March 5, 1940. L. M. C. SEAMARK 2,192,805

CASING HEAD EQUIPMENT FOR BORE HOLES OR WELLS

Original Filed March 18, 1936 3 Sheets-Sheet 1

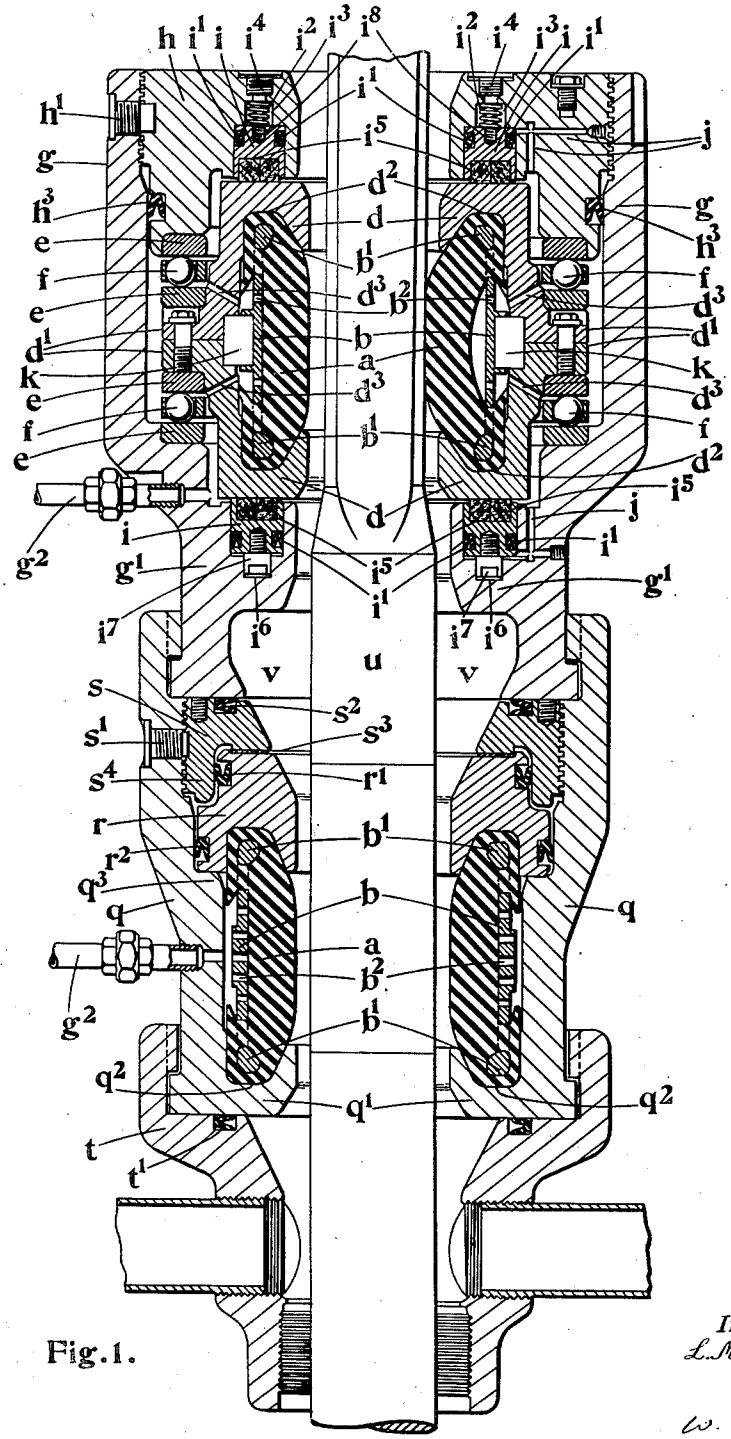

Fig. 1.

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Original Filed March 18, 1936 3 Sheets-Sheet 2

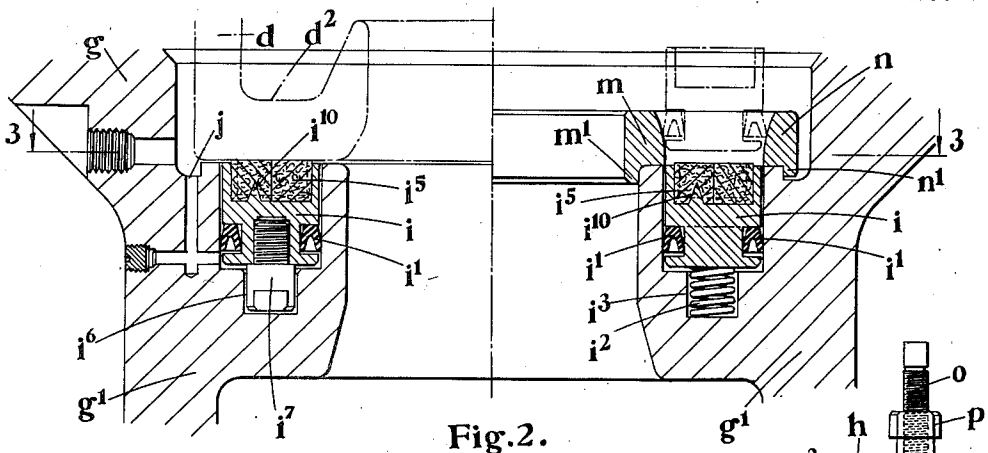

Fig.2.

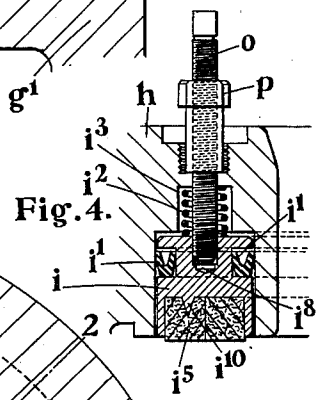

Fig.4.

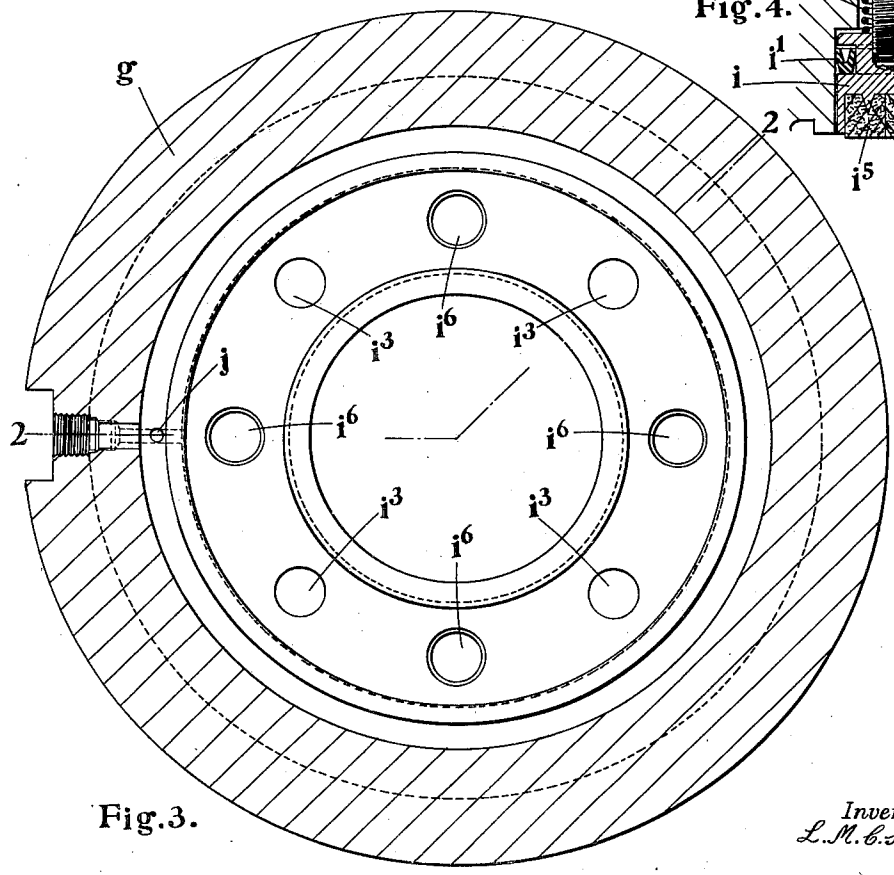

Fig.3.

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CASING HEAD EQUIPMENT FOR BORE HOLES OR WELLS

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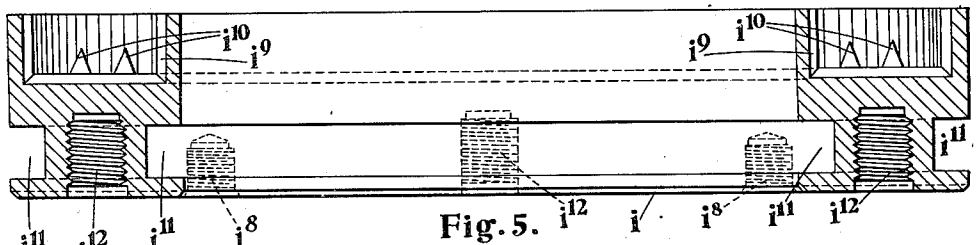


Fig. 5.

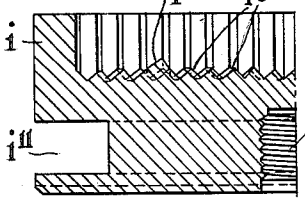


Fig. 7

Fig 8

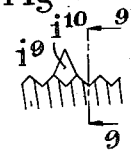
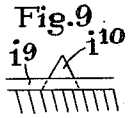


Fig. 9



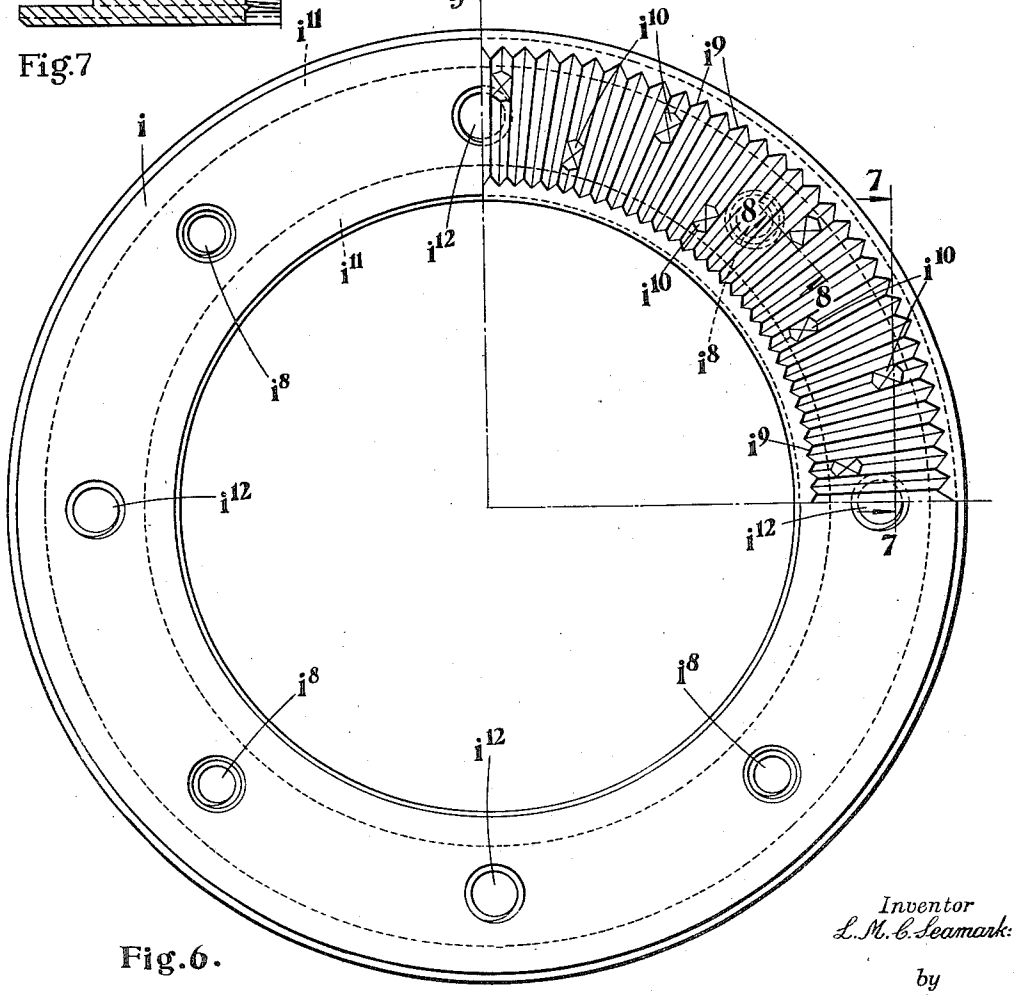


Fig. 6.

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Patented Mar. 5, 1940

2,192,805

UNITED STATES PATENT OFFICE

2,192,805

CASING HEAD EQUIPMENT FOR BORE HOLES OR WELLS

Lewis Mervyn Cecil Seamark, Petersfield, England

Application March 18, 1936, Serial No. 69,476
Renewed June 1, 1939

12 Claims. (Cl. 255—1)

This invention relates to casing head equipment for bore holes or wells of the kind in which a massive elastic sleeve is employed through which connected sections of the casing or drilling tools may be passed into and withdrawn from the well without escape of oil or gas and by which boring may be continued while the well is under pressure.

The invention is applicable to static packers as well as to packers or blow-out preventers of the rotary and rotary-gyratory types of the kind described in the specifications of the prior Patents Nos. 1,942,366 and 1,902,906.

The invention has among its objects to ensure gas and fluid tightness of the massive elastic sleeve and housing, to simplify construction and so to provide the massive elastic sleeve or the unit in which it is mounted that the sleeve or the unit may be readily withdrawn, assembled and rendered accessible.

According to the invention the massive elastic sleeve has moulded or mounted within it a rigid support or supporting ring by which the sleeve is rendered substantially incontractible or incompressible lengthwise but is contractible inwards under pressure externally applied in direction normal to the centre line or axis of the sleeve.

According to the invention moreover the massive elastic sleeve is set within end rings or the equivalent having annular cavities of a cross-sectional form corresponding to the cross-sectional form of the ends of the sleeve, whereby the sleeve is held at its ends without fastening.

The invention comprises the constructional features which are hereinafter described.

The invention is diagrammatically illustrated in the accompanying drawings, in which

Figure 1 is a sectional elevation of a casing head equipment constructed according to the invention, in which in the upper part a rotary-gyratory packer is mounted, while in a position beneath a static packer is provided. On the right-hand side of the upper part of Figure 1 the massive elastic sleeve is shown in the inwardly contracted position under pressure externally applied to it, while at the opposite side the massive elastic sleeve is shown in its normal unstressed position. The massive elastic sleeve of the static packer is shown in its uncontracted and unstressed condition.

Figure 2 is a partial sectional elevation on an enlarged scale through the lower end of the upper part of the casing illustrated in Figure 1 and on the line 2—2 Figure 3, showing the manner in which the lower jointing ring carrying the packing may be mounted in position.

Figure 3 is a sectional plan view of the casing on the line 3—3 Figure 2.

Figure 4 illustrates in traverse cross-section the manner in which the upper jointing ring carrying the packing is temporarily held in position in the annular cavity provided for its reception on the underside of the cap or cover of the casing illustrated in Figure 1, preparatory to mounting the cap or cover in position.

Figure 5 is a detail sectional elevation showing the form of jointing rings that may be employed for carrying the packing.

Figure 6 is an under plan view corresponding to Figure 5 showing a segmentary part in transverse cross-section across the respective inner and outer walls by which the annular cavity is formed in the jointing ring for the reception of the packing.

Figure 7 is a detail sectional view on the line 7—7 Figure 6.

Figure 8 is a detail sectional view on the line 8—8 Figure 6.

Figure 9 is a detail sectional view on the line 9—9 Figure 8.

In carrying the invention into effect as illustrated in Figure 1 of the accompanying drawings the massive elastic sleeves *a* of the top packer illustrated in the upper part of the figure and the bottom packer illustrated in the lower part, have moulded or mounted within the sleeves a rigid support *b* advantageously of cylindrical form. The massive elastic sleeve *a* is advantageously provided of india rubber and the rigid cylindrical support *b* is incorporated within the sleeve in moulding it. The support *b* is perforated with transverse holes b^2 extending from face to face and distributed throughout that part of the support that is exposed at the external peripheral face. The support *b* is also advantageously provided with enlarged upper and lower non-angular edges b^1, b^1.

The housing or rotor *d*, *d* of the top packer illustrated in the upper part of Figure 1 is made of two symmetrical parts set one upon the other in concentric alignment, with the outwardly extending flanges d^1, d^1 contacting and secured together, by which the parts of the housing or rotor are connected together and accommodation afforded for bearing rings *e*, *e* for ball bearings *f*, *f* disposed above and beneath the flanges d^1, d^1, corresponding bearing rings *e*, *e* being mounted respectively at the bottom of the enlarged part of the stationary casing *g* and at the underface of

the closure cap *h*. The bearing rings *e*, *e* are secured in their positions to serve as oppositely disposed sets of bearing faces for the purpose of taking the upward and downward stresses that are imparted to the housing or rotor *d*, *d* in operation.

Means are provided in the top packer to ensure substantial fixity of position of the cylindrical support *b* with respect to the symmetrical parts of the housing or rotor *d*, *d* with a view to ensure against tendency of the sleeve *a* to creep under the conditions of operation. This conveniently may be done by providing blocks *k*, *k* which may be of cylindrical form, to engage within cavities of corresponding form respectively in coincident positions on the external face of the cylindrical support *b* and on the internal face of the housing or rotor *d*, *d* as illustrated in Figure 1. Or again instead of the blocks *k*, *k* a ring may be provided within the annular cavity formed in a central position on the inner face of the housing or rotor *d*, *d* which may be securely held on the connection together of the respective parts thereof, the ring being provided with inwardly projecting parts which may be of a circular or cylindrical shape for entry within cavities of corresponding form on the external face of the cylindrical support *b*.

The massive elastic sleeve *a* of the top packer may advantageously have a transverse cross-sectional form such as illustrated in Figure 1, whereby its respective upper and lower ends may be accommodated in annular cavities d^2 of corresponding form respectively provided in the parts of the housing or rotor *d*, *d*, so that thus on the parts of the latter being secured together the sleeve is held, whereby in operation the perforated cylindrical support *b* serves to resist the stresses imposed upon the sleeve by the external application of the fluid pressure employed, such as hydraulic pressure, whereby the sleeve is contracted to engage the sections of the drill stem or other parts suspended in the well, and to ensure a tight joint against the well pressure, it being understood that the fluid pressure medium is accessible externally of the massive elastic sleeve *a* through passages d^3 within the respective parts of the housing or rotor *d*, *d*, being admitted to the casing *g* through an inlet pipe g^2, and thence passing to the annular space surrounding the cylindrical support *b* where it is accessible at the rear face of the sleeve *a* at its central part through the perforations b^2. Thus the fluid pressure medium will cause the inward contraction of the sleeve *a*, as indicated at the right hand side of Figure 1 at the top. The sections of the drill stem *u* or other parts suspended in the well or the Kelly or grief stem may thus be embraced to maintain a pressure tight joint in the operation of drilling or in raising or lowering the drill stem or other parts.

The casing *g* of the top packer (Figure 1) may be provided with a closure cap *h* which may be secured in position by means of radial locking screws h^1 and fluid tightness of the closure cap *h* may be ensured by means of a U ring h^3. The closure cap *h* is provided on its underface with an annular cavity for the accommodation of a top jointing ring *i*, and the latter is on its underface itself provided with an annular cavity for the reception of packing i^5. The packing i^5 may be provided as rings or turns of packing of known kind made of consolidated fabric with which metal is incorporated, whereby the metal is exposed upon the wearing face in contact with the top horizontal face of the housing or rotor *d*, *d*. It will be understood that the fluid pressure medium from within the stationary casing *g* is accessible at the upper face of the top jointing ring *i*, through passages such as *j*, and that annular cavities may be provided in opposite positions at the sides of the top jointing ring for the reception of U rings i^1, i^1 to ensure fluid tightness. The top jointing ring *i* is also subject to pressure through a series of helical springs such as i^2 (Figures 1, 2 and 3) mounted in cavities i^3 set at equal distances apart in the closure cap *h*. Screw-threaded closure plugs i^4 may be provided to close the cavities i^3. Intermediate of the helical springs i^2 and cavities i^3, cavities i^6 (Figures 1, 2 and 3) are provided for the accommodation of the heads of studs i^7 by which the top jointing ring is fixedly held in position against rotation. It will be understood that provision as hereinbefore described for making a fluid tight joint at the horizontal top face of the housing or rotor *d*, *d* is similarly made for the horizontal bottom face. For this purpose a bottom jointing ring *i* similar to the top jointing ring *i* and similarly provided with an annular cavity for the accommodation of packing i^5, is mounted within an annular cavity of corresponding form at the upper face of the inwardly extending integral flange g^1 of the casing *g*. The bottom jointing ring *i* is also similarly provided with screw-threaded studs i^7 set at its underside at equal distances apart for accommodation within corresponding cavities i^6 within the flange g^1, whereby the bottom jointing ring *i* is fixedly held in position against rotation; while the bottom jointing ring *i* is similarly subjected to the pressure of the helical springs i^2 set within cavities i^3 at equal distances apart; and the bottom jointing ring *i* is also accessible through passages such as *j* to the fluid pressure medium maintained within the casing *g*.

Thus the bottom jointing ring *i* is provided in all respects the same as the top jointing ring except that at the upper face of the top jointing ring *i* alone are provided screw-threaded holes i^8 (Figures 1, 4, 5 and 6) for a purpose hereinafter described. Figures 2 and 3 illustrate the annular cavity for the bottom jointing ring *i* and the cavities or holes i^3 and i^6 that open into the annular cavity, it being understood that the screw-threaded plugs i^4 are provided only in the closure cap *h* and thus in the flange g^1 the cavities i^3 are closed at the bottom.

The annular cavities in the jointing rings *i* provided for the reception of the packing i^5 as illustrated in Figures 5 to 9 are formed with serrated faces i^9 or otherwise to an irregular shape of the faces or walls of the cavity for the purpose of ensuring fixity of position of the packing therein. The serrations of the faces i^9 may as illustrated be arranged with the alternating ridges and furrows in alignment on the oppositely disposed faces and across the bottom face of the cavity. Furthermore within the annular cavities in the jointing rings *i* upstanding integral or firmly secured pyramids or spikes i^{10} may be provided which may for example be set alternately in inner and outer series as illustrated in Figure 6. By such means the rings or turns of packing i^5 may be compressed in the annular cavity in the jointing rings *i* and thus the packing caused to accommodate itself to the irregular faces of the cavity and to the integral pyramids or spikes i^{10}, whereby the packing i^5 may be held immovable within the cavity provided for its re-

ception in the jointing rings. Alternatively the packing i^5 may itself be preformed or compressed to the irregular faces or form of the cavity provided in the jointing rings for the reception of the packing.

In Figures 5, 6 and 7 the internal and external cavities i^{11} are shown for the reception of the U rings i^1 and the series of holes i^{12} are also indicated for the reception of the studs i^7, the holes i^{12} being set intermediate of the holes i^8 in the same series in circular line.

For the purpose of mounting the bottom jointing ring i in position within the cavity in the inwardly extending flange g^1 of the casing two guide rings m, n (Figure 2) may advantageously be set temporarily in position in concentric relation. The rings m, n are respectively provided with downwardly extending flanges m^1, n^1 and their oppositely disposed inner faces flare outwardly towards the top faces of the rings. By such means on the insertion of the bottom jointing ring into its cavity the U rings i^1 are confined as they enter the upper part of the annular cavity, whereby the insertion of the jointing ring is facilitated without liability of the deformation of the U rings.

The series of helical springs i^2 are intended to apply pressure to maintain a tight joint at the respective top and bottom horizontal faces of the rotor or housing d, d. It is thus necessary that the top jointing ring i be held in position within the annular cavity on the underface of the closure cap h provided for its reception, against the action of the helical springs i^2. For this purpose as illustrated in Figure 4, the screw-threaded closure plugs i^4 are removed, the helical springs i^2 are inserted into their cavities i^3 and the top jointing ring i is then passed into the annular cavity provided for its reception on the underside of the closure cap h, by means of screw-threaded pins and nuts o, p. The screw-threaded pins o are caused to enter the screw-threaded holes i^8 and as the nuts p contact with the closure cap h on the rotation of the nuts p, the top jointing ring is gradually raised within its cavity against the pressure of the respective helical springs i^2. It will be understood that on the closure cap h being secured in position the screw-threaded pins o and the nuts p are removed whereupon the top jointing ring is then subject to the pressure of the helical springs i^2 and the screw-threaded closure plugs i^4 are then replaced.

It will be understood that ample clearance is provided between the rotor or housing d, d of the top packer and the casing g and the closure cap h or that packer to permit of the slight gyratory or eccentric movement of the rotor in its rotation when drilling is in progress. It will however be understood that the rotor d, d may be provided without such accommodation.

It will furthermore be understood that the fluid pressure medium supplied through the admission pipe g^2 may be maintained at the desired pressure, for example at a pressure higher than the well pressure, and that the fluid pressure medium is accessible to the annular space between the rotor or housing d, d and the stationary casing g and thence is also accessible through the passages j to the outer faces of the jointing rings i.

The bottom packer illustrated in Figure 1 is provided with a massive elastic sleeve a and a rigid cylindrical and perforated support b of a form similar to that of the top packer, the support b being similarly incorporated in the moulding of the sleeve. The lower part of the sleeve a of the lower packer is engaged within an annular cavity q^2 of a corresponding transverse cross-sectional form in the inwardly protruding flange q^1 of the lower part of the casing q; while the upper part of the sleeve a is engaged within an annular cavity of corresponding form in the end ring r which is adapted to seat upon a shoulder q^3. The closure cap s of the lower packer is set immediately beneath the underface of the base of the casing g and held in position by a bayonet joint or other connection, and a packed joint provided. Thus the closure cap s of the bottom packer may be screwed into position and locked by radial locking screws s^1, and a U ring s^2 may be provided in an annular cavity on the top face of the closure cap s, with the cavity of the U ring s^2 open inwardly to provide a fluid tight joint with the underface of the base of the casing g. A sheet of packing s^3 may be applied between the underface of the closure cap s and the end ring r, while the latter may be reduced in diameter at its upper part and an external annular cavity provided for the reception of a U ring r^1, the cavity of which is directed upwardly and a joint provided against the downwardly extending flange s^4 of the closure cap s. At the lower part of the end ring r an external annular cavity may be provided for the reception of another U ring r^2 with its cavity directed downwardly.

Means similar to those by which the base of the casing g is secured upon the casing q may be provided for mounting the casing q upon the well head flange t which is mounted and equipped in known manner. An annular cavity may be provided for the reception of a U ring t^1 whose cavity is directed inwardly. A central cavity v of conical shape is advantageously provided beneath the inwardly extending flange g^1 for the purpose of guiding the sections of the drill stem or other parts through the upper end ring r of the bottom packer.

The fluid pressure medium is accessible to the annular space surrounding the massive elastic sleeve a and its support b through the admission pipe g^2 and the fluid pressure medium is accessible in turn to the outer face of the massive elastic sleeve through the perforations b^2.

It will be understood that the invention is not limited in its application to the construction exemplified in Figure 1 of the accompanying drawings, for a massive elastic sleeve mounted and provided as hereinbefore described may be employed alone in a static packer or in a rotary type of packer or in a rotary-gyratory type of packer.

It will be understood that in the construction described in Figure 1 the second or bottom packer may serve as an emergency or standing packer capable of being brought into use either to enable the massive elastic sleeve of the top packer to be replaced if necessary when a static packer would be effective in a position beneath, or in special circumstances where very high pressures are encountered in the well the second or bottom packer would be available to supplement the top packer.

I claim:

1. A casing head equipment for boreholes or wells comprising the casing head, a self-contained packer unit for enclosure within the casing head, the packer unit comprising a massive elastic sleeve and a rigid substantially concentric annular support for the sleeve integrally incorporated

with the sleeve, the sleeve being substantially incontractible lengthwise and that part of the sleeve disposed inward of the support being contractible inwards in position between the ends of the support under fluid pressure applied externally to the periphery of the packer unit, the fluid pressure being made accessible through the annular suppport and at the rear thereof, the casing head and the packer unit being so related as to form between them an annular space, means for the admission into the said annular space of a fluid pressure medium and means for holding the packer unit substantially immovable axially within the casing head, comprising oppositely disposed parts within which annular cavities are provided within which the annular ends of the packer unit are held.

2. A casing head equipment for boreholes or wells comprising the casing head, a self-contained packer unit for enclosure within the casing head, the packer unit comprising a massive elastic sleeve and a rigid and substantially concentric annular support for the sleeve integrally incorporated with the sleeve and at least partially enclosed by the sleeve, the sleeve being substantially incontractible lengthwise and that part of the sleeve disposed inwards of the support being inwardly contractible under fluid pressure applied externally to the periphery of the packer unit, the fluid pressure being made accessible through the annular support and at the rear thereof, the casing head and the packer unit being so related as to form between them an annular space, means for the admission into the annular space of a fluid pressure medium and means for holding the packer unit substantially immovable axially within the casing head comprising oppositely disposed parts within which annular cavities are provided of radial cross-section corresponding to the radial cross-section of the packer unit at its ends whereby the annular ends of the packer unit are held.

3. A casing head equipment for boreholes or wells comprising the casing head, a self-contained packer unit for enclosure within the casing head, the packer unit comprising a massive elastic sleeve and a rigid and substantially concentric annular support for the sleeve integrally incorporated with the sleeve, the sleeve being substantially incontractible lengthwise and that part of the sleeve disposed inwards of the support being inwardly contractible under fluid pressure, accessible through the annular support and at the rear thereof, a rotatable housing mounted within the casing head within which housing the packer unit is mounted; the said housing comprising parts presenting oppositely disposed open annular cavities therein within which the ends of the packer unit are held immovable axially and means for rendering a fluid pressure medium accessible to the rear face of the inner part of the sleeve.

4. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing comprises two co-axial parts having outwardly extending flanges adapted to be applied in contact and connected together to hold the packer unit within and between oppositely disposed cavities of the said co-axial parts and in which anti-friction bearings are provided between the connected flanges and the oppositely disposed parts of the casing head.

5. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing comprises two co-axial parts having outwardly extending flanges adapted to be applied in contact and connected together to hold the packer unit within and between oppositely disposed cavities of the said co-axial parts and in which means are provided engaged by the respective co-axial parts for connecting the annular support of the packer unit with the housing on the respective co-axial parts being connected together.

6. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing has horizontal top and bottom jointing faces respectively provided on its upper and lower parts and packing disposed within the casing head in oppositely disposed positions in contact with the said respective jointing faces.

7. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing is provided with horizontal top and bottom jointing faces and the casing head is provided with annular cavities in position opposite to the said jointing faces for the reception of jointing rings within which packing is mounted adapted to contact with the respective top and bottom jointing faces of the rotatable housing.

8. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing is provided with horizontal top and bottom jointing faces and the casing head is provided with annular cavities in position opposite to the said jointing faces for the reception of jointing rings within which packing is mounted adapted to contact with the respective top and bottom jointing faces of the rotatable housing, and means whereby the said jointing rings are rendered subject to the same fluid pressure medium as the elastic sleeve of the packer unit.

9. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing is provided with horizontal top and bottom jointing faces and the casing head is provided with annular cavities in position opposite to the said jointing faces for the reception of jointing rings within which packing is mounted adapted to contact with the respective top and bottom jointing faces of the rotatable housing, and means for preventing the rotation of the lower jointing ring comprising pins whose heads extend beneath the jointing ring and are accommodated within recesses within an internal shoulder of the casing head.

10. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing is provided with horizontal top and bottom jointing faces and the casing head is provided with annular cavities in position opposite to the said jointing faces for the reception of jointing rings within which packing is mounted adapted to contact with the respective top and bottom jointing faces of the rotatable housing, and means for mounting within the lower annular cavity the lower jointing ring having provided therein in lateral annular cavities on the inner and outer peripheral faces an inverted U-packing, said means comprising concentrically disposed guiding rings set in determined concentric relation above the annular cavity provided for the reception of the lower jointing rings, the respective oppositely disposed inner faces of the guiding rings being disposed in the said temporary position in alignment with the respective oppositely disposed peripheral faces of the annular cavity, the respective oppositely disposed inner faces of the guiding rings flaring outwardly towards the top of the guiding rings.

11. A casing head equipment for boreholes or wells as specified in claim 3, in which the rotatable housing is provided with horizontal top and bottom jointing faces and the casing head is provided with annular cavities in position opposite to the said jointing faces for the reception of jointing rings within which packing is mounted adapted to contact with the respective top and bottom jointing faces of the rotatable housing, and means for mounting the top jointing ring within the annular cavity on the underside of the closure cap of the casing head against the pressure of helical springs by which pressure is mechanically applied to the top jointing face of the rotatable housing of the packer unit in normal use, the said means comprising a number of devices consisting of screw-threaded pins and nuts mounted upon the closure cap of the casing head at equidistant positions by which the top jointing ring is temporarily held within the said annular cavity on the application of the closure cap in position on the casing head, the said devices being withdrawn on the mounting of said closure cap in position whereby the top jointing ring then becomes subject to the pressure of said helical springs.

12. A self-contained pressure packer unit for the casing head equipments of boreholes by which a pressure tight joint may be made with the connected sections of the drill stem held within or passing through the casing head, the packer unit comprising a massive elastic sleeve and a rigid and substantially concentric annular support for the sleeve, the end portions of the sleeve being molded about the end portions of the support, forming a unitary structure, the material of the sleeve entirely covering both ends of the support and extending for a substantial distance over the outer face of the support near said ends, the support, between said extensions, being perforated, and that part of the sleeve at the inner side of the support being contractible inwardly under fluid pressure applied peripherally of the unit through the space between said extensions, and means for holding the packer unit substantially immovable axially within the casing head, comprising oppositely disposed parts having annular cavities into which the ends of the unit, including the ends of the support and its covering extend.

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