June 26, 1962 P. E. CHANEY 3,040,927

CLOSURE MEANS FOR WITHSTANDING HIGH PRESSURES

Filed Feb. 19, 1960

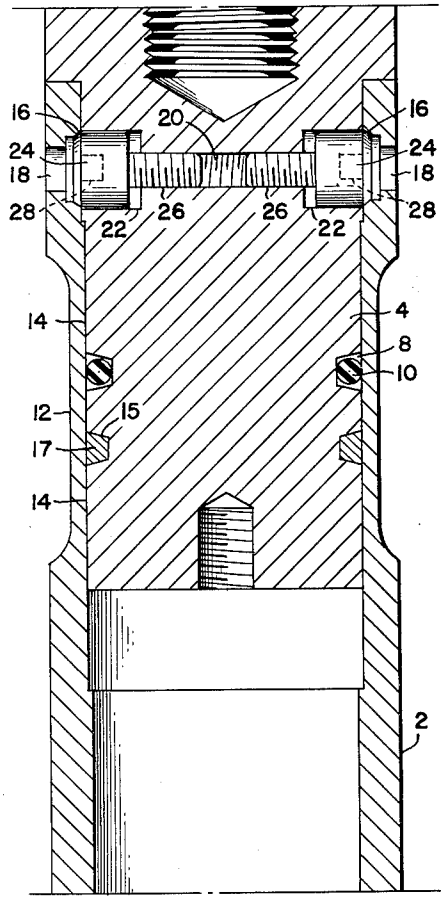


FIG. 1.

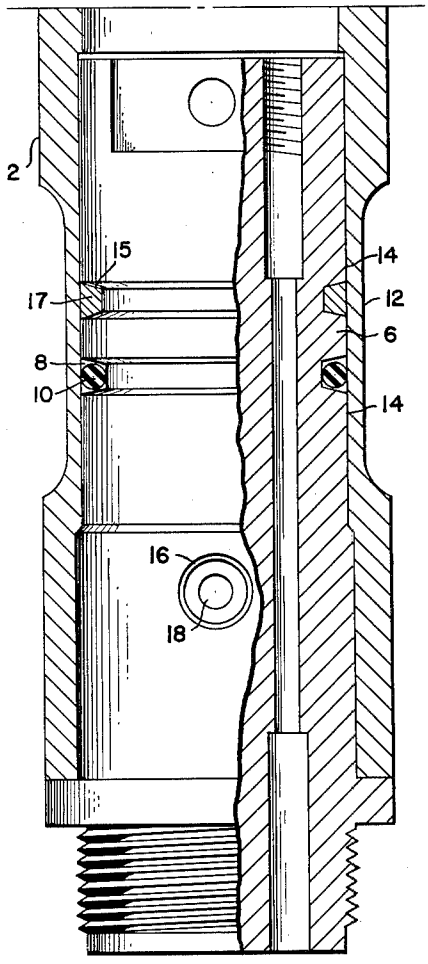


FIG. 2.

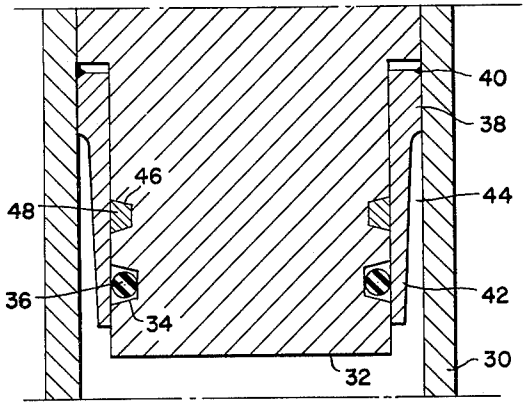


FIG. 3.

INVENTOR.
PRESTON E. CHANEY
BY
Brescr, Smith & Harding
ATTORNEYS

United States Patent Office 3,040,927 Patented June 26, 1962

3,040,927

CLOSURE MEANS FOR WITHSTANDING HIGH PRESSURES

Preston E. Chaney, Dallas, Tex., assignor to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey

Filed Feb. 19, 1960, Ser. No. 9,868
7 Claims. (Cl. 220—46)

This invention relates to closure means for withstanding high pressures, and has particular utility in the provision of closures for protective casings adapted to enclose apparatus which is to be lowered within bore holes.

Closure means of the type aforesaid is disclosed in applicant's copending application, Serial No. 818,161, filed June 4, 1959, according to which, briefly, a plug for a protective casing or the like has appreciable clearance with the casing, and an O-ring is utilized for packing purposes. The portion of the casing in the vicinity of the O-ring is made deformable under high pressures so that as extreme pressures are applied it binds against the plug, eliminating clearance between the surfaces to be packed and thereby preventing the existence of a space into which the O-ring may be extruded. Such an assembly is capable of withstanding extremely high pressures, while, nevertheless, when the pressures are removed a joint is provided which may be readily assembled or disassembled. While such a seal is effective against liquids at pressures presently encountered in well bores, it has not proved to be entirely satisfactory because it does not provide a completely leak-proof seal against gases when long periods of time are involved. Gases can and will diffuse through the O-ring. While it is true that diffusion occurs very slowly, nevertheless, it is appreciable and therefore cannot be tolerated. Accordingly, the general object of the present invention is to provide a closure of the type aforesaid with improved sealing means capable of preventing diffusion of gases over long periods of time.

The foregoing and other objects of the invention will become apparent from the following description, read in conjunction with the accompanying drawing, in which:

FIGURES 1 is an axial section showing a closure provided at the upper end of a protective casing in accordance with the invention, the arrangement being suitable for withstanding high external pressures;

FIGURE 2 is an exial section showing a similar closure provided at the lower end of a protective casing; and

FIGURE 3 is an axial section showing a closure for a chamber having high internal pressures.

A protective casing is indicated at 2 having through its major portion a wall thickness capable of withstanding the highest pressures expected to be encountered. This casing may be arranged to enclose recording or similar apparatus used in conjunction with well logging, which apparatus is, for example, of the type disclosed in the application of John D. Bennett, Preston E. Chaney, Jack Weir Jones and Fred M. Mayes, Serial No. 685,717, filed September 23, 1957, or the application of Fred M. Mayes and Jack Weir Jones, Serial No. 818,066, filed June 4, 1959. The foregoing applications disclose well logging apparatus in which a protective casing is required. Other uses of the invention are to be found in protective casings for well surveying instruments of various known types.

If the use of magnetic material is not objectionable, the protective casing may be made of steel; but, if non-magnetic casings are required, the materials used may be, for example, Monel metal or the like, capable of withstanding high pressures, but not interfering with magnetic field conditions.

Referring to FIGURES 1 and 2 of the drawing, the protective casing 2 is provided with an upper plug 4 and a lower plug 6, both of which involve similar closure construction and may be attached to other elements of the particular device involved. Since the arrangement is the same for both plugs, the lower will be primarily described, though the reference numerals apply to similar parts at both the upper and lower ends of the casing. It will be understood that single or multiple O-rings may be provided, the same being true in the case of the locking elements hereafter described. In many bore hole applications the protective casing 2 may be of very considerable length, depending upon the space required for recording or other apparatus, power supply batteries, or the like.

Considering an arrangement utilizing a single O-ring, the plug is provided with an annular groove 8 for the reception of the O-ring 10, the relative dimensions here involved being in accordance with customary practice which involves the provision of a groove having an axial length exceeding the cross-sectional diameter of the ring. In accordance with the present invention, the portion of the casing in the axial vicinity of the O-ring 10 is thin, as indicated at 12, so as to be inwardly deformable under the external pressures which may be encountered, the thickness of material at this thinned section being so chosen that under such high pressures as might otherwise produce extrusion of the O-ring the portion of the casing thereat will be deformed diametrically inwardly so as to provide metal-to-metal contact at 14 thus eliminating the clearance which is desirably existent under low pressure conditions to facilitate assembly and disassembly. In brief, the major portion of the casing is substantially undeformable under the external pressures and capable of fully sustaining them whereas in the region 12 it is deformable to provide the metal-to-metal contact just indicated.

The result of this design is to provide, consistently with substantial original clearance, an arrangement in which the higher the pressure, the less possibility exists of any extrusion of the O-ring out of its groove 8 into the clearance to be packed. The arrangement has been found capable of withstanding pressures encountered in the deepest mud-filled bore holes to prevent passage of liquid. As indicated hereinbefore, however, over long periods of time, diffusion of gases at an appreciable rate past the O-ring may and will occur. Even though metal-to-metal contact occurs, the surfaces cannot be finished to a degree precluding the passage of gas under high pressure gradients.

To check effectively such diffusion, the plug is provided with a second annular groove 15 similar to the groove 8, for the reception of an annulus 17 made of a soft metal, such as lead or a soft alloy. This annulus 17 is disposed on the low pressure side of the O-ring 10, in axially spaced relation thereto, as shown, and has an axial length for providing a substantial surface area presenting toward the thin wall casing portion 12. The annulus 17 is firmly embedded in the groove 15, preferably being

cast therein to make it annularly complete, and it not only fills the same but initially is machined so as to project slightly beyond the boundary of the plug, for example, to the extent of one or a few thousandths of an inch. When the closure is initially exposed to pressure, the O-ring alone acts as an effective seal against liquid and gases, but as the pressure rises the thin wall portion 12 of the casing is reduced in diameter against the influence of its inherent resilience sufficiently to engage and press against the annulus 17, thus effecting a hard-to-soft metal seal against diffusion of gases, the soft metal flowing into even the most minute depressions such as scratches in the hard metal surfaces. Pressure across the O-ring eventually equalizes due to diffusion of gases past the O-ring, and thus the sealing function, so far as gases are concerned, is finally completely transferred to the annulus 17.

The arrangement just described does not, of course, serve to lock the plug and protective casing against axial movements. For this purpose a special locking means is provided which, in particular, avoids projection of any element outside the cylindrical envelope of the protective casing and also avoids the setting up of any stresses which might tend to provide, even locally, clearances into which the O-ring may be extruded. In accordance with the invention, the protective casing, in a region where its wall thickness is maximum, is provided with an opening indicated at 16 provided by a countersink from the inside of an opening 18 of smaller internal diameter. When the plug and housing are assembled there is in line with the opening 18 a threaded bore 20 in the plug which at its outer end or ends is enlarged to a cylinder 22 arranged to receive the bevelled end of a cylindrical head 24 of a screw threaded at 26 into the threaded portion of the bore 20, the head 24 being arranged to enter the countersink 16 snugly to provide locking. The head 24 may be provided with any suitable sockets such as indicated at 28 for a wrench inserted through the opening 18.

Prior to assembly, the screw is threaded inwardly, the head 24 being then seated within the bore 22 so as to clear the internal surface of the casing. When the plug is in place, each screw 26 may be then threaded outwardly to enter the countersink 16. Secure locking is thus obtained without the imposition of any radial strains on the casing which might possibly interfere with the desirable contact produced at 14 under high pressure conditions as described above.

FIGURE 3 illustrates the application of the invention to a casing closure wherein the casing is subject to high internal pressures exceeding exterior ones. The casing is indicated generally at 30 and may be of any desired shape, and may be provided with more than one closure of the type illustrated. A closure plug is shown at 32 and is provided with the annular groove 34 for reception of the O-ring 36. An annular interior ring is provided at 38 which may be integral with the casing but generally is more conveniently secured thereto as by welding at 40 whereby it becomes in effect integral with the casing with complete closure against leakage between it and the casing. Extending inwardly is a lip portion 42 which closely embraces the periphery of the plug and extends across the groove 34 containing the O-ring. As will be evident, a space 44 exists outside the ring 42 and the pressure inside the casing is applied in this space to force the ring 42 inwardly to provide tight and extended contact with the exterior of the plug, the high pressure causing the ring 42 to be distorted inwardly, the ring being relatively thinner than the wall 30 of the casing. The plug is also provided with a second annular groove 46, similar to the grooves 8 and 34, for the reception of the soft metal annulus 48, similar to the annulus 17 provided as described above. The annulus 48 is disposed on the low pressure side of the O-ring 36, in axially spaced relation thereto, as shown. It will be evident that this arrangement has the same general sealing properties as that previously described, the tight contact of the ring 42 with the plug in the vicinity of the O-ring preventing extrusion thereof, and the tight contact of the ring 42 with the annulus 48 preventing diffusion of gases over long periods of time.

It will be evident that various changes in details of the invention may be made without departing from the scope of the following claims.

What is claimed is:

1. In combination, a hollow casing member adapted to withstand high pressures and provided with a cylindrical bore at an end thereof, a cylindrical plug member arranged to enter said bore, an O-ring packing about the plug and engageable with the wall of said bore when the casing and plug are assembled, a soft metal annulus about the plug and engageable with the wall of said bore when the casing and plug are assembled, said casing having a portion extending axially across the location of said O-ring and soft metal annulus when the casing and plug are assembled and adapted to be deformed inwardly by pressure externally of said casing portion to provide tight contact of the wall of the bore with the plug to eliminate clearance into which extrusion of the O-ring under pressure could occur, and to provide tight contact of the wall of the bore with the soft metal annulus to effect a seal against diffusion of gases.

2. The combination according to claim 1 in which the soft metal annulus is tightly embedded in one of said members and presents a substantially broad surface area to the other, the O-ring packing and the soft metal annulus are axially spaced relative to each other, and the portion of the casing embracing said soft metal annulus is made of comparatively hard metal deformable radially inwardly under high pressure.

3. The combination according to claim 1 in which the soft metal annulus is tightly embedded in one of said members and presents a substantially broad surface area to the other, the O-ring packing and the soft metal annulus are disposed in axially spaced relation to each other and with the soft metal annulus on the low pressure side of the O-ring packing, and the portion of the casing embracing said soft metal annulus is made of comparatively hard metal deformable radially inwardly under high pressure.

4. The combination according to claim 1 in which the soft metal annulus is tightly embedded in one of said members and presents a substantially broad surface area to the other, the O-ring packing and the soft metal annulus are disposed in axially spaced relation to each other and with the soft metal annulus on the axially inner side of the O-ring packing, and the portion of the casing embracing said O-ring packing and soft metal annulus is relatively thin walled and made of comparatively hard metal deformable radially inwardly under high pressure.

5. The combination according to claim 1 in which said casing portion comprises a tubular lip affixed by an outer end portion to the casing and extending axially into said casing, said lip being spaced radially inwardly from the casing.

6. In combination, a hollow casing member adapted to withstand high pressures and provided with a cylindrical bore at an end thereof, a cylindrical plug member arranged to enter said bore, an O-ring packing about the plug and engageable with the wall of said bore, when the casing and plug are assembled, a soft metal annulus about the plug and engageable with the wall of said bore when the casing and plug are assembled, said casing having a portion extending axially across the location of said O-ring and soft metal annulus when the casing and plug are assembled and deformable inwardly by pressure which said casing can more readily withstand to provide tight contact of the wall of the bore with the plug to eliminate cearance into which extrusion of the O-ring under pressure could occur, and to provide tight contact of the wall of the bore with the soft metal annulus to effect a seal against diffusion of gases.

7. In combination, a hollow casing member adapted to withstand high pressures and provided with a cylindrical bore at an end thereof, a cylindrical plug member arranged to enter said bore, an O-ring packing about the plug and engageable with the wall of said bore when the casing and plug are assembled, a soft metal annulus about the plug and engageable with the wall of said bore when the casing and plug are assembled, said casing having a portion extending axially across the location of said O-ring and soft metal annulus when the casing and plug are assembled and having a thickness sufficiently thin to be deformed inwardly by pressure which said casing can withstand to provide tight contact of the wall of the bore with the plug to eliminate clearance into which

extrusion of the O-ring under pressure could occur, and to provide tight contact of the wall of the bore with the soft metal annulus to effect a seal against diffusion of gases.

References Cited in the file of this patent

UNITED STATES PATENTS

2,436,407	Stephens	Feb. 24, 1948
2,457,927	Scudder	Jan. 4, 1949
2,483,156	Schmitz	Sept. 27, 1949
2,687,910	Petch et al.	Aug. 31, 1954
2,800,597	Dunn	July 23, 1957
2,839,218	Zerbe	June 17, 1958