

July 10, 1956

W. N. PHILLIPS

2,754,136

PRESSURE ACTUATED SEAL BETWEEN CONCENTRIC PIPES

Filed July 12, 1955

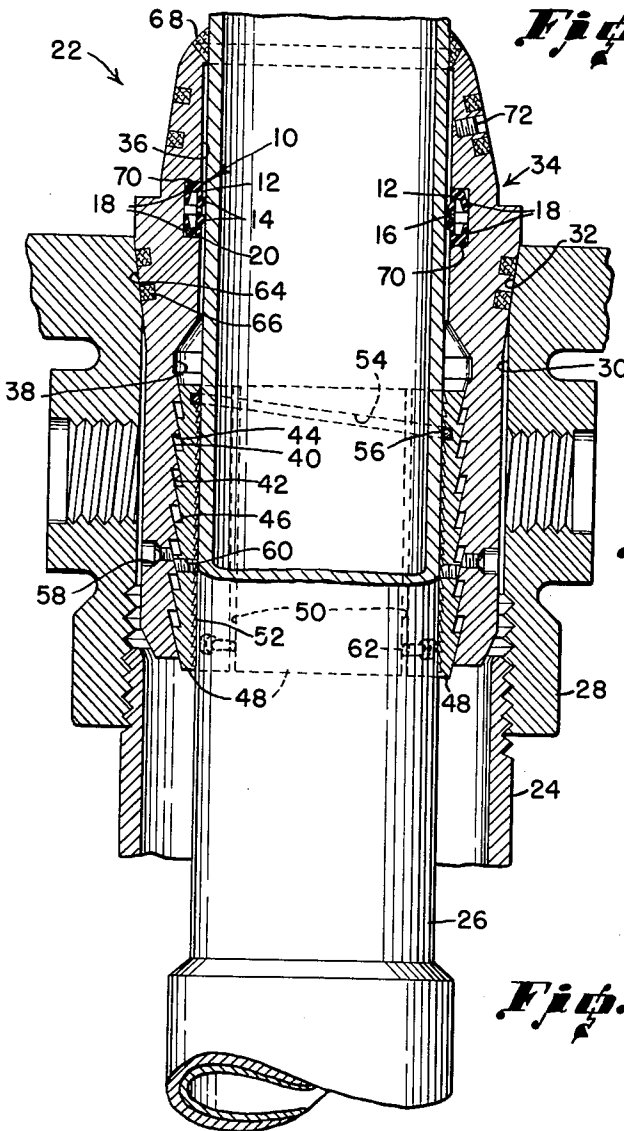


Fig. 1.

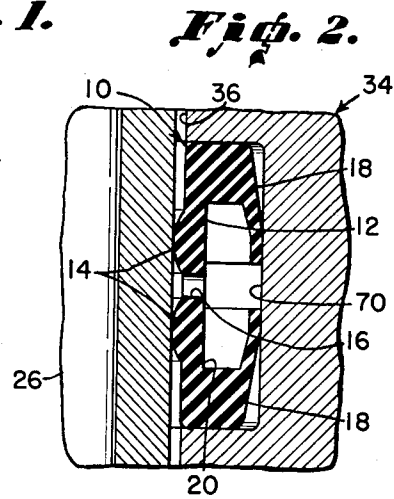


Fig. 2.

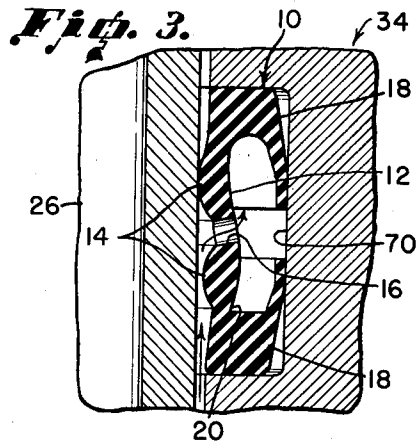


Fig. 3.

Fig. 4.

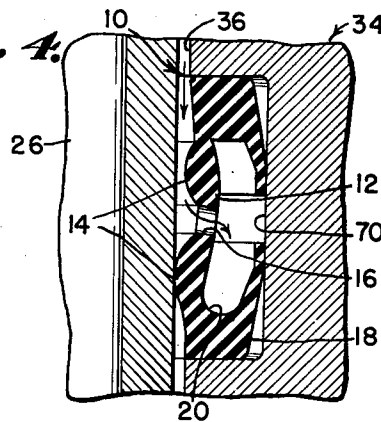
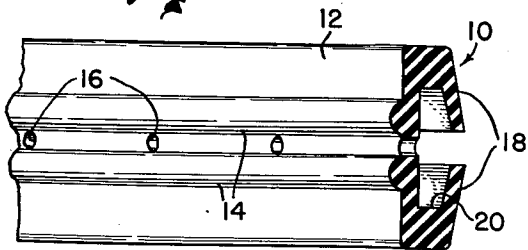


Fig. 5.



INVENTOR.

WILLIAM NEWTON PHILLIPS

BY

Cushman, Darby & Cushman
ATTORNEYS

1

2,754,136

PRESSURE ACTUATED SEAL BETWEEN CONCENTRIC PIPES

William Newton Phillips, Houston, Tex., assignor to Gray Tool Company, Houston, Tex., a corporation of Texas

Application July 12, 1955, Serial No. 521,439

2 Claims. (Cl. 285—106)

This invention relates to sealing elements and more particularly to improvements in sealing rings of the type adapted to form a pressure-tight seal between two complementary cylindrical surfaces, such as a well pipe and a hanger therefor.

The present invention constitutes an improvement upon the invention disclosed in copending application Serial No. 315,002, filed October 16, 1952, by John D. Watts and Elwood K. Pierce, Jr. In brief, the above-mentioned application discloses a novel sealing element or ring particularly adapted to be used in a hanger for suspending an oil well pipe in a well head. The sealing element provides for the forming of an effective seal at the instant the hanger is landed in the well head, which seal is strengthened or made more effective, depending on the pressure to which it is subjected, at the time the hanger is landed, or at any time when an increased pressure condition arises in the well either from above or below.

While the sealing element of the present invention is of general utility, like the sealing element disclosed in the aforesaid application, it is particularly adaptable for use in an oil well hanger. The invention may be employed, for example, with a hanger for use in building safe oil wells by the methods described in United States Patents Nos. 2,117,444, May 17, 1938, and 2,082,413, June 1, 1937, to Mueller and Yancey. The description of applicable structure and steps in operation which appear in these patents is not repeated in detail herein, it being understood that they are referred to as showing equipment and methods which would be used with the present invention and to that extent they form part of the present disclosure.

Further, United States Patent No. 2,207,469, to Royce, July 9, 1940, discloses a practice analogous to the said Mueller et al. patents but wherein provision is made for pulling the casing upwardly after the hanger is landed to remove the slack and put a strain on the casing, slip means being provided in the hanger to support the pipe after the strain has been taken. The present invention contemplates use of a hanger with the method of landing a casing as disclosed in the above-mentioned Royce patent but having further refinements of the practices disclosed therein. Therefore, the Royce patent is mentioned to disclose the details and description of an applicable structure in the operation of landing a casing in a casing head and such steps are not repeated herein in detail, it being understood that they are referred to as disclosing well known equipment and methods which would be used with the present invention, and to that extent they form part of the present disclosure.

Mueller et al. Patent No. 2,620,880, issued December 9, 1952, also disclosed equipment and methods which would be used with the present invention, and to that extent they form part of the present disclosure.

In the present application, reference is made to now well known control equipment, including master drilling valves and blowout preventers. It will be understood

2

that such control equipment as is referred to, is of the now recognized and standardized rated size, with respect to the casing on which it is mounted, and that such control equipment is of the full open type, having a bore therethrough substantially equal to the maximum diameter of the hanger seat above which it is mounted, whereby all operations requiring the full width of the casing previously landed may be carried out, through the control equipment, the construction of the equipment being such that the hanger may be passed through the control equipment to its seat, and the control equipment removed, while providing complete mechanical control of the well throughout all of the operations which are involved.

Accordingly, it is an object of the present invention to provide a sealing element of the type described which includes improved means for effecting a seal having a minimum contact with the sealing surface.

Another object of the present invention is the provision of a sealing element operable to contact a sealing surface so as to effectively seal the same but yet, to permit easy movement of the sealing surface with respect thereto.

A still further object of the present invention is the provision of a sealing element having improved means including spaced, interconnected, sealing surface contacting portions either one of which is operable in response to an increase of pressure to move out of contact with the sealing surface and permit the increased pressure to intensify the sealing contact of the other.

Still another object of the present invention is the provision of an improved sealing element particularly suited for use in a casing hanger to contact and seal with an oil well pipe being suspended, which is of such design that the pipe may be readily moved relative to the hanger without damaging the pipe contacting surfaces of the sealing element.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the accompanying drawings wherein an illustrative embodiment is shown.

In the drawings:

Figure 1 is a vertical sectional view through a portion of a well head, showing a casing hanger landed in a casing head, the casing hanger having the sealing element of the present invention incorporated therein for the purpose of illustrating one use to which the sealing element of the present invention is particularly suited;

Figures 2, 3 and 4 are enlarged, fragmentary cross-sectional views, showing the sealing action of the sealing element of the present invention in response to different pressure conditions; and

Figure 5 is a detailed fragmentary cross-sectional view of the sealing element.

Referring now more particularly to Figure 5 of the drawings, there is shown a sealing element or ring, generally indicated at 10, embodying the principles of the present invention. The sealing ring 10 is of expansible construction being made of rubber, synthetic rubber or rubber composition, such as neoprene. It is flexible and resilient, and of such design and construction that it may be expanded or deflected and distorted under pressure after which it will resume its normal relaxed condition.

In construction, the sealing ring includes what may be termed an outer annular wall 12, since in use, this wall is arranged to extend or face outwardly from the adjacent surface of the member within which it is mounted. This outer wall is relatively thin so as to be capable of flexible movement and includes a pair of integral, outwardly projecting annular beads 14 which function to contact a cooperating sealing surface during use. Beads 14 are

formed on the outer wall 12 in spaced relation on opposite sides of the center line thereof so that the central portion of outer wall 12 serves to integrally interconnect the two beads together. Extending through the central portion of outer wall 12 between beads 14 are one or more openings 16 which perform a function to be hereinafter more fully explained. The number of openings provided may vary with the size of the sealing ring, a preferred arrangement being shown in the drawings wherein one opening is provided every two or three inches around the circumference of the sealing ring. Moreover, the opening or openings 16 may assume various sizes and shapes, the preferred condition being that there remains sufficient material in the central portion of the outer wall to integrally interconnect the two beads.

Extending inwardly from opposite edges of the outer wall 12 are angular end walls 18, each of which includes a relatively thick portion integral with an edge of the outer wall and an inwardly extending lip portion integral with the relatively thick portion. The sealing ring is thus of hollow construction, the outer wall 12 and end walls 18 defining an annular chamber 20 adapted to receive operating pressures through openings 16 when in use. As shown, the free ends of the inwardly extending lip portions of end walls 18 are preferably spaced apart so that they may be more easily deflected into contact with a surrounding surface during use. However, it will be understood that the free ends of the lip portions may be integrally joined so that chamber 20 will be completely enclosed, except for openings 16, by the ring itself. In other words, with the construction shown, the lip portions cooperate with a surface of the member within which the sealing ring is mounted, to provide a pressure-tight chamber, but such pressure-tight chamber may be provided entirely by the sealing ring itself by extending a solid inner wall between the edges of the thickened portions of the end walls. While the lip portion construction shown is preferred, the latter arrangement is within the concept of the present invention.

With the above in mind, it will be readily apparent that the sealing ring of the present invention has general utility in providing a seal between any two relatively movable members having cooperating cylindrical surfaces. For example, the sealing ring may be employed to effect a seal between a piston and cylinder or the like. However, in order to clearly illustrate the advantages of the present invention, there is shown in Figures 1-4 one application to which the present invention is particularly suited wherein the same is incorporated in an oil well completion assembly, generally indicated by the numeral 22.

Referring now to Figure 1, the assembly 22 comprises an outside casing 24, and an inside casing string 26 is shown landed within the outside casing. On the outside casing, there is the usual casing head 28 having a full open bore 30 therethrough and an upwardly and outwardly flaring hanger seat 32 at the upper end of its bore. Mounted on the casing head, as by flange or other suitable type connections, is now conventional control equipment (not shown) having a bore substantially equal to the maximum diameter of seat 32. The items of control equipment may vary depending on the well which is being built, and may comprise simply a blowout preventer, or a pair of blowout preventers or the usual master drilling valve plus one or more blowout preventers. A hanger, generally indicated at 34, of the type described in the aforesaid Watts et al. application, Serial No. 315,002, is provided between the inside casing string and outside casing whereby the former is hung on the latter. After the well has been drilled through the casing 24, the inside casing string 26 is lowered through the control equipment, and at the proper time, the hanger 34 is slidably positioned on the casing 26, and lowered to its position to seat and seal in the casing head 28. At this time, the control equipment may be removed, it being understood that the casing 26 is provided with the

usual inside control means comprising a removable back pressure valve. Thereafter, further casing may be run, involving the mounting of another casing head, or tubing may be run, the latter operation involving the mounting of a tubing head.

The hanger 34 comprises a body having a bore 36 extending therethrough, this bore being slightly larger than the outside diameter of the inner casing 26, in order that it may be slidably positioned thereon. There is an enlarged counterbore 38 in the hanger which extends throughout the length of the depending shank portion of the hanger and to the lower end thereof. The inner wall of this counterbore is formed to receive and support the slip assembly, the construction of the wall of the counterbore and that of the slip segments which form the slip assembly, being described and claimed in a copending application of John D. Watts and Elwood K. Pierce, Jr., entitled, "Oil Well Hanger Assembly," Serial No. 313,706, filed on October 8, 1952. The interior wall of the counterbore 38 is formed with a continuous spiral surface having downwardly and inwardly inclined slip guiding areas 40 positioned one above another in vertical alignment. Similarly and exactly cut inclined exterior areas 42 are provided on the outer walls of the slip elements. The areas 40 on the wall of the counterbore are separated by continuous downwardly presented horizontal spiral cut ledges 44, and the guiding areas 42 on the slips are separated by similarly formed ledges 46. The areas 40 and 42 are formed by spiral surfaces of fixed lead, the areas 40 extending from the upper end of the counterbore to the lower open end thereof so that the slip assembly can be threaded upwardly into the counterbore, through a lower end thereof and the hanger can be unthreaded from the slip assembly as described in copending application of Watts and Pierce, Serial No. 313,706, as referred to above. The areas 40 and 42 and the ledges 44 and 46 are cut or formed as described in Mueller et al., Patent No. 2,624,413.

As described in the Watts et al. application just referred to, there are four arcuate slip segments 48 which make up the slip assembly, and they are separated from one another by slots 50. In cutting the slots between the segments, sufficient of the metal may be removed so that the slip segments may move toward one another as they grip the pipe, during their movement from a retracted position to the operative position of Figure 1. The movement of the slips, between retracted and operative positions, is a limited vertical and inward movement of the slip segments, which is permitted by the formation of the inner wall of the counterbore and the formation of the outer walls of the slip segments, as previously described. The inner faces of the slip segments are formed with upwardly presented gripping teeth 52, which grip and suspend the pipe in the usual manner, as is well known in the art. When the hanger is landed in the casing head, and when the usual upward support of the derrick on the casing 26 is released, the slip segments are caused by the casing to slide downwardly controlled by the engagement of the surfaces 40 and 42, and as the segments move downwardly, they move inwardly whereby their teeth engage the casing to support and suspend the same.

As described in the Watts et al. application Serial No. 313,706, referred to, the inner faces of the slip segments may also be formed with a groove 54, as shown in dotted lines in Figure 1, which is continuous from one segment to another when same are in proper alignment, the said groove being out of phase with the outside spiral surfaces 42 of the slip segments, extending for approximately two complete turns around the interior wall of the slip assembly, and a spring wire 56 is inserted into this groove before inserting the slip assembly into the hanger, in order to properly align the slip segments with respect to one another. Thereafter, and as described in the copending application, Serial No. 313,706 of Watts and Pierce referred to, the slip assembly may be threaded

5

upwardly into the counterbore of the hanger, to its proper position. At this time, locking or set screws (not shown) may be threaded through openings 58 extending through the shank of the hanger and into threaded openings 60 in the body of the slip segments, in order to lock the slip segments in their retracted position. As disclosed in the Royce patent referred to above, when the hanger is initially slidably positioned over the casing, the set screws are removed from the openings 58 and 60, before sliding the hanger downwardly through the control equipment, thereby releasing the slip segments for downward movement, when the hanger reaches the landed position, as shown in Figure 1.

The shank of the hanger is provided with suitable openings through which guide screws 62 are threaded after the slip assembly is initially installed to proper position within the counterbore of the hanger body. These guide screws pass between the adjacent edges of the slip segments defining slots 50, and when so positioned, they restrain the slip segments 48 against any unthreading movement.

With the construction as described, the slip assembly may be assembled into a unit and threaded upwardly into the counterbore of the hanger body and the guide screws 62 and the set screws may be installed to hold the slips in their proper retracted positions. Upon removal of the set screws, the hanger may be passed downwardly through the control equipment to its seat. When the tension of the casing 26 is released, the slip segments move downwardly to the position of Figure 1, to grip and support the casing in the well head. At this time, a seal is formed between the outer wall 64 of the hanger with its well known packing rings 66, and the seat 32 of the casing head as shown in Figure 1. At the same time, a seal is formed between the bore of the hanger and the outer wall of the casing 26, as hereinafter described. It will be understood that the hanger may be reset, if the initial setting is unsatisfactory, as described in the copending application of Watts and Pierce, referred to above.

The shank portion of the hanger body is of relatively great length, and the slip segments themselves, are of relatively great length, as compared with hangers of this type known in the art. The suspension area where the slips engage the casing 26, is positioned below the suspension area where the hanger engages the seat of the casing head.

Upon removal of the control equipment, and prior to the mounting of the next tubing or casing head, as described in the prior patents and applications previously referred to, the hanger may be permanently secured to and sealed to the casing, as by welding the same as indicated at 68 in Figure 1. Such a welding operation is customarily performed after the control equipment is removed and when the casing is supported by the slip segments, the hanger being in turn supported in the bowl of the casing head. Another practice for permanently sealing the hanger to the casing is disclosed in Mueller et al., Patent No. 2,620,880, issued December 9, 1952. In that patent, a hanger and associated means are disclosed, providing for the cold rolling of the casing into permanent sealing engagement with the hanger in order to form a permanent union between the casing and the hanger. The details and description of applicant's structure and the steps in the operation which appear in the application just mentioned above, are not repeated herein, it being understood that they are referred to as disclosing equipment which could be used with the present invention, and to that extent they form a part of the present disclosure.

The sealing ring 10 of the present invention may be utilized to provide for effectively sealing the space through the bore of the hanger around the casing 26 at the instant the hanger is landed and when it assumes the support of the inner casing. The ring 10 is automatically operable to seal the well and is actuated and made more

6

intense by any pressure which may exist in the well. To this end, an enlarged annular recess 70 is preferably formed in the bore 36 of the hanger between the welding point 68 and the counterbore 38. This recess is of substantial depth, and is preferably located above that thickest portion of the hanger which seats in and seals in the bowl of the casing head. The recess is shown in the drawings as having a straight inner wall and straight bottom and top walls. There may be some variation in the shape of this recess, for example, the inner wall may be curved in the manner indicated in the Watts et al. application, Serial No. 315,002, mentioned previously.

The sealing ring 10 is of such size that it snugly fits within the recess 70, substantially filling the same with the beads 14 protruding slightly beyond the recess in order to engage the well casing 26. The design of the sealing ring is such that an initial circumferential tension maintains it in contact against the casing 26, as shown in Figure 2, under neutral conditions, whereby a constant low pressure seal is provided. Under these conditions, there is also an initial radial compression of the sealing ring against the inner wall of the recess 70. These sealing contacts as just referred to, are present even if the inner casing or pipe is oversize, undersize, or if it is off-center with respect to the hanger bore.

When the hanger is applied to a well casing or other pipe and when it is lowered through the control equipment to its seat, the sealing ring normally maintains the shape for which it was designed, as shown in Figures 2 and 5, and in the absence of an excess of pressure either above or below the sealing ring. If the well is quiet, the hanger is lowered through open control equipment, and the sealing element will not be subjected to pressures which would distort it from its normal or relaxed condition. If some pressure exists in the well, it might be that the upper blowout preventer would be closed after the hanger is passed below the same, but prior to actual landing of the hanger, pressure exerted upon the sealing element from below and above the same are equalized.

Assuming that some pressure condition exists in the well immediately upon the landing of the hanger in the seat of the casing head, that pressure within the casing 24 of the well, or other casing above which the hanger is being landed, immediately exerts its full effect upwardly through the bore of the hanger and upon the sealing ring, to distort the same into intense sealing condition, as is illustrated in Figure 3. Thus, when the hanger is landed, any upward passage of well pressure exteriorly of the hanger, is prevented by reason of the seal formed by the outer wall 64 and packing rings 66 of the hanger when it lands on the casing head seat 32, but at this time fluid under pressure may pass upwardly through the bore of the hanger past the slip segments 48, and when this pressure reaches the sealing ring 10, and if it is of sufficient intensity, it will deflect the lower bead 14 below the opening 16, inwardly of the recess 70, thus exposing the opening or openings 16 to the well pressure and permitting same to enter the pressure chamber 20 within the sealing ring, as is shown in Figure 3 by the arrow which illustrates the movement of the fluid under pressure through the exposed opening 16.

Upon entering the pressure chamber 20 within the sealing ring, and when sufficient pressure is built up therein, which is substantially instantaneously upon the landing of the hanger, the effect will be to expand the upper bead 14 into tight engagement with the outer cylindrical wall of the casing 26. This pressure acting within the chamber 20 will also press the lip portions of the end walls 18 into pressure-tight engagement with the adjacent wall of the recess 70.

As previously mentioned, the lip portions of the sealing ring may be integrally joined and made sufficiently flexible to permit the reaction of the sealing element to the pressure as just described, although it is preferable to

7

have the lip portions spaced apart throughout the circumference of the ring. Further variations in the design in this respect may be provided, and satisfactory results may be obtained by simply integrally connecting the lip portions at spaced points, rather than completely joining the lip portions around their entire periphery. Of course, the chamber 20 within the sealing ring is closed within the recess by the walls thereof, the action of the pressure within the chamber of the sealing ring, being such as to expand the lip portions of the sealing ring against the walls of the recess.

In operation, when the hanger lands on its seat, the full pressure within the casing 24 is instantly exerted upwardly against the lower bead 14, deflecting it inwardly toward the recess as shown in Figure 3 to enter the pressure chamber 20 within the sealing ring, where it then acts to press against all portions of the upper part of the sealing ring to form an intense seal between the hanger and the casing. A seal within the bore of the hanger is thus instantly formed, at the moment the hanger is landed. The seal is effected by the well pressure being controlled, and it is made more intense and more effective as the well pressure increases. Accordingly, even though an intense pressure condition exists in the well, by reason of the condition of, or the absence of mud fluid therein, this seal will be instantly effective, and will be constantly maintained and augmented by the pressure which is encountered. When the hanger is landed, the weight of the casing is taken on the slips in the hanger body, and the weight of the casing thus completes the seal formed by the outer surface of the hanger against the bowl or seat of the casing head.

With an arrangement as described, it is possible to remove the control equipment while maintaining complete mechanical control of the well, in preparation for welding the hanger to the casing, or rolling the casing to the hanger, as previously described. Of course, the invention herein may be used where seals other than those formed by welding or rolling are desired; for instance, this invention may be used in association with that of Patent 2,568,581, Crain, which issued on September 18, 1951, and which shows an alternative seal formed by the compression of packing. Complete mechanical control is maintained throughout all of the operations referred to, both within and around the casing being landed, the usual back pressure valve being employed within the casing, as required, to resist any undesired flow of fluid through the casing, as is well known in the art. By reason of the availability of this effective seal, instantly operable, and by well pressure when the casing is landed, a great flexibility in the selection of operations at this stage is permitted, and various adjustments of the casing may be made, as required, with the well under complete mechanical control at all times.

It will be understood that the precise design of the sealing ring may be varied. The design includes the hollow pressure chamber and the protruding sealing beads, which normally engage the outer wall of the casing, the sealing ring being formed and arranged in its recess to admit fluid under pressure from the bore of the hanger into its hollow interior to expand its walls and beads into intensified sealing engagement with the wall of the recess and the casing. In the design described herein, we have disclosed an arrangement wherein the pressure is admitted to the interior of the sealing ring, by openings in the sealing wall 12, which are exposed when the pressure in the well rises to a sufficient extent to press the wall outwardly, as in Figure 3. The sealing wall has two beads, one of which is forced inwardly by the pressure, and the other of which is forced outwardly by the pressure into more intense sealing engagement with the oil well pipe.

Comparing Figures 2 and 3, when the hanger is landed and pressure acts within the pressure chamber of the sealing ring, the first or lower portion of the sealing chamber is reduced in volume, whereas the second or

8

upper portion of this chamber is increased in volume. Thus, entry of fluid under pressure and the resulting sealing action, changes the shape of the pressure chamber in cross-section, the upper or second portion thereof being expanded, whereas the first or lower portion thereof is contracted.

The symmetrical design and action of the sealing ring, wherein it will operate in the same way in response to pressures from opposite axial directions increases the usefulness of the invention in well head equipment. It has long been the practice to test welds, or other seals, in various arts, by closing off a space to fluid under pressure, in order to test the weld. This conventional practice has been applied to oil wells. For instance, and referring to Figure 1, the weld 68 may be tested by projecting fluid under pressure through a conventional fitting 72 which provides an opening into the space between the weld and the sealing ring 10 as is well known in the art. The test fitting 72 has a radial port therein and it may be closed by a suitable cap screw or the like when not in use. An ordinary pressure gun for discharging fluid under pressure may be employed in this test. The sealing ring will act as described previously and as illustrated in Figure 4, to hold this pressure, which may then be built up in the confined space to determine the condition of the weld seal 68, as is conventional.

Referring again to Figure 1, it will be understood that the inventions and practices described herein may be employed in the running and landing of successive casings, the successive casing heads being mounted on the well one above another, and terminating in a tubing head. As stated, the novel sealing unit, and associated means described herein, provides for complete mechanical control of the well both within and around the hanger, at all times, and at the instant the hanger is landed. By reason of the above, the control equipment can be safely removed after the casing is landed, or after cementing, in order to immediately perform various operations, such as rolling or welding the casing to the hanger, and cutting off the end of the casing, in order to secure additional casing or tubing head equipment above the hanger which has been landed.

It will be appreciated that the seal of the present invention may be utilized in the same manner set forth in the aforesaid Watts et al. application, Serial No. 315,002, with respect to the seal disclosed therein. It will also be apparent that the seal of the present invention obtains all of the advantages attributed to the Watts et al. seal as set forth above. In addition, the seal of the present invention obtains two distinct advantages over the seals heretofore utilized. First, because of the provision and construction of the beads of the present seal, there is less rubber to pipe contact. This reduces the drag on the hanger and permits the same to drop down the pipe easier. Moreover, the arcuate cross-sectional shape of the beads is such that substantial line contact is made and "roll back" or tearing off of any of the rubber is therefore virtually eliminated. This latter characteristic is also enhanced by the fact that the beads are integrally interconnected. Second, the provision of a thin integral connecting wall between the thicker beads permits one bead to be "lifted" or deflected inwardly by gas pressure substantially independently of the other bead. The flexing of the thin connecting wall thus reduces the tendency for gas to blow by the other bead. Moreover, the movement of one of the thicker beads inwardly tends somewhat to flex the other bead in the opposite direction due to the construction of the interconnecting wall. In general, the bead construction of the present seal provides optimum sealing effect with a minimum sealing surface engagement.

It is to be understood that the forms of the invention herewith shown and described are to be taken as the preferred embodiment of the same and that various changes may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. For use between an oil well pipe and a well head member having a bore of slightly greater diameter than the outside diameter of the well pipe for receiving the well pipe and an annular recess open at one side toward the well pipe and closed at its opposite side; sealing means for providing a pressure-tight seal between the well pipe and well head member and operable upon an increase of fluid pressure from either axial direction to move into increased pressure-tight engagement, said sealing means comprising an annular deformable sealing ring of rubber or the like adapted to be disposed within said recess, said ring being of a size to substantially fill said recess and having a relatively thin wall arranged to protrude beyond the open side of said recess into slidable pressure-tight engagement with the exterior surface of the well pipe, relatively thick end walls extending from the edges of said first-mentioned wall toward the closed side of said recess, and integral wall means disposed on the free edges of said end walls arranged to engage the closed side of said recess and defining with said first-mentioned wall and said end walls a circular pressure chamber within said recess, the protruding part of said first-mentioned wall comprising

spaced flexible lips having annular beads extending outwardly therefrom for initial substantial line sealing contact with the exterior surface of the well pipe and an intermediate wall portion integrally interconnecting said lips, said intermediate wall portion having an opening extending therethrough into communication with said pressure chamber, said first-mentioned wall being sufficiently yieldable so that an increase in fluid pressure from either axial direction is operable to move the adjacent bead out of engagement with the exterior surface of the well pipe to thereby permit said increased pressure to enter said pressure chamber through said opening and urge the other bead into increased pressure-tight engagement with the exterior surface of the well pipe.

2. Sealing means as defined in claim 1 wherein said projecting beads are convexly arcuate in cross section.

References Cited in the file of this patent

UNITED STATES PATENTS

1,613,355	Miller	Jan. 4, 1927
2,469,516	Pearson	May 10, 1949
2,568,581	Crain	Sept. 18, 1951
2,624,413	Mueller	Jan. 6, 1953