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E. J. CLARK ET AL

1,835,377

REMOVABLE CLOSURE FOR WELL CASINGS

Filed Aug. 12, 1930

2 Sheets-Sheet 1

Fig. 1.

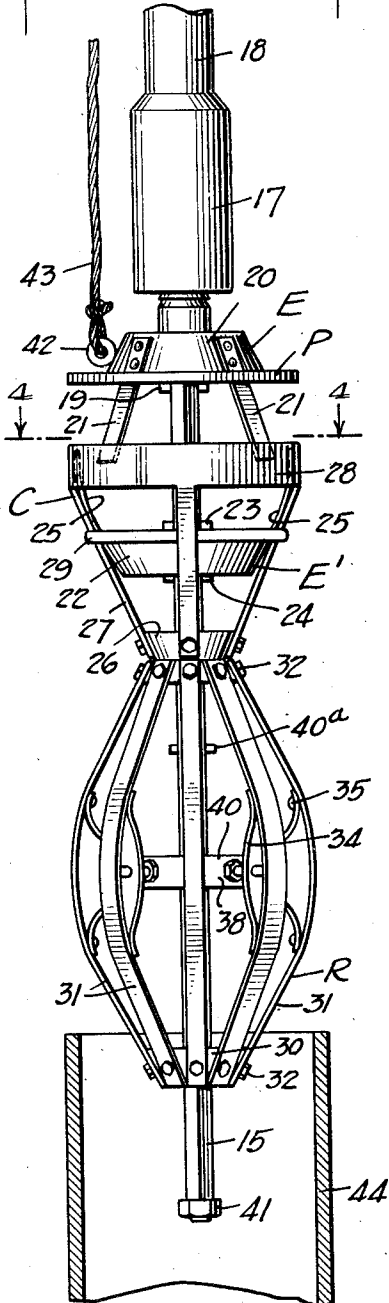
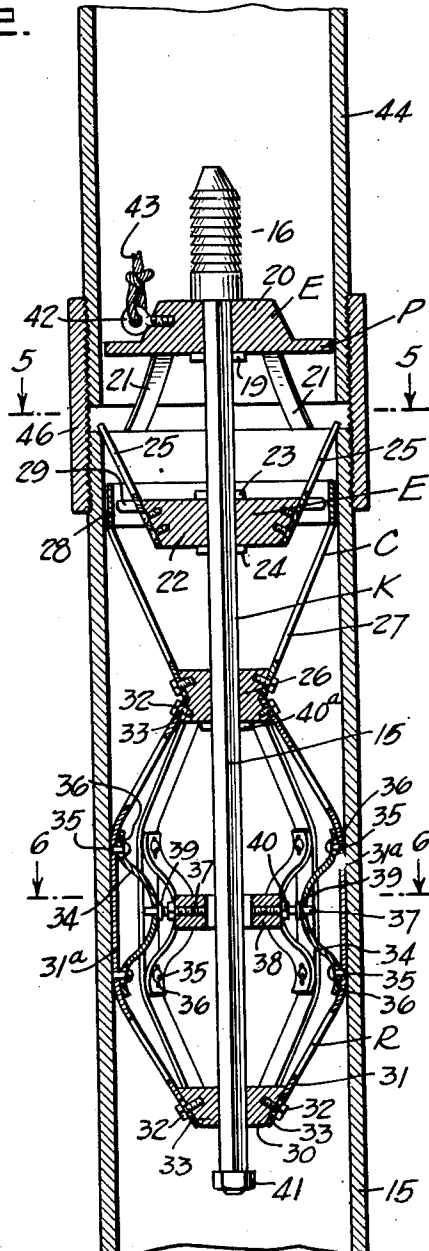


Fig. 2.



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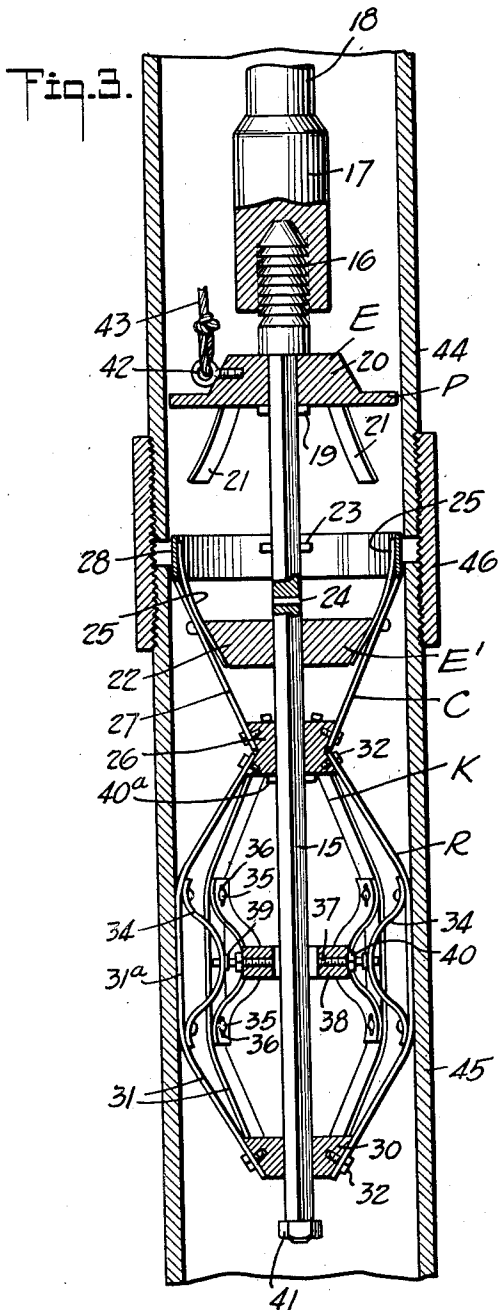
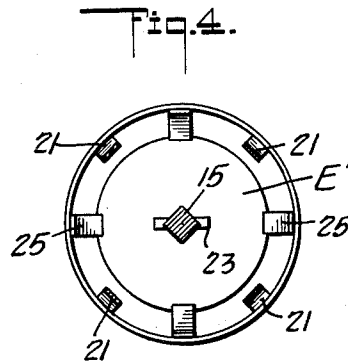
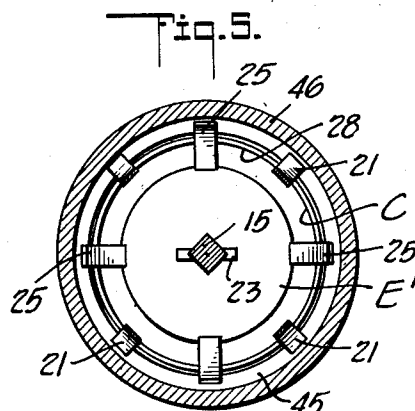
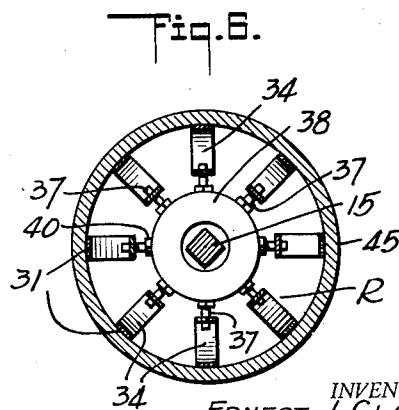
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REMOVABLE CLOSURE FOR WELL CASINGS

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2 Sheets-Sheet 2



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REMOVABLE CLOSURE FOR WELL CASINGS

Application filed August 12, 1930. Serial No. 474,863.

Our invention relates to closures for well casings, designed to plug the casing against the admission of water and to form a substantial foundation for the cement in cementing off a well.

It is a purpose of our invention to provide a casing closure which can be operated from the mouth of the well to be locked to any section of a string of casing and completely plug the casing, and which is readily releasable and removable from the casing and without injury to the closure or casing.

It is also a purpose of our invention to provide a casing closure in which the locking means therefor, in order to properly function, requires no structural modification of the well casing but utilizes the ends of the casing sections as abutments for the locking elements of the closure to secure the closure in fixed position vertically within the well casing.

We will describe only one form of removable closure for well casings embodying our invention, and will then point out the novel features thereof in claims.

In the accompanying drawings:

Fig. 1 is a view showing in side elevation one form of casing closure embodying our invention, and in entering position with respect to the upper end of a well casing.

Fig. 2 is a view showing in vertical section a casing closure in applied position within a casing.

Fig. 3 is a view similar to Figure 2 but showing the closure in released position to permit of its removal from the casing.

Fig. 4 is a transverse sectional view taken on the line 4—4 of Figure 1 and looking in the direction of the arrows.

Figs. 5 and 6 are transverse sectional views taken on the lines 5—5 and 6—6 respectively, of Figure 2, and looking in the direction of the arrows.

In carrying out our invention, we provide a carriage K comprising a rod 15 of suitable length and non-circular in cross section, the upper end of the rod being provided with a threaded stem 16 which is adapted to be received in a socket 17 of a fishing tool 18 to provide an operative connection between the

carriage and the fishing tool by which the former may be raised and lowered within a well casing, and the fishing tool detached from the carriage once the casing closure has been locked within the casing.

A plug P of disk form and of a diameter slightly less than the internal diameter of the well casing to which the closure is applied, is fixed upon the rod 15 just beneath the stem 16, and by the employment of a key 19. This plug, when fixed against vertical movement within a well casing functions to seal the casing against the admission of water or sand, and it provides a substantial foundation for the cement inserted into the casing for cementing off of the well. This plug may be of any construction suitable for the purpose, and it will be understood that it may be varied as to diameter to fit different size casings.

For the purpose of securing the plug P in fixed position within a well casing, our closure includes an upper locking element E designed to secure the plug against movement downwardly within the well casing, and a lower locking element E' designed to secure the plug against movement upwardly within the casing. The locking element E comprises a head 20 having the form of a truncated cone and preferably formed integral with the plug P so as to reinforce the latter and to coact with the stem 16 in securing the plug against movement upwardly of the rod 15. Secured at circumferentially spaced intervals on the periphery of the head 20 are a plurality of resilient arms 21, these arms extending through suitable openings in the plug P so that their lower ends are disposed below the plug. These arms are preferably formed of spring steel and normally they occupy an expanded position in which they are divergent with respect to the head.

The lower locking element E' comprises a head 22 having the form of a truncated cone and reversely disposed with respect to the head 20. This head 22 is permanently fixed against movement upwardly on the rod 15 by means of a key 23, but the rod is capable of being moved upwardly through the head when sufficient pull is exerted upwardly on

the rod to shear a pin 24 which normally engages the under side of the head to prevent movement of the head downwardly on the rod. This pin 24 may be formed of soft iron as distinguished from the pins 19 and 23 which are formed of steel.

The lower locking element E' also includes a plurality of resilient arms 25 which are secured to and project upwardly from the periphery of the head 22, and preferably in a staggered relation with respect to the arms 21 of the upper locking element E. The arms 25 are of such length that their upper ends are disposed in over-lapping relation with respect to the lower ends of the arms 21, and similarly, the arms 25 normally occupy an expanded position in which they are divergent with respect to the head 22.

The casing closure also includes what we term a contracting element C, in that it is designed to produce an inward flexing of arms 25, and to maintain both sets of arms 21 and 25 flexed inwardly so that the upper and lower locking elements E and E' are held in contracted position, thus rendering such elements ineffective to engage the well casing and lock the plug against vertical movement in the casing. It will be understood that this element C is effective in respect to the arms 21 only after the latter have been flexed inwardly by some other means than the element itself. The element C comprises a head 26 having a non-circular and axial opening to receive the rod 15 in a manner to permit relative movement of the two vertically but to lock the two against movement circumferentially. Secured to and projecting upwardly from the head is a skeleton frame 27 on the upper end of which is formed a band 28 which is of a diameter to have a loose sliding fit within the well casing to which the closure is applied, and which is adapted to engage the arms 25 and 21 to flex them to a contracting position. This band is maintained centered with respect to the head 22 by means of projections 29 formed on the periphery of the head 22, and in order that the band in its vertical movement will effect the required inward flexing of the arms 25 to move them free of the well casing.

A retainer, generally designated at R is embodied in the closure for effecting a predetermined actuation of the locking elements incident to the application and removal of the closure to and from a well casing. This retainer includes a lower head 30 movable vertically on the rod 15 and coacting with the upper head 26 to provide a mounting for a plurality of ribs 31 arranged in a circular series about the rod to form a cage or basket. These ribs are secured at their respective ends to the heads 26 and 30 by means of screws 32 which extend through slots 33 in the ribs for the purpose of allowing radial adjustments of the ribs to increase or decrease the diam-

eter of the cage or basket and for the purpose of rendering the retainer applicable to well casings of different diameter.

The several ribs 31 are urged outwardly by means of springs 34 in order that the flattened portions 31^a of the ribs may have proper frictional contact with the inner wall of a well casing to perform the functions for which the retainer is intended. There is one spring 34 for each rib 31, and the ends of each spring are connected to the respective rib by means of rivets 35 extending through slots 36 of the rib. The effective tension of each spring may be effected by means of a rod 37 screw threaded in a collar 38 loosely fitted on the rod 15. The rod 37 is provided with a flange 39 against which the medial portion of the respective spring 34 bears. This flange 39 is of angular form to permit the application thereto of a wrench for turning the rod to effect adjustment thereof longitudinally in the collar and in consequence to increase or decrease the effective tension of the spring depending upon in which direction the rod is adjusted. An adjustment of the rod may be maintained by means of a lock nut 40 which engages the periphery of the collar 38.

The head 26 is secured against movement downward on the rod 15 by means of a key 40^a, and this key is non-shearable so that it provides a positive stop for the head. The lower end of the rod 15 is provided with a nut 41 to prevent possible displacement of the head 30 from the lower end of the rod, although it will be understood that the nut 41 is not essential to the operation or functioning of the retainer.

By means of a screw-eye 42 and a rope 43 connected to the eye at one end and to the fishing tool at the other at a point above the socket 17, a temporary connection is provided between the carriage and the fishing tool when the stem 16 is removed from the socket 17, and for the purpose of elevating the locking elements E and E' beyond the contracting influence of the band 28, as will be better understood from a consideration of the operation of the entire closure.

In Figures 1, 2, and 3 we have illustrated a conventional form of well casing, the two adjacent sections 44 and 45 of which are exteriorly threaded to receive a sleeve 46 by which the two sections are coupled. It is important to note that the confronting ends of the casing sections are spaced apart as coupled, for our casing closure utilizes these confronting ends as abutments for the resilient arms 21 and 25 in effecting locking of the plug P against movement vertically within the well casing.

The operation of the closure is as follows:

With the closure in position for insertion into the upper end of the well casing, as illustrated in Figure 1, the rope 43 is connected to the locking element E and the fishing tool

18 is connected to the carriage K, and by means of which tool the entire closure is adapted to be lowered into the casing. In this position of the closure, the arms 21 and 25 of the two locking elements E and E' are held in contracted position by reason of the band 28 being in its uppermost position. As previously stated, the band 28 is only operable to inwardly flex the arms 25, and that the arms 21 must be initially flexed by some other means than the band, such as by the use of a suitable tool.

To render the retainer R applicable to the casing of a given diameter, the ribs 31 are adjusted radially in the manner previously described and so as to exert sufficient radial pressure against the inner wall of the casing to maintain the band 28 in its uppermost position during the entire lowering movement of the closure into the casing, and yet not interfere with such lowering movement, for it will be clear that the ribs 31 are adapted to have sliding contact with the casing wall.

Thus, with the closure lowered to the desired casing coupling, the fishing tool is detached from the rod 15 and the tool elevated from the casing. During the first part of the upward movement the fishing tool acts through the rope 43 to elevate the carriage and with it the two locking elements E and E', the band 28 being held against upward movement by the security with which the ribs 31 engage the casing. Thus, the locking arms 21 and 25 are permitted to expand so that their free ends now engage between the confronting ends of the two casing sections, as illustrated in Figure 2, and, as a consequence, the locking elements now function to positively lock the plug P against vertical movement in the casing.

Once the carriage has been elevated sufficiently to effect this locking movement of the plug, it will be understood that continued upward movement of the fishing tool causes the rope to break, and thereby leaving the tool free to be removed from the well. To remove the closure from the casing after it has served its purpose, the fishing tool is again applied to the stem 16 and the rod 15 pulled upwardly. With initial movement of the rod, the key 40 abuts the head 26 and thus elevates the whole retainer and the contracting element to cause the band 28 to engage and flex the arms 25 to contracted position whereby the lower locking element is released with respect to the casing coupling. However, before this release can be accomplished, the key 24 must be sheered to permit elevation of the rod 15 independently of the lower locking element E'. This sheering of the key is effected upon initial movement of the rod inasmuch as elevation of the lower locking element is restrained through its arms 25 which are still in engagement with the respective casing section 44.

During upward movement of the rod 15 during which contraction of the lower locking element E' has been effected as described, the upper locking element E has been elevated clear of the end of the casing section 45, so that now both of the locking elements are in contracted position to permit complete withdrawal of the closure from the well casing through the medium of the fishing tool.

Although we have herein shown and described only one form of removable closure for well casings embodying our invention, it is to be understood that various changes and modifications may be made therein without departing from the spirit of the invention and the spirit and scope of the appended claims.

We claim:

1. A removable closure for well casings comprising a carriage, a plug fixed to the carriage, casing engaging means positively fixed against movement upward on the carriage and normally acting to lock the plug against movement upwardly in the casing, a second casing engaging means fixed on the carriage for locking the plug against movement downward in the casing, a third means movable on the carriage to occupy either of two extreme positions and movable to one extreme position upon movement of the carriage downward into the casing by frictional engagement with the latter and in which position it engages both of said means to render the latter inactive to lock the plug, and to the other extreme position by upward movement of the carriage in the casing wherein the first mentioned means is rendered inactive thereby to release the casing, and means on the carriage for securing the first means against movement downward on the carriage but which is yieldable when sufficient upward pull is exerted on the carriage and while the first means is in locking engagement with the casing whereby, the carriage is released to allow the third means to be pulled upward and render the first means inactive, thereby permitting removal of the closure from the casing.

2. A removable closure for well casings comprising a carriage, a plug fixed to the carriage, casing engaging means positively fixed against movement upward on the carriage and normally acting to lock the plug against movement upwardly in the casing, a second casing engaging means fixed on the carriage for locking the plug against movement downward in the casing, a third means movable on the carriage to occupy one extreme position in which the first and second means are engaged and moved to a released position with respect to the casing, and another extreme position in which the first and second means are disengaged to allow them to have locking engagement with the casing, a fourth means movable on the carriage and

adapted when inserted into the casing to have frictional engagement therewith, the fourth means being connected to the third means for movement therewith and, by frictional contact with the casing, to cause the third means to be moved to the first extreme position when and as the closure is forced downward into the casing, and a fifth means on the carriage for securing the first means against movement downward on the carriage but which is yieldable when upward pull is exerted on the carriage and while the first means is in locking engagement with the casing whereby, the carriage is released to allow the third means to be pulled upward and render the first means inactive, thereby permitting removal of the closure from the casing.

3. A removable closure for well casing comprising a carriage, a plug fixed to the carriage, casing engaging means positively fixed against movement upward on the carriage and normally acting to lock the plug against movement upwardly in the casing, a second casing engaging means fixed on the carriage for locking the plug against movement downward in the casing, a third means movable on the carriage to occupy either of two extreme positions and movable to one extreme position upon movement of the carriage downward into the casing by frictional engagement with the latter and in which position it engages both of said means to render the latter inactive to lock the plug, and to the other extreme position by upward movement of the carriage in the casing wherein the first mentioned means is rendered inactive thereby to release the casing, and means on the carriage for securing the first means against movement downward on the carriage but which is yieldable when sufficient upward pull is exerted on the carriage and while the first means is in locking engagement with the casing whereby, the carriage is released to allow the third means to be pulled upward and render the first means inactive, thereby permitting removal of the closure from the casing, the third means having a part which is adjustable as to diameter to fit casings of different diameters and contractible to permit insertion of said means into the casing so that it is under tension when in the casing and thus frictionally retained with such security as to permit raising of the second means beyond influence of the third means and to thereby allow the second means to lockingly engage the casing.

4. A removable closure for well casings comprising a carriage, a plug fixed to the carriage, one locking element on the carriage normally expanded to engage the end of a casing section for locking the plug against downward movement in the casing, and a second locking element on the carriage normally expanded to engage the confronting end of an adjacent casing section for locking

the plug against upward movement in the casing.

5. A removable closure for well casings comprising a carriage, a plug fixed to the carriage, one locking element on the carriage normally expanded to engage the end of a casing section for locking the plug against downward movement in the casing, a second locking element on the carriage normally expanded to engage the confronting end of an adjacent casing section for locking the plug against upward movement in the casing, and means on the carriage operable by movement of the latter downward in the casing for contracting the locking elements to permit lowering of the plug to any desired point in the casing, said means being also operable by movement of the carriage upward in the casing for releasing the locking elements.

6. A removable closure for well casings comprising a carriage, a plug fixed to the carriage, one locking element on the carriage normally expanded to engage the end of a casing section for locking the plug against downward movement in the casing, a second locking element on the carriage normally expanded to engage the confronting end of an adjacent casing section for locking the plug against upward movement in the casing, means on the carriage for holding the locking elements in contracted position and for releasing the locking elements, a second means on the carriage engageable with the casing to move the first means to holding position as the carriage is moved downward into the casing, and effecting movement of the first means to releasing position as the carriage is moved upward in the casing, and a releasable connection between the carriage and one of the locking elements releasable under upward pull on the carriage and while said element is in engagement with the casing to allow elevation of the first means to contract said element free of the casing.

7. A removable closure for well casings comprising a carriage, a plug fixed to the carriage, one locking element on the carriage normally expanded to engage the end of a casing section for locking the plug against downward movement in the casing, a second locking element on the carriage normally expanded to engage the confronting end of an adjacent casing section for locking the plug against upward movement in the casing, and means on the carriage operable by movement of the carriage for contracting the locking elements as the closure is lowered into the casing, releasing the locking elements to expand and engage confronting casing section ends, and to contract the lower locking element to permit removal of the entire closure from the casing.

8. A well casing closure, comprising a car-

riage, means on the carriage arranged to close the casing, two sets of resilient members reversely disposed on the carriage and arranged to normally engage confronting ends of adjacent casing sections, and means on the carriage for causing the members to dis-engage the casing section ends.

9. In a removable closure for well casings, a carriage, and a cage-like member on the carriage having ribs adjustably correlated to the carriage to permit variation in the diameter of the member, springs for urging the ribs outwardly, and means for adjusting the springs.

10. A removable closure for well casings, comprising a carriage, an upper locking element fixed to the carriage and comprising a head having flexible arms secured thereto and extending downwardly and readily therefrom, a plug fixed to the head, a lower locking element comprising a head permanently fixed on the carriage against upward movement, and flexible arms fixed to the head and extending upwardly and radially therefrom, a sheerable member on the carriage beneath the head of the lower locking element for releasably securing the carriage against movement upwardly through the head, a contracting element including a band movable on the carriage to engage and flex the arms inwardly of both of the locking elements, and a retainer on the carriage and connected to the contracting element, said retainer being adjustable to fit casings of different diameter.

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