June 7, 1932. C. A. RASMUSSEN 1,861,755

BLOW-OUT PREVENTER AND WELL SEALING MEANS

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Fig. 1.

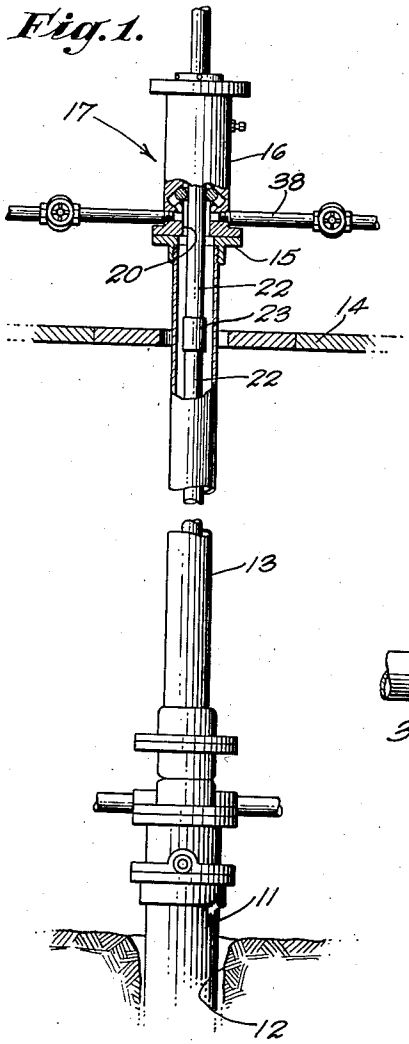


Fig. 2.

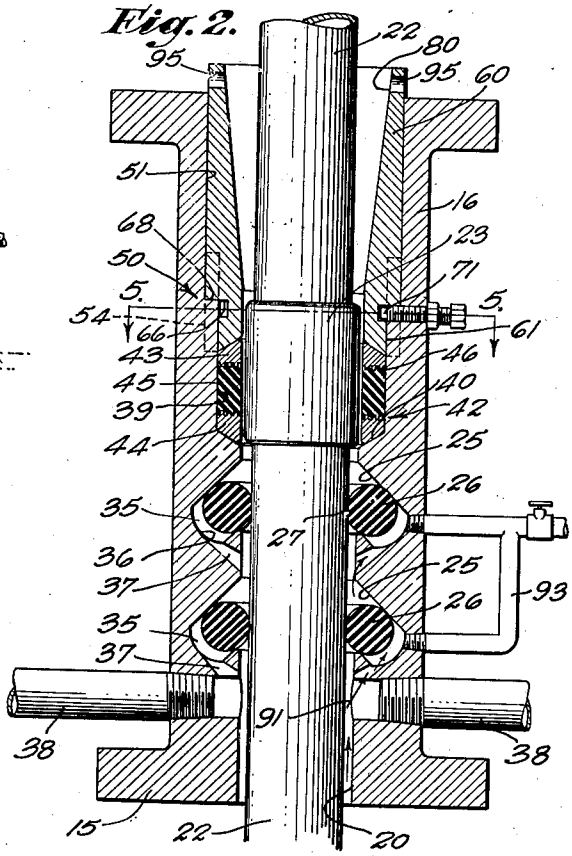


Fig. 8.

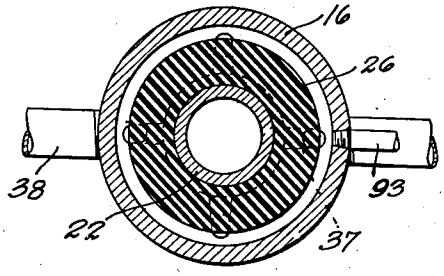
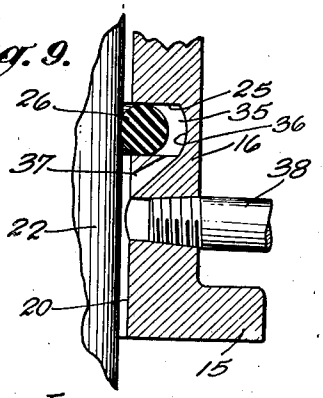


Fig. 9.



INVENTOR:
CHESTER A. RASMUSSEN.
BY
Fud W. Mann
ATTORNEY.

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BLOW-OUT PREVENTER AND WELL SEALING MEANS

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Fig. 3.

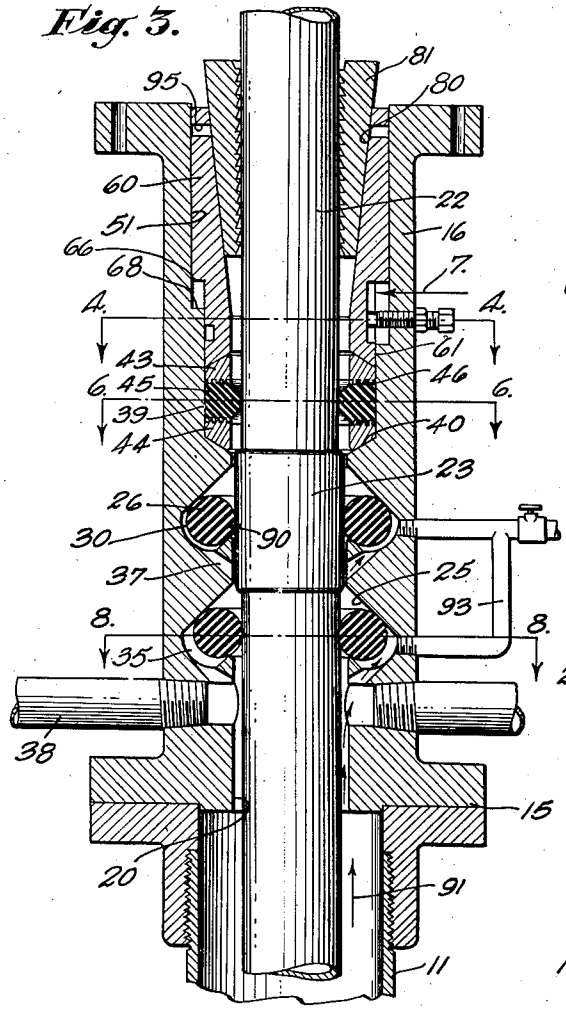


Fig. 7.

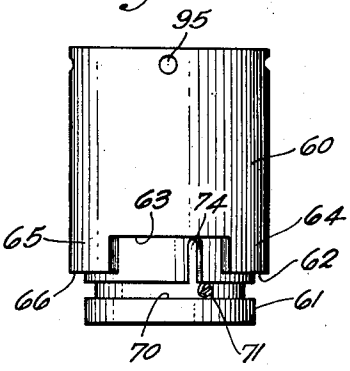


Fig. 4.

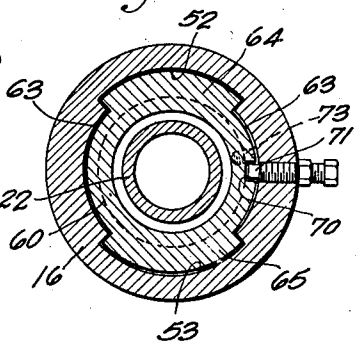


Fig. 5.

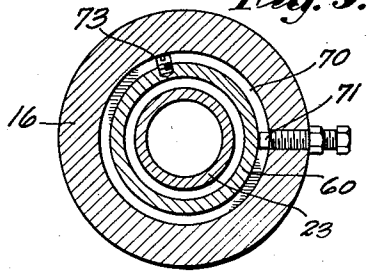
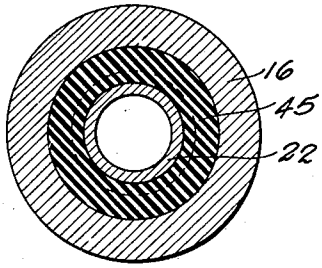


Fig. 6.



INVENTOR:
CHESTER A. RASMUSSEN
BY

Fred W. Lamm

ATTORNEY.

June 7, 1932. C. A. RASMUSSEN 1,861,755

BLOW-OUT PREVENTER AND WELL SEALING MEANS

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Fig. 10.

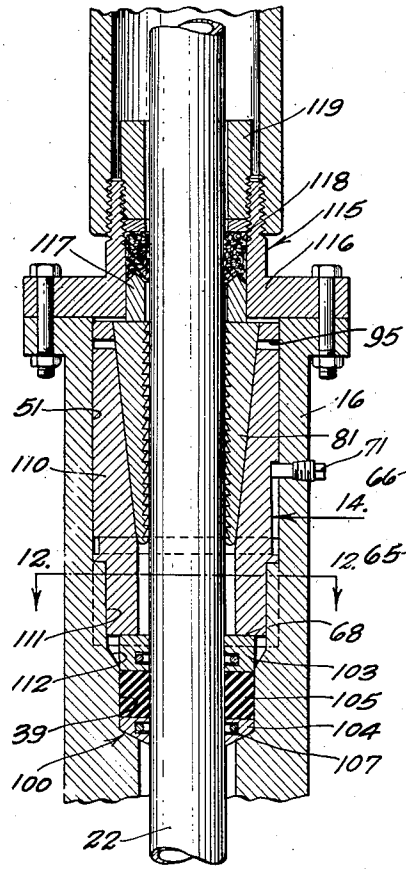


Fig. 14.

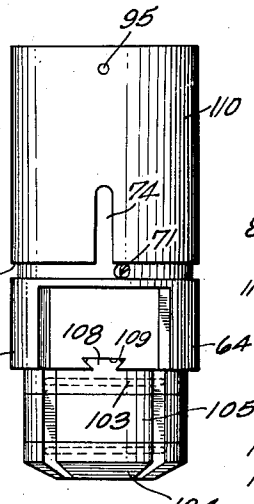


Fig. 11.

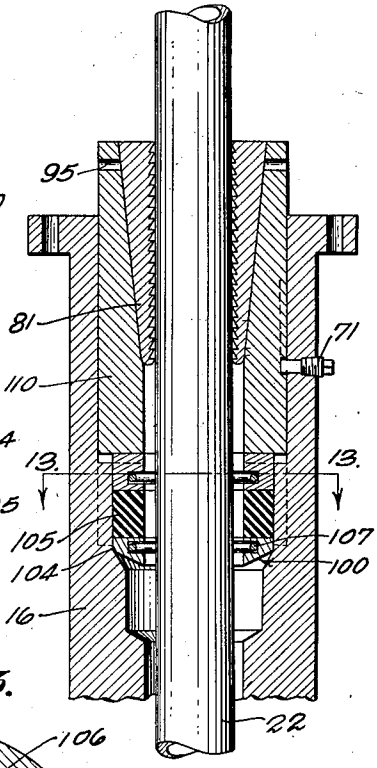


Fig. 13.

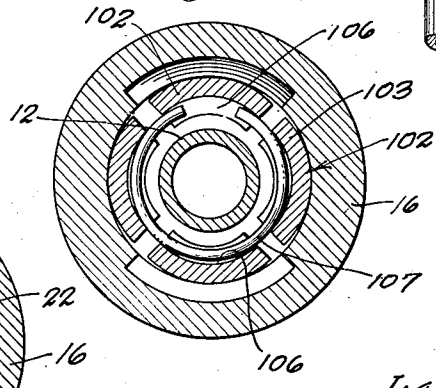
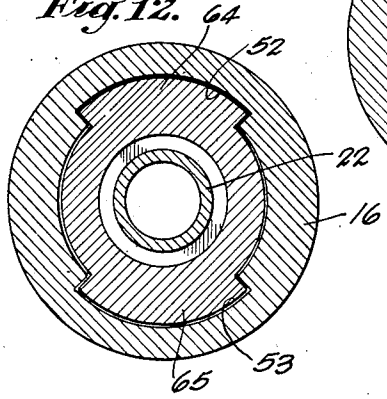


Fig. 12.



INVENTOR:
CHESTER A. RASMUSSEN
BY
Fred W. Lamm
ATTORNEY.

Patented June 7, 1932 1,861,755

UNITED STATES PATENT OFFICE

CHESTER A. RASMUSSEN, OF LONG BEACH, CALIFORNIA, ASSIGNOR OF ONE-HALF TO WILLIAM A. TROUT, OF LOS ANGELES, CALIFORNIA

BLOWOUT PREVENTER AND WELL SEALING MEANS

Application filed January 7, 1931. Serial No. 507,104.

My invention has to do with the oil well drilling industry and is embodied in a blowout preventer which includes a sealing means automatically operable to constantly seal the upper end of an oil well casing while offering no obstacle to the raising, lowering, or rotation of the drill pipe or casing.

It is of course understood by those familiar with the art that a blowout preventer is installed at the top of a well before the well is "brought in". Ordinarily after the casings are installed the well is "swabbed" to remove the circulating mud fluid, thereby lowering the hydrostatic pressure in the well and allowing the pressure within the well to cause the oil to flow. In case of a high pressure in the formation it is necessary to close the blowout preventer very quickly. Quite often no warning is given when the well "comes in" and it is impossible to close a manually operable blowout preventer because there is insufficient time. Some of the well known automatic blowout preventers in use at the present time have been known to fail to seal a well because during the slight elapse of time necessary for the sealing means to close, the flow of the oil, gas, and sand had corroded the closing parts of the blowout preventer to such an extent that the seal was ineffectual.

To overcome the disadvantages of the present blowout preventers, my invention provides a plurality of sealing members which are constantly closed around the drill pipe during the drilling operations necessary for penetrating the oil formation, or for the swabbing operation just described, and through which the well tubing may be raised and lowered without interrupting the seal.

It is an object of my invention to provide means of directing the fluid pressure built up within the well casing against these sealing members in such a manner as to compress the sealing members more tightly around the well tubing. By this novel method the greater the well pressure after the well "comes in", the more efficient will be the grip of the sealing members around the well tubing.

A further provision of the invention is that my blowout preventer includes an additional mechanical packing means which may be brought into operation after the flow of oil, gas, and sand has been stopped.

Another object of the invention is to provide a mechanical packing means of this character which includes pipe engaging means adapted to grip the well tubing or casing so that the weight of the well string may be suspended thereby.

A still further object of my invention is to provide a packing means of this character in which the packing element included therein is operable by the weight of the well string thereon.

Another object is to provide lock means included in the packing means normally preventing the operation of the packing element so that the weight of the well string may be supported on the packing means without causing the packing element to operate to grip the tubing.

These and other objects will be apparent from a perusal of the following part of the specification, the accompanying drawings, and the appended claims.

Referring to the drawings,—

Fig. 1 is an elevational utility view, partly in section, showing the blowout preventer comprising my invention installed on the upper end of a conventional well casing.

Fig. 2 is a vertical section through my blowout preventer showing the mechanical packing means included therein in an operative position.

Fig. 3 is a vertical section comparable to Fig. 2 but showing the packing means in an operative position.

Fig. 4 is a horizontal section taken as indicated by the line 4—4 of Fig. 3.

Fig. 5 is a horizontal section taken as indicated by the line 5—5 of Fig. 2.

Fig. 6 is a horizontal section taken as indicated by the line 6—6 of Fig. 3.

Fig. 7 is an elevational view of a gland member included in the packing means of the invention, this view being taken as indicated by the arrow 7 of Fig. 3.

Fig. 8 is a horizontal section taken as indicated by the line 8—8 of Fig. 3.

Fig. 9 is a fragmentary sectional view com-

parable to the lower portion of Fig. 2 but showing an alternative form of sealing member.

Fig. 10 is a vertical section through my blowout preventer showing an alternative form of mechanical packing means. In this view the moving parts of this packing means are shown in an inoperative or normal position.

Fig. 11 is a vertical section comparable to Fig. 10 but showing the relative parts in an operative position.

Fig. 12 is a horizontal sectional view taken as indicated by the line 12—12 of Fig. 10.

Fig. 13 is a horizontal sectional view taken as indicated by the line 13—13 of Fig. 11.

Fig. 14 is an elevational view of the gland member included in this form of packing means, this view being taken as indicated by the arrow 14 of Fig. 10.

Referring first to Figs. 1 and 2 of the drawings, the numeral 11 represents a well casing positioned in a well 12. Connected to the upper end of the casing 11 by a fitting of any preferred type is a pipe 13 of reduced diameter, commonly termed an "oil string", extending to a point above a derrick floor 14. Threadedly connected to the upper end of the casing 13 is a flanged fitting 15 to which a flanged body 16 comprising the body portion of my blowout preventer, generally designated by the numeral 17, is secured. The body portion 16 is provided with a vertical bore 20 through which a well string, comprising sections of tubing or casing 22 connected by couplings 23, extends.

Provided in the bore 20 of the body portion 16 is a plurality of annular recesses 25 adapted for the reception of annular sealing rings 26 which are formed of an elastic material, preferably rubber. The sealing rings 26 are of such diameter that the inner surface 27 closely contacts the periphery of the well tubing or casing 22. The annular recesses 25 are of such depth as to allow considerable displacement of the body of the ring 26. This permits the sealing ring to be stretched into the position indicated at 30 in Fig. 3 when the coupling 23 is moved downwardly or upwardly therethrough.

Although the recesses 25 are shown as sloping downwardly at an oblique angle relative to the longitudinal axis of the bore 20, it should be understood that this is not essential to the invention. The recesses 25 might be formed horizontally, as shown in Fig. 9, and would operate satisfactorily if provided with sealing rings of proper proportions and therefore I do not intend that the scope of my invention shall be limited to the details of construction of any single form of the invention herein shown and described.

Annular spaces 35 between the outer peripheries of the sealing rings 26 and the bottoms 36 of the recesses 25 are in open communication with the bore 20 through the medium of a plurality of passages 37 provided substantially in the manner shown. Threadedly connected to the body member 16 directly below the lowermost sealing member are two or more of laterally extending valved oil lines 38 adapted to convey oil and gas from the well to a remote place of storage.

At a point directly above the uppermost sealing member the bore 20 is enlarged as shown at 39 to form an upwardly facing ledge 40 upon which rests a packing element 42 slidably positioned in the bore 39. This form of packing element 42 comprises a pair of metal end rings 43 and 44 between which is confined a packing ring 45 formed of a suitable compressible material such as rubber. The rubber ring 45 is preferably molded to the end rings 43 and 44, there being serrated grooves provided in these rings into which the rubber is molded as indicated at 46 in Figs. 2 and 3. In the drawings the ledge 40 and the upper and lower faces of the metal end rings 43 and 44 are shown as being conical in form. This, however, is immaterial as a horizontally extending ledge 40 and a packing element having flat upper and lower faces would be satisfactory in this form of my invention.

At a point, indicated at 50 in Fig. 2, somewhat above the upper surface of the end ring 43, the bore 39 is enlarged to form a bore 51 which extends to the top of the body member 16. The portion of the bore 39 that is adjacent to and immediately above the end ring 43 of the packing element 42 is provided with a pair of oppositely disposed dovetail slots 52 and 53 best shown in Fig. 4, these slots being of such a depth as to form continuations of the bore 51 as indicated in Fig. 2 by the dotted lines 54.

Slidably positioned in the bore 51 is a gland member 60 in the form of a sleeve having a reduced diameter portion 61 adapted to be received in the bore 39. A downwardly facing shoulder 62, formed by the reduced diameter portion 61, is cut away, as best shown at 63 in Figs. 4 and 7, to form a pair of diametrically disposed dovetail tongues 64 and 65 adapted for reception into the grooves 52 and 53 in the bore 39.

In its normal position the gland 60 is positioned in the bore 51 so that the lower faces 66 of the tongues 64 and 65 rest upon the upwardly facing shoulders 68 formed between the grooves 52 and 53. In order that downward movement of the gland 60 relative to the body 16 may occur, it is clear that the gland 60 must be rotated so that the tongues 64 and 65 thereon are in register with the grooves 52 and 53. For the purpose of facilitating this register I provide an annular groove 70 in the portion 61 of the sleeve gland 60, into which a pin 71 extends, this pin threadedly engaging the body 16 as shown.

Provided in the groove 70 is a stop post 73 suitably positioned so that when the gland 60 is rotated from its normal position, shown in Figs. 2 and 5, into its operative position, shown in Figs. 3 and 4, the stop 73 will engage the pin 71, thus assuring perfect alignment between the tongues 64 and 65 and the grooves 52 and 53.

Formed adjacent the stop 73 in the gland 60 is an upwardly extending slot 74 to accommodate the pin 71 when the gland is moved downward.

The interior surface of the sleeve gland 60 is conical in form, as shown at 80 in Figs. 2 and 3, for the reception of slips 81 adapted to grip the drill pipe 22 in a well known manner.

It is apparent that my invention should not be too closely limited to the details of construction just described for although I have shown a dovetail tongue and groove arrangement between the gland 60 and the body 16, numerous equivalent structures could be devised and substituted which would still come within the scope of the invention.

The operation of my invention is as follows. When for any reason it is desired to form a seal around a pipe extending into a well, for instance during a swabbing operation which necessitates the reciprocation of the pipe in the well casing, my blowout preventer 17 may be installed in the casing 11 with the moving parts of the device in the relative positions shown in Fig. 2. It will be seen that the sealing rings 26 which are constantly stretched tightly around the periphery of the pipe 22 offer no material resistance to the reciprocation thereof and allow the passage of the coupling 23 in the manner shown at 90 in Fig. 3, the ring 26 being stretched to accommodate the diameter of the coupling and being forced outwardly into the recess 25. As the pressure within the well casing 11 builds up, this pressure is exerted to press the sealing rings inwardly against the pipe 22 in the manner indicated by the arrows 91 of Figs. 2 or 3. It will be understood that only such fluid pressure as leaks past the lowermost sealing ring 26 is exerted in this manner upon the upper ring or rings. It is, of course, apparent that any desired number of the sealing rings may be used. In formations where the pressures are known to be very high my blowout preventer may be equipped with several of the sealing rings 26 and the recesses 25. If desired, fluid pressure may be introduced into the spaces 35 of the recesses 25 from a suitable pressure source through a valved pipe line 93 threadedly connected to the body 16, as shown in Fig. 2.

If it is desired to temporarily suspend the pipe 22 in the well during the swabbing operations or while coupling up an additional length of pipe to be "run in" the well, the working parts of the blowout preventer are positioned as shown in Fig. 2 and the slips 81 are inserted in the conical bore 81 of the gland 60. The slips 80 grip the pipe and carry the entire weight thereof, these slips being in turn supported by the gland 60.

When the above described operation is completed and it is desired to permanently suspend the pipe 22 in the well and to provide a packing therearound, the gland 60 is rotated from the position shown in Fig. 5 to the position shown in Fig. 4, as before described, by a tool inserted into the openings 95 provided therein for this purpose. The slips 81 are then inserted, as before, and the weight of the string of pipe 22 is suspended on the gland 60 which moves downwardly and compresses the packing ring 45, distending it into the pipe engaging position shown in Fig. 3.

Referring to Figs. 10 to 14 inclusive, I show an alternative form of mechanical packing means. For the purpose of simplifying the description of these figures I will designate similar parts with numerals identical with those used in the description of the previously described form.

In this form a mechanical packing element 100 is used which is formed of a plurality of segments 102, each segment comprising upper and lower end pieces 103 and 104 between which is confined a compressible portion 105 formed preferably of rubber. When the packing element 100 is positioned in the bore 39, as shown in Fig. 10, the segments 102 form a fully circular ring which closely surrounds the pipe 22. Each of the segments is provided with a groove 106 cut in the inner surface thereof, these grooves cooperating to form an annular channel for the reception of a circular spring 107 which tends to force the segments 102 outwardly, as indicated in Fig. 13. The upper end ring 103 of each segment 102 is provided with a dovetail tongue 108 adapted for slidable engagement with a dovetail groove 109 formed in the lower surface of a gland 110, which is comparable to the gland 60. The grooves 109 and the tongues 108 are formed radially in a horizontal plane relative to the longitudinal axis of the bore 39 of the body 16 so that the segments 102 are horizontally slidable from the open or normal position shown in Figs. 11 and 13 to the closed or pipe engaging position shown in Fig. 10. In this form an intermediate bore 111 is formed in the body 16 between the bore 39 and the bore 51, this bore being of larger diameter than the bore 39 to form a conical cam surface 112 and being of smaller diameter than the bore 51, and having the dovetail grooves 52 and 53 formed therein to provide the upwardly facing shoulders 68 upon which the lower faces 66 of the tongues 64 and 65 rest

when the packing element 100 is in its inoperative position shown in Fig. 11.

In the operation of this form of my invention the weight of the tubing may be suspended on the gland 110 by use of the slips 81 in exactly the same way as in the previously described form, the moving parts of the device being positioned as indicated in Fig. 11. It will be seen that the gland 110 is supported on the shoulders 68 and that the packing element is withdrawn from the bore 39 and is in a fully open position within the bore 111, the segments 102 being spread by the spring 107 as shown in Fig. 13. When it is desired to bring the packing element into operative position, the gland 110 is rotated relative to the body 16 until the tongues 64 and 65 are in register with the grooves 52 and 53 and the weight of the tubing 22 is suspended thereon. When this occurs the gland 110 will move downwardly and the segments 102 will be forced inwardly by the cam surface 112 until fully closed, whereupon the packing element 100 will move downwardly into the bore 39 to the position shown in Fig. 10. It will be understood that the weight of the pipe 22 compresses the rubber portions 105 causing them to distend in such a manner as to form a fluid-tight seal between the bore 39 and the pipe 22.

If desired, additional packing means may be installed at the upper end of the body 16. In Fig. 10 I show a packing means 115 comprising a flanged fitting 116 secured as shown to the body 16, this fitting 116 confining a retaining ring 117 which rests upon the upper surfaces of the slips 81 and against which a body of packing 118 is compressed by a gland 119 threadedly engaging the fitting 116 as shown.

Although I have herein described two operable embodiments of my invention, it should be understood that I am aware that other forms thereof might be devised without departing from the spirit and scope of my invention.

I claim as my invention:

1. In a blowout preventer of the character described the combination of: a body connected to the upper end of a well casing; walls forming an opening in said body through which a sectional member connected by couplings is freely passable; a plurality of elastic sealing members contacting said sectional member within said opening, said sealing members being capable of stretching to allow the passage of said couplings therethrough; means for directing the fluid pressure within said casing against said sealing members to force said sealing members into pressural contact with said sectional member; a packing element surrounding said sectional member within said opening and being operable by the weight of said sectional member thereon to distend into engagement with said sectional member; and means for suspending the weight of said sectional member on said packing element.

2. In a blowout preventer of the character described the combination of: a body connected to the upper end of a well casing; walls forming an opening in said body through which a sectional member connected by couplings is freely passable; a plurality of elastic sealing members contacting said sectional member within said opening, said sealing members being capable of stretching to allow the passage of said couplings therethrough; means for directing the fluid pressure within said casing against said sealing members to force said sealing members into pressural contact with said sectional member; a compressible packing element surrounding said sectional member and being supported by a ledge formed within said opening; and a gland member slidable in said opening and contacting said packing element, said gland member being adapted for connection with said sectional member by insertable slips to cause the weight of said sectional member to be supported by said packing element and cause said packing element to distend into engagement with said sectional member.

3. In a blowout preventer of the character described the combination of: a body connected to the upper end of a well casing; walls forming an opening in said body through which a sectional member connected by couplings is freely passable; a plurality of elastic sealing members contacting said sectional member within said opening, said sealing members being capable of stretching to allow the passage of said couplings therethrough; means for directing the fluid pressure within said casing against said sealing members to force said sealing members into pressural contact with said sectional member; a compressible packing element surrounding said sectional member and being supported by a ledge formed within said opening; a gland member slidable in said opening and contacting said packing element, said gland member being adapted for connection with said sectional member by insertable slips to cause the weight of said sectional member to be supported by said packing element and cause said packing element to distend into engagement with said sectional member; and lock means operable by a rotation of said gland member relative to said body to prevent said gland member from longitudinal movement in said opening.

4. In a blowout preventer of the character described the combination of: a body connected to the upper end of a well casing; an opening in said body through which a sectional member connected by couplings is freely passable; a plurality of elastic sealing

members contacting said sectional member within said opening, said sealing members being capable of stretching to allow the passage of said couplings therethrough; means for directing the fluid pressure within said casing against said sealing members to force said sealing members into pressural contact with said sectional member; a compressible packing element surrounding said sectional member and being supported by a ledge formed within said opening; a gland member slidable in said opening and contacting said packing element, said gland member being adapted for connection with said sectional member by insertable slips to cause the weight of said sectional member to be supported by said packing element and cause said packing element to distend into engagement with said sectional member; and lock means operable by a rotation of said gland member relative to said body to permit the weight of said sectional member to be suspended by said gland member without distending said packing element.

5. A blowout preventer of the character described: a body adapted for connection with the upper end of a well casing and having an opening therein through which a sectional member connected by couplings is freely passable; an elongated recess provided by said body, a sealing member disconnectedly situated within said elongated recess, fluid pressure means for urging the sealing member into engagement with the sectional member to seal said opening, said elongated recess permitting the stretching of the sealing member within the recess when the sealing member is engaged by the couplings of the sectional member.

6. A blowout preventer of the character described: a body adapted for connection with the upper end of a well casing and having an opening therein through which a sectional member connected by couplings is freely passable; an elongated inclined recess provided by the body member, a resilient sealing element disconnectedly situated within said inclined elongated recess, means for applying fluid pressure to said sealing element to force the same into pressural engagement with the sectional member to seal said opening, said inclined elongated recess permitting the resilient sealing element to become distorted therein when the sealing element is engaged by the couplings of the sectional member.

7. A blowout preventer of the character described including: a body adapted for connection with the upper end of a well casing and having an opening therein through which a sectional member connected by couplings is freely passable; an elongated recess provided by the body member, a substantially cylindrically shaped, in cross-section, resilient sealing member mounted within said elongated recess, means for applying pressure to said sealing member to urge the same into contact with said sectional member to seal said opening, said elongated recess permitting the sealing member to be distorted within the recess when the same is engaged by the couplings of the sectional member.

8. A blowout preventer of the character described including: a body adapted for connection with the upper end of a well casing and having an opening therein through which a sectional member connected by couplings is freely passable; a plurality of inclined, upwardly extending elongated recesses provided by the body member, a plurality of packings located within said recesses and mechanically disconnected therefrom, means for applying fluid presure to said sealing elements to urge the same into contact with said sectional member to seal said opening, said elongated recesses permitting the disconnected sealing elements to be distorted within said recesses when engaged by the enlarged couplings of the sectional member.

9. A blowout preventer of the character described including: a body adapted for connection with the upper end of a well casing and having an opening therein through which a sectional member connected by couplings is freely passable; and sealing means operable by the fluid pressure within said casing to contact said sectional member to seal said opening, a packing element operable by the weight of said sectional member thereon to distend into engagement with said sectional member.

10. A blowout preventer of the character described, including: a body adapted for connection to the upper end of a well casing and having an opening therein through which a sectional member connected by couplings is freely passable; a plurality of elastic sealing members positioned within said opening and contacting said sectional member, said sealing members being capable of stretching to allow the passage of said couplings therethrough; means for directing the fluid pressure within said casing against said sealing members to force said sealing members into pressural contact with said sectional member to seal said opening; and a packing element positioned with in said opening and surrounding said sectional member and being operable by the weight of said sectional member thereon to distend into engagement with said sectional member.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 2nd day of January, 1931.

CHESTER A. RASMUSSEN.