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WELLHEAD SEALING ARRANGEMENT

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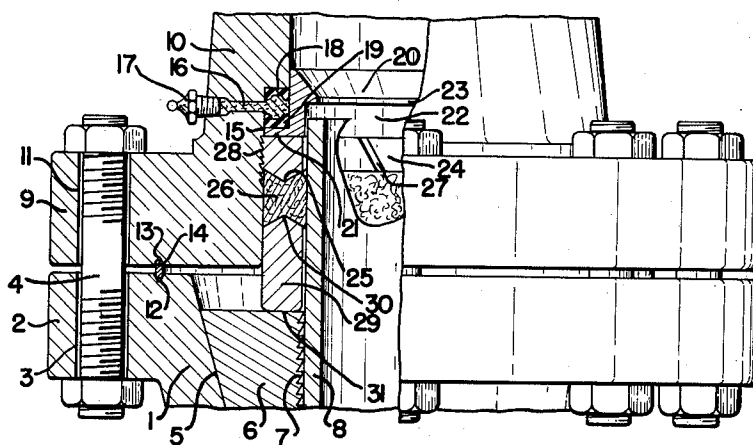


FIG. 1

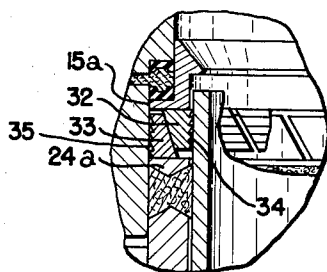


FIG. 2

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WELLHEAD SEALING ARRANGEMENT

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This invention relates in general to seal forming combinations and has for its general object the provision of such a combination which will be suited for use in sealing between a well casing and a casing head tubing head combination surrounding same.

More specifically it is an object of this invention to provide a seal forming means for sealing between a well head and an inner pipe and to provide means in connection therewith which will make it possible to effect the seal required after the well head or other equipment has been installed.

Another object of this invention is to provide a seal forming means which may be mounted in the tubing head or other equipment on top of the casing head and which will not require any special construction of the casing head. In this connection it is to be understood that throughout the specification and claims reference to a tubing head is intended to include either a tubing head or other equipment which may be placed upon a casing head.

Another object of this invention is to provide a seal of the character referred to which may be tightened and rendered effective by means of hydraulic pressure after the apparatus has been fully assembled.

Another object of this invention is to provide a seal of the character referred to in combination with means for holding the seal effective even though the pressure which was applied to render it effective should be released.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein is set forth by way of illustration and example two embodiments of the invention.

In the drawings:

Fig. 1 is a fragmentary view partly in side elevation and partly in vertical cross section illustrating a portion of a casing head, a tubing head and a casing together with a seal forming apparatus constructed in accordance with this invention.

Fig. 2 is a view corresponding to a portion of that part of Fig. 1 which is shown in cross section and illustrating a slightly modified form of the invention.

The illustration in the drawing in Fig. 1 shows the upper end portion of the usual casing head 1 having an outwardly extending flange 2 with openings 3 therethrough for the reception of the studs 4. This casing head 1 is provided with a tapered inner surface 5 customarily referred to as a slip bowl adapted to receive tapered slips 6 having upwardly directed gripping teeth 7 on

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their inner surfaces for the purpose of gripping and suspending the casing 8 that extends up through the casing head and into the apparatus above the casing head.

The structure thus far described is conventional.

Secured to the upper flange 2 of the casing head by means of the studs 4 is the flange 9 of the tubing head or other well head apparatus 10, the flange 9 having openings 11 therethrough for the reception of the studs 4.

The adjacent surfaces of the flanges 2 and 9 have formed therein opposed sealing ring receiving grooves 12 and 13 respectively, and mounted in these grooves is a sealing ring 14 which provides a seal between the casing head and tubing head or the like.

In order to provide the necessary seal between the upper end of the casing 8 and the interior of the casing head, tubing head combination, the tubing head is in this instance provided with a counterbore 15 and with a passageway 16 leading from the counterbore adjacent the upper end thereof outwardly through the wall of the tubing head and threaded adjacent its outer end to receive a pressure retaining check valve fitting 17 of any suitable well known construction.

Adjacent its upper end this counterbore is provided with smooth walls and there is located at its upper end a lip-type or other suitable type of sealing ring 18, while spaced therefrom and on the opposite side of the opening from the passageway 16 is a second inverted sealing ring 19 similar in all respects to the ring 18. A follower ring 20 having its larger portion of an outer diameter to fit within the smaller portion of the bore of the tubing head and a laterally extending flange 21 having an outer diameter adapted to fit within the counterbore 15 is placed in the counterbore following the ring 19. It will be seen from the drawing that the main body portion of this ring taken with the flange 21 provides a closed annular receptacle for the reception of pressure fluid forced into the counterbore through the fitting 17 and the passageway 16, and that forcing such fluid into the counterbore will cause the follower ring 20 to move downwardly with respect to the tubing head.

The following ring 20 is also provided with a larger portion 22 of an inner diameter large enough to receive the upper end of the casing 8 and with an overhanging lip 23 adapted to overhang the upper end of the casing 8 and limit the downward movement of the follower ring 20. From the overhanging lip 23 to its upper end the follower ring 20 is preferably flared outwardly to provide a guide for tubing or other apparatus to be later inserted into the well.

Below the follower ring 20 there is inserted in the counterbore a split ring 24 forming a packing ram and being tapered at its lower end as shown at 25 to more effectively expand the annular packing body 26 which is inserted into the counterbore below the ram 24. This ring 24 is split at 27 and is provided on its outermost surface with upwardly directed ratchet teeth 28 fitting into corresponding ratchet grooves formed in the wall of the counterbore 15 intermediate the ends of the counterbore. It will be seen that this construction will permit the ring 24 to be forced downwardly by the follower 20, but that due to the fact that the ring 24 is given a set which makes it normally of larger diameter than the counterbore, it will expand until its ratchet teeth 28 are engaged with the corresponding grooves in the counterbore thus providing a mechanical detent which will prevent its retrograde or upward movement away from the packing body 26.

The packing body 26 is supported by a support ring 29 which is tapered on its upper end at 30 in the same manner as the ram 24, and is adapted to rest at its lower end 31 upon the upper ends of the slips 6.

It will be seen that in operation after the casing has been hung in the casing head in the usual manner and severed at a desired distance above the casing head, the rings 18 and 19 may be placed in the counterbore 15 together with the follower ring 20, the ram 24, the packing body 26 and the support ring 29, and that this assembly may then be placed on the upper end of the casing head with the sealing ring 14 in place in the grooves 12 and 13, and secured to the casing head by means of the studs 4.

In order to provide the necessary seal between the casing head, tubing head combination, it is thereupon necessary only to attach a source of hydraulic pressure to the valved fitting 17 and force a pressure fluid into the counterbore between the rings 18 and 19 and around the outside of the follower 20. This hydraulic pressure will move the follower 20 downwardly and serve as an actuator for the ram 24 and packing body 26, forcing the ram 24 against the packing body 26 and causing the same to expand laterally into sealing engagement both with the casing 8 and with the wall of the counterbore in the tubing head 10. It will be understood that the necessary degree of sealing may be effected by the amount of pressure fluid and the pressure of the fluid injected through the bore 16. The packing body 26 will of course be made of a material flowable under pressure so that when the pressure is thus applied to it it will be compressed endwise and caused to expand laterally to provide the necessary seal.

It will further be seen that the interengagement of the ratchet teeth 28 on the ram 24 with the grooves formed in the inner surface of the counterbore will provide a mechanical detent preventing the retrograde movement of this ram away from the packing once the packing has been compressed by movement of the ram. This is of importance in that if the fitting 17 should become ineffective for any reason or should be knocked off, thereby releasing the pressure acting upon the follower 20, the ram 24 would not be allowed to move upwardly and release the pressure on the packing body 26. Therefore, the seal about the casing within the tubing head would remain effective even though the hydraulic

pressure which rendered it effective in the first place should be released.

Referring now more particularly to Fig. 2, the parts are identical with those illustrated in Fig. 1 having corresponding numbers except for the fact that the counterbore 15a in the tubing head is not provided with the grooves illustrated in the form shown in Fig. 1 but has a smooth wall throughout, and the ram 24a is not provided with teeth such as the teeth 28 on the ram 24. Instead, there is interposed between the ram 24a and the follower 20 a pair of split co-acting wedge shaped rings 32 and 33 respectively. The ring 32 has upwardly directed teeth 34 in engagement with the casing and the ring 33 has similar upwardly directed teeth 35 in engagement with the inner wall of the counterbore. These two rings are so arranged that a downward movement of the ring 32 or an upward movement of the ring 33 will tend to wedge them between the casing and the inner wall of the counterbore. However, due to the fact that the teeth 34 and 35 are all directed upwardly, pressure exerted by the follower 20 against the ring 32 will cause downward movement of both rings and corresponding downward movement of the ram 24a resulting in the expansion of the packing. But when there is any tendency for the ram 24a to move upwardly, this will be opposed by both sets of teeth 34 and 35 and the rings will wedge against each other between the casing and the wall of the counterbore so that substantial upward movement of the ram 24a will be prevented.

This provides a mechanical detent having much the same effect as that illustrated in Fig. 1, but having the advantage that less retrograde movement of the ram is permitted before it is stopped all together because the teeth 34 and 35 may grip the casing and the tubing head at any point, and the additional advantage that it is unnecessary to form grooves in the wall of the counterbore.

From the foregoing, it will be appreciated that a device has been provided which is capable of carrying out and accomplishing all of the objects and advantages sought by this invention.

Having described my invention, I claim:

1. A seal assembly comprising in combination with an annular deformable packing body, a ring movable against said body in an endwise direction to cause said body to expand laterally, a hydraulic actuator for moving said ring in such direction, and a mechanical retainer for holding said ring against retrograde movement to maintain pressure on said packing body once the same has been applied.

2. In combination with two spaced members one of which is located within the other, the other of said members being counterbored, an annular packing body within said counterbore and surrounding the other member, an annular ram within said counterbore and movable to apply pressure endwise against said packing body to cause the same to expand laterally and form a seal between said members, a hydraulic actuator for moving said ram toward said packing body, and a detent for holding said annular ram against retrograde movement in a direction away from said packing body.

3. In combination with a well casing, casing head and tubing head in which the casing head and tubing head are secured and sealed to each other and surround the upper end of said casing in spaced relation thereto and said tubing head is provided with a counterbore extending upwardly

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from its lower end and surrounding said casing, an annular packing body within said counterbore and surrounding said casing, a support ring extending upwardly from within said casing head and engaging said packing body to support the same against downward movement, an annular ram above said packing body and movable downwardly to apply pressure thereto and cause the same to expand laterally into sealing engagement with said casing and tubing head, a detent for holding said ram against retrograde movement away from said packing body, and a hydraulic actuator for moving said ram toward said packing body to compress the same.

4. In combination with a well casing, casing head and tubing head in which the casing head and tubing head are secured and sealed to each other and surround the upper end of said casing in spaced relation thereto and said tubing head is provided with a counterbore surrounding said casing, an annular packing body within said counterbore and surrounding said casing, a support ring engaging said packing body to support the same against movement, an annular ram on the other side of said packing body from said support ring and movable to apply pressure thereto and cause the same to expand laterally into sealing engagement with said casing and tubing head, a detent for holding said ram against retrograde movement away from said packing body, and a hydraulic actuator for moving said ram against said packing body to compress the same.

5. In combination with a well casing, casing head and tubing head in which the casing head and tubing head are secured and sealed to each other and surround the upper end of said casing in spaced relation thereto and said tubing head is provided with a counterbore extending upwardly from its lower end and surrounding said casing, an annular packing body within said counterbore and surrounding said casing, a support ring extending upwardly from within said casing head and engaging said packing body to support the same against downward movement, an annular ram above said packing body and movable downwardly to apply pressure thereto and cause the same to expand laterally into sealing engagement with said casing and tubing head, a detent for holding said ram against retrograde movement away from said packing body, and a hydraulic actuator within said counterbore above said ram for moving said ram downwardly against said packing body to compress the same, said tubing head having a passageway there-through from its exterior to said hydraulic actuator whereby hydraulic fluid under pressure may be supplied to said actuator.

6. In combination with a well casing, casing head and tubing head in which the casing head and tubing head are secured and sealed to each other and surround the upper end of said casing in spaced relation thereto and said tubing head is provided with a counterbore extending upwardly from its lower end and surrounding said casing, an annular packing body within said counterbore and surrounding said casing, a support ring extending upwardly from within said casing head and engaging said packing body to support the same against downward movement, an annular ram above said packing body and movable downwardly to apply pressure thereto and cause the same to expand laterally into sealing engagement with said casing and tubing head, a detent for holding said ram against retrograde

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movement away from said packing body, said ram comprising a split ring of a resilient material having an outer diameter when uncompressed which is greater than the inner diameter of said counterbore, and said detent comprising mating ratchet teeth on the outer surface of said ram and the inner surface of said counterbore.

7. In combination with a well casing, casing head and tubing head in which the casing head and tubing head are secured and sealed to each other and surround the upper end of said casing in spaced relation thereto and said tubing head is provided with a counterbore extending upwardly from its lower end and surrounding said casing, an annular packing body within said counterbore and surrounding said casing, a support ring extending upwardly from within said casing head and engaging said packing body to support the same against downward movement, an annular ram above said packing body and movable downwardly to apply pressure thereto and cause the same to expand laterally into sealing engagement with said casing and tubing head, a detent for holding said ram against retrograde movement away from said packing body, said detent comprising a pair of wedge shaped split rings in wedging engagement with each other between said casing and the wall of said counterbore and one of said rings being in engagement with said ram and adapted to be forced into tighter wedging engagement with the other ring upon movement of said ram away from said packing body.

8. In combination with a well casing, casing head and tubing head in which the casing head and tubing head are secured and sealed to each other and surround the upper end of said casing in spaced relation thereto and said tubing head is provided with a counterbore extending upwardly from its lower end and surrounding said casing, an annular packing body within said counterbore and surrounding said casing, a support ring extending upwardly from within said casing head and engaging said packing body to support the same against downward movement, an annular ram above said packing body and movable downwardly to apply pressure thereto and cause the same to expand laterally into sealing engagement with said casing and tubing head, a detent for holding said ram against retrograde movement away from said packing body, said detent comprising a pair of wedge shaped split rings in wedging engagement with each other between said casing and the wall of said counterbore and one of said rings being in engagement with said ram and adapted to be forced into tighter wedging engagement with the other ring upon movement of said ram away from said packing body, and said rings having upwardly inclined gripping teeth in engagement with the wall of said counterbore and the outside of said casing respectively.

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