

April 23, 1929.

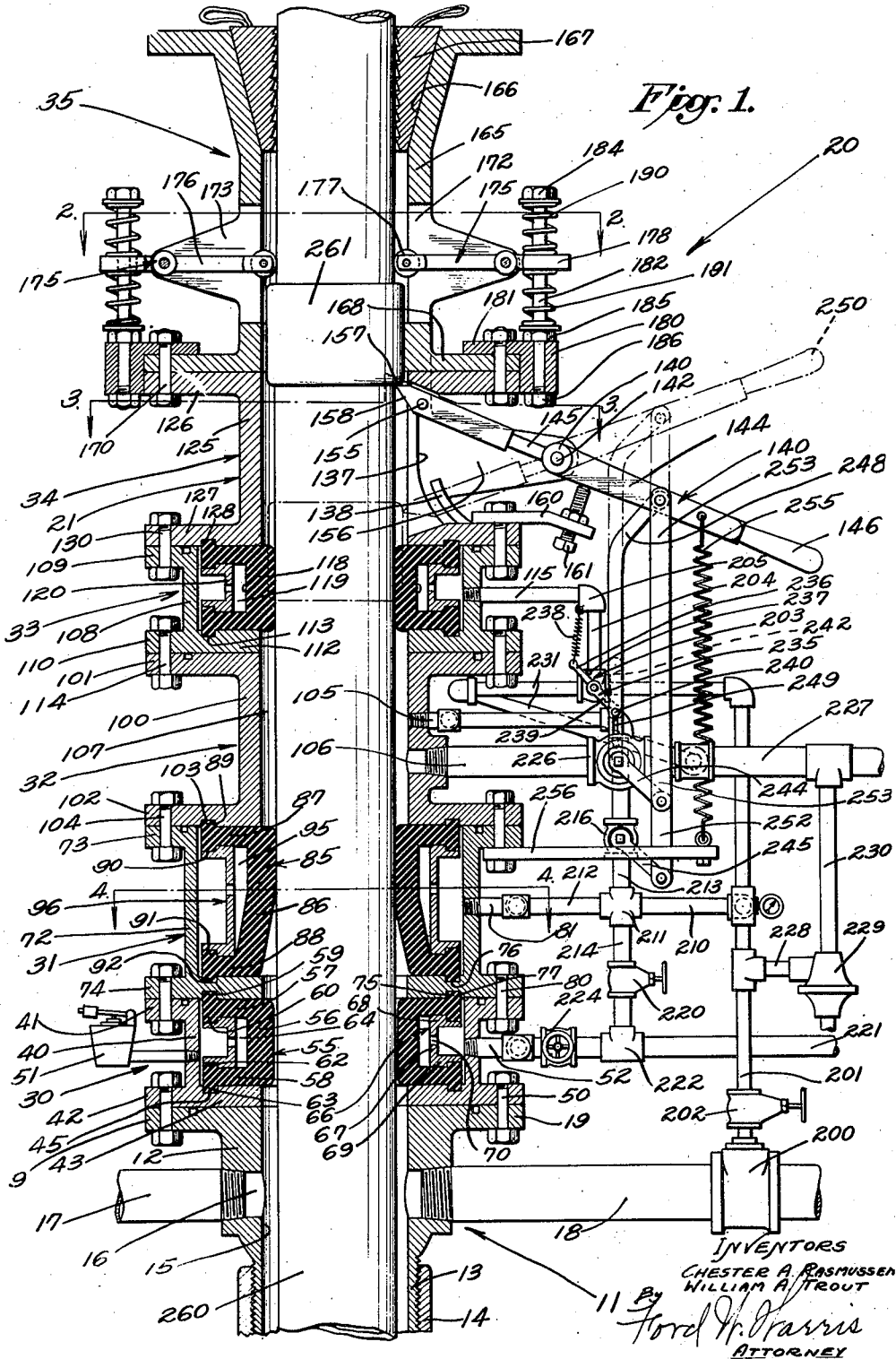
C. A. RASMUSSEN ET AL

1,709,949

AUTOMATIC SEAL CONTROL BLOW-OUT PREVENTER

Filed Oct. 11, 1927

5 Sheets-Sheet 1



April 23, 1929.

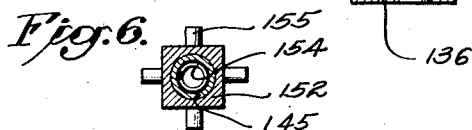
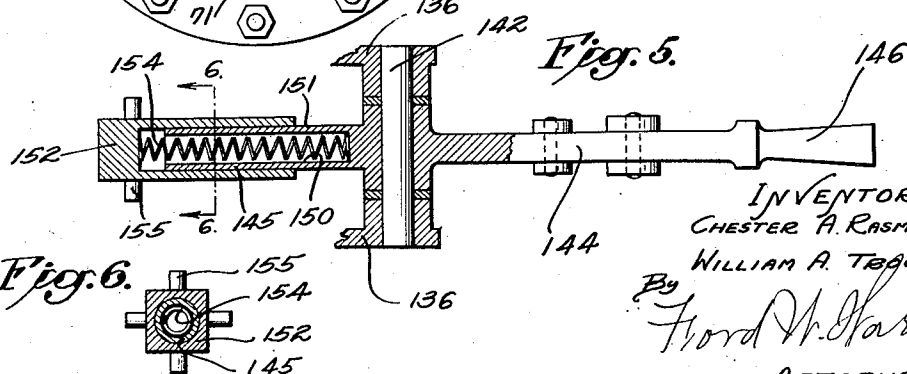
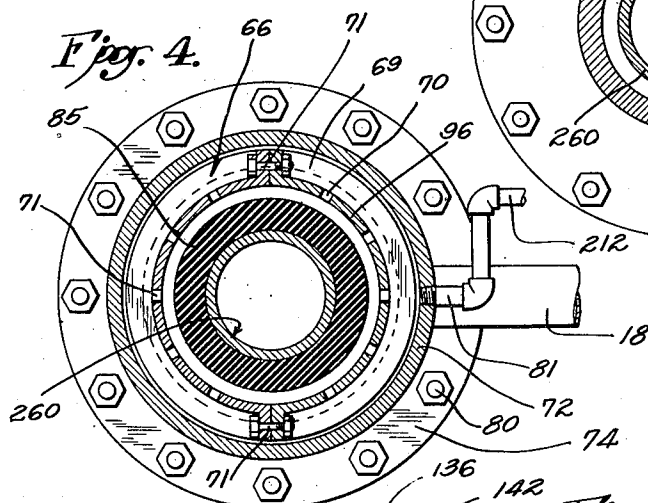
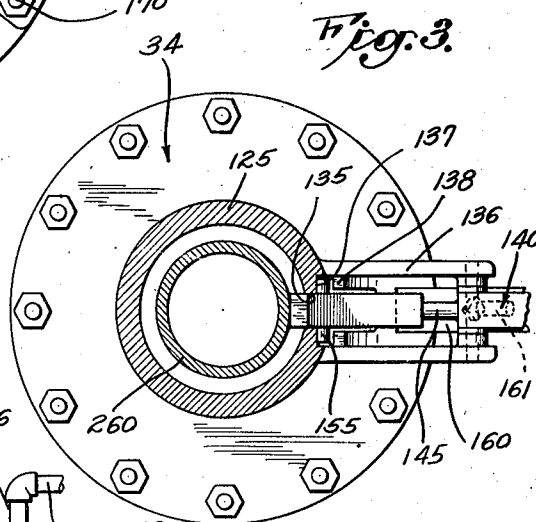
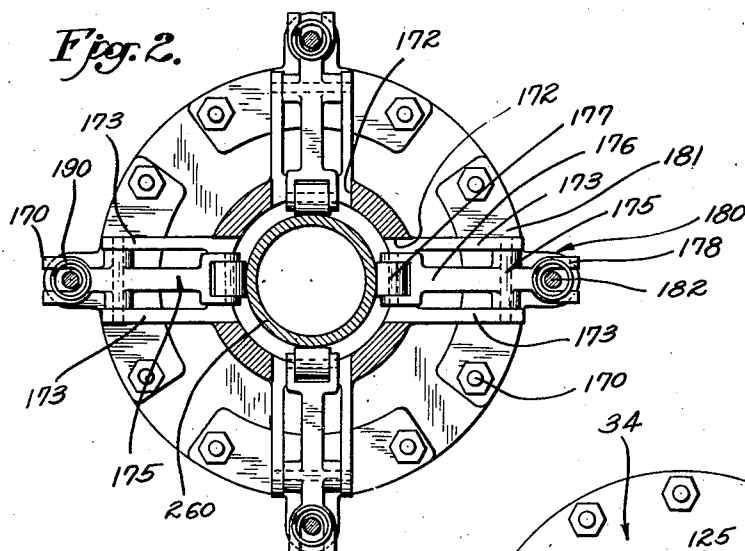
C. A. RASMUSSEN ET AL

1,709,949

AUTOMATIC SEAL CONTROL BLOW-OUT PREVENTER

Filed Oct. 11, 1927

5 Sheets-Sheet 2



INVENTORS
CHESTER A. RASMUSSEN
WILLIAM A. TROUT

By *Flord W. Harris*
ATTORNEY

April 23, 1929.

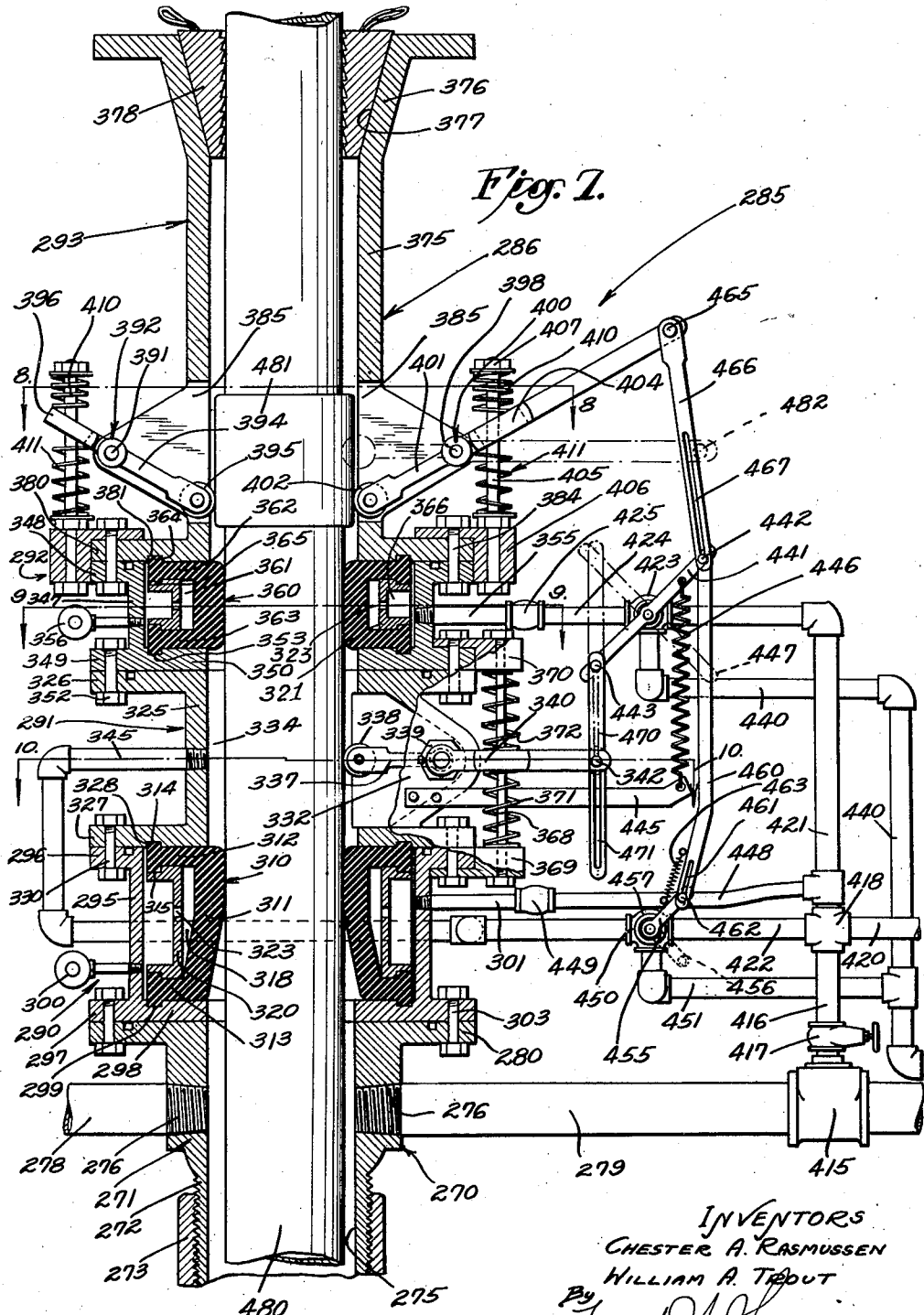
C. A. RASMUSSEN ET AL

1,709,949

AUTOMATIC SEAL CONTROL BLOW-OUT PREVENTER

Filed Oct. 11, 1927

5 Sheets-Sheet 3



INVENTORS
CHESTER A. RASMUSSEN
WILLIAM A. TROUT
By *Thorvald V. Harris*
ATTORNEY

April 23, 1929.

C. A. RASMUSSEN ET AL

1,709,949

AUTOMATIC SEAL CONTROL BLOW-OUT PREVENTER

Filed Oct. 11, 1927

5 Sheets-Sheet 4

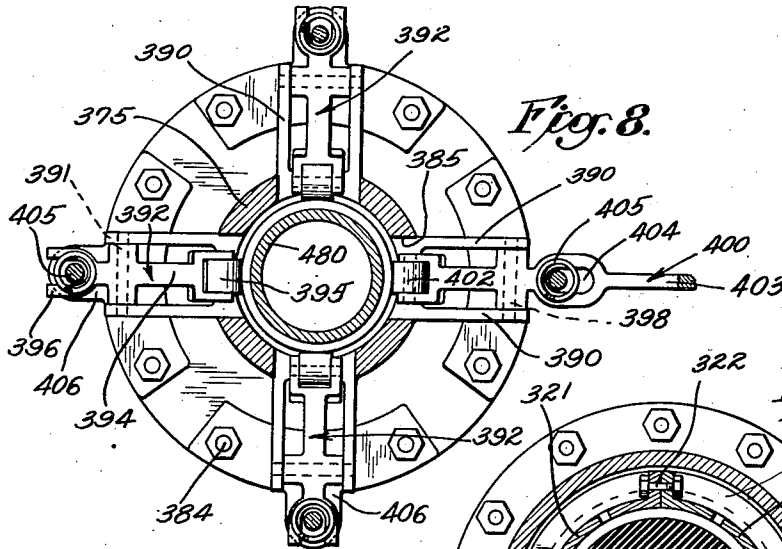


Fig. 8.

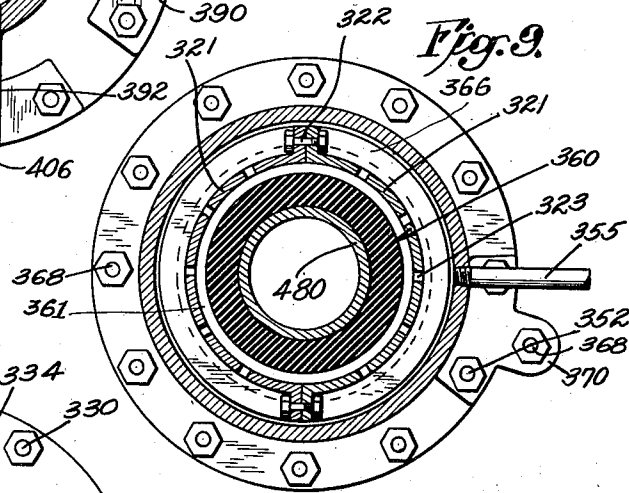


Fig. 9.

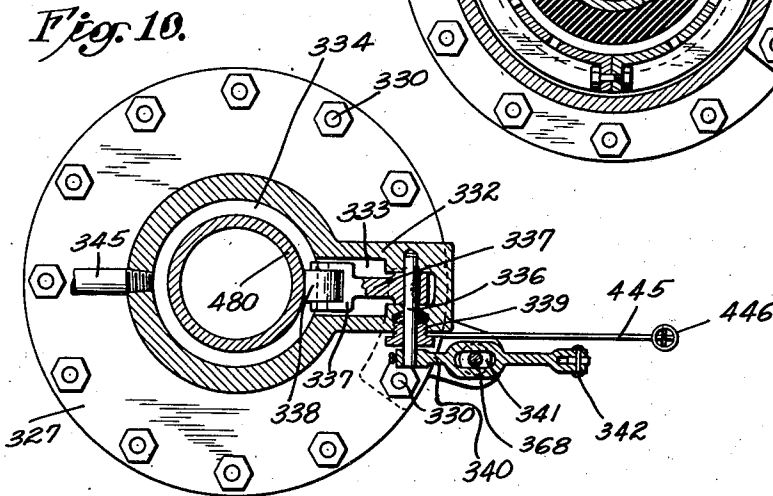


Fig. 10.

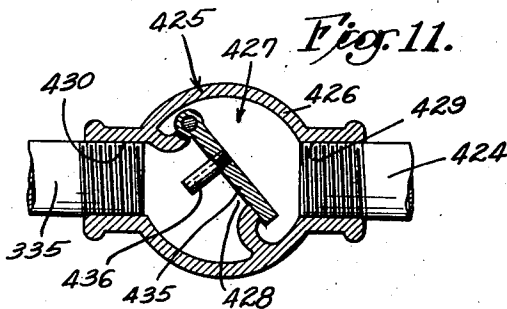


Fig. 11.

INVENTORS
CHESTER A. RASMUSSEN
WILLIAM A. TREGUT
By *Ford H. Harris*
ATTORNEY

April 23, 1929.

C. A. RASMUSSEN ET AL

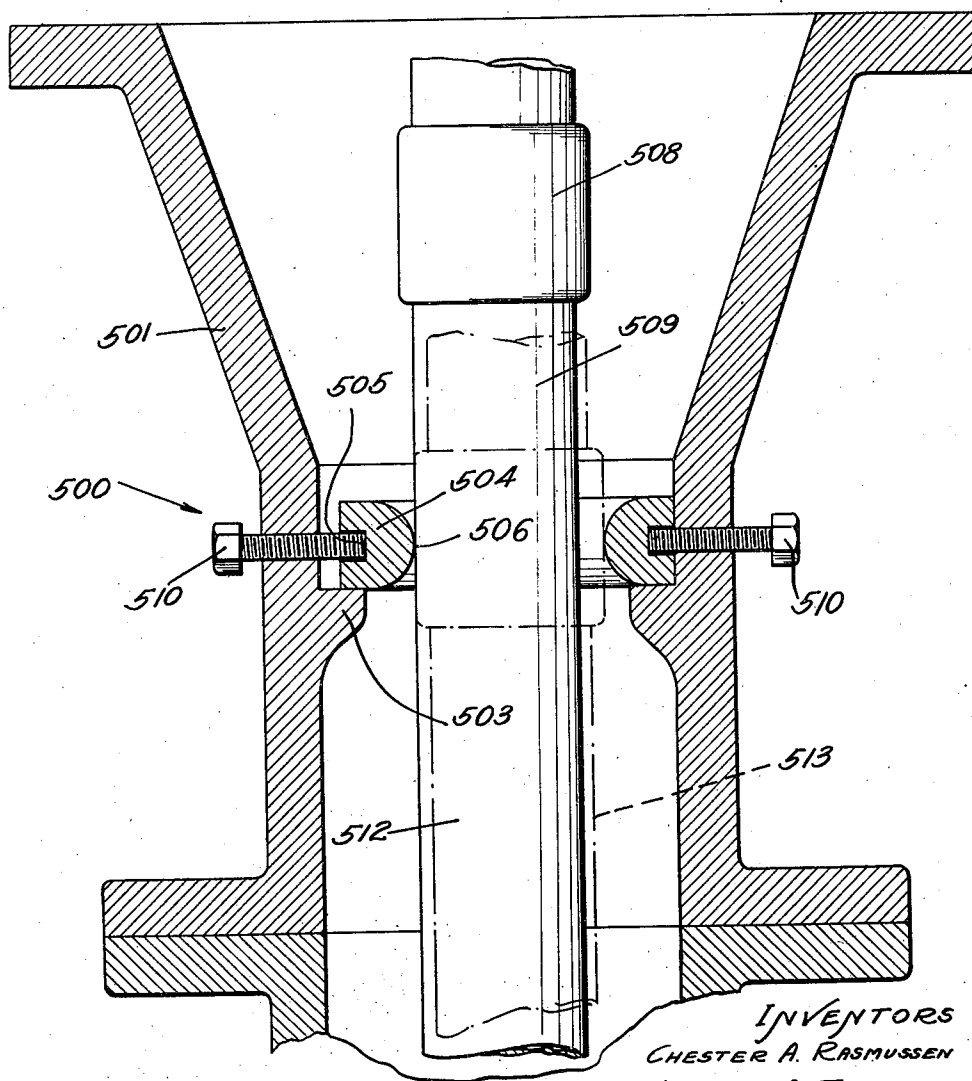
1,709,949

AUTOMATIC SEAL CONTROL BLOW-OUT PREVENTER

Filed Oct. 11, 1927

5 Sheets-Sheet 5

Fig. 12



INVENTORS
CHESTER A. RASMUSSEN
WILLIAM A. TROUT
By *Ford W. Harris*

ATTORNEY

UNITED STATES PATENT OFFICE.

CHESTER A. RASMUSSEN, OF LONG BEACH, AND WILLIAM A. TROUT, OF LOS ANGELES,
CALIFORNIA.

AUTOMATIC SEAL-CONTROL BLOW-OUT PREVENTER.

Application filed October 11, 1927. Serial No. 225,430.

Our invention relates to the deep well drilling art and particularly to packing devices employed in that art.

Frequently, in drilling deep wells for oil, pockets of gas in which the gas is stored up at an exceedingly high pressure are bored into so that this gas flows upward through the well. The presence of this gas about the upper end of the well where the workmen are employed is a constant danger. However, the high pressure at which this gas flows makes it exceedingly difficult to prevent its escape from the upper end of the well during drilling operations, such as drilling, or running casing.

It is therefore an object of our invention to provide a blow-out preventer which will retain the gas in a well during the insertion of a drill stem or a string of casing into or drawing these from the well.

While packing devices have previously been devised for preventing the escape of gas from a well, these have been faulty in operation owing to the fact that there was a considerable escape of gas each time a packer was released to permit a coupling of the casing or drill stem to pass through the packer.

It is a further object of our invention to provide a blow-out preventer in which the couplings of a sectional member, such as a casing or drill stem, may be advanced through the blow-out preventer with practically no leakage of gas therefrom.

Former blow-out preventers have been operated by hand, which requires the constant attention of one man during the insertion or withdrawal of a drill stem or a string of casing.

It is a still further object of our invention to provide a blow-out preventer as set forth above, the operation of which is automatic.

It is yet another object of our invention to provide a blow-out preventer which is normally operated by the pressure of fluid in the well.

Further objects and advantages will be made manifest in the following description and the accompanying drawings in which a preferred embodiment of our invention is illustrated.

In the drawings,

Fig. 1 is a vertical sectional view diagram-

matically illustrating the preferred embodiment of our invention.

Figs. 2, 3, and 4 are horizontal sectional views taken on the correspondingly numbered lines of Fig. 1.

Fig. 5 is a plan view of the operating lever of the blow-out preventer, shown in Fig. 1, with portions thereof broken away to illustrate the interior of the lever.

Fig. 6 is a vertical sectional view taken on the line 6—6 of Fig. 5.

Fig. 7 is a vertical sectional view diagrammatically illustrating a modified form of our invention.

Figs. 8, 9, and 10 are horizontal sectional views taken on correspondingly numbered lines of Fig. 7.

Fig. 11 shows a flow bean check valve used in our invention.

Fig. 12 is a vertical sectional view illustrating a modified form of casing centralizing means which may be utilized in the blow-out preventer of our invention.

Referring specifically to the drawings:

Fig. 1 shows a casing head 11, which includes a tubular body 12, the lower end 13 of which is of reduced diameter and is threaded and screwed into a coupling 14 provided on the upper end of an outer well casing, not shown. The body 12 has a bore 15 and threaded lateral openings 16 which lead therefrom. Fluid conducting pipes 17 and 18 are screwed into the holes 16 so as to communicate with the bore 15. In Fig. 1, the pipes 17 and 18 are broken off but the outer ends of these pipes are normally closed by suitable fittings, not shown. The body 12 is provided with a suitable annular flange 19 at its upper end.

Adapted to be supported upon the casing head 11 is a blow-out preventer 20, which is the preferred embodiment of our invention. The blow-out preventer 20 has a tubular body 21 which is built up from a number of tubular sections placed end to end, one upon the other. Each of these sections has radial end flanges which are provided with a uniform arrangement of bolt holes. This permits abutting flanges of each pair of adjacent sections to be secured together by bolts which effects the assembly of all the sections to form the body 21. These tubular sections, beginning at the bottom of the body 21, may be generally desig-

nated as follows: an auxiliary packer section 30, a lower packer section 31, an intermediate chamber section 32, an upper packer section 33, a control section 34, and a slip seat and centralizing section 35.

The tubular auxiliary packer section 30 has a central tubular wall 40, which is provided at its upper and lower ends with external radial flanges 41 and 42, and at its lower end with an internal radial flange 43. The flange 43 has an opening which is of the same diameter as the bore 15 of the casing head body 12. Formed in the upper face of the flange 43, adjacent its outer edge is an annular channel 45. The flange 42 of the auxiliary packer section 30 is connected to the flange 19 of the casing head 11 by bolts 50. Connecting with the tubular wall 40 is an escape valve 51, for a purpose to be described later.

Also, connecting with the wall 40 so as to communicate with the space within the auxiliary packer section 30, for a purpose to be described later, is a fluid supply pipe 52.

Disposed within the auxiliary packer section 30 is an auxiliary packer 55 which is annular in shape and has a cross-section which appears as a gothic U with rectangular serifs and turned upon its side. The packer 55 thus has a central tubular wall 56 and upper and lower radial walls 57 and 58 extending therefrom. At the outer edges of the radial wall 57 are formed upward and downward extending annular ridges 59 and 60. At the outer edge of the radial wall 58 are formed upward and downward extending annular ridges 62 and 63. The various parts of the packer 55 thus form an externally exposed annular channel 64. Disposed in the outer portion of the channel 64 is a compression ring 66 which has an inner tubular wall 67 and upper and lower radial flanges 68 and 69 extending outward from the wall 67. The wall 67 is provided with a series of openings 70, for a purpose to be described later. The compression ring 66 may be formed in one piece, but is preferably in the form of two semi-circular halves provided with suitable terminal flanges, which are connected together in a manner the ring 96 is made, as shown in Fig. 4.

The upper and lower radial flanges 68 and 69 contact the inner surfaces of the radial packer walls 57 and 58 and are annularly recessed to receive the ridges 60 and 62 provided inwardly upon the radial packer walls 57 and 58. When the packer 55 is placed within the tubular auxiliary packer section 30, the annular ridge 63 extends into the annular channel 45 formed in the internal auxiliary packer section flange 43.

Disposed immediately above the auxiliary packer section 30, the lower packer section 31 includes a tubular wall 72 from the upper and lower ends of which radial flanges 73 and 74 extend outward. From the lower end of the tubular wall 72, a radial flange 75 extends

inward. Formed in the upper and lower faces of the internal radial flange 75 are annular channels 76 and 77 of the same size and diameter as the annular channel 45. The flange 74 of the lower packer section 31 and the flange 41 of the auxiliary packer section 30 are connected together as by bolts 80, thus uniting these sections. Screwed into a threaded hole in the wall 72, so as to connect with the space therein is a fluid supply pipe 81, for a purpose to be described later. Disposed within the lower packer section 31 is a packer 85 which is similar in shape and construction to the auxiliary packer 55. The packer 85 has an inner tubular wall 86 which flares outward at its lower end. Extending outward from the upper and lower ends of the wall 86 are radial walls 87 and 88. The wall 87 has upper and lower annular ridges 89 and 90 formed upon peripheral portions. Also formed on the peripheral portion of the radial wall 88 are upper and lower annular ridges 91 and 92. The walls 86, 87, and 88 of the lower packer 85 thus form a peripherally exposed annular recess 95. Disposed in the outer portion of the recess 95 is a compression ring 96 which is of substantially the same construction as the compression ring 66, excepting that it is longer so as to fit the interior of the lower packer 85. When the packer 85 is in place, the annular ridge 92 extends into the annular channel 76.

Disposed immediately above the lower packer section 31 is the intermediate chamber section 32 which has a tubular wall provided with external radial flanges 101 and 102 at its upper and lower ends. The flange 102 has an annular channel 103 formed in the lower face thereof, which is of substantially the same size in diameter as the channels 45, 76, and 77, previously mentioned. The flanges 102 and 73 are adapted to be secured together as by bolts 104 so that the annular ridge 89 projects into the annular channel 103. Screwed into threaded holes in the tubular wall 100 are a fluid supply pipe 105 and a fluid exhaust pipe 106, for purposes to be described.

Disposed directly above the intermediate chamber section 32 is the upper packer section 33 which has a tubular wall 108 having radial flanges 109 and 110 formed outward from the upper and lower ends thereof. Extending inward from the lower end of the tubular wall 108 is an internal radial flange 112 which has an annular channel 113 formed in the upper face thereof. The flange 110 of the upper packer section 33 is adapted to be secured to the flange 101 of the intermediate chamber section 32 as by bolts 114, so as to secure these sections together. Tapped into a hole in the wall 108 is a fluid inlet and exhaust pipe 115.

Disposed within the upper packer section 33 is an upper packer 118 which is identical

in form and structure with the auxiliary packer 55 so that upper and lower annular ridges are formed on the peripheral portions of each of the radial walls. The upper packer 118, therefore, has a peripherally exposed annular recess 119 in which a compression ring 120, which is identical with the compression ring 66, is disposed. When the packer 118 is in place, the lowermost of the annular ridges formed thereon projects into the annular channel 113 formed in the internal radial flange 112.

Disposed directly above the upper packer section 33 is the control section 34 which includes a tubular wall 125 having radial flanges 126 and 127 projecting from the upper and lower ends thereof. Formed in the lower face of the flange 127 is an annular channel 128 which is of the same shape and diameter as the annular channel 45. The control section is adapted to be secured to the upper packer section by the connecting of the flanges 127 and 109 by bolts 130. When these sections are thus connected, the uppermost annular ridge formed on the upper packer 118 extends into the annular channel 128. Formed in one side of the wall 125 is a vertical slot 135, and extending outward on opposite sides of this slot are fulcrum arms 136 which are preferably formed integral with the wall 125. On opposite sides of the slot 135 are formed cam faces 137. Disposed opposite the lower portion of the cam face 137 are bosses 138, the inner surfaces of which extend parallel with the lower portion of the cam faces 137.

Mounted between the fulcrum arms 136 is a control lever 140 which has a hub 141 which is pivotally mounted upon a pin 142 which extends through suitably aligned apertures provided in the hub 141 and the end portions of the fulcrum arms 136. Extending in opposite direction from the hub 141 are outer and inner arms 144 and 145, the arm 144 being provided with a handle 146. The arm 145, as shown in Fig. 5, is provided with an internal bore 150 and has a cylindrical outer face 151. Slidably disposed upon the arm 145 is an actuating head 152, this head being urged off of the arm 145 by a compression spring 154, disposed in the bore 150. Extending in opposite directions from the outer end of the head 152 are pins 155 which normally bear against the cam surface 137. The outer end of the head 152 has a chisel point formed by upper and lower beveled faces 157 and 158. Secured between the flange 127 and the head of one of the bolts 130 is a bracket 160 which extends outward beneath the inner portion of the lever arm 144. Threadedly received in the outer end of the bracket 160 is a screw 161 which extends upward into the path of the lever arm 144 so as to determine the lowermost position of this arm.

Disposed above the control section 34 is the

slip seat and centralizing section 35 which includes a tubular wall 165. At its upper end, the wall 165 flares to provide a frust-conical interior surface 166 which is suitable for the reception of slips 167. From the lower end of the tubular wall 165, a radial flange 168 extends outward. The slip seat and centralizing section 35 is adapted to be secured to the control section 34 by the uniting of the flanges 168 and 126 by bolts 170. Formed in the central portion of the tubular wall 165 is a series of vertical slots 172 which are preferably four in number and which are symmetrically disposed about the axis of the body 21. Formed integrally with the wall 165 and extending outward on opposite sides of each of the slots 172 are arms 173. Mounted between pairs of the arms 173 are rocker levers 175, each of which has an inner arm 176 provided with a roller 177 at its lower end and an outer forked arm 178. When the levers 175 are in horizontal position, the rollers 177 extend inward through the slots 172. Opposite each of the lever arms 175 is provided a bracket 180 which has a securing flange 181 which is held between certain of the bolts 170 and the flange 168. Each bracket 180 provides a rod 182 which extends upward therefrom through the forked arm 178 of an adjacent rocker lever 175. Each rod 182 has a head 184 formed at its upper end and nuts 185 and 186 which are provided upon the rod in such a position as to rigidly secure the rod upon its respective bracket 180. Disposed about each rod 182 between the forked lever arm 178, through which it passes, and the head 184 is a compression spring 190, and between the forked arm 178 and the nut 185 is a compression spring 191. These two compression springs exert a powerful force against the forked arm 178, tending to keep the rocker lever 175 in horizontal position.

A means for supplying fluid under pressure to the blow-out preventer 20 is devised as follows:

As previously stated, the outer ends of the casing head fluid pipes 17 and 18 are closed. A T-fitting 200 is placed in the fluid pipe 18, and a fluid pipe 201, having a valve 202, leads from the fitting 200 to a three-way valve 203. From the valve 203, a service pipe 204 connects through an elbow 205 to the pipe 115, which connects with the space within the upper packer section 33. Leading from the pipe 201 is a branch 210 which connects with a cross-fitting 211 from which lead pipes 212, 213, and 214. The pipe 212 connects with the pipe 81 which communicates with the interior of the lower packer section 31. The pipe 213 connects to one end of a two-way valve 216, the opposite end of which is connected to the pipe 105. The pipe 214 has a valve 220 and connects with an auxiliary fluid pressure pipe 221 through a T 222. The T 222 also connects with the pipe 52 which has a valve 224.

The exhaust pipe 106 connects with a two-way valve 226 which connects with a main exhaust pipe 227. The main fluid supply pipe 201 has a branch pipe 228 which connects with a pressure exhaust valve 229, which connects through the pipe 230 with the main exhaust pipe 227. The valve 203 also connects with an exhaust pipe 231 which leads to the main exhaust pipe 227. The valve 203 has an operating lever 235, an arm 236 of which is adapted to be held against a stop 237, provided on the body of the valve, by a compression spring 238 which is connected to the arm 236 and the elbow 205.

The lever 235 also has an arm 239 which extends in the opposite direction from the arm 236, and is provided at its extremity with a pin 240. The three-way valve 203 is of such construction that when the lever 235 is in the position shown in full lines in Fig. 1, the valve connects the pipe 201 with the pipe 204, but when the lever 235 is turned 90° from this position, as shown by dotted lines 242, the valve 203 connects the pipe 204 with the exhaust pipe 231.

The valve 226 has an operating arm 244 which closes the valve when it is in the full line position shown in Fig. 1 and which opens the valve when this arm is swung upward through an arc of 90°. The valve 216 has an operating arm 245 which holds the valve open when it is positioned as shown in full lines in Fig. 1, and which closes the valve when it is swung upward through an arc of 90°.

Pivotally connected at its upper end to the operating lever arm 144, is a link 248 which has a closed slot 249 at its lower end which is adapted to receive the pin 240. When the operating lever 140 is in its full line position, as shown in Fig. 1, the pin 240 rests in the uppermost end of the slot 249; and when the operating lever 140 is in its dash-dot position 250, shown in Fig. 1, the pin 240 is engaged by the lower end wall of the slot 249 so as to throw the valve operating lever 235 into its dotted line position 242. Pivotally connecting the outer ends of the valve levers 244 and 245 is a link 252, and pivotally connecting the outer end of the valve lever 244 and the operating lever arm 144 is a link 253. When the operating lever 140 is in its broken line position 250, supporting the valve levers 244 and 245 in their upward position, the valve 216 is closed and the valve 226 is open. The operating lever 140 is yieldably held in its downward position by a tension spring 255 which is connected to an arm 256 which is rigidly gripped between one of the bolts 104 and the upper radial flange 73 of the lower packer section 31.

The operation of the preferred embodiment 20 of our invention is as follows:

In Fig. 1, a casing 260 is shown extending downward through the blow-out preventer 20

into the well, at the top of which the blow-out preventer is mounted. This casing 260 is made up of sections of tubing which are connected by couplings 261, one of which is shown disposed in the lower portion of the slip seat and centralizing section 35. The blow-out preventer is particularly adapted for use in running casing into the well, and its operation will therefore be described in this connection.

As the blow-out preventer 20 is used only when there is gas present in the well, this gas tends to flow up in the casing head counter-bore 15 around the casing 260 as the latter is being lowered into the well. The pressure of this gas generally ranges between 200 and 2,000 pounds per square inch. In case it is desired to operate the blow-out preventer 20 by the fluid pressure of this gas, the valve 220 is closed and the valve 202 is opened. As the normal position of the parts of the blow-out preventer 20 are shown in full lines in Fig. 1, the gas thus admitted into the supply pipe 201 from the casing head pipe 18 flows upward through the pipe 201, the valve 203, the pipe 204, the elbow 205, and the pipe 115 into the interior of the upper packer section 33 and from there through the opening in the compression ring 120 into the inner chamber 119 of the packer 118. This causes the upper packer 118 to expand into close contact with the outer surface of the casing 260. The gas under pressure also flows from the gas supply pipe 201 through the branch pipe 210, the cross fitting 211, the pipe 212 and the pipe 81 into the interior space within the lower packer section 31, and from there through the central openings in the compression ring 96 into the central chamber 95 of the packer 85. This expands the upper portion of the packer 85 into tight packing engagement with the casing 260. The gas under pressure also flows from the cross fitting 211 through the pipe 213, the valve 216 and the pipe 105 into the intermediate chamber section 32. Thus the packer 118 and the packer 85 are both forced into sealing engagement with the casing 260, and the chamber 107 is filled with gas at the same pressure as that which expands the packers 118 and 85.

As the casing 260 moves downward so that the coupling 261 passes into the control section 34, the lower end of the coupling 261 contacts the cam face 157 of the lever actuating head 152. Thus the coupling 261 moves the operating lever 140 from its full line position to its broken line position, as shown in Fig. 1. As the lever 140 approaches its broken line position 250, the pins 155 move between the lower portion of the cam surfaces 137 and the curved bosses 138 so as to draw the point of the actuating head 152 outward. This permits the coupling 261 to pass by the point of the head 152. As the arm 144 of the operating lever 140 commences

its upward movement, the valve arms 244 and 245 are swing upward so as to close the valve 216 and open the valve 226. This stops the supply of gas to the chamber 107 and opens an exhaust therefrom through the pipe 106, the valve 226, and into the main exhaust pipe 227. At the conclusion of the upward movement of the operating lever arm 144, the bottom wall of the slot 249 engages the pin 240 so as to direct the valve lever 235 into its dotted line position 242, thereby closing the supply of gas to the upper packer section 33, and connects this packer section with the main exhaust pipe 227, through the pipe 115, the valve 203 and the pipe 231.

As the pressure within the packer 118 is thus lowered, this packer retracts from engagement with the casing 260 so as to readily permit the coupling 261 to extend into the packer. As the coupling 261 moves downward into the packer 118, it approaches the broken line position 265, as shown in Fig. 1. Upon the coupling moving downward from the position 265, the actuating head 152 is freed so that the operating lever 140 may return to its full line position under the influence of the spring 255. During the first portion of the downward movement of the operating lever 144, the valve lever 235 is moved from its dotted line position 242 to its full line position by the spring 238 so as to shut off the passage between the pipe 204 and the exhaust pipe 231, and again admit gas under pressure from the pipe 201 into the upper packer section 33, through the pipes 204 and 115. This actuation of the valve 203 causes the expansion of the packer 118 upon the coupling 261, as this coupling is disposed directly within this packer. As the blow-out preventer 20 will be constantly lubricated by a suitable supply of water, or other lubricant, the coupling 261 will easily slide through the inflated packer 118 as it continues its downward movement. With the downward movement of the operating lever arm 144, the valve lever arms 244 and 245 are actuated so as to close the exhaust valve 226 and open the valve 216 so that the gas pressure in the chamber 107 is raised to equal the pressure in the casing head 11 and in the packers 118 and 85, and immediately after the reinflation of the packer 118. The maintaining of gas under pressure in the chamber 107 during the further downward movement of the coupling 261 makes it unnecessary to deflate the packer 85, as the gas under pressure in the chamber 107, coupled with the gas under pressure which forces its way upward against the flaring inner surface of the lower portion of the tubular wall 86 of the packer 85 causes this packer to practically float between its internal and external pressures so that the coupling easily distends the tubular wall 86 and passes downward through the packer 85. As the auxiliary packer 55 is not normally inflated,

it will be retracted to a position where it will not interfere in any way with the couplings 261 passing downward through this packer.

Thus, it is seen that the blow-out preventer 20 practically completely retains the gas in the well outside of the small amount permitted to escape through the exhaust pipe 227 in the operation of the device. The gas thus escaping through the exhaust pipe 227 is conducted to some suitable place of storage or a location where it may be discharged into the atmosphere without danger.

The pressure release valve 229 is provided so that in case the gas pressure in the well should rise suddenly beyond a point where it could be safely used in the operation of the blow-out preventer 20, the release valve 229 would permit the discharge of a sufficient amount of gas to lower its pressure in the pipe 201 to a point where no danger would be done to the packers 85 and 118.

The auxiliary packer 55 is provided for emergency use only, and is usually operated by an auxiliary pressure pump (not shown) which supplies fluid under pressure through the pipe 221 to the valve 224. In case it should become necessary to use the auxiliary packer 55, it is merely necessary to open the valve 224 which admits fluid under pressure through the pipe 52 into the inner chamber 64 of the packer 55. Damage to the packer 55 is prevented by the pressure release valve 51, which permits the escape of fluid from the auxiliary packer section when the pressure of the fluid rises above a certain value.

In case it should be desired to operate the entire blow-out preventer 20 by fluid supplied under pressure to the pipe 221 from a pump, the valve 202 should be shut and the valve 220 opened.

It is to be noted that the inside diameter of the slip seat and centralizing section 35 is but slightly larger than the outside diameter of the couplings 261, so that these couplings are accurately centralized as they pass through this section. The centralizing of the couplings 261 in this manner causes the sectional casing 260 therebelow to be accurately centralized relative to the packer through which it is passed. As each coupling 261 passes by the centralizing levers 175, these are returned to normal horizontal position by the springs 190 and 191. The levers 175 remain in this position while the entire following casing section passes downward between these levers. Owing to the pressure of the springs 190 and 191 upon the levers 175, it is quite difficult to dislodge these levers from their horizontal position so that the casing 260 is accurately centralized at all times when passing through the blow-out preventer 20.

The packers 55, 85, and 118 are cast with

the central holes thereof larger in diameter than the outside diameter of the casing 260. This causes the packers to draw away from the casing when the pressure is released therefrom, which causes the packers to have a maximum life as there is practically no wear on the packers when these are relaxed.

Referring now to the embodiment of our invention illustrated in Figs. 7 to 10 inclusive, 270 indicates a casing head which includes a tubular body 271, the lower end of which is of reduced diameter and is provided with threads 272 which are screwed into a coupling 273 provided on the upper end of an outer well casing, not shown. The body 271 has a bore 275 and threaded radial holes 276 which lead therefrom. Fluid conducting pipes 278 and 279 are screwed into the holes 276 so as to communicate with the bore 275. While the outer ends of the pipes 278 and 279 are shown as broken off in Fig. 7, these are closed by suitable fittings. The head 270 is provided with a suitable horizontal annular casing flange 280 at its upper end. Adapted to be supported upon the casing head 270 is a modified form of blow-out preventer 285.

The blow-out preventer 285 has a tubular body 286 which is built up from a number of tubular sections placed end to end, one upon the other, each of these sections has radial end flanges which are provided with a uniform arrangement of bolt holes. This permits abutting flanges of each pair of adjacent sections to be secured together by bolts which effect the assembly of all the sections formed in the body 286. These tubular sections beginning at the bottom of the body 286 may be formally designated as follows:

A lower packer section 290, an intermediate chamber section 291, an upper packer section 292, and a control section 293. The tubular lower packer section 290 has a central tubular wall 295, from the upper and lower ends of which radial flanges 296 and 297 extend outward. Extending radially inward from the lower edge of the wall 295 is an internal radial flange 298. Formed in the upper face of the flange 298 is an annular channel 299. Provided upon the wall 295 so as to communicate with the space therein is a fluid pressure release valve 300. Also provided on the wall 295 is a fluid supply pipe 301 which communicates with the space within this wall. Connecting the flanges 280 and 297 so as to rigidly mount the lower packer section 290 upon the casing head 270 are bolts 303.

Disposed within the lower packer section 290 is a lower packer 310 which is annular in shape and has a cross-section which has the appearance of a gothic U with rectangular serifs, and turned upon its side. The packer 310 has a central tubular wall 311, the lower portion of which flares outward and downward, and upper and lower radial walls 312 and 313 extend outward from the upper and

lower ends of the tubular wall 311. Formed peripherally upon each of the radial walls 312 and 313 are upper and lower annular ridges 314 and 315. The walls 311, 312 and 313 of the packer 310 thus cooperate to form a peripherally exposed annular channel 318. When the packer 310 is in place in the lower packer section 290, the annular ridge 315 of the wall 313 extends into the annular channel 299 formed in the flange 298. Disposed in the outer portion of the packer channel 318 is a compression ring 320 which is preferably formed in complementary sections 321 which are secured together as by bolts 322. The ring 320, is tubular in shape is perforated medially by a series of radial holes 323, and is provided with radial flanges at its upper and lower ends which snugly fit the lower outer portions of the packer wall 312 and the upper outer portion of the packer wall 313 so as to rigidly space the inner surfaces of these walls when pressure is applied axially to the top and bottom of the packer 310.

Disposed directly above the lower packer section 290 is an intermediate chamber section 291 which has a tubular wall 325 from the upper and lower ends of which extend radial flanges 326 and 327. Formed in the lower surface of the flange 327 is an annular channel 328. Flanges 327 and 296 are adapted to be rigidly secured together by bolts 330. When the section 291 is thus assembled upon the section 290, the upper annular ridge 314 of the packer wall 312 extends into the annular channel 328. Formed integral with the wall 325 is an operating arm housing 332 forming a pocket 333 which communicates inwardly with a central chamber 334 formed within the intermediate chamber section 291.

Keyed upon the shaft 336, which is journaled in suitable openings formed in the housing 332, is an operating arm 337 having a roller 338 pivotally mounted upon its inner end. A packing gland 339 surrounds the shaft 336 where this enters the housing 332 so as to prevent passage of gas between the shaft and the housing. Keyed upon the outer end of the shaft 336 is an arm 340 which is provided with a longitudinal slot 341 intermediate its ends and the outer extremity of which is bifurcated and provided with a pivot pin 342 for a purpose to be described later. Tapped into a suitable hole in the wall 325 is a fluid supply and exhaust pipe 345. Disposed directly above the intermediate chamber section 291 is the upper packer section 292 which has a main tubular wall 347 which is provided at its upper and lower ends with outward extending flanges 348 and 349, and at its lower end with an inward extending flange 350. The flange 349 is adapted to be rigidly secured to the upper flange 326 of the intermediate section 291 as by bolts 352. The inward extending flange 350 has an annular channel 353 formed in its upper face.

Tapped into a suitable hole in the wall 347 is a pressure release valve 356. Exposed within the upper packer section 292 is an upper packer 360 having a central tubular portion 361, from the upper and lower ends of which radial walls 362 and 363 extend outward. Each of the walls 362 and 363 is provided with upper and lower annular ridges 364 and 365. The packer 360 is thus seen to be very similar in form to the packer 310 so that the parts thereof form an outward exposed annular channel 366. When the packer 360 is properly placed in the upper packer section 292, the annular ridge 365 of the lower radial wall 363 thereof extends into the annular channel 353, formed in the internal flange 350.

A centering means for the operating lever 337 includes a rod 368 which extends vertically through the slot 341 and the lever arm 340, and is mounted at its lower and upper ends upon brackets 369 and 370 which are secured to the blow-out preventer body 285 by certain of the bolts 330 and 352 respectively. Disposed about the rod 368 between the lever arm 340 and the opposite ends of this rod are coiled compression springs 371 and 372.

Disposed directly above the upper packer section 292 is the control section 293 which includes a tubular wall 375 which is provided at its upper end with a flaring portion 376 which provides a slip seat 377 for receiving slips 378, and at its lower end with an outward extending radial flange 380. The flange 380 has an annular channel 381 formed in its lower end and this flange is adapted to be secured to the flange 348 of the upper packer section 292 by bolts 384 so that the upper annular ridge 364 of the upper wall 362 of the packer 360 will extend into the annular channel 381 of the flange 380.

Disposed at regular intervals about the axis of the control section 293 and formed in the wall 375 thereof is a number of vertical slots 385. These slots are preferably four in number, as shown in the present embodiment, and formed integral with the wall 375 and extending outward on opposite sides of each slot is a series of fulcrum arms 390. Pivotaly mounted upon suitable pins 391 extending through aligned openings in the outer ends of three of the series of arms 390 are centralizing levers 392. Each of the levers 392 has an inward extending arm 394 provided with a horizontal pivoting roller 395 at its inward extremity. On the opposite ends of the lever 392 from the arm 394 is formed a bifurcated arm 396. Mounted pivotaly upon a pin 398, secured in suitable openings in the extremity of the four pairs of fulcrum arms 390 is a control lever 400. The control lever 400 has an inner arm 401 and roller 402 identical with the arms 394 and rollers 395 of the

levers 392. On the opposite side of the pin 398 from the arm 401, the lever 400 is provided with an arm 403 which has an elongated slot 404 formed therein, as clearly shown in Figs. 7 and 8. Centralizing means for the levers 392 and 400 include rods 405 which are suitably mounted at their lower ends on brackets 406 which are secured to the blow-out preventer body 286 by certain of the bolts 384. The rods 405 extend upward through the bifurcated arms 396 of the levers 392 and the slot 404 of the lever 400. Suitable abutments 407 such as may be formed by washers and nuts, are provided upon the upper ends of the rods 405. Provided on each rod 405 between the lever arm through which it extends and the upper and lower ends of the rods are coiled compression springs 410 and 411. The action of the springs 410 and 411 upon the levers 392 and 400 will be to yieldably maintain these levers in horizontal position.

Means are provided for supplying fluid under pressure to the packers 310, 360, and the intermediate chamber 334, which means may be described as follows:

The casing head fluid pipe 279 is provided with a fitting 415 to which is connected a fluid supply pipe 416 having a valve 417 and which leads to a cross fitting 418. Also leading into the cross fitting 418 is a pressure supply line 420 which may lead from any suitable source of fluid under pressure, such as a hydraulic pump, not shown. Leading from the cross fitting 418 are pipes 421 and 422. The pipe 421 connects with a three-way valve 423 which also connects with a bean check valve 425 which is in turn connected to the fluid supply and exhaust pipe 355 of the upper packer section 292.

The bean check valve 425 is clearly illustrated in Fig. 11 and includes a shell 426 enclosing a chamber 427, the opposite ends of which are connected by a valve opening 428 from which open tapped apertures 429 and 430. Screwed into the aperture 429 is a pipe 424, while screwed into the aperture 430 is the pipe 335. Hingedly mounted in the chamber 427 so as to swing downward by gravity and close the seat 428 is a valve member 435. Tapped into a suitable aperture in the valve member is a flow bean 436. Thus, fluid under pressure in the pipe 424 may pass through the flow bean check valve 425 only by passing through the flow bean 436, whereas fluid may pass in the opposite direction very easily by lifting the valve member 435.

The three-way valve 423 also connects with an exhaust pipe 440. The valve 423 has an operating lever 441 mounted upon the shaft thereof, there being pins 442 and 443 provided at the opposite extremities of the lever 441. Stretched between one of the arms of the lever 441 and the extremity of a bracket arm 445 which is rigidly secured upon the

blow-out preventer body 286 is a coiled tension spring 446 which tends to maintain the lever 441 in its broken line position 447, shown in Fig. 7. Leading from the fluid supply pipe 421 is a branch pipe 448 which connects with a bean fitting 449 which in turn connects with the lower packer fluid supply pipe 301. The pipe 422 connects the fluid supply cross fitting 418 to a three-way valve 450 which connects with the pipe 345 and with a pipe 451 which connects with the exhaust pipe 440. The valve 450 has an operating arm 455 which, when it is in the full line position shown in Fig. 7, closes the pipe 422 and connects the pipes 345 and 451, and which when it is in its broken line position 456, closes the pipe 451 and connects the pipe 422 and 345. When in its uppermost position, the lever 455 rests against a stop 457 formed upon the body of the valve.

Pivotaly mounted in its upper end on the lever 455 is a link 460 which has a closed slot 461 in its lower end which is adapted to receive a pin 462 provided on the outer end of the valve operating lever 455. Connected to the valve operating lever 455 and the link 460 so as to yieldably urge the pin 462 toward the upper end of the slot 461 is a coiled tension spring 463. Pivotaly connected at its upper end by a pin 465 to the outer end of the operating lever arm 404 is a link 466 which has a closed slot 467 in its lower end in which the pin 442 is adapted to be disposed. Pivotaly mounted at its upper end on the pin 443 is a link 470 which has a closed slot 471 formed in its lower end, in which slot the pin 342 provided on the end of the lever arm 340 is adapted to be disposed.

The operation of the blow-out preventer 285 will be described in connection with extending a casing 480 into the well over which the blow-out preventer is mounted. The casing 480 comprises sections of tubing connected by couplings 481. After a first tubing section has been inserted through the blow-out preventer 285, the valve 417 is opened so that a flow of fluid under pressure passes upward from the well into the fluid supply pipe 416. At this time we will assume that there is no casing coupling exposed within the zone of the blow-out preventer and the centralizing levers 392 and 400 will therefore be in the broken line position 482, as shown in Fig. 7. This will permit the spring 446 to rotate the valve control lever 441 into its broken line position 447. When the lever 441 is in the broken line position 447, the pipe 440 is shut off and the pipe 421 is connected with the pipe 424 so that the gas under pressure in the pipe 416 is conducted to the flow bean check valve 425 through which the gas passes in a small stream into the recess 366 of the upper packer 360. This causes the expansion of the packer 360 against the casing 480. Gas under pres-

sure also flows from the pipe 421 through its branch 448, the flow bean fitting 449 of the pipe 301, into the inner annular chamber 318 of the lower packer 310. Thus, both the packers are expanded by fluid pressure into tight sealing engagement with the casing 480. When the valve lever 441 is in its broken line position 447, the link 460 is also in its downward position which causes the valve operating arm 455 to swing into its dotted line position 456 which, as previously described, will close the pipe 451 and connect the pipe 422 to the pipe 345. Thus, fluid under pressure will pass through the valve 450 of the pipe 345 into the chamber 334 intermediate the lower and upper packers 310 and 360.

As the casing 480 continues to move downward, a coupling 481 will pass through the control section 293 and contact the rollers 395 and 402 on the inner ends of the arms 394 and 401. This causes these arms to be depressed and rocks the levers 392 and 400 into the full line position in which they are shown in Fig. 7. After the pin 442 has been resting in the lower end of the closed slot 467 of the link 466, this rocking of the lever 400 rotates the lever 441 from its dotted line position 447 to its full line position. This operates the valve 423 so as to close the pipe 421 and connect the pipes 424 and 440 permitting the fluid under pressure within the packer 360 to be exhausted into the exhaust pipe 440.

During the first part of this movement of the lever 441, the valve arm 455 is moved the entire way from its dotted line position 456 to its full line position so as to close the pipe 422 and connect the pipe 345 with the exhaust pipe 451. After the lever 455 has left its dash line position, and during the farther upward movement of the link 460, the spring 463 is stretched and the slot 461 slides upward upon the pin 462. As the operation of valve 450 is completed, during the first part of the motion necessary for operating the valve 423, the fluid under pressure in the intermediate chamber 334 is exhausted prior to the relaxing of the upper packer 360. This order of operations prevents an escape of gas from the intermediate section 334, owing to the relaxing of the packer 360.

Continuing downward, while the levers 392 and 400 are retained in their full line position by contact of the rollers 395 and 402 with the exterior surface of the coupling 481, the latter enters the relaxed packer 360 with ease. The coupling 481 has practically passed through the packer 360, prior to the release of the levers 392 and 400 so that these will resume their normal horizontal position. As the lever 400 resumes its horizontal position, the spring 466 draws the lever 441 into its broken line position 447 so that the valves 423 and 450 again cause the intermediate chamber 334 in the packer 360 to again be supplied

with fluid under pressure. This, of course, causes the packer 360 to make a fluid tight seal with the coupling 481 as this slides downward out of this packer. Moreover, as the coupling leaves the packer, the latter flows inward into sealing engagement with the full tubing section of the casing 480. The valve operating mechanism is now in its broken line position so that the pin 342 is disposed in the lower end of the slot 471 formed in the link 470. Thus, when the coupling 481 engages the roller 338 of the operating arm 337 so as to rock the arm 340 upward, this will have no effect whatever upon the valve control system as the pin 342 will merely slide upward in the slot 471. When the coupling 481 passes by the roller 338, the arms 337 and 340 mounted upon the shaft 336 are returned to normal horizontal position by the pressure of the spring 372. Owing to the lower packer section being constantly supplied with fluid under pressure through the pipe 448, the flow bean fitting 449, and the pipe 301, it is necessary that the pressure in the chamber 334 be substantially equal to the pressure within the packer 310 in order to facilitate the passage of each of the couplings 481 through the packer 310 without the deflation of the latter. This is accomplished by the valve operating mechanism shown and described herein.

The blow-out preventer 285 is particularly designed so that the valves thereof will be automatically operated to carry out the desired function of the blow-out preventer, whether casing or some other sectional member be passed downward or drawn upward through the blow-out preventer. The operation of the device has already been described above in connection with the passing of the casing downward into the well. The operation which takes place when the casing is drawn upward from the well will now be described.

As each coupling 481 approaches the lower packer 310, the intermediate chamber 334 is supplied with fluid at substantially the same pressure as that used in inflating the packer 310 which is usually equal to the well pressure. Owing to the flaring shape of the lower portion of the packer 310, the coupling 481 easily passes through this packer and, continuing upward, contacts the roller 338 so as to rock the outer end of the arm 340 downward. Owing to the fact that the valve operating mechanism was formerly at its normal position, shown by broken lines in Fig. 7, the pin 342 now rest at the bottom of the closed slot 471, and as the arm 340 rocks downward it, therefore, draws the link 470 with it so as to move all the valve operating mechanism except the lever 400 and link 466 into its full line position. With the valve operating mechanism in full line position, the intermediate chamber 334 is first exhausted

and then the packer 360 is deflated so as to permit the rising coupling 481 to extend thereinto. As the coupling 481 rises out of the intermediate chamber section 291, the roller 338 is disengaged by the coupling so as to permit the lever arm 340 to rise upward to its horizontal position under the influence of the spring 371. Thus, the valve operating mechanism is returned to its normal broken line position and the packer 360 is inflated and fluid under pressure is supplied to the intermediate chamber 334 so that a complete sealing about the casing 480 is continued as the coupling 481 passes on upward out from within the packer 360.

All of the valve operating mechanism at this time is in its broken line position and the pin 442 is disposed in the lower end of the slot 467 in the link 466. As the coupling 481 moves upward into the control section 293, it engages the rollers 395 and 402 of the levers 392 and 400 so as to rock the lever arms 394 and 401 upward. This causes the arm 404 of the lever 400 to be rocked downward, but owing to the position of the slot 467 relative to the pin 442, the pin merely rides in the slot so that no effect is had upon the valve operating mechanism by the downward movement of the lever arm 404. Needless to say, as the coupling 481 continues upward out of range of the rollers 395 and 402, the levers 392 and 400 return to normal horizontal position under the influence of the springs 411.

Thus, it will be seen that a complete seal is effected by the blow-out preventer 285 between the casing head and the casing, whether this is being extended into the well or drawn therefrom.

The use of flow beans in the fluid supply pipes leading to the packers 310 and 360 and the provision of pressure valves 300 and 356 in the lower and upper packer sections respectively is for the purpose of controlling the actual pressure utilized in these two packers, irrespective of the pressure in the well itself. This control is desirable because often, particularly where the packers 310 and 360 are new, the pressure in the well is greater than necessary to effect a proper seal between the packers and the casing. Under these circumstances, the flow beans used are chosen and the pressure release valves are set so that only sufficient pressure is used in the packers 310 and 360 to effect a good seal and prevent the escape of gas from the well. In casting the packers 310 and 360, the central hole therein is formed of a smaller diameter than that of the casing which the packers are adapted to accommodate so that by the use of a suitable lubricant, such as water, a fairly good seal can be maintained between the packers and the casing without the use of very high fluid pressure on the interior of the packers. As the packers grow older, however, and become worn, the pres-

sure used in their expansion is increased so as to insure their making the proper seal with the casing.

In quite a few cases in which a blow-out preventer might be used, the crown block of the derrick is slightly off plumb so that the casing hangs toward one side of the axis of the blow-out preventer.

After a few lengths of casing have been inserted into the well, the weight of the casing is sometimes sufficient under these circumstances to place quite a burden upon the centralizing levers 175 of the blow-out preventer 20, or upon the centralizing levers 392 and 400 of the blow-out preventer 285.

Therefore, where the crown block upon which the casing is supported is out of plumb more than a small distance, it may be desirable to use a casing centralizing device 500 which is illustrated in Fig. 12.

The centralizing device 500 includes a suitable tubular body 501 which is adapted to take the place of the slip seat and centralizing section 35 of the blow-out preventer 20. The tubular body 501 has inwardly extending annular shoulders 503 upon which rests a centralizing ring 504 which is provided with an annular channel 505 formed in the periphery thereof. The ring 504 has a central opening 506, the diameter of which is approximately equal to the outside diameter of couplings 508 of a string of casing 509 which is being extended downward through the blow-out preventer upon which the device 500 is provided. Threadedly received in suitable openings formed in the tubular body 501 is a series of adjusting screws 510 which extend into the channel 505 of the ring 504 so as to permit rigidly fixing this ring in any desired position upon the shoulders 503.

As the casing 509 is advanced into the well, the ring 504 is adjusted by manipulation of the screws 510 so that it contacts tubular sections 512 of the casing 509 so as to centralize the casing 509 while the tubular sections 512 are in contact with the ring 504.

In Fig. 12, the casing 509 is shown in centralized position in full lines. When a coupling 508 engages the ring 504, the casing 509 is forced into the dotted line position 513 while the coupling is passing through the ring 504. As the sections 512 are usually 20 feet or over in length and as the couplings 508 are but a few inches in length, it is clear that the casing 509 is moved out of centralized position only a very small portion of the time that it is passing through the blow-out preventer upon which the centralizing device 500 is used.

One of the principal merits of the device 500 is its relative simplicity and cheapness of construction, as well as ease of operation. It requires practically no attention after once having been adjusted for handling a given size of casing.

We claim as our invention:

1. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a packer; means for causing said packer to expand into engagement with said member; and means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said packer to relax to permit one of said couplings to extend thereinto.

2. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a primary packer; a secondary packer spaced therefrom; means for causing said packers to expand into engagement with said member; and means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto.

3. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a primary packer; a secondary packer spaced therefrom; means for causing said packers to expand into engagement with said member; means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereto; and means forming an intermediate pressure chamber between said packers.

4. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a primary packer; a secondary packer spaced therefrom; means for causing said packers to expand into engagement with said member; means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto; means forming an intermediate pressure chamber between said packers; and means for controlling the fluid pressure in said chamber.

5. A combination as in claim 4 in which the last mentioned means is controlled by said coupling operated means.

6. A combination as in claim 4 in which the last mentioned means is controlled by said coupling operated means so that the pressure of said chamber is reduced immediately previous to the relaxing of said primary packer.

7. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a packer; means for causing said packer to expand into engagement

with said member; means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said packer to relax to permit one of said couplings to extend thereinto; and means for centralizing said member relative to said packer.

8. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a primary packer; a secondary packer spaced therefrom; means for causing said packers to expand into engagement with said member; means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto; and means for centralizing said member relative to said packers.

9. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a primary packer; a secondary packer spaced therefrom; means for causing said packers to expand into engagement with said member; means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto; means forming an intermediate pressure chamber between said packers; and means for centralizing said member relative to said packers.

10. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a primary packer; a secondary packer spaced therefrom; means for causing said packers to expand into engagement with said member; means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto; means forming an intermediate pressure chamber between said packers; means for controlling the fluid pressure in said chamber; and means for centralizing said member relative to said packers.

11. In a blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings, the combination of: a packer; means for causing said packer to expand into engagement with said member; and means for centralizing said member relative to said packer, said last mentioned means, when contacted by one of said couplings, actuating said first mentioned means to cause said packer to relax to permit one of said couplings to extend thereinto.

12. In a blow-out preventer for use in

packing the space between the upper end of a well and a sectional member connected by couplings, the combination of: a primary packer; a secondary packer; means for causing said packers to expand into engagement with said member; and means for centralizing said member relative to said packers, said last mentioned means, when contacted by one of said couplings, actuating said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto.

13. In a blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings, the combination of: a primary packer; a secondary packer; means for causing said packers to expand into engagement with said member; means for centralizing said member relative to said packers, said last mentioned means, when contacted by one of said couplings, actuating said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto; and means forming an intermediate pressure chamber between said packers.

14. In a blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings, the combination of: a primary packer; a secondary packer; means for causing said packers to expand into engagement with said member; means for centralizing said member relative to said packers, said last mentioned means, when contacted by one of said couplings, actuating said first mentioned means to cause said primary packer to relax to permit one of said couplings to extend thereinto; means forming an intermediate pressure chamber between said packers; and means for controlling the fluid pressure in said chamber actuated by said centralizing means so that said pressure is reduced immediately previous to the relaxing of said primary packer.

15. A blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a packer; means for causing said packer to expand into engagement with said member; means operated by movement of one of said couplings with said member to actuate said first mentioned means to cause said packer to relax to permit one of said couplings to extend thereinto; an auxiliary packer; and separate means for expanding said auxiliary packer into engagement with said member.

16. In a blow-out preventer for use in packing the space between the upper end of a well and a sectional member connected by couplings which comprises: a packer; means for causing said packer to expand into engagement with said member; means operated by

movement in a given direction of one of said couplings with said member to actuate said first mentioned means to cause said packer to relax to permit one of said couplings to extend into one end thereof; and means operated by movement, in another direction, of one of said couplings with said member to cause said packer to relax to permit one of said couplings to extend into the other end of said packer.

In testimony whereof, we have hereunto set our hands at Los Angeles, California, this 28th day of September, 1927.

CHESTER A. RASMUSSEN.
WILLIAM A. TROUT.