June 1, 1943. J. W. MacCLATCHIE 2,320,974

BLOWOUT PREVENTER

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Fig. 1.

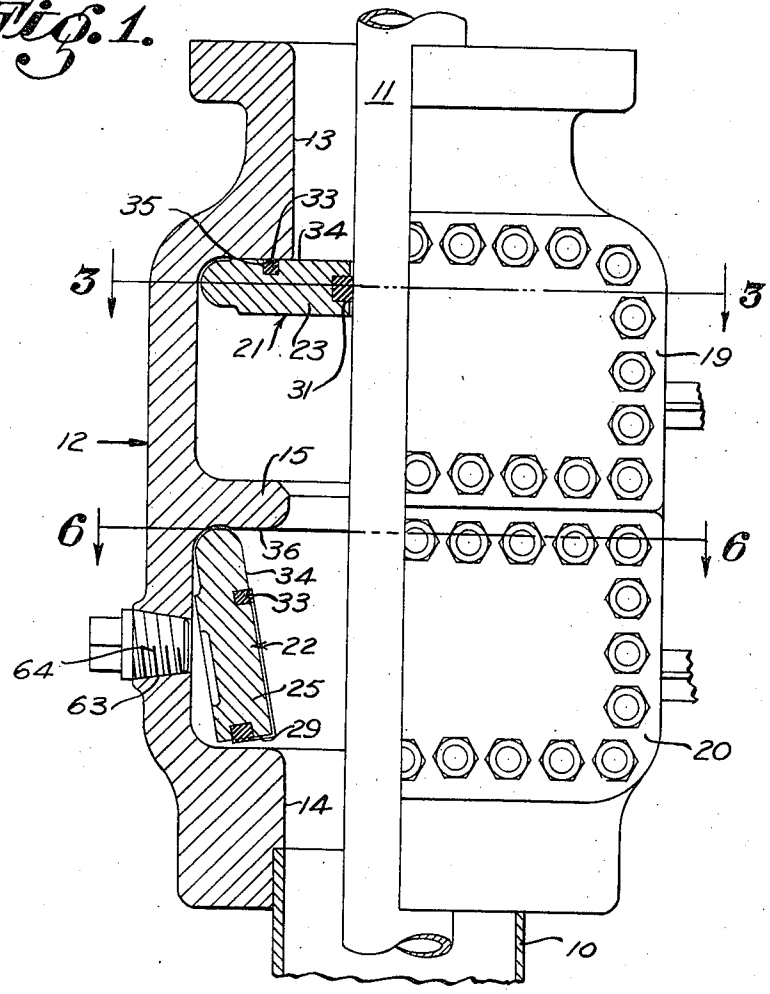
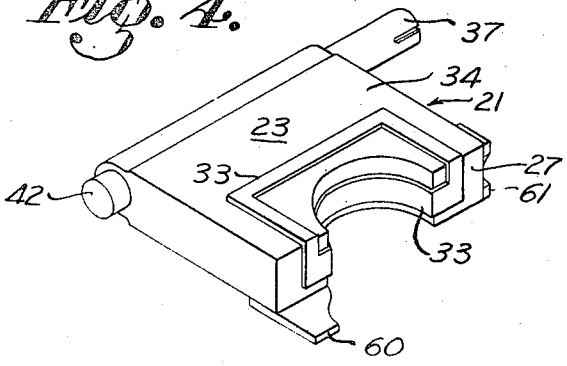


Fig. 4.



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Fig. 2.

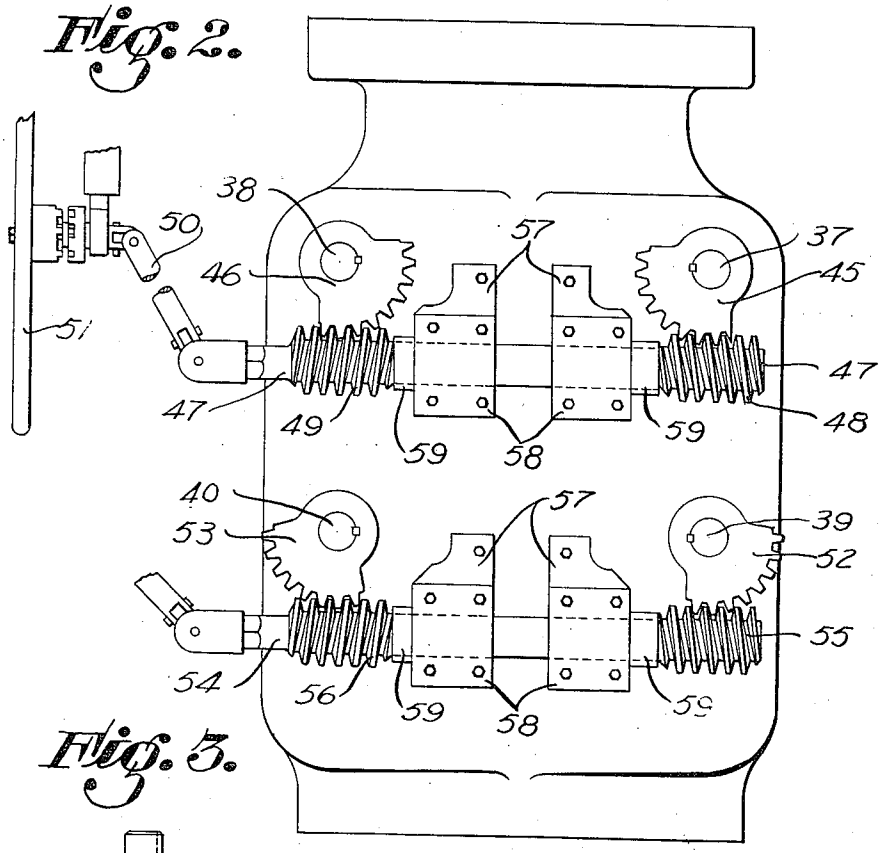
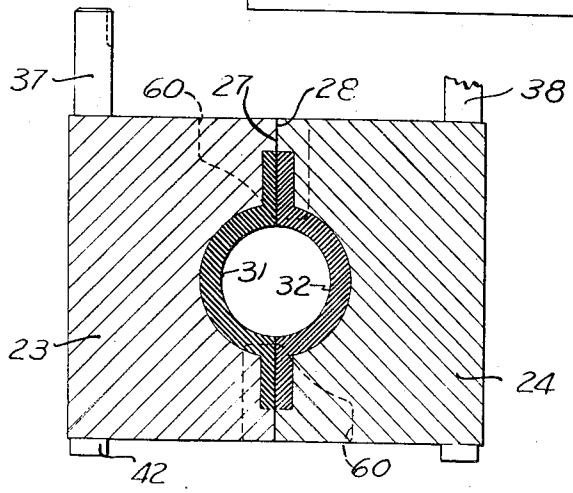


Fig. 3.



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BLOWOUT PREVENTER

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Fig. 5.

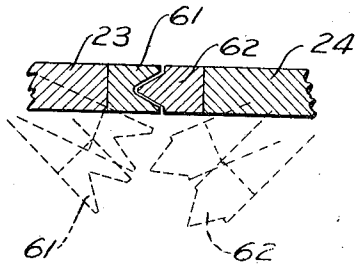
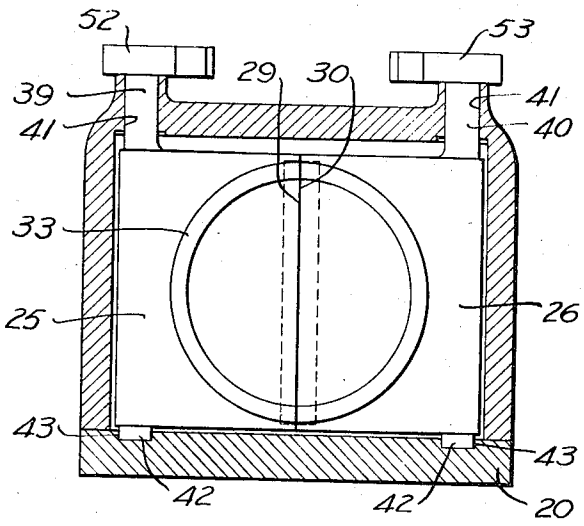


Fig. 6.



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Fig. 7.

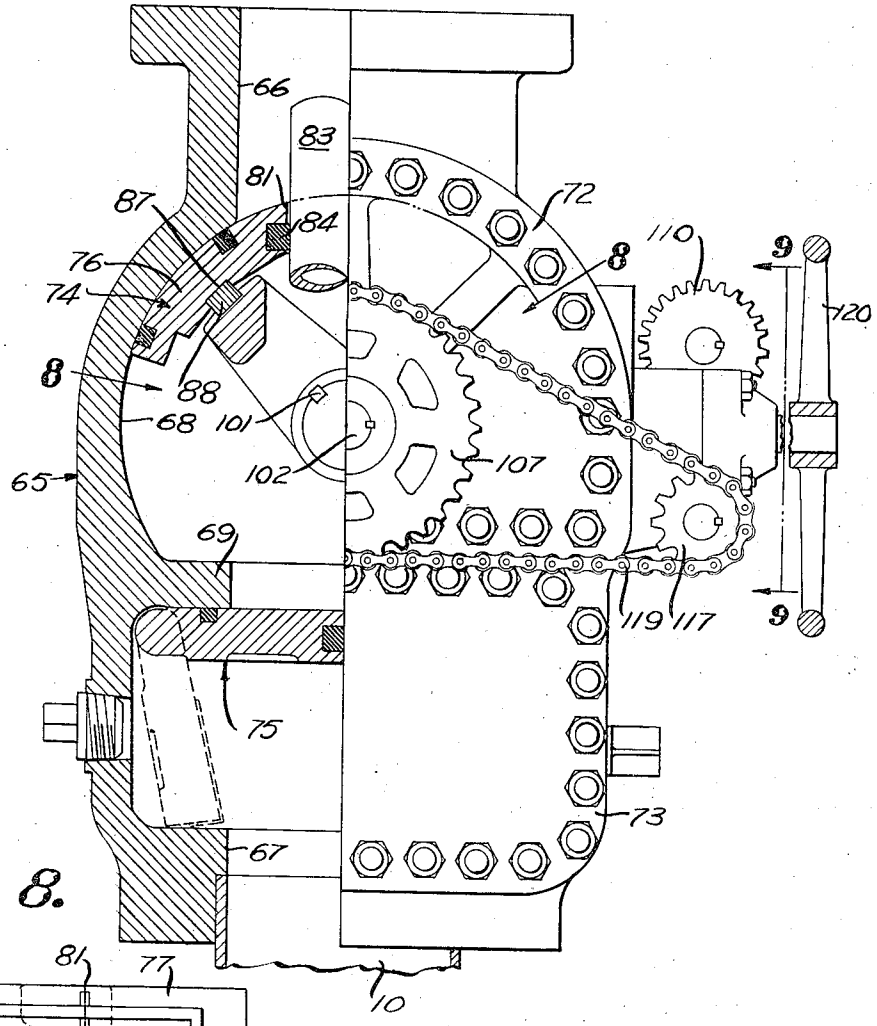
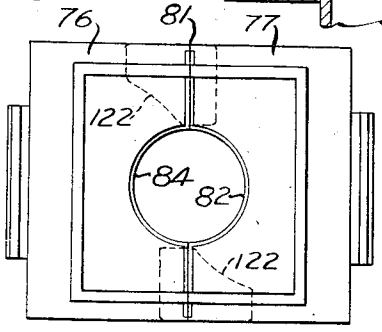


Fig. 8.



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Fig. 9.

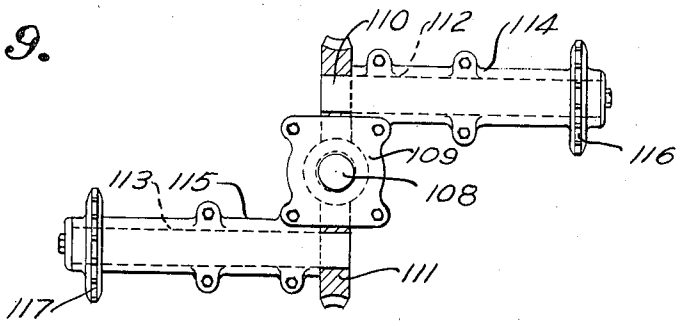
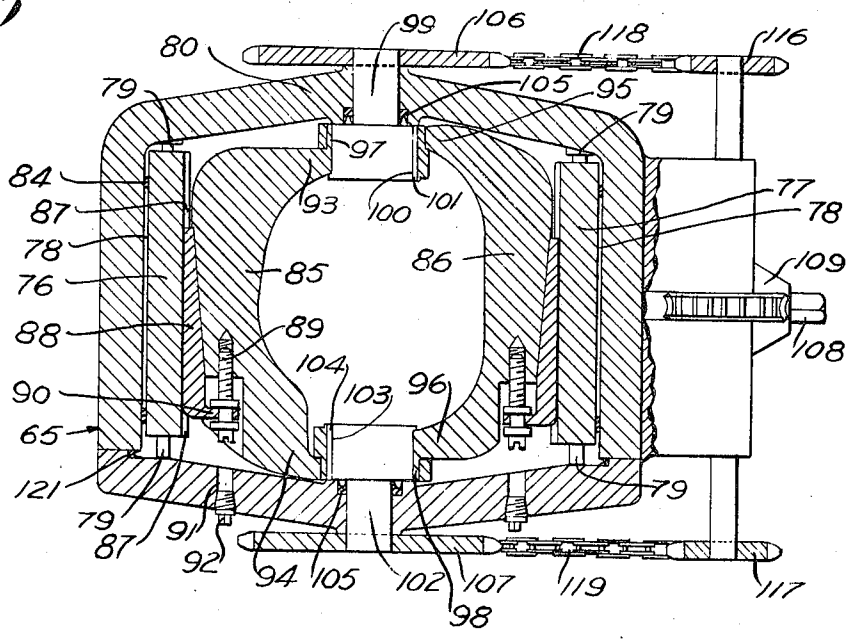


Fig. 10.



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Patented June 1, 1943 2,320,974

UNITED STATES PATENT OFFICE

2,320,974

BLOWOUT PREVENTER

John W. MacClatchie, Los Angeles, Calif., assignor to MacClatchie Manufacturing Company of California, Compton, Calif., a corporation of California

Application August 18, 1941, Serial No. 407,345

2 Claims. (Cl. 251—18)

This invention relates to a blowout preventer for wells of the type shown in my Patent No. 2,159,540, granted May 23, 1939.

One of the objects of my invention is to provide a blowout preventer with two closure members, one closure member being adapted to be operated when a well string is in the well, and another closure member being adapted to be operated when there is no well string in the well.

Another object of my invention is to provide a blowout preventer with closure members, said closure members comprising cooperating elements.

Another object of my invention is to provide a blowout preventer with closure members comprising cooperating elements in which means are provided to insure the simultaneous closing of the cooperating elements.

Another object of my invention is to provide a blowout preventer in which pressure from the well tends to close and seal the closure member with the housing, both in the instance in which a well string is in the well, and in the instance in which no well string is in the well.

Another object of my invention is to provide a blowout preventer in which all of the operating mechanism is on the outside of the housing so that the operating mechanism cannot become sanded or otherwise contaminated.

Another object of my invention is to provide a blowout preventer in which all of the parts are readily and easily accessible, and can be readily changed.

Another object of my invention is to provide a blowout preventer in which means are provided to adjust the pressure of the cooperating closure elements against the housing.

Another object of my invention is to provide a blowout preventer which requires a minimum of space to occupy and operate.

My invention has many other objects, advantages, and features, some of which, with the foregoing, will be set forth in the following description where I shall outline two forms of my invention, which I have selected for illustration in the drawings accompanying and forming a part of the present specification.

Referring to the drawings:

Figure 1 is a side elevation of one form of my invention, partly in axial section, showing the upper closure member in closed position around a well string.

Figure 2 is a side elevation of the opposite side of the device shown in Figure 1.

Figure 3 is a view taken on the line 3—3 of Figure 1.

Figure 4 is an isometric view of one of the cooperating elements of the upper closure member.

Figure 5 is an enlarged fragmentary view of the means to insure proper closing of the closure members.

Figure 6 is a view taken on the line 6—6 of Figure 1.

Figure 7 is a side elevation of another form of my invention, partly in axial section, showing the upper closure member in closed position around a well string.

Figure 8 is a view taken on the line 8—8 of Figure 7.

Figure 9 is a view taken from the right of Figure 7, showing the means for operating the upper closure member.

Figure 10 is a view, partly in section, showing the upper closure member in open position.

The blowout preventer is adapted for use in connection with a usual well structure which includes a well casing 10 adapted to receive a drill string or production tubing, shown in the present instance as well string 11.

A housing 12 is mounted on the casing 10 and has upper and lower openings 13, 14, concentric with the bore of the casing. Transversely of the axis of the casing 10 the housing is substantially rectangular in form, with an inwardly extending flange 15 medial of the height of the housing. The flange 15 extends around the housing near the sides of said housing but does not extend into the center of said housing. One side of the housing is open and is adapted to be closed by an upper plate 19 and a lower plate 20.

Closure member 21 is provided in the housing to close and seal off the housing 12 from the well with a well string passing through the housing into the well bore, and closure member 22 is provided to close and seal off the housing from the well in the instance in which no well string passes through the housing 12.

As an instance of this arrangement, the closure members 21 and 22 comprise cooperating elements or swinging doors 23 and 24, and 25 and 26, respectively. The cooperating elements 23, 24, 25 and 26 may be substantially rectangular in form, with cooperating abutment surfaces 27, 28, 29 and 30, respectively. The cooperating abutment surfaces are of appreciable area and adapted for area contact. The abutment surfaces 27 and 28 are provided with semi-circular recesses 31 and 32, respectively, in their medial portions so that when the surfaces 27 and 28 abut as shown in Figure 3, the cooperating elements 23 and 24 completely close and seal off the well except for the restricted bore which is defined by the cooperating medial recesses 31 and 32. The restricted bore is concentric with the openings 13 and 14 and is of a diameter to snugly receive the well string 11.

As shown in Figure 4, packing 33 is provided on the abutting surfaces 27, 28, 29, and 30 and on the upper surfaces 34 of the cooperating ele-

ments, said packing being preferably mounted in grooves in the cooperating elements. The packing 33 on the upper surfaces 34 of the cooperating elements 23 and 24 is adapted to seal against the inner wall of the housing as indicated at 35 and the packing 33 on the upper surfaces 34 of the cooperating elements 25 and 26 is adapted to seal against the lower surface 36 of the flange 15.

The cooperating elements 23 and 24, are adapted for simultaneous swinging movement in the housing 12 to either open or closed position. The cooperating elements 25 and 26 are also adapted for simultaneous swinging movement to either open or closed position.

As an instance of this arrangement, the cooperating elements 23, 24, 25 and 26 are provided with shafts 37, 38, 39, and 40, respectively, and are preferably made integral with said shafts. Openings 41 are provided in the walls of said housing to accommodate said shafts. The opposite ends of said cooperating elements are provided with stub shafts 42 which are received in circular recesses 43 in the upper and lower plates 19 and 20. As shown in Figure 2, the shafts 37, and 38 are keyed to worm segments 45 and 46 respectively, which segments mesh with worm shaft 47. The teeth 48 of the worm shaft 47 which mesh with the teeth of the worm segment 45 are threaded in the opposite direction to the teeth 49 of the worm shaft 47 which mesh with the teeth of the worm segment 46. The shaft 47 may be extended by a flexible shaft 50 to a point remote from the blowout preventer, and may be rotated by a hand wheel 51 which has preferably a clutch engagement with the shaft 47 or by any other suitable manual or power means. The clutch is normally disengaged, and in order to manually actuate the driving connection the hand wheel 51 is first axially shifted to engage the clutch and is then selectively rotated in either of reverse directions so as to simultaneously swing the cooperating elements 23 and 24 in either of reverse directions.

In a like manner the shafts 39 and 40 are keyed to worm segments 52 and 53 respectively, which segments mesh with worm shaft 54. The teeth 55 of the worm shaft 54 which mesh with the teeth of the worm segment 52 are threaded in the opposite direction to the teeth 56 of the worm shaft 54 which mesh with the teeth of the worm segment 53. The shaft 54 may be extended and operated in a manner similar to the extension and operation of the worm shaft 47.

The worm shafts 47 and 54 may be mounted on the outside of the housing 12 by means of bearing blocks 57, bearing caps 58, and shaft bushings 59.

Means may also be provided to center the well string 11 in the housing 12, for example, centering plates 60.

Means may also be provided to insure the simultaneous closing of the cooperating elements. As an instance of this arrangement and as shown in Figure 5, the cooperating elements 23 and 25 may be provided with grooves 61 and the cooperating elements 24 and 26 may be provided with tongues 62.

The housing 12 may also be provided with a large threaded opening 63 for drainage purposes which opening is adapted to receive a plug 64.

It will be noted that the construction of the device is such that it is adapted to be readily and quickly assembled and disassembled. The assembly of the device may be as follows:

The packing 33 is inserted in the grooves of the cooperating elements 23, 24, 25 and 26. The shafts of the elements are then inserted in the openings 41 with the elements in open position. The plates 19 and 20 are secured to the housing 12 after the stub shafts 42 are positioned in the recesses 43. The worm segments 45, 46, 52 and 53 are then placed over and secured to the shafts 37, 38, 39 and 40, respectively by means of keys or any other convenient means.

The operation of the device may be as follows:

During normal operations, the cooperating elements 23, 24, 25 and 26 are in open or inoperative position. When it is desired to seal off the housing from the well with a well string in the well, the worm shaft 47 is rotated, thereby rotating the worm segments 45 and 46, the shafts 37 and 38, and swinging the doors 23 and 24 to closed position. The centering plates 60 center the well string in the housing and the simultaneous closing of the elements 23 and 24 is insured by the tongue 62 engaging the groove 61, as the elements 23 and 24 swing to closed position.

When it is desired to open the closure member 21, the shaft 47 is rotated in the opposite direction, thereby swinging the doors 23 and 24 to open position.

When it is desired to seal off the housing from the well when no well string is in the well, the closure member 22 is moved to closed position. The operations in opening and closing the closure member 22 are similar to the operations in opening and closing the closure member 21, and will therefore not be set forth herein.

Another advantage of my invention is the speed with which the closure members 21 and 22 can be operated or closed in that it only takes a few seconds to effect either operation.

It will be readily seen that the cooperating members 23, 24, 25 and 26 are adapted for free swinging movement in the housing 12. By "free" swinging movement," I mean movement in which the moving parts are not in contact with any other part whatever during the period of movement.

It will also be seen that any subterranean pressure from the well would tend to move the cooperating elements to closed position and to tighten the sealing engagement of said elements with the housing after said elements are moved to closed position.

Another advantage of my invention is that it is adapted to be readily and quickly changed to seal off the housing from the well with a different size of well string in the well than the size of the well string 11. The worm segments 45 and 46 are removed from the shafts 37 and 38 respectively, after which the upper plate 19 and the cooperating elements 23 and 24 are removed. Other cooperating elements similar to the cooperating elements 23 and 24 but differing therefrom in having cooperating medial recesses 31 and 32 of a diameter to snugly receive the new well string are mounted in the housing.

In the modification of my invention shown in Figures 7–10 inclusive, housing 65 is mounted on the casing 10 and has upper and lower openings 66, 67, concentric with the bore of the casing. Transversely of the axis of the casing 10 the upper inner portion is semi-cylindrical in form as indicated at 68, and the lower inner portion may be similar to the lower inner portion of the form

of my invention shown in Figures 1–6 inclusive. The housing 65 is provided with an inwardly extending flange 69 around the edge of the housing. One side of the housing is open and is adapted to be closed by an upper plate 72 and a lower plate 73.

Closure member 74 is provided in the housing to seal off the housing 65 from the well with a well string passing through the housing into the well and closure member 75 is provided to close and seal off the housing from the well in the instance in which no well string passes through the housing 65.

As an instance of this arrangement, the closure member 74 may comprise cooperating elements 76 and 77 which are arcs of a circle, these closure plates being journaled in the housing 65 on opposite sides of the axis of the openings 66 and 67, with the outer peripheral bearing surfaces 78 of the arcuate cooperating elements 76 and 77 concentric with the semi-cylindrical portion 68, and with the ends 79 of the arcuate cooperating elements 76 and 77 preferably bearing against arcuate guides on the end 80 of the housing 65 and on the upper plate 72 as shown in Figure 10. Packing is provided between the housing 65 and the plate 72 in order to seal the housing.

The abutment surfaces of the arcuate cooperating elements 76 and 77 are shown at 81, and are of appreciable area and extend radially of the semi-cylindrical portion 68 so that when the elements 76 and 77 are swung to their operative position shown at Figs. 7 and 8 the surfaces 81 abut throughout their entire areas and with said abutment at the axis of the opening 66 and 67.

The top surfaces 81 are semi-cylindrically recessed medially of their length, and are flat surfaces beyond these medial recesses, so that when the surfaces 81 abut as shown at Fig. 8 the elements 76 and 77 completely close the opening 66 except for a restricted bore which is defined by the cooperating medial recesses. The restricted bore 82 is concentric with the openings 66 and 67 and is of a diameter to snugly receive the well string 83.

When the cooperating elements 76—77 thus close the opening 66 as shown in Figure 8, they seal around said opening and around the well string 83 which extends through the bore 82. For this purpose packing 84 is provided as shown in Figures 7 and 8, which packing is preferably mounted in grooves in the cooperating elements 76, 77.

When the cooperating elements 76, 77, are in the operative position shown in Figures 7 and 8, the packing strips 84 seal completely around the opening 66, the cooperating abutment surfaces 81, the surface 68, and completely around the well string 83.

The cooperating elements 76, 77 are adapted for simultaneous swinging movement in the semi-cylindrical portion 68 to either their inoperative position shown in dotted lines in Figure 7 or to their operative position shown in Figures 7 and 8. For this purpose cranks 85 and 86 may be journaled in the housing 65 concentric with the axis thereof, with the shafts of the cranks preferably projecting outwardly beyond the respective end 80 of the housing 65 and the upper plate 72. The cranks 85 and 86 are adjustably connected to the cooperating elements 76 and 77 respectively in order to adjust the pressure of the bearing surfaces 78 of the cooperating elements 76 and 77 against the bearing surface of the semi-cylindrical portion 68, in order to compensate for wear, etc. As an instance of this arrangement, the cooperating elements 76, 77 may be provided with slots 87, and gib keys 88 mounted in said slots. Adjustment bolts 89 may be inserted through the gibs 90 of the gib keys 88 and are adapted to adjust the pressure of the bearing surfaces 78 against the bearing surfaces of the semi-cylindrical portion 68. The housing 65 is provided with threaded openings 91 and threaded plugs 92 which plugs may be removed in order to insert a tool into the housing to contact the heads of the adjustment bolts 89 in order to effect any adjustment which may be advisable.

As shown at Fig. 10 the throws of the cranks 85 and 86 are of such dimensions as to clear the prolongation of the openings 66, 67 when the cooperating elements 76, 77 are in their inoperative position, and clear the well string 83 and its coupling collars when said cooperating elements 76, 77 are swung to their operative position as shown in Figure 7.

As shown at Figure 10, the throws of the cranks 85 and 86 are offset from one another longitudinally of the semi-cylindrical portion 68. The cranks 85 and 86 are provided with arms 93 and 94 and 95 and 96, respectively. The arms 93 and 96 are provided with bearing extensions 97 and 98 respectively. The ends of said arms and the bearing extensions 97 and 98 are each provided with cylindrical bores. The bearing extensions 97 and 98 are inside of the arms 95 and 94 respectively. A stub shaft 99 provided with a slot 100 is inserted in the bore of the arm 93 and the bearing extension 97 and secured to said arm and bearing extension by means of a key 101 and then journaled in the end 80 of the housing 65. A stub shaft 102 provided with a slot 103 is inserted in the bore of the arm 96 and the bearing extension 98 and secured to said arm and bearing extension by means of a key 104 and then journaled in the upper plate 72. In order to seal the housing 65 where the crank shafts project outwardly through the end 80 and the upper plate 72, packing 105 is provided in the end 80 and the upper plate 72 at the bearings for the stub shafts 99 and 102. The packing 105 is preferably hydraulic packing operatively expanded by pressure in the housing 65.

The cranks 85 and 86 are adapted for simultaneous opposite oscillation whereby they may be selectively swung to either operative or inoperative position, and for this purpose driving connections which preferably have a common drive, are adapted to respectively engage the projecting crank shafts 99 and 102. As an instance of this arrangement large sprockets 106 and 107 are mounted on the stub shafts 99 and 102 respectively. Mounted on one of the sides of the housing adjacent to the open side, is a worm shaft 108 mounted in a center cap 109 which worm meshes with worm wheels 110 and 111. The worm wheels 110 and 111 are secured on lay shafts 112 and 113 which are secured in housings 114 and 115. Small sprockets 116 and 117 are also secured on said lay shafts 112 and 113. The sprockets 106 and 116 and 107 and 117 are connected together by chains 118 and 119, respectively. The common shaft 108 may be extended by a flexible shaft (not shown) to a point remote from the blowout preventer, and may be rotated by a hand wheel 120 which has preferably a clutch engagement with the shaft 108 or by any other suitable manual or power means.

Rotation of the shaft 108 thus simultaneously swings the cranks 85 and 86 in opposite directions, and by reversing the direction of rotation of the shaft 108, the cranks 85 and 86 may be swung in either of reverse directions, in other words, to move the cooperating elements 76, 77 to either operative or inoperative position.

The assembly of the member 74 may be as follows:

The packing 84 is placed in the grooves of the cooperating elements 76 and 77. The cranks 85 and 86 are moved with respect to each other so that the bearing extensions 97 and 98 are inside of the arms 95 and 94 respectively as shown in Figure 10. The stub shafts 93 and 102 are then inserted through the bores of the arm 93 and extension bearing 97 and of the arm 96 and the extension bearing 98, respectively. The packing 105 in the end wall 89 is placed in position. The cranks 85 and 86 are then moved into position in the housing 65 and the shaft 99 inserted through the bore in the end wall 89 of said housing. The cooperating elements 76 and 77 are then secured to the cranks 85 and 86 respectively, by means of the gib keys 88 mounted in the slots 87 and the adjustment bolts 89. The proper adjustment is then made by means of said adjustment bolts.

The packing 105 around the bore through the upper plate 72 and packing 121 adapted to seal off between the housing 65 and the upper plate 72 are then placed in position. The upper plate is raised into position so that the shaft 102 extends through the bore in said plate which is provided for that purpose and said plate is then secured to the housing 65. The large sprockets 106 and 107 are mounted on the shafts 99 and 102 respectively. The sprockets 106 and 116 and 107 and 117 are connected together by means of the chains 118 and 119 respectively.

The construction, assembly, and means for operating the closure member 75 may be similar to the construction, assembly and means for operating the closure member 22 and will therefore not be set forth herein.

The operation of the device may be as follows:

During normal drilling operations the cooperating elements 76, 77, 25 and 26 are in open or inoperative position. When it is desired to seal off the housing from the well with a well string in the well, the worm shaft 103 is rotated, thereby rotating the worm wheels 110, 111, lay shafts 112 and 113, small sprockets 116 and 117, large sprockets 106 and 107 which are connected to small sprockets 116 and 117 by means of chains 118 and 119, and stub shafts 99 and 102, thereby swinging the cooperating elements 76 and 77 to closed position. Centering plates 122 center the well string in the housing as the cooperating elements 76 and 77 swing to closed position.

When it is desired to open the closure member 74, the shaft 108 is rotated in the opposite direction until the cooperating elements 76, 77, have been moved to open position.

When it is desired to seal off the housing from the well when no well string is in the well the closure member 75 is moved to closed position. As an instance of this operation, the worm shaft 54 is rotated thereby rotating the worm segments 52 and 53 and the shafts 39 and 40, and swinging the doors 25 and 26 to closed position. The simultaneous closing of the elements 25 and 26 is insured by the tongue 62 engaging the groove 61.

When it is desired to open the closure member 75, the shaft 54 is rotated in the opposite direction, thereby swinging the doors 25 and 26 to open position.

It only takes a few seconds to operate the closure members 74 and 75. Another advantage of my invention is that the cooperating elements 76, 77 are adapted to be readily and quickly changed to seal off the housing from the well with a different size of well string in the well than the size of the well string 83.

The cooperating elements 76 and 77 are replaced by cooperating elements similar to the cooperating elements 76, 77 but differing therefrom in having cooperating medial recesses of a diameter to snugly receive the new well string.

From the foregoing description taken in connection with the accompanying drawings, the construction, operation, uses and advantages of my invention will be readily understood by those skilled in the art to which the invention appertains. While I have described the forms of my invention which I now consider to be the best embodiments thereof, I desire to have it understood that the forms shown are merely illustrative and that the invention is not to be limited to the details disclosed herein, but is to be accorded the full scope of the appended claims.

I claim:

1. In a blowout preventer, a housing having a passageway therethrough adapted to communicate with a well bore, a pair of shafts extending into said housing, a pair of closure elements in said housing mounted on said shafts for movement into said passageway, said elements having surfaces thereon for engaging the wall of the housing to seal therewith and abutment surfaces adapted to contact each other to form a seal when said closure elements are moved into said passageway, said abutment surfaces having complementary recesses for receiving an object extending through said passageway and forming a seal therewith, cam like centering members carried by said closure elements offset from said abutment surfaces and arranged to engage the object extending through said passageway and move it into alignment with said recesses as said closure elements move into contacting position.

2. In a blowout preventer, a housing having a passageway therethrough communicating with a well bore, a pair of shafts extending into said housing, closure means for said passageway comprising cooperating elements mounted on said shafts for movement into said passageway, said cooperating elements having abutment surfaces adapted to contact each other to form a seal between said cooperating elements when said cooperating elements are in said passageway, said abutment surfaces having complementary recesses defining an opening through said closure means when said cooperating elements are in sealing position, the surfaces of said recesses being formed to engage and provide sealing contact with a well string extending through said passageway, said cooperating elements being provided with cam members offset from said abutment surfaces and operative to center the well string in said opening during closing of said closure means, and means associated with said shafts exterior of said housing for simultaneously oscillating said cooperating elements to open or close said closure means.

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