

May 11, 1943.

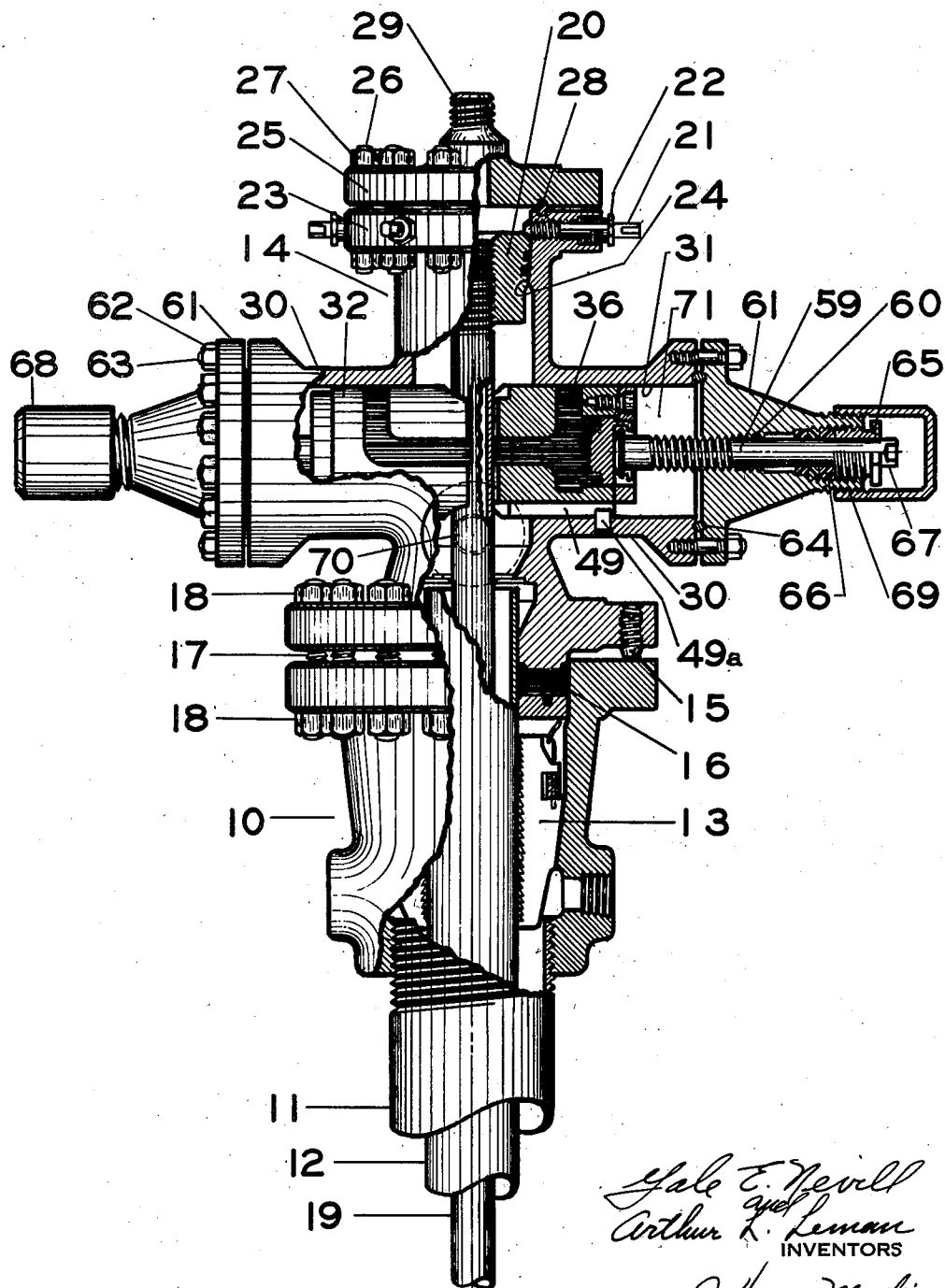
G. E. NEVILL ET AL

2,318,882

RAM CONSTRUCTION FOR BLOWOUT PREVENTERS

Filed Dec. 18, 1941

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

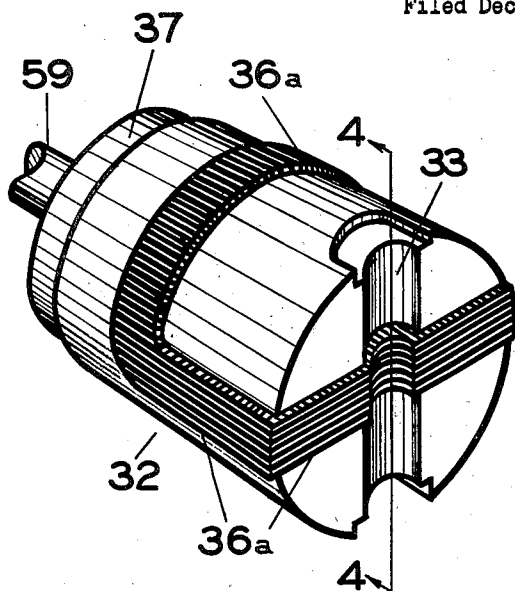


FIG-2

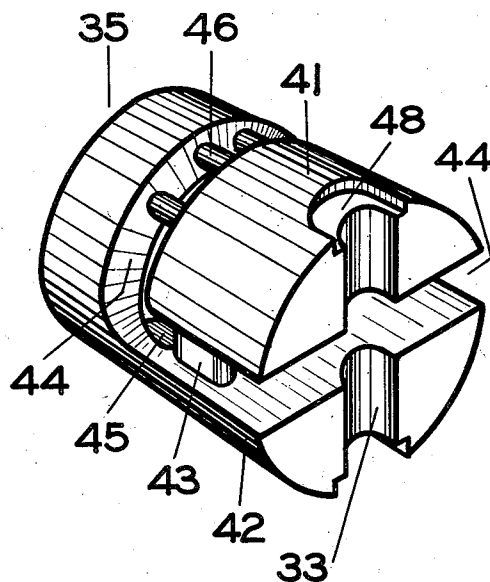


FIG-3

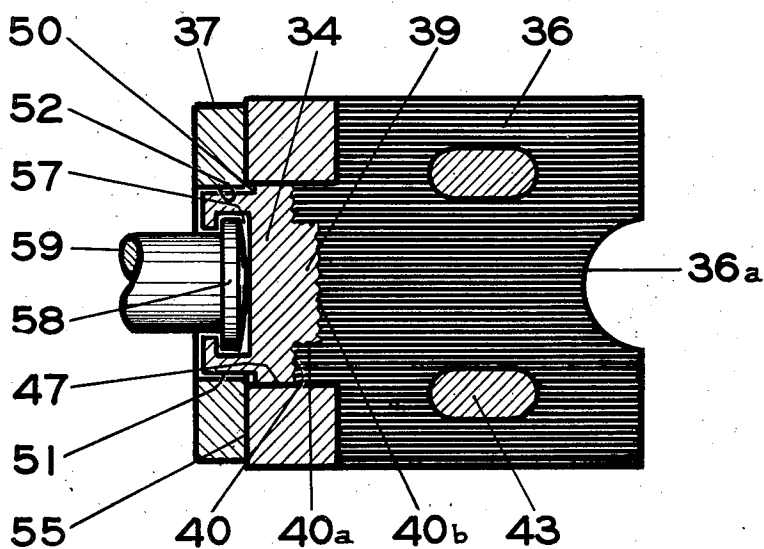


FIG-5

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3 Sheets-Sheet 3

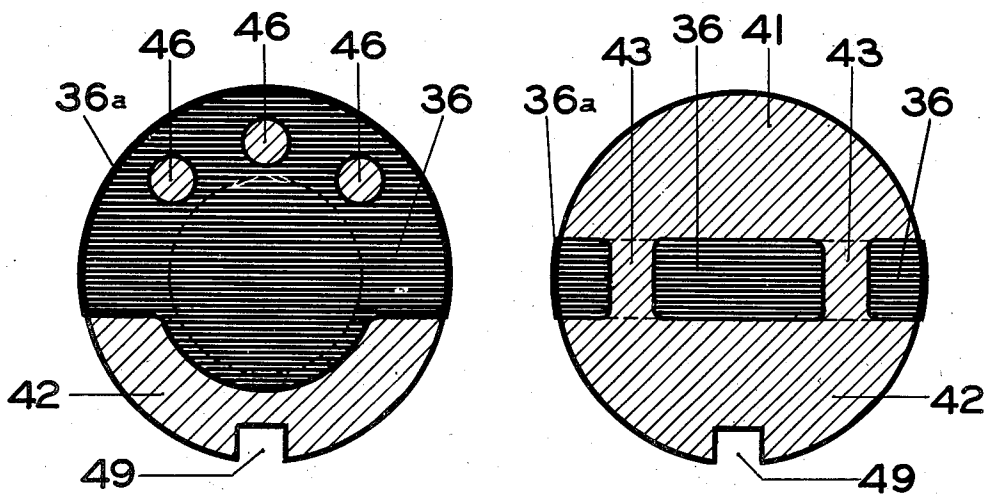


FIG-6

FIG-7

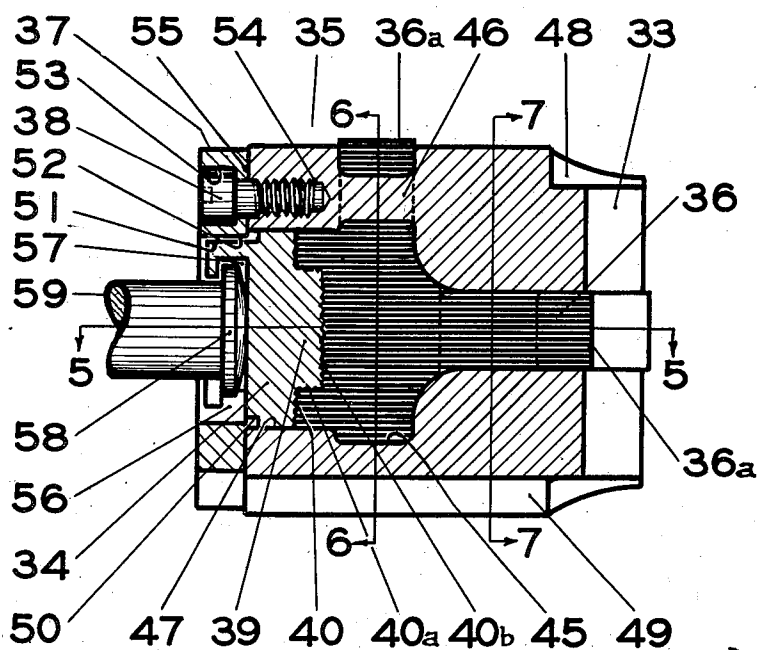


FIG-4

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2,318,882

RAM CONSTRUCTION FOR BLOWOUT
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Application December 18, 1941, Serial No. 423,508

2 Claims. (Cl. 251—51)

Our invention relates to a safety apparatus for oil well drilling equipment, and especially to a high pressure control valve adapted for use on a well casing, particularly for the purpose of making an effective fluid tight closure about an inner string of drill pipe or tubing, suspended within a casing head and extending therethrough.

In the drilling of deep wells, it frequently develops that extremely high gas and fluid pressure are encountered. Precautionary measures must be taken to prevent such pressures from blowing up around the drill stem and tubing, thus causing serious damage to life and property, such as occurs when a well gets out of control and goes "wild."

It is, therefore, an object of our invention to provide an apparatus adapted to be mounted upon an outer string of pipe or casing in a well bore for the purpose of controlling or preventing the escape of fluid under pressure from the well between the bore of the outer pipe or casing and the outside of an inner string of pipe or tubing extending through the apparatus, which includes means to preclude the escape of fluid pressure from the sealing apparatus.

A more specific object of our invention is to provide a pair of rams or plungers for closing the passage through the pipe which are adapted to be easily moved to and from closed position under enormous well pressure and at the same time to maintain a fluid tight seal between these rams or plungers and their retaining walls.

A further object of our invention is to provide a blow-out preventer using a balanced plunger construction in which the sealing element is actuated into sealing engagement with the surfaces to be sealed off by means of the relative movement between the follower plate and the ram, which causes the sealing element to expand longitudinally and radially, whereby a principle similar to that employed in an hydraulic jack is made use of. This is accomplished by equalizing the pressure on both sides of the plungers, thus forming a balanced plunger construction, in which there is practically no opposition to the movement of the plungers except that caused by friction between the surfaces. We actuate the plungers manually by means of an operating screw which moves the plungers against a relatively small area, building up a high unit pressure which is transmitted through the plastic sealing element over a relatively large sealing area.

A still further object of our invention is to provide a blow-out preventer with closing rams

of the self-feeding type, in which the resilient packing material may be forced out beyond its original position either to adapt itself to variations in the dimensions of the parts it is sealing around and against, or to compensate for wear which may take place when the parts move with respect to each other, or when the tubing is moved through the packing or rotated while in sealing engagement.

Other objects and advantages will be apparent in the following description of an embodiment of the invention illustrated in the accompanying drawings, wherein:

Figure 1 is a view partly in elevation and partly in section through the preferred form of blow-out preventer and casing head assembly embodying the features of our invention.

Figure 2 is a perspective view showing the assembled relationship of the component parts comprising the plunger.

Figure 3 is a perspective view similar to Figure 2 showing the ram construction only.

Figure 4 is a transverse section of the plunger assembly taken on the line 4—4 of Figure 2.

Figure 5 is a transverse section of the plunger assembly taken on the line 5—5 of Figure 4 and at right angles to the section shown in Figure 4.

Figures 6 and 7 are transverse sections taken on the lines 6—6 and 7—7 respectively of Figure 4, showing the relationship between the packing element and the ram.

In the drawings the numeral 10 designates a casing head mounted upon an outer string of casing 11. Within the casing 11 and spaced therefrom is a second string of casing 12 suspended within the casing head 10 by means of slips 13.

A blow-out preventer, generally referred to as 14, is maintained in predetermined relation to the casing head 10 by means of adjusting screws 15, packing 16, through bolts 17 and their respective nuts 18.

A string of tubing 19 in spaced relation to casing 12 is suspended from a tubing support 20 mounted in the upper end of the blow-out preventer and passes therethrough and extends downwardly into the oil bearing sand. Adjusting screws 21 passing through stuffing boxes 22 in the upper flanged body portion 23 of the blow-out preventer retain the tubing support in place in the upper bore 24 and assist in preventing the tubing and support from being blown out of the well in case of extreme internal well pressure. An upper flange 25 is suitably secured to the upper flanged body portion 23 by means of bolts 26

and nuts 27. Suitable packing 28 provides a seal for these surfaces. A threaded outlet 29 is provided to receive a well tubing for conducting the fluid to a storage tank or flow line.

A pair of lateral oppositely disposed cylindrical sections 30 are formed integral with the blow-out preventer body, each being provided with a bore 31 in axial alignment with respect to each other and normal to the axis of the well tubing extending through said blow-out preventer body. Plunger assembly units 32 are positioned within said cylindrical bores 31 and adapted for sliding movement so that they may move towards or away from each other in order to form a fluid tight closure or allow a free passage about the tubing 19 extending through the blow-out preventer.

The plunger units shown in assembled relation in Figures 1 and 2 are of a semi-circular configuration at their extreme inner ends 33 to cooperate with each other to form a seal about the tubing 19. These units, 32, comprise a follower plate 34, a ram 35, a resilient packing element 36, a retainer ring 37 and retaining screws 38.

The follower plate 34 is cylindrical in cross section and is provided at its inner or forward end with a boss 39 and having serrated surfaces 40, 40a and 40b.

The ram 35 consists of a cylindrical chambered body, the forward or inner portion of which is divided into upper and lower semi-cylindrical half sections 41 and 42, held in spaced relation to each other by a plurality of ribs 43, which forms a recess 44 therebetween. This recess extends along a medial plane of the ram, that is to say, parallel to the longitudinal axis of the ram in a rearward direction to approximately the midsection of said ram. From this point it merges into an enlarged aperture 45, cylindrical in cross section on its lower half portion and extending radially to the outer periphery of the ram on its upper half portion in a configuration similar in cross section to the recess 44, forming a continuation therewith.

A plurality of tie members 46, together with the ribs 43, retain the upper half section 41 of the ram in longitudinal and circumferential alignment with the main body portion and maintains the sections in a solid unit which will retain its initial structural shape when subjected to pressure.

A counterbore 47 at the outer or rearward end of the ram 35 is coextensive with the aperture 45 and completes the chambered interior of said ram. This counterbore is adapted to freely and slidably receive the follower plate 34.

The extreme inner or forward ends of the ram are constructed to conform to the outside diameter of the well tubing 19, which they surround when in closed position. A spot faced recess 48, in vertical alignment and concentric with the tubing opening through the ram section, is provided for on the extreme upper and lower peripheral surfaces of the ram sections 41 and 42 upon which a tubing coupling (not shown) may rest.

A keyway 49 extends the full length of the lower section 42 of the ram at its extreme lower portion. The ram is positioned within the cylindrical bore 31 in registry with a key 49a, secured as by welding or otherwise, in the lower cylindrical portion of the section 30 to serve as a guide for the plunger unit in its forward and rearward movement within said bore 31.

The resilient packing element 36 is molded

with the follower plate 34 and ram 35 to form a yieldable unitary plunger construction. The resilient element bonds itself to the follower plate 34 with the assistance of the serrations on the surfaces 40, 40a and 40b of the plate 34, filling the recess 44, becoming imbedded in the aperture 45, and flowing around the ribs 43 and the tie members 46.

The extreme outer peripheral and tubing contacting surfaces of the resilient packing element 36 protrude slightly beyond the outer surface of the ram as particularly shown at 36a in Figure 2 in order to more effectively provide a fluid seal around the tubing and between the upper portion of the ram section and the cylinder bore.

The rearward end of the follower plate 34 is shouldered as at 50, providing an external surface 51 of smaller diameter than the main body portion. The retainer ring 37 is provided with a bore 52 of sufficient diameter to form a free sliding fit about the surface 51 of the follower plate 34.

A plurality of retaining screws 38 pass through counterbored openings 53 in the retainer ring 37, registering with a plurality of tapped holes 54 in the outer end face 55 of the ram 35. The retainer ring thus held in place provides an end closure for the plunger assembly unit and a supplemental means for retaining the follower plate and ram in assembled relation, while at the same time permitting relative movement between the plate and the ram.

A slotted opening 56 is provided in a recessed chamber 57 in the outer end of the follower plate 34 to receive the head 58 of an actuating shaft 59. The shaft 59 is disposed within a threaded portion 60 forming an integral part of the closure head 61.

Pressure applied to a plurality of nuts 62 on corresponding studs 63, positioned in registering openings in the cylindrical section 30 and head 61, serves to maintain these elements in sealing engagement with a packing 64 disposed in suitable packing grooves in said elements.

A stuffing box 65 and packing 66 seals off the shaft 59 where it projects through the outer end of the closure head 61. The extreme outer end of the shaft 59 is provided with a wrench square 67 for applying pressure to said shaft to move said plunger assembly into and out of sealing engagement with the well tubing.

A retainer cap 68 is threadably secured to the outer end of the closure head 61, as at 69, to protect the end of the shaft 59 from damage and dirt.

Tapped side outlets 70 are provided in the main body of the blow-out preventer below the plunger assembly to allow for connections to emergency take-off lines.

In operation:

In the case of impending danger from a sudden uprushing of well pressure through casing 12, it is of greatest importance that an effective fluid-tight seal be provided above the exposed end of such casing 12 and around the well tubing 19.

It will be noted that the well fluid pressure passing up through the casing 12 and around the tubing 19 also fills the space in the keyway 49 and the space behind the plunger assembly around the actuating shaft 59, thus providing a pressure balance at the opposite ends of the plunger assembly.

When it becomes necessary to move the plunger assembly into sealing engagement around the

tubing, the cap 68 is removed and a wrench (not shown) is applied to the wrench square 67 on the end of the shaft 59. The shaft is then turned to the right in a forward direction in the screw threaded portion 60 of head 61, which in turn moves the head 58 against the follower plate 34 of the plunger assembly 32. Since the pressure is the same on each end of the plunger assembly it will require very little force to cause the plunger assembly to move in either direction.

The entire plunger assembly is moved axially until the protruding surfaces of the resilient packing element 36 engages the periphery of the tubing 19. Due to the construction of the plunger assembly, wherein relative movement is provided for between the plate 34 and the ram 35, a slight additional pressure on the plate forces said plate longitudinally with respect to the ram and against the small exposed area of the packing element thus compressing it and causing it to flow longitudinally of the axis of the plunger assembly against the outer surface of the tubing 19 and radially against the cylindrical bore 31 and into fluid sealing engagement with these surfaces.

With the construction disclosed the follower plate 34 can be forced forward an appreciable distance as required, thus displacing a corresponding amount of resilient sealing material 36, which is accordingly made available to feed the exposed surfaces 36a as they become worn. This displacement, therefore, constitutes a reservoir of plastic sealing material which may be drawn upon as required, thus providing a self-feeding type of packing.

In some instances where the rams have been closed about a tubing string for some considerable time there is a tendency for the resilient packing material to adhere or become vulcanized to the surfaces against which it has been forced into sealing engagement, that is, against the tubing circumference, the adjacent ram faces and the cylindrical bore of the ramway. This vulcanizing tendency causes serious trouble in withdrawing or retracting the rams.

In the construction disclosed in our application, namely, by molding or bonding the resilient packing element 36 to the serrated faces of the follower plate 34 and to the ram 35 we form a yieldable unitary plunger construction. These plunger assemblies are provided with a positive retracting connection to the actuating shafts 59. When these shafts are retracted or backed out they first release the pressure holding the packing in intimate sealing contact, thus breaking the vulcanizing effect described above, and subsequently exerting a pull on the complete unit, packing included, which allows the assembly to be freely withdrawn from the surfaces to which it has adhered. Consequently our device reduces or eliminates this source of annoyance and trouble.

Sufficient space 71 behind the plunger assembly is provided to retract said plunger assembly to allow free access to the full opening in casing 12 when desired or necessary.

While only a typical preferred form and application of our invention has been herein disclosed, we do not wish to be limited or restricted to the specific details set forth and wish to reserve to ourselves any further embodiments, modifications and variations that may appear to those skilled in the art or fall within the scope of the appended claims.

Having described our invention, we claim:

1. In a blow-out preventer adapted to abut an object to seal an opening against pressure, including a housing integrally formed with a pair of oppositely disposed laterally extending cylindrical bores, a plunger assembly in each cylindrical bore, comprising a follower plate provided with serrated surfaces on its inner end face, a ram encircling said plate, formed with a recess therein, and shaped to conform to the external contour of said abutting object at its forward or inner end, a resilient packing element molded into the recess in said ram and bonded to the serrations in said follower plate to form a yieldable unitary structure, said ram and follower plate being relatively movable, means secured in abutting contact with said ram and freely encircling said follower plate to limit its axial movement, and a manually operated screw threaded shaft adapted to bear against the outer end of said follower plate to exert external force to urge said plunger assemblies forwardly to compress and outwardly expand said resilient element into sealing engagement about said abutting object and establish a pressure in said packing element of a value greater than that in the opening to be sealed.

2. In a blowout preventer for controlling or sealing off the flow of fluid under well pressure about a tubing passing therethrough including a housing integrally formed with a pair of oppositely disposed laterally extending cylindrical bores, a plunger assembly in each cylindrical bore, comprising a ram, a follower plate, a resilient packing element molded with and bonded to said ram and follower plate respectively to form a yieldable unitary structure, and annular retaining means secured in abutting contact with said ram and freely encircling said follower plate to limit its axial movement, a passageway below said packing element to allow well fluid pressure to communicate with said bore and actuating means secured to and in axial alignment with said follower plate and adapted to exert external force to urge said assemblies towards said tubing to compress and outwardly expand said resilient packing element and establish a pressure in said element of a value greater than that of the said well pressure existing about said tubing to be sealed, the same actuating means being adapted to retract said plunger assemblies, whereby said assemblies may be moved to retracted position by first releasing the surface contact pressure of the packing.

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