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SEAL ASSEMBLY

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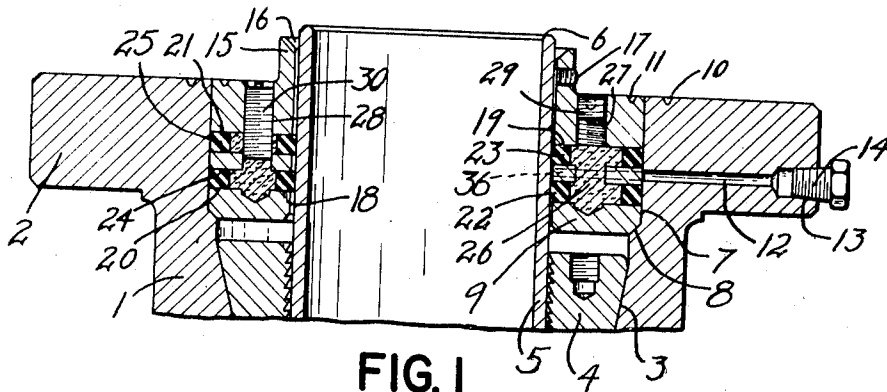


FIG. 1

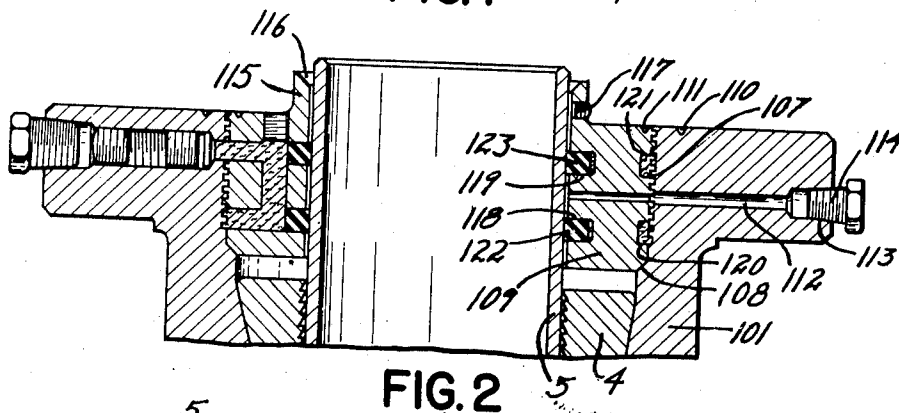


FIG. 2

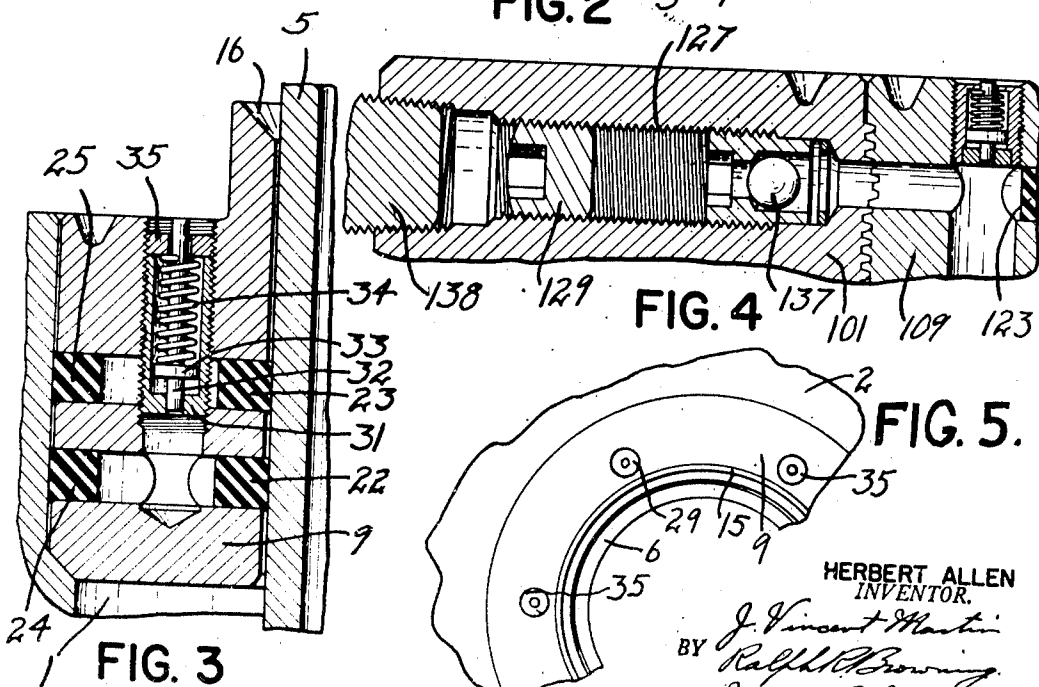


FIG. 3

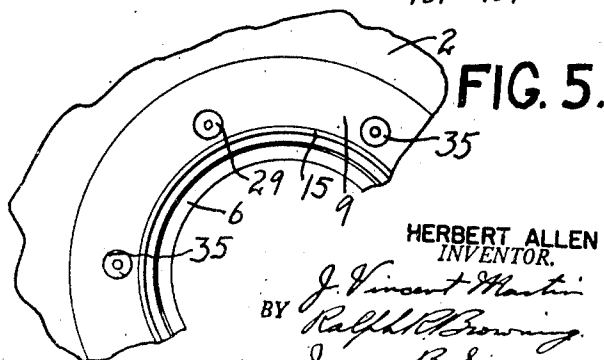


FIG. 4

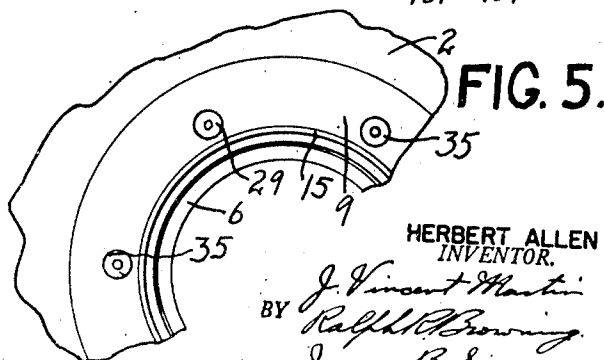


FIG. 5.

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SEAL ASSEMBLY

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This invention relates to seal assemblies and particularly to seal assemblies which may be employed in combination with the casing heads, casing and other equipment employed at the tops of wells. The general object of this invention is to provide an improved seal assembly of the type referred to in which a means of improved efficiency will be provided for forming seals between a casing head or the like and a pipe passing therethrough, together with a means for testing such seal.

Another object of this invention is to provide a seal assembly of the type referred to in which spaced seals may be formed by the application of fluid pressure from a single source and in which said seals may be tested by the injection of testing fluid under pressure between them.

Another object of this invention is to provide such a structure in which it will be possible to determine visually the distribution of pressure applied to various portions of the circumference of the device in forming such seals.

Another object of this invention is to provide a structure of the type referred to with means for applying at spaced points the seal forming pressure for forming the spaced seals between the well casing or the like and the casing head.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example and not by way of limitation two embodiments of the invention.

In the drawings:

Fig. 1 is a fragmentary view showing in vertical cross section a seal assembly constructed in accordance with this invention located in the upper portion of a casing head or the like;

Fig. 2 is a view similar to Fig. 1 but illustrating a modified form of the invention;

Fig. 3 is an enlarged view showing a portion of the structure illustrated in Fig. 1 and illustrating in vertical cross section the means for indicating the pressure being applied to form a seal;

Fig. 4 is a view on an enlarged scale showing the pressure applying and pressure indicating means employed in the form of the invention shown in Fig. 2; and

Fig. 5 is a fragmentary plan view of a portion of the structure shown in Fig. 1, illustrating the disposition of the pressure applying and pressure indicating means forming a part thereof.

With more particular reference to the drawing, the numeral 1 designates the upper portion of the usual casing head having a flange 2 or other

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means of connecting it to a tubing head or other equipment at its upper end. The inner lower portion of this casing head is provided with a tapered surface forming a bowl 3 for the reception of slips 4 which are shown gripping a casing 5 extending upwardly through the casing head and terminating at 6 a short distance above the casing head.

Above the slip bowl 3 the casing head is provided on its inner surface with a cylindrical zone 7 terminating at its lower end in an upwardly facing shoulder 8 adapted to receive an annular body or ring 9, this body 9 providing the major portion of a closure for the annular space between the casing head 1 and the casing 5. Suitable sealing ring grooves 10 and 11 may be provided on the upper surfaces of the flange 2 or the annular body 9 or both.

At one point of its circumference the flange is provided with a radial passage 12 having a threaded opening at its outer end 13 which may when desired be closed by a plug 14. The purpose of this passage and a threaded opening leading thereto will be presently described.

The annular body 9 may if desired be provided with an upstanding neck or collar portion 15 flared outwardly at its upper end as shown at 16 to provide for welding the annular body 9 to the casing 5 if this be desired. This neck 15 may also be provided with a threaded opening 17 leading from the exterior thereof to the interior, the purpose of which will be presently set forth.

The annular body 9 is illustrated as being provided on its inner surface with two spaced grooves 18 and 19 respectively and on its outer surface with two correspondingly positioned spaced grooves 20 and 21, respectively. The grooves 18 and 19 have located in them a pair of flexible sealing rings 22 and 23, respectively, and the outer grooves 20 and 21 have disposed within them likewise flexible sealing rings 24 and 25 respectively. In each case, however, these sealing rings are of such radial extent that they will be spaced slightly from the bottoms of their respective grooves.

At circumferentially spaced positions the grooves 18, 19, 20 and 21 are all interconnected by suitable passages in the annular member 9 as indicated at 26, thereby providing intercommunication between all of the grooves. Also, at circumferentially spaced points the annular body 9 is provided with tapped openings extending from the upper surface of this annular body downwardly and into the intercommunicating passageways between the grooves. These

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tapped openings alternate between those such as indicated at 27 which extend only to the level of the uppermost of the grooves, and those such as 28 which extend on downwardly into communication with the passages in the annular body 9 at a level substantially that of the lowermost of the grooves. In each of the tapped openings 27 there is provided a screw type ram or plug 29 by which it is possible upon removal of the plug to fill the opening with a stiff plastic material flowable under pressure and then to force such material into the grooves 18, 19, 20 and 21 by re-inserting the plug 29 and screwing it down into the tapped opening 27. In this manner all of the grooves and the passages communicating between them may be filled with a flowable material under any desired pressure and this material will serve to urge the flexible sealing rings 22, 23, 24 and 25, respectively, into sealing engagement with the casing 5 and with the inner surface of the casing head 1. Thus, there will be provided two vertically spaced seals between the annular body and casing and likewise two vertically spaced seals between the annular body and the casing head.

In order to prevent the possibility of applying too little or too great a pressure upon the flowable material supplied through the tapped openings 27, each of the tapped openings 28 is provided with a pressure indicator in the form of a housing or body 30 having the interior construction shown in Fig. 3. It will be seen that the lower end of the housing or body 30 is provided with a partition 31 having a central opening therein which receives the lower end of a plunger 32, the lower end of the plunger 32 being thus exposed to the pressure within the passage that communicates between the respective grooves. In this instance it will be seen that the housing 30 extends downwardly past the level of the uppermost sealing rings so that the pressure which it indicates or to which it is subject will be that substantially at the level of the lower sealing rings. Other pressure indicators may if desired be provided which extend only to the level of the upper sealing rings as indicated in Fig. 4 and as will be presently described.

The plunger 32 of each indicator is provided with an enlargement 33 forming a stop limiting the downward movement of the plunger. The plunger is constantly urged downwardly by means of a spring 34 which surrounds it and bears against the upper surface of the enlargement 33, this spring at its upper end bearing against the lower surface of a nut 35 which in effect forms a part of the housing 30. The upper end of the plunger extends through an opening in the nut 35 and the area of the lower end of the plunger, the strength of the spring 34, and the length of the plunger are so proportioned with respect to the body 9 and the position which they are to occupy in the body 9 that when the desired predetermined pressure exists within the passages in the body 9 the upper end of the plunger will be substantially flush with the upper surface of the body 9.

Thus, it will be seen that the indicators such as just described provide an accurate means for determining the pressures existing at various points within the body 9 but these indicators are of such a nature that at no time when the pressures are not greater than they should be will any portion of the indicators project beyond the regular contour of the exterior of the body 9. With reference to Fig. 5, it is contemplated by

this invention that a number of the indicators such as just described will be located at various points about the circumference of the body 9 so as to provide visual indication to the operator of the pressures existing within the various portions of the body 9. Also, at alternate positions between the indicators referred to the body 9 will be provided with the tapped openings and rams 27 and 29. Thus, there will be a means of applying additional pressure to the flowable material within the body 9 at a point or points adjacent each of the indicators and there will be an indicator adjacent each of the pressure applying means. If the material within the body 9 were a readily flowable material such an arrangement would perhaps be superfluous but in order to prevent extrusion of this material past the sealing rings 22, 23, 24 and 25 it is desirable that the material be of a very stiff fibrous nature presenting many of the characteristics of a solid when not under pressure, and since such material flows only very slowly when under pressure it would be possible without the arrangement just referred to or its equivalent to create a highly excessive pressure at one point in the system while at another point in the system the pressure would not be great enough to provide the necessary sealing force behind the sealing rings.

It is to be appreciated that while the invention is illustrated in connection with two spaced sealing rings both on the exterior and on the interior of the body 9, the use of the plurality of indicators and pressure applying means is not limited to this number or arrangement of sealing rings but may be applied to any arrangement in which one or more seals are to be provided by a flowable material, whether sealing rings separate from the material itself are employed or not.

Referring back to the passageway 12 in the flange 2 and the tapped entrance thereto, it will be seen that this passage is so located as to lie between the levels of the upper and lower sealing rings carried by the body 9. Furthermore, the body 9 is provided at about the same level with one or more passageways 36 extending radially therethrough independently of the passages interconnecting the grooves. By means of this arrangement it is possible to inject through the passageway 12 and into the zones between the body 9 and the casing head and between the rings 22 and 23 a testing fluid under pressure. This testing fluid is preferably liquid and will apply a pressure against each of the four seals formed by the four sealing rings, and by noting any leakage once this pressure has been fully applied it can be determined whether or not the seal provided by any of these rings is leaking. If a leak is noted, the pressure against the rings may be increased by tightening up on the respective plugs 29 in the manner hereinbefore discussed, and the seals provided by these rings may thereby be rendered more perfect for the purpose of eliminating any such leak.

Likewise, if it be desired to provide a welded connection between the body 9 and the casing at the point 16, such a welded connection may be tested by the injection of a testing fluid under pressure through the port 17.

As an alternate to the construction just described, the casing head may be in the form of that indicated in Fig. 2 at 101. The slips 4 and the casing 5 in this figure are identical with the corresponding elements shown in Fig. 1, but in-

stead of being provided with a smooth cylindrical bore or zone adjacent its upper end the casing head 101 is provided with a coarse threaded zone 107 terminating in a shoulder 108 at its lower end. The annular body 109, corresponding to the body 9 of Fig. 1, is likewise provided with threads on its outer surface for engagement with those formed in the casing head.

The casing head and the body 109 may be provided on their upper surfaces with sealing ring grooves 110 and 111 in the same manner as shown in Fig. 1 and the body 109 may be provided with an upstanding neck portion 115 terminating in a welding bevel 116. This neck portion may likewise be provided with a plugged tapped opening 117 for the same purpose as the opening 17 in Fig. 1.

As in the form shown in Fig. 1, the casing head is preferably provided with a passage 112 terminating in a threaded opening 113 in which may be inserted a plug 114, all these being for the purpose of the injection of a testing fluid under pressure in the manner hereinafter set forth.

As in the case of the annular member 9, the annular member 109 is provided with four grooves, two in its inner surface as indicated by the numerals 118 and 119, and two in its outer surface indicated by the numerals 120 and 121. The inner grooves are illustrated as having disposed therein sealing rings 122 and 123 respectively, but the outer grooves are not shown as having any sealing rings therein, it being contemplated that since these grooves open into a threaded joint, the flowable plastic material will resist extrusion sufficiently without the necessity for the sealing rings such as employed in Fig. 1.

Referring to Fig. 4, it will be seen that in this form the flowable material under pressure will be injected through registering openings in the flange of the casing head and in the annular member 109. In this instance, the casing head is provided with a tapped opening 127 adapted to receive a threaded ram or plug 129 which may be removed to insert the material to be used in forcing the sealing rings 122 and 123 into sealing position, and then replaced and tightened to force such material past the ball valve 137 and into the passages within the annular member 109. The outer end of the threaded opening 127 may if desired be closed by means of a suitable plug 138.

The pressures within the passages in the annular member 109 may be indicated by means of pressure indicators such as that illustrated in Fig. 3 and heretofore described or by similar indicators such as shown in Fig. 4 which are in substance identical with those shown in Fig. 3 except that they are made of shorter dimensions so that they may indicate pressures substantially at the level of the upper sealing rings instead of at the level of the lower rings. Otherwise, they are substantially the same in structure and function. It is to be noted that in the case of the pressure indicator shown in Fig. 4 just as in the case of that shown in Fig. 3, the parts are so proportioned that the plunger will be substantially flush with the outer contour of the ring 109 when the pressure within this ring is at the desired predetermined value.

From the foregoing it will be apparent that

an apparatus has been shown and described which is fully capable of carrying out and accomplishing all of the objects and advantages sought by this invention.

Having described my invention, I claim:

1. In a seal assembly for sealing off an annular space, an annular body having a pair of annular grooves in its inner and in its outer surfaces, flexible sealing rings in said grooves respectively, said grooves being all interconnected, and means for supplying a flowable material under pressure to said grooves behind said rings.

2. In a seal assembly for sealing off an annular space, an annular body having an annular groove in its inner surface, a flexible sealing ring in said groove, means for forcing a viscous flowable material under pressure into said groove behind said ring, and pressure indicators at spaced points about said body and connected with said groove for indicating the pressures existing in such flowable material at points in said groove adjacent to such indicators respectively.

3. In a seal assembly for sealing off an annular space, an annular body having a pair of annular grooves in its inner surface and a pair of annular grooves in its outer surface, said grooves being all interconnected, and means for supplying a flowable sealing material under pressure to the interiors of said grooves.

4. In a seal assembly for sealing off an annular space, an annular body having a pair of annular grooves in its inner surface and a pair of annular grooves in its outer surface, a pair of flexible sealing rings in said grooves in the inner surface respectively, all of said grooves being interconnected, and means for supplying a flowable sealing material under pressure to said grooves.

5. In combination with a well head, a seal assembly for sealing off an annular space within the well head comprising an annular body having a pair of annular grooves in its inner and in its outer surfaces, a pair of flexible sealing rings in the grooves in said inner surface respectively, all of said grooves being interconnected, and means for supplying a flowable material under pressure to all of said grooves, said body and said well head having radial passages interconnecting the exterior of said well head with the inner and outer surfaces of said body between said grooves whereby a test fluid under pressure may be applied from the exterior of said well head simultaneously to the zones between the seal rings on the inner surface and between the grooves on the outer surface of said body, said body being threaded into the interior of said well head.

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