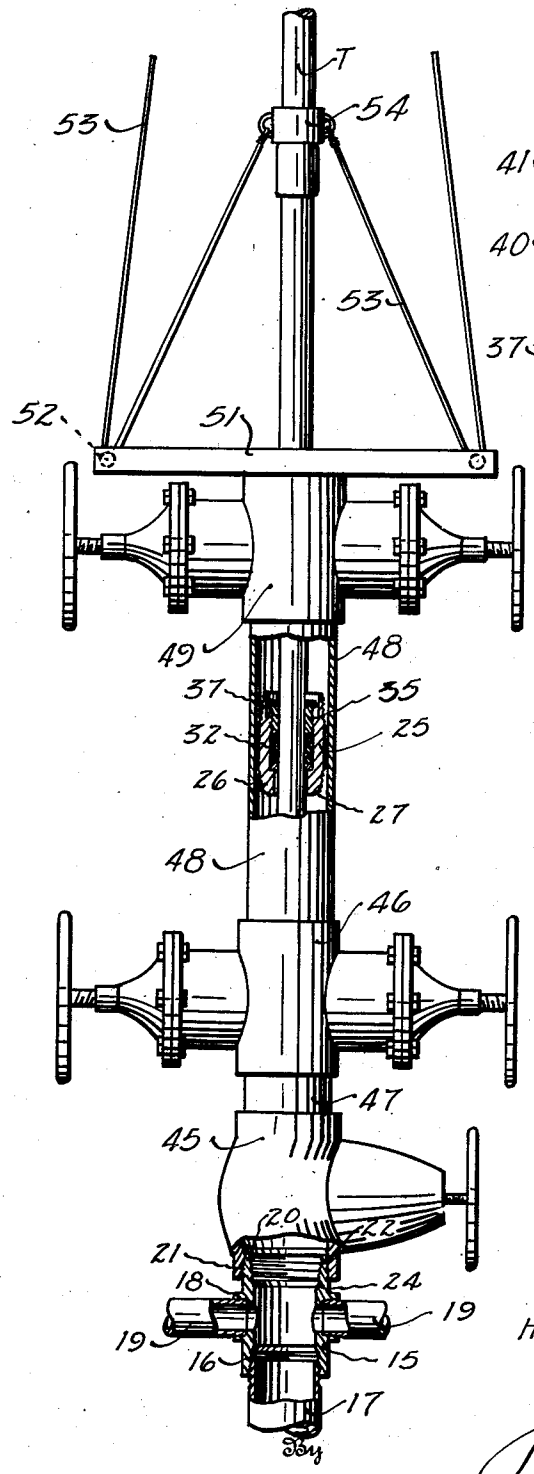

Fig. 1

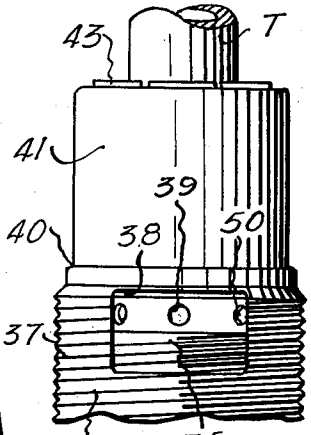

Fig. 9

Inventor
Herbert C. Otis

Jack Athley

Attorney

July 20, 1937. H. C. OTIS 2,087,528

WELL SEAL

Filed Sept. 3, 1935 5 Sheets-Sheet 2

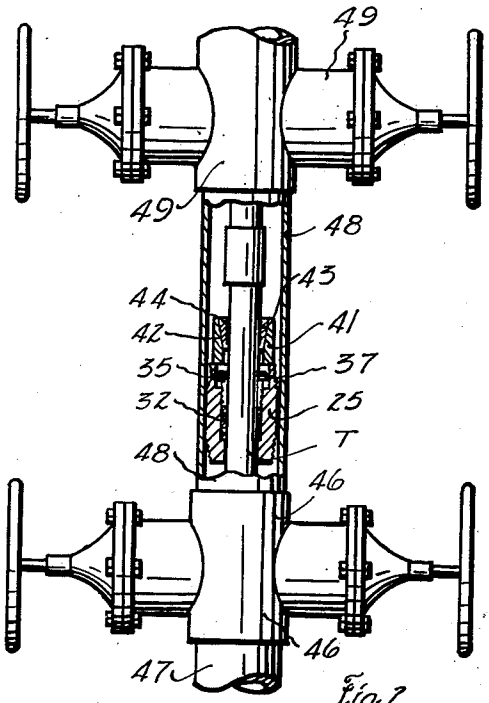

Fig. 2

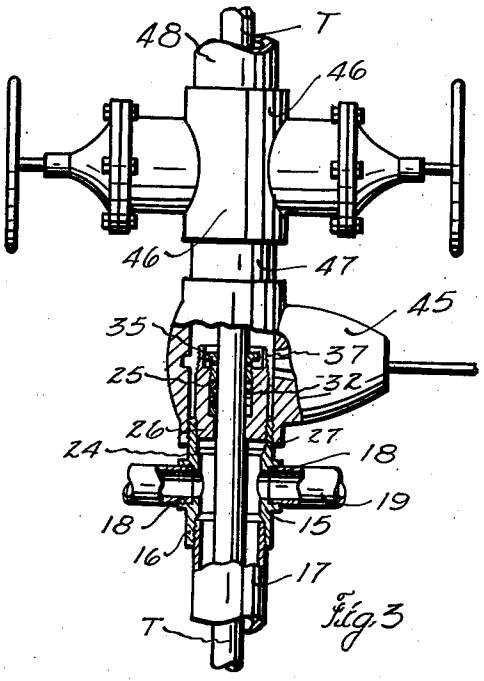

Fig. 3

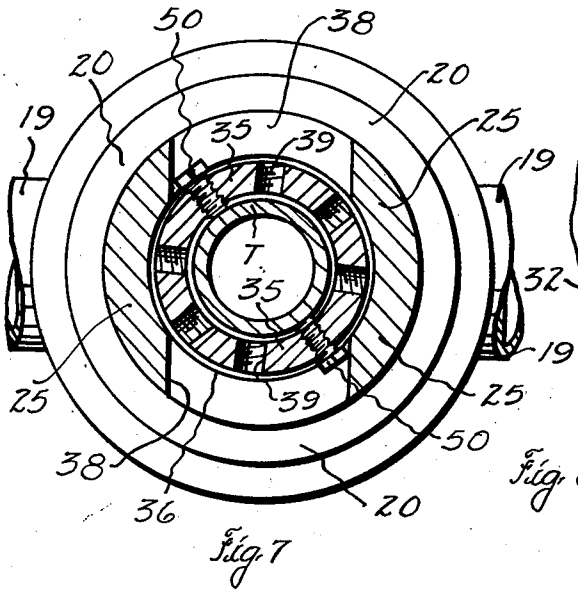

Fig. 7

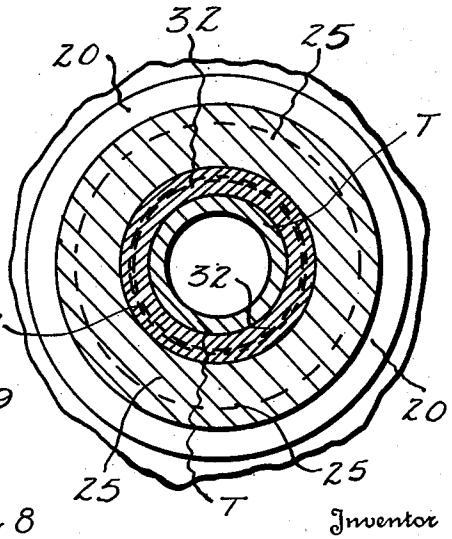

Fig. 8

Inventor
Herbert C. Otis

By

Attorney

July 20, 1937. H. C. OTIS 2,087,528

WELL SEAL

Filed Sept. 3, 1935 5 Sheets-Sheet 3

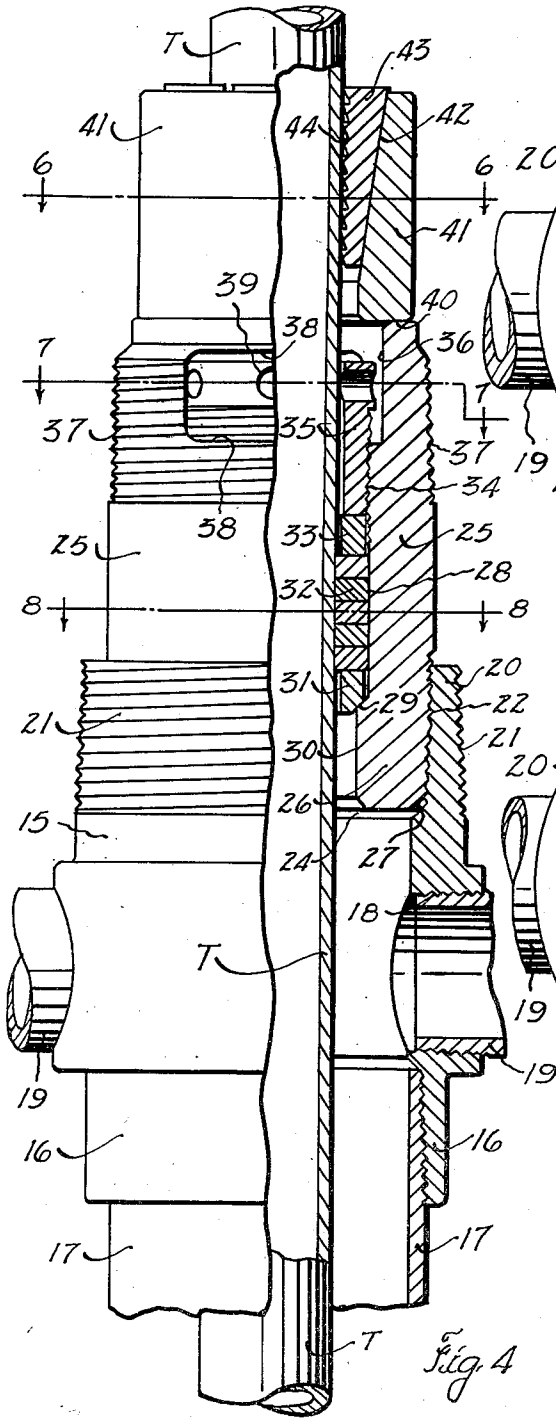

Fig. 4

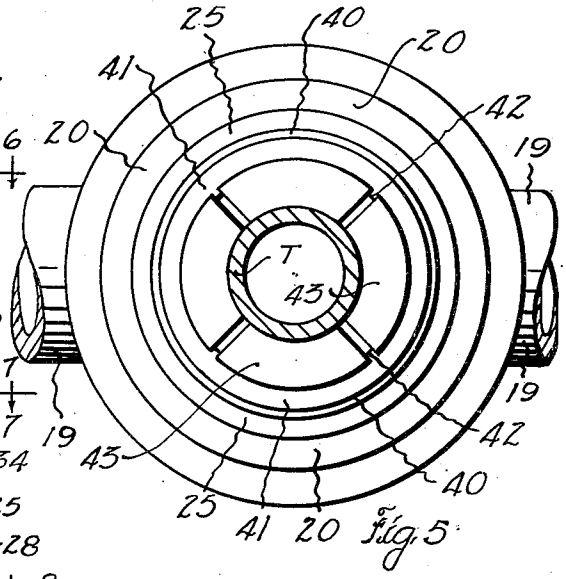

Fig. 5

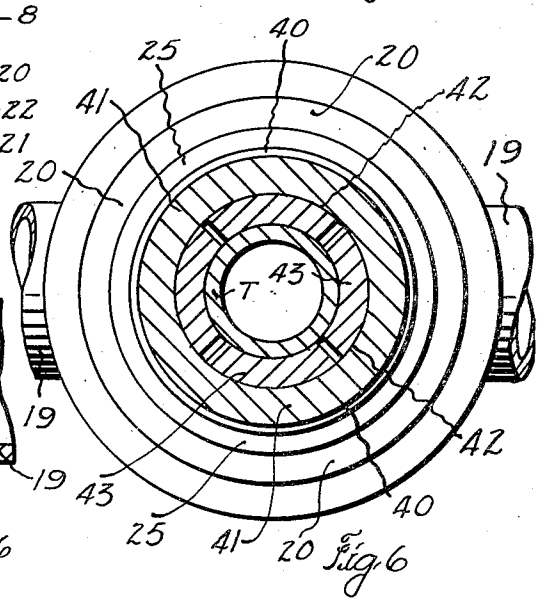

Fig. 6

Inventor
Herbert C. Otis

By

Attorney

July 20, 1937. H. C. OTIS 2,087,528

WELL SEAL

Filed Sept. 3, 1935 5 Sheets-Sheet 4

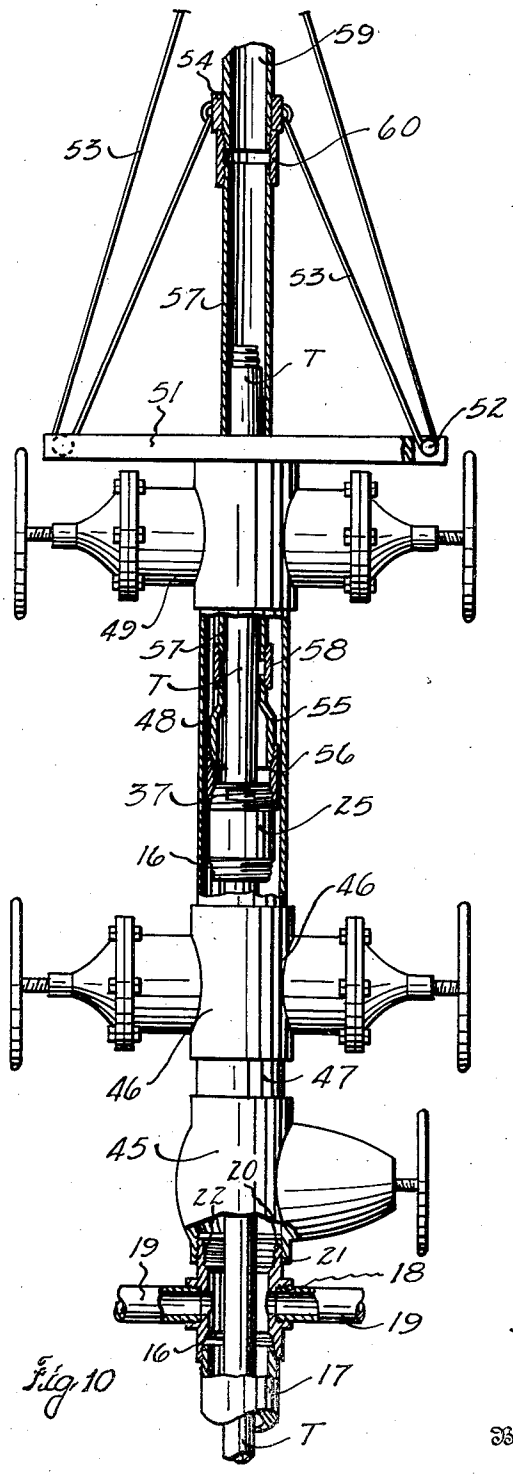

Fig. 10

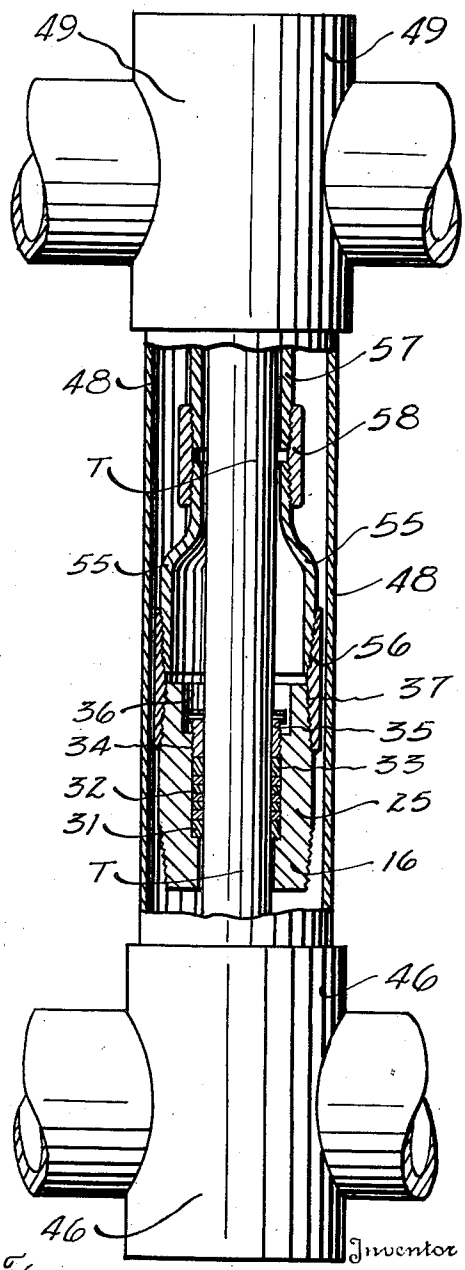

Fig. 11

Inventor
Herbert C. Otis

By

Attorney

July 20, 1937. H. C. OTIS 2,087,528

WELL SEAL

Filed Sept. 3, 1935 5 Sheets-Sheet 5

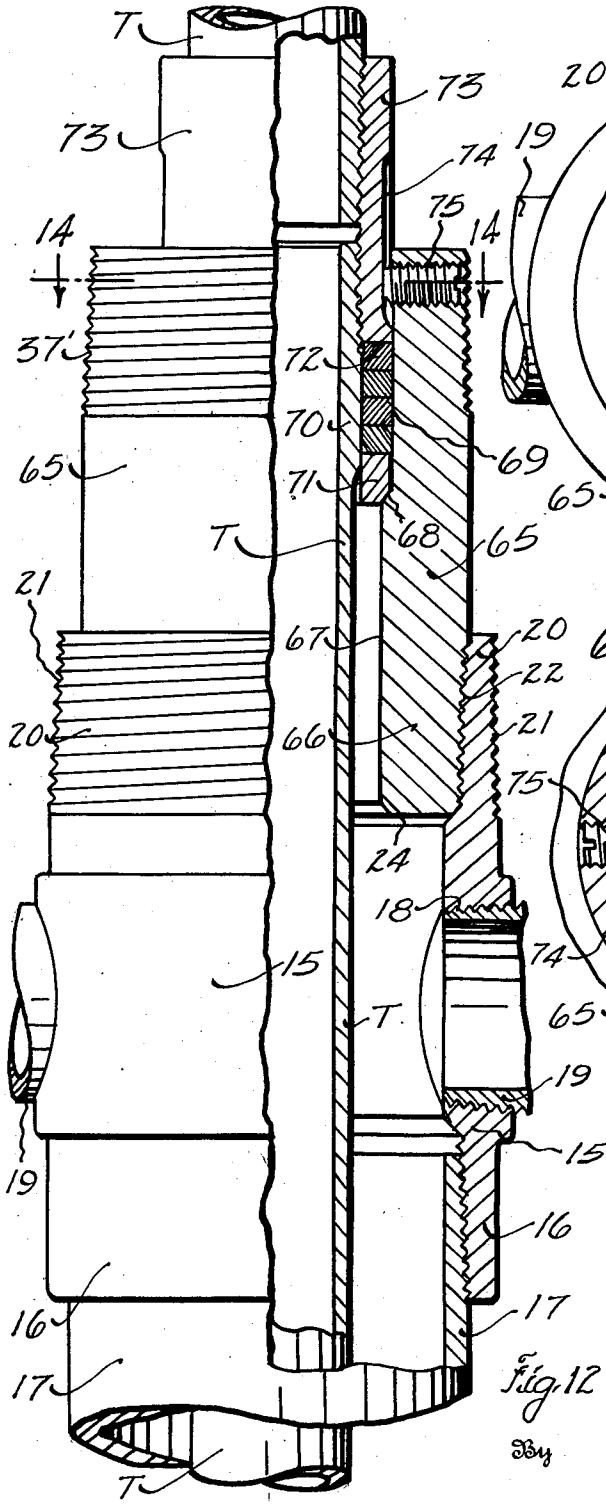

Fig. 12

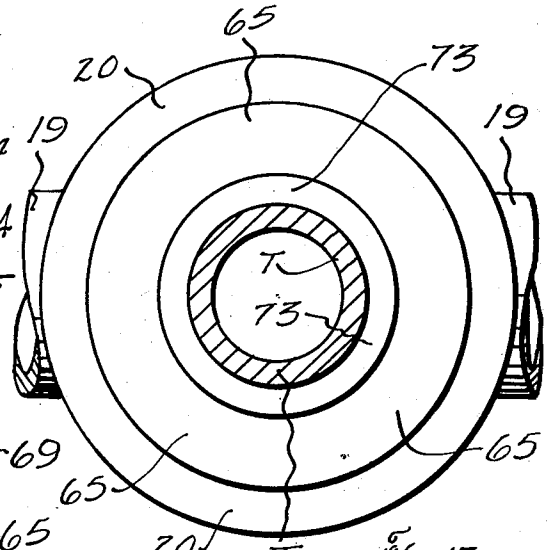

Fig. 13

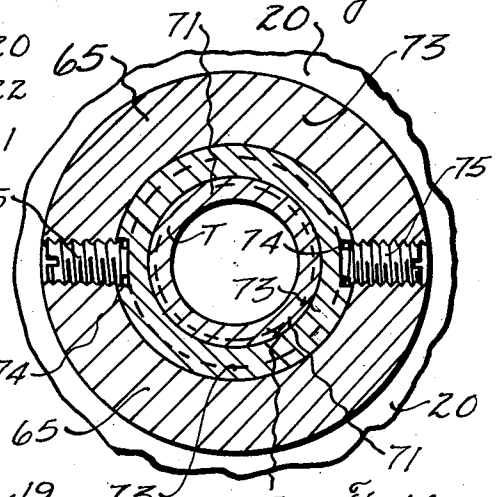

Fig. 14

Inventor
Herbert C. Otis

By

Attorney

Patented July 20, 1937 2,087,528

UNITED STATES PATENT OFFICE

2,087,528

WELL SEAL

Herbert C. Otis, Dallas, Tex.

Application September 3, 1935, Serial No. 38,862

9 Claims. (Cl. 166—15)

This invention relates to new and useful improvements in tubing and sealing wells.

One object of the invention is to provide an improved seal whereby tools, packers and the like may be introduced into, or removed from, a well which is under pressure, without opening up the well to the atmosphere.

Another object of the invention is to provide improved means for introducing or removing tubing and landing or removing a stuffing box where the casing contains well fluids under pressure, and in so doing without opening up the well to the atmosphere.

A further object of the invention is to provide improved means for inserting or removing tubing carrying a packer, into a well under pressure and also landing or removing a stuffing box for packing off the tubing, without rotating the tubing or opening the well to the atmosphere.

Still another object of the invention is to land or remove supporting slips associated with, but separate from, the stuffing box.

Another object of the invention is to provide an improved stuffing box having means whereby it may be fastened on a tubing and lowered, landed and screwed into a supporting fixture.

A further object of the invention is to provide equipment for running tubing and tools into a casing or removing the same therefrom, and packing off the tubing in a new and novel manner, said equipment being adapted to be removed after the tubing is packed off, all without opening the well to the atmosphere.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings in which an example of the invention is shown, and wherein:

Figure 1 is a view partly in elevation and partly in section showing an apparatus for carrying out the invention,

Figure 2 is a view partly in section and partly in elevation showing a stuffing box and slips on the tubing between the closures,

Figure 3 is a similar view showing the stuffing box landed,

Figure 4 is a view partly in section and partly in elevation showing the stuffing box and slips landed and the closure fixtures removed,

Figure 5 is a plan view of the parts shown in Figure 4,

Figures 6, 7 and 8 are horizontal cross-sectional views taken on their respective lines of Figure 4,

Figure 9 is an elevation of the upper end of the stuffing box,

Figure 10 is a view similar to Figure 1 showing equipment for landing the stuffing box when the tubing is supported by a packer,

Figure 11 is an enlarged view of a portion of the same,

Figure 12 is a view similar to Figure 4 showing a stuffing box which supports the tubing without the aid of slips,

Figure 13 is a plan view of the same, and

Figure 14 is a horizontal cross-sectional view taken on the line 14—14 of Figure 12.

In the drawings the numeral 15 designates a tubing head (Figure 4) having an internally screw-threaded collar 16 at its lower end adapted to receive the upper end of a well casing 17. At its mid-section the head has the usual internally screw-threaded outlets 18 receiving pipes 19 for carrying off fluids and liquids which flow up the casing.

The head also has an upstanding flange or collar 20 (Figure 4) provided with external screw threads 21 and internal screw threads 22. The flange is reduced in thickness toward its upper end, whereby the threaded portions are tapered. The head has an internal downwardly inclined annular seat or shoulder 24. It is to be noted that the head has a bore as large as the casing so that tools may be freely passed therethrough. A packing unit or stuffing box 25 has an externally screw-threaded pin 26 at its lower end adapted to screw into the flange 20 and engage the threads 22. The lower end of the pin may have a bevel 27 complementary to the seat 24 and where a very tight joint is desired the pin may be screwed down until the bevel engages the seat.

The stuffing box 25 may vary in structure so long as it will pack off a string of tubing and screw into the head 15. A satisfactory structure includes a smooth bore 28 having an annular inclined shoulder 29 at its lower end within the pin 26 and a reduced counter bore 30 is thereby formed below said shoulder. A metallic split packing ring 31 is beveled to rest on the shoulder 29 and loosely fits around a section of tubing T. A plurality of packing rings 32 (Figures 4 and 8) split or otherwise, or any suitable packing, are supported on the ring in the bore 28 so as to snugly embrace the tubing and pack off therearound. A split metallic follower ring 33 rests upon the uppermost packing ring.

The upper portion of the bore 28 is internally screw-threaded at 34 to receive an annular pack-

ing nut 35 having ample clearance around the tubing and screwed down to engage the ring 33, whereby the packing rings are compressed. The upper end of the box 25 has an enlarged counterbore 36 to provide clearance for the upper end of the nut. The upper end of the box is slightly tapered and provided with external screw threads 37. Horizontal openings or slots 38 in opposite sides of the upper end of the box gives access to the nut (Figures 4, 7 and 9). The nut has radial holes 39 for receiving a suitable tool (not shown) which may be inserted through one of the openings 38, whereby said nut may be rotated.

The upper edge 40 of the box is finished flat to form a rest for an annular slip housing 41. The housing has the usual inclined bore 42. A plurality of slips 43 are mounted in the bore and have teeth 44 engaging the tubing and supporting the latter. The slip housing may be placed upon and removed from the box when desired.

In Figure 1 I have shown an ordinary full-opening gate valve 45 screwed onto the flange 20 of the head 15 and engaging the threads 21. This gate valve is connected with a lower blowout preventer 46 by a casing-size nipple 47. The lower preventer supports an elongate casing-size nipple 48 onto the upper end of which is screwed an upper blowout preventer 49. These blowout preventers are now in common use in the oil fields and it is not considered necessary to describe them. When the preventers are opened, any tool, packer or other device which the casing 17 will accommodate may be passed through the elements 15, 45, 46, 47, 48 and 49.

Assuming that the casing 17 is filled with fluids or liquids under pressure and the gate valve 19 and preventers 46 and 49 are closed to maintain the pressure and it is desired to run the tubing T into the well, the valve 19 is kept closed. The preventers 46 and 49 are opened and the first section of tubing is passed down through said preventers and the nipples 47 and 48. The openings are large enough to pass a working barrel, tubing catcher or other tool which may be carried by the first or subsequent sections of the tubing.

After the tool or other device has passed through the upper preventer 49, the latter is closed around the tubing. The gate 19 is then opened and the tubing run down through the head 15 into the casing 17. When a coupling between two sections of tubing is introduced the lower preventer 46 may be closed and the upper preventer 49 is opened to permit passage of the coupling. When the coupling arrives in the nipple 48, the upper preventer is closed and the lower one opened to permit passage of the coupling.

When the last joint or section of tubing is picked up, the stuffing box 25 is sleeved over said section and the nut 35 (Figures 4 and 7) is tightened to compress the packing rings 32 around the tubing. The box is fastened on the tubing at the proper place by steel set screws 50 engaged in two of the holes 39 which are screw-threaded for this purpose. The heads of the screws project into the openings 38. If necessary an extra length of tubing is added.

After the coupling on the lower end of this section of tubing has been run into the casing as described, the upper preventer 49 is opened and the box 25 is lowered therethrough into the nipple 48, (Figures 1 and 2) the lower preventer being closed. The upper preventer is next closed and the lower one opened and the tubing lowered until the pin 26 of the stuffing box 25 enters the flange 20 of the head. By rotating the tubing the pin is screwed into the head and the box thus landed, as is shown in Figures 3 and 4. When the tubing is rotated the heads of the screws 50 engage the ends of the openings 38 and cause the box to rotate with the tubing.

While the slip housing 41 may be lowered with the box, it is convenient to sleeve it over the tubing after the box is landed. The fixtures 45 to 49 inclusive may now be removed leaving the structure as shown in Figure 4. It is obvious that in coming out of the well, after the fixtures are replaced, the order would be reversed, the valve 19 and lower preventer 46 being first opened while the upper preventer remains closed. After the box 25 or other tool is received in the nipple 48, the lower preventer 46 is closed and the upper preventer 49 is opened.

When a packer is carried by the tubing it is undesirable to rotate the tubing, therefore the stuffing box 25 must be landed without rotating the tubing T. In running in a packer it is necessary to snub the tubing and this may be done by fastening a cross head 51 on the upper preventer 49, as is shown in Figure 10, and providing it at its ends with sheaves 52. When the tubing is being run, cables 53 each having one end fastened to one side of a split collar 54, are passed under said sheaves and connected to a suitable snubbing apparatus. When a pull is exerted on the cables the collar 54 will be pulled down against the tubing coupling and the tubing forced into the well.

When the tubing has been run and it is desired to land the stuffing box 25, said box is sleeved over the tubing, but the screws 50 are omitted, and a bell nipple 55 is used instead. The tubing is supported entirely by the packer. This nipple is screwed into a collar 56 which in turn is screwed onto the threads 37 of the box as is shown in Figures 10 and 11. The upper end of said nipple is connected to the lower end of an oversize length of tubing 57 by a coupling 58. This tubing 57 is sleeved over the tubing T and another length 59 is connected thereto by a coupling 60.

With the tubing projecting as shown in Figure 10, the rams in the preventer 49 are changed to fit the oversize tubing 57. The snubbing collar 54 is applied and pulled down against the coupling 60, whereby the tubing 57 is forced down, whereby the box 25 is sleeved over the tubing T. When the box assembly arrives in the nipple 48, as is shown in Figure 10, the upper preventer 49 is closed against the tubing 57 and the lower preventer 46 is opened. The box is now forced down to the head 15 and screwed thereinto by rotating the tubing 57—59. This is accomplished without rotating the tubing T. After the fixtures 46 to 49 inclusive are removed the elements 55 to 60 are removed and the slip housing 41 may then be placed.

In Figures 12, 13 and 14, I have shown another form of stuffing box or packing unit 65. This box is adapted to support the tubing string so that the slip housing 41 will not be required. The box includes an externally screw-threaded pin 66 at its lower end adapted to engage in the threads 22 of the head 15. The box has an axial bore 67 extending upwardly from its bottom to an inclined shoulder 68, from which an enlarged counterbore 69 extends to the top of said box. The box has external screw threads 37' like the box 25.

This type head is preferably used with upset tubing T provided with an upset tapered pin 70 having its end screw-threaded. A split metallic ring 71 is beveled to rest upon the shoulder 68 and

supports a plurality of packing rings **72** in the bore **69** embracing the smooth outer surface of the pin **70**. A coupling sleeve or nut **73** is screwed onto the pin **70** and is carried by the packing rings, whereby the tubing is supported.

The sleeve **73** extends above the box to receive the next joint of tubing T. Retaining screws **75**, mounted horizontally in the top of the box, engage in vertical slots in the sleeve. These screws do not bind the sleeve and while holding it against rotation, permit it to freely move vertically.

In using the packing unit shown in Figures 12, 13 and 14, the stuffing box **65** is sleeved onto the section of tubing T and the coupling **73** is screwed onto the pin **70** so as to rest upon the upper packing ring **72**. The set screws **75** are then inserted and their inner ends extended into the grooves **74**. An extra section of tubing **76** is screwed into the coupling **73** and the lowering of the tubing into the well continued. The box **65** is passed through the closures **49** and **46** and the pin **66** of said box is spotted in the flange **20** of the head **15**. The box is then landed and the job completed as in Figures 1 to 9 inclusive.

What I claim and desire to secure by Letters Patent is:

1. A well seal including in combination, a casing, a tubing head having a fluid-tight connection with the casing, a packing unit having a fluid-tight connection with the head, and a packing within the unit for sealing off the tubing and the unit to retain a pressure in the casing and head, the head having external screw threads at its top for receiving a fixture, the packing unit having external threads at its top for receiving a fixture.

2. A well seal including in combination, a casing, a tubing head having a fluid-tight connection with the casing, a packing unit having a fluid-tight connection with the head, a packing within the unit for sealing off the tubing and the unit to retain a pressure in the casing and head, the head having external screw threads at its top for receiving a fixture, the packing unit having external threads at its top for receiving a fixture, and a slip housing resting on the packing unit and having slips therein for gripping the tubing.

3. A well seal including in combination, a casing, a tubing head having a depending collar screwed onto the casing and provided with an upstanding annular flange internally and externally screwthreaded, a packing unit externally screwthreaded at its top and bottom and having its bottom screwed into the flange of the head, and a packing supported in the unit for sealing off the tubing and the unit, the external threads of the head and the unit being adapted to receive fixtures.

4. A well seal including in combination, a casing, a tubing head having a depending collar screwed onto the casing and provided with an upstanding annular flange internally and externally screwthreaded, a packing unit externally screwthreaded at its top and bottom and having its bottom screwed into the flange of the head, a packing supported in the unit for sealing off the tubing and the unit, the external threads of the head and the unit being adapted to receive fixtures, and a slip housing resting on the packing unit and having slips therein for gripping the tubing.

5. A well sealing packing unit including, an elongated tubular member having external screw threads at its top and bottom, packing elements supported within the tubular member, a packing nut screwthreaded into the upper end of the member, and set screws mounted in the nut for fastening it to a tubing, the tubular member having side openings in its upper end for receiving said set screws for giving access to said screws and also for causing rotation of the tubular member when said nut is rotated.

6. A well sealing apparatus including, a tubing head having internal screw threads, a packing unit having external screw threads at its upper and lower ends and internal packing means, a bell nipple connected with the upper threads of the unit, and an oversize tubing attached to nipple, said unit and nipple and oversize tubing being adapted to sleeve over a tubing extending through said head, whereby the threads on the lower end of said unit may be screwed into the head without rotating the tubing.

7. The combination with tubing having partially threaded pins at its ends, of a stuffing box having an externally screwthreaded pin at its lower end for screwing into a head, a metallic ring supported in the box, packing rings fitting the tubing and carried by said supporting ring, said packing rings embracing the pin at one end of a section of tubing, a coupling screwed onto said pin and having an upright groove, said coupling resting on the packing rings for hanging the tubing, and a set screw carried by the box and extending into the groove of the coupling to cause the box to rotate when the coupling is rotated and permitting said coupling to undergo vertical movement.

8. A well seal including in combination, a casing, a tubing head mounted on the casing, means on the upper portion of the tubing head for removably mounting and fastening a well closure fixture on the exterior of said head of such size as to permit a stuffing box to pass therethrough, means in the tubing head for landing and securely fastening a stuffing box in said head against upward displacement by the pressure of the well, a trapping enclosure removably carried by the closure fixture and coacting with the closure fixture to pass the stuffing box therethrough with substantially no loss of well pressure, and means for rotating said stuffing box to fasten it in the tubing head.

9. A well seal including in combination, a casing, a tubing head having a fluid-tight connection with the casing, a packing unit having a fluid-tight connection with the tubing head, a packing within the unit for sealing off the tubing and the unit to retain a pressure in the casing and tubing head, the head having external means at its upper portion for removably mounting a well fixture thereon, the packing unit having external screw threads at its upper portion for receiving a well device.

HERBERT C. OTIS.