

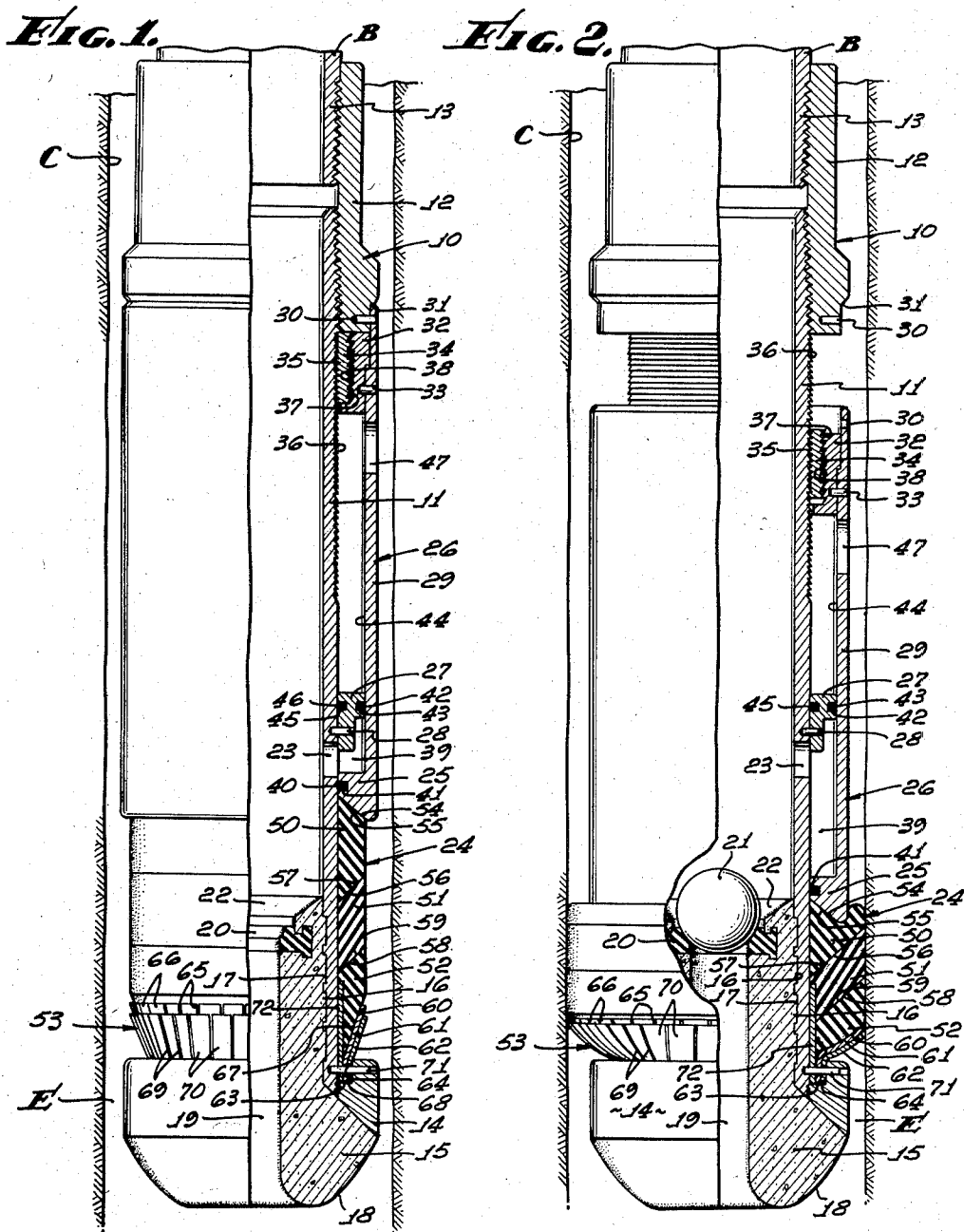
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WELL BORE PACKER

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WELL BORE PACKER

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7 Claims. (Cl. 166—190)

The present invention relates to well bore apparatus, and more particularly to packers adapted to effect seals against confining enclosures, such as the wall of an open well bore, casing or liner.

An object of the present invention is to provide a well packer embodying an initially retracted packing structure that requires a much lesser force to expand it into packed-off condition against the wall of a confining enclosure, such as a well bore.

Another object of the invention is to provide a well packer embodying an initially retracted packing structure, which can be made of harder rubber or rubber-like material, and which still requires a reduced force to expand the structure into sealing relation against the wall of the confining enclosure, such as a well bore.

A further object of the invention is to provide a well packer embodying an initially retracted well packing structure that aids in its own outward expansion against a confining enclosure, such as against the wall of a well bore.

An additional object of the invention is to provide an initially retracted packing structure in a well packer that forms a plurality of lip seals against the wall of the confining enclosure when expanded, to insure against leakage of fluent substances between the packing structure and the enclosure wall.

Yet another object of the invention is to provide an initially retracted packing structure in a well packer capable of outward expansion to a substantial extent, and in which the expanded packing structure can withstand high pressure and loads imposed thereon.

Another object of the invention is to provide a well packer embodying an initially retracted packing structure expandible outwardly hydraulically, in which the hydraulic device can have a relatively small pressure actuable area, and still be effective to expand the packing structure to the required extent.

This invention possesses many other advantages, and has other objects, which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a combined longitudinal section view and side elevation of an apparatus embodying the invention, with its parts in their initial and retracted position;

Fig. 2 is a view similar to Fig. 1, disclosing the packing structure expanded outwardly against the well bore;

Fig. 3 is a view similar to Fig. 1, disclosing the packing structure expanded outwardly to a still further extent;

Fig. 4 is an enlarged fragmentary longitudinal section,

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illustrating the expansion of the packing structure to its maximum extent.

The invention disclosed in the drawings is applied to a casing shoe apparatus forming the lower end of a string of well casing B to be lowered within a well bore C to the required extent, after which the casing is to be cemented in the well bore. If the apparatus A were incorporated in the casing string above its lower terminus, then it would be considered to be a casing collar.

As specifically shown, the apparatus includes a tubular casing member 10 made of several parts. Thus, its main central portion 11 is threadedly secured to an upper box 12 that is, in turn, threaded onto the lower pin end 13 of an adjacent casing section B thereabove. The lower portion of the intermediate tubular member 11 is threadedly secured within a lower abutment 14. For the purpose of facilitating lowering of the casing string in the well bore, a cementitious plug 15 is cast within the lower portion of the tubular casing member, this plug being integrated to the tubular member, as by having cementitious ribs 16 of material cast within longitudinally spaced internal grooves 17 in the tubular member 11. The plug 15 itself extends below the lower abutment 14, terminating in a rounded nose 18, to function as a guide capable of steering the casing past minor obstructions or restrictions in the well C as the casing string is being lowered therewithin. The plug has a central passage 19 therethrough to permit fluid to flow between the interior and the exterior of the tubular member 10. However, as described hereinbelow, fluid may be prevented from passing in a downward direction through the central plug passage 19, as by providing a valve seat 20 cast in the upper portion of the plug and surrounding the central plug passage, this seat being engageable by a suitable valve element 21, such as a trip ball, which can be dropped or pumped down the casing string B into engagement with the seat 20. To insure engagement between the valve element 21 and the seat 20, the upper end 22 of the lower plug 15 may be tapered or be made divergent in an upward direction, so that the ball will be guided toward the central plug passage 19 and seat 21.

It is desired to pump fluid down the casing string B and completely through the apparatus A for subsequent passage to the top of the hole through the annulus D around the casing string. Thereafter the central passage 19 is to be closed against downward flow of fluid and the apparatus sealed off between its tubular member 10 and the wall of the well bore C, side ports 23 above the packed-off region being opened. This will insure that all cementitious material pumped down the casing string B will pass out through the side ports 23 for upward travel through the annulus D surrounding the casing string, none of the cementitious material being capable of dropping down the well bore C, or through the central passage 19, to contaminate the formation below the apparatus A.

To accomplish the aforementioned purposes, an initially retracted packing structure 24 (described in detail below) is disposed around the tubular member 11, the lower portion of this packing structure bearing upon the lower abutment 14. The upper portion of the packing structure is engaged by the lower head or abutment 25 of an annular cylinder 26 extending upwardly from the head along the tubular member 10. The lower head 25 is disposed immediately below the plurality of side ports 23, which are initially closed by the hydraulic portion of the apparatus now to be described. Thus, the tubular member 11 has an annular piston 27 disposed on its exterior above the ports 23, this piston being releasably secured to the tubular member by one or more shear pins or screws 28. The sleeve 29 of the cylinder 26 is integral with the lower head 25, extending upwardly

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along the annular piston 27, the uppermost end of the sleeve 29 being initially releasably secured to the upper box 12 of the tubular member 10 by one or more shear pins 30. When the shear pins 30 are intact, the upper end of the cylinder sleeve 29 may engage a downwardly facing shoulder 31 on the upper box.

Secured to the upper end of the sleeve 29 is a cylinder retaining device in the form of an upper head 32 attached to the sleeve 29 by a plurality of coupling pins 33. The upper head 32 contains a split ratchet ring or sleeve 34 having upwardly facing internal circumferential ratchet teeth 35 adapted to coact with downwardly facing peripheral ratchet teeth 36 provided on the tubular member 11 below the upper box 12. The outer portion 37 of the ratchet ring 34 is in the form of a plurality of circumferential cam teeth adapted to coact with companion cam teeth 38 on the upper head 32, in order that any tendency of the upper head 32 and its cylinder 26 to move in an upward direction with respect to the tubular member 10 will cause the cam teeth 37, 38 to urge the ratchet sleeve 34 inwardly to maintain its teeth 35 engaged with the external teeth 36 on the tubular member 10. However, downward movement of the upper head 32 and the complete cylinder 26 along the tubular member 10 is permitted, inasmuch as the slope of the ratchet teeth 35, 36 will merely force the ratchet ring 34 outwardly, allowing it to ratchet freely over the teeth 36 on the tubular member. In effect, the upper head 32 is connected to the tubular member 10 by a one-way ratchet clutch, the cylinder 26 being movable downwardly along the tubular member, but its upward movement with respect thereto being prevented by the coaction of the ratchet teeth 35, 36 and the camming action between the cam teeth 37, 38 to hold the split ratchet ring sleeve 34 with its teeth 35 engaged with the tubular member ratchet teeth 36.

Fluid from within the tubular member 10 can pass outwardly through the ports 23 into an annular cylinder space 39 provided between the lower cylinder head 25 and the piston 27. Leakage of fluid in a downward direction between the lower head 25 and the tubular member 11 is prevented by providing a suitable side seal 40, such as a rubber or rubber-like O ring, in an internal groove 41 in the lower head which slidably and sealingly engages the periphery of the member 11. Leakage of fluid in an upward direction out of the cylinder space 39 around the annular piston 27 is prevented by an outer seal ring 42, such as a rubber or rubber-like O ring, disposed in a peripheral groove 43 in the piston and slidably and sealingly engaging the inner wall 44 of the cylinder sleeve 29. Leakage of fluid along the inner surface of the piston 27 is prevented by a suitable inner seal ring 45, such as a rubber or rubber-like O ring, in an internal groove 46 in the piston, which slidably and sealingly engages the periphery of the tubular member 11.

Because of the relationship between the annular piston 27, cylinder 26 and tubular member 10, fluid cannot flow initially out of the cylinder space 39, the side ports 23 being initially closed. When in this closed position, the packing structure 24 is in its retracted position, there being ample clearance between the exterior of the packing structure and the wall of the well bore C. The cylinder 26 is movable downwardly along the annular piston 27 and the tubular member 10 to shift the lower piston head 25 toward the lower abutment 14, thereby foreshortening and compressing the packing structure, expanding it laterally outward into firm sealing engagement with the wall of the well bore C, as well as with the periphery of the tubular member 11 itself. The downward movement of the cylinder 26 is permitted by the ratcheting action of the split ratchet ring 34 along the tubular member teeth 36. When the cylinder 26 is moved downwardly to a certain extent, an upper set of ports 47 in the cylinder sleeve 29, disposed below the upper

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head 32, is placed in communication with the tubular member ports 23, which effectively opens the ports 23 after the packing structure 24 has been sealed off against the formation, in the manner that will now be described in detail.

The apparatus A so far described can be run in the well bore C, with the passage 19 through the lower plug 15 fully open and with the parts around the exterior of the tubular member 10 occupying the position illustrated in Fig. 1. The fluid in the well bore can flow upwardly into the casing B through the lower passage 19. The casing string B is lowered in the well bore C to the desired location, whereupon the well can be conditioned by pumping circulating fluid down the casing string. All of the circulating fluid will pass outwardly of the shoe A through its central passage 19 for return flow around the apparatus and the annulus D around the casing string to the top of the well bore.

After the well bore C has been properly conditioned, the trip ball valve element 21 is dropped or is pumped down the casing string until it comes into engagement with its companion valve seat 20, which closes the central passage 19 against downward flow of fluid therethrough. The pressure of the fluid in the well casing B and apparatus A can now be increased, this fluid under pressure passing through the ports 23, acting on the lower cylinder head 25 and piston 27. When the pressure of the fluid is sufficient, it overcomes the strength of the shear pins 30 (which are of much less shear strength than the pins 28), whereupon the cylinder 26 is shifted downwardly along the tubular member 10 and piston, to foreshorten the packing structure 24 and expand it outwardly until it firmly and securely seals against the wall of the well bore C (Fig. 2). This action may normally occur with the side ports 47 in the setting sleeve 29 still disposed above the piston 27, so that the tubular member ports 23 are still in closed condition. However, an increase in the fluid pressure to the required extent will effect a shearing of the pins or screws 28 securing the piston 27 to the tubular member 11, the fluid then forcing the piston 27 upwardly along the tubular member and the cylinder sleeve 29 to a position above the sleeve ports 47, as disclosed in Fig. 3, which places the tubular member ports 23 in communication with the sleeve ports 47. Fluent material can now pass outwardly of the tubular member 10 through the side ports 23, moving through the annular cylinder space 39 between the tubular member 10 and cylinder 26, and exiting into the annulus D around the apparatus and the casing string B through the setting sleeve ports 47.

The required amount of cement slurry, or other cementitious material, can be pumped down the casing string B, this cement slurry being prevented from passing down through the lower plug passage 19 by the engagement of the valve element 21 with its seat 20. The cement slurry is forced to travel out through the side ports 23, the annular cylinder space 39, and the sleeve ports 47 into the annulus around the apparatus A, flowing upwardly through the annulus D around the casing string. None of the cement slurry can drop down along the casing to contaminate the formation therebelow because of the sealing action of the packing structure 24 against the wall of the formation, as well as against the periphery of the tubular member 11.

The packing structure 24 can only be subjected to a certain maximum expanding pressure determined by the shear strength of the screws 28. As an example, the pressure may be 1000 p. s. i. When the predetermined pressure is exceeded, the piston shear screws 28 are disrupted, and the piston is moved upwardly to the position establishing communication between the tubular member ports 23 and the setting sleeve ports 47. Assurance is had that the packing structure will be held in its expanded condition by the coupling action of the ratchet sleeve teeth 35 with the peripheral teeth 36 on the tubular member

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After the cement has set and hardened, the interior of the apparatus can be drilled out, if desired. It is only necessary to remove the ball valve element 21, the valve seat (which may be made of a suitable material, such as rubber), and the cementitious lower plug 15. The packing structure 24 and setting and port controlling structure 26, 27, etc. remain cemented in place on the exterior of the apparatus, providing no obstruction to the interior of the tubular member 10.

The packing structure 24 disclosed in the drawings can be in its initial retracted position when the casing string B is being lowered in the well bore, and can be expanded outwardly through the use of a substantially lesser force than in prior packing structures. In addition, the packing structure 24 is capable of supporting relatively large loads or pressures after it has been expanded outwardly into firm sealing engagement with the wall of the well bore C.

As specifically disclosed, the packing structure 24 is composed of a plurality of rubber or rubber-like ring members 50, 51, 52 positioned between the lower cylinder head 25 and the lower abutment 14. In the specific form illustrated, three rubber, or rubber-like, packing rings are shown, consisting of an upper ring 50 engaging the cylinder head, an intermediate ring 51 engaging the upper ring 50, and a lower ring 52 engaging the intermediate ring 51 and disposed immediately above the guide 14. The lower ring 52 is supported within an expandable metallic sleeve device 53, which can prevent cold flowing of the rubber-like packing material in a downward direction through the annular space E between the lower guide 14 and the wall of the well bore C, after the packing structure 24 has been expanded into engagement with the latter.

The upper packing ring 50 has an upper inclined surface 54 that tapers in an upward and inward direction, engaging a companion tapered surface 55 formed on the lower portion of the head 25. These surfaces are provided in order that downward movement of the cylinder 26 and its cylinder head 25 will tend to urge the upper portion of the packing ring 50 in an inward direction against the tubular member 11. The lower end 56 of the upper packing ring 50 is formed as an expander, being inclined in a downward and inward direction for cooperation with a companion tapered surface 57 at the upper end of the intermediate ring 51. When the upper ring 50 is moved downwardly by the lower head 25, it will tend to urge the upper portion of the intermediate ring 51 in an outward direction.

The lower end 58 of the intermediate ring 51 is likewise formed as an expander, being tapered in a downward and inward direction and coacting with a companion tapered surface 59 at the upper surface of the lower packing ring 52, so that downward movement of the intermediate ring along the tubular member 11 will cause it to expand the upper portion of the lower ring 52 outwardly.

The lower portion 60 of the lower packing ring 52 is also formed as an expander, for the purpose of expanding a pair of metallic sleeves 61, 62 outwardly toward and against the wall of the confining enclosure, such as the well bore C. These sleeves 61, 62 are metallic, preferably being made of a malleable material, such as mild steel. When expanded outwardly, they will serve to support the rubber packing elements 50, 51, 52 thereabove, to prevent pressure and loads in the annulus D above the packing structure 24 from forcing it down into the annular space E between the lower guide 14 and the wall of the well bore.

The lower sleeve arrangement 53 includes an inner sleeve member 61, the lower portion 63 of which is circumferentially continuous and generally cylindrical, being received within a circumferential groove 64 defined between the upper portion of the lower abutment 14 and the tubular member 11. Above the lower abutment 14 the inner sleeve 61 is frusto-conical in shape, flaring or diverging in an upward direction. The frusto-conical

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portion of the inner sleeve is provided with a plurality of longitudinal splits or slots 65 therethrough to form a plurality of fingers 66 that can be expanded downwardly. The tapered inner surface 67 of the inner sleeve 61, which is inclined in a downward and inward direction, engages the companion tapered surface 60 on the lower portion of the lower packing ring 52, this lower portion actually being received within the fingers 66 of the inner sleeve.

The inner sleeve 61 is disposed within an outer sleeve 62 of the same general shape and construction as the inner sleeve. Thus, the lower portion 68 of the outer sleeve is circumferentially continuous, being disposed within the lower recess 64 and encompassing the circumferentially continuous portion 63 of the inner sleeve 61. The upper portion of the outer sleeve is also frusto-conical, encompassing the frusto-conical portion of the inner sleeve, and being provided with a plurality of slots 69 to form fingers 70 that can be expanded outwardly. The slots 69 of the outer sleeve are staggered with respect to the slots 65 of the inner sleeve, to prevent the existence of a free passage through the sleeve structure 53 through which the rubber material of the lower packing ring 52 could be forced after the packing structure 24 had been expanded outwardly against the wall of the well bore C. To insure the staggered relationship between the inner and outer sleeve slots 65, 69, and also to anchor the metallic sleeves 61, 62 to the tubular member 11 and the lower abutment 14, one or more transverse pins 71 may extend from the lower abutment 14, through the circumferentially continuous portions 63, 68 of the inner and outer sleeves, and into the tubular member 11. Accordingly, the pins 71 will serve to properly orient the slots 65, 69 in the desired staggered relation with respect to each other, and will prevent inadvertent displacement of the sleeve structure 53 out of the circumferential groove 64.

To place a limit on the extent of outward expansion of the packing structure 24, and to insure the building up of sufficient pressure to shear the screws 28 holding the annular piston 27 to the tubular member 11, which is necessary for the upward shifting of the piston and the placing of the cylinder sleeve ports 47 in communication with the tubular member ports 23, a stop sleeve 72 is incorporated in packing structure 24. This stop sleeve surrounds the tubular member 11, extending into the groove or recess 64 between the lower abutment 14 and the tubular member 11. It may be held in a lower position by the same orienting pins 71 that pass through the flow preventing metallic sleeves 61, 62.

The stop sleeve 72 is disposed within the lower packing ring 52, its upper end terminating a substantial distance below the cylinder head 25 when all of the parts are in their initial retracted position for lowering in the well bore C. Accordingly, the cylinder 26 can move downwardly to expand the packing structure 24 out against the casing to the maximum extent limited by the engagement of the head 25 with the upper end of the stop sleeve 72, as disclosed in Fig. 4.

When the trip ball 21 is lowered through the casing and comes to rest upon its seat 20, fluid pressure can be built up within the casing string B and the cylinder space 39, as described above, shearing the screws 30 holding the cylinder sleeve 29 to the upper member 12 and shifting the cylinder 26 downwardly. During such a downward shifting, the cylinder head 25 will tend to hold the upper portion of the upper packing ring 50 inwardly, but its lower portion 56 will expand the intermediate ring 51 in an outward direction. The downward force imposed by the cylinder head 25 upon the upper packing ring 50 will be transmitted to the intermediate ring 51, its expander portion 58 expanding the lower ring 52 in an outward direction. The lower ring will also be moved downwardly within the flow preventing inner and outer sleeves 61, 62, its tapered expander 60 urging the

fingers 66, 70 of the latter outwardly toward the wall of the well bore C. In effect, the downward movement of the cylinder head 25 causes the lower ring 52 to expand the sleeve fingers 66, 70 outwardly against the wall of the well bore, the fingers 70 of the outer sleeve overlapping the slots 65 of the inner sleeve. The intermediate packing ring 51 expands the lowermost ring 52 outwardly, whereas the upper packing ring 50 expands the intermediate ring outwardly. The direction of taper of the coengaging surfaces 55, 54 on the head and the upper portion of the upper packing ring 50 is such as to tend to prevent ready outward expansion of the upper portion of the upper ring.

As a result of the packing structure 24 described, the packing rings 50, 51, 52 can be expanded outwardly with a much lesser force imposed upon them than would be the case if a single rubber or rubber-like sleeve were disposed between the cylinder head and the lower tubular member 14. Accordingly, the pressures that are required within the cylinder space 39 to urge the cylinder 25 in a downward direction need not be too high, despite the relatively limited annular area in the cylinder on which the pressure can act. Not only can a relatively small pressure effective area be used, but the provision of the plurality of rings 50, 51, 52, with their coacting expander surfaces thereon makes it possible to use rubber or rubber-like materials that are comparatively hard. Yet, effective outward expansion of the packing structure 24 is secured. As a matter of fact, it is actually unnecessary to use very hard rubber, since the downward flow of the packing material through the annular space E between the lower abutment 14 and wall of the well bore C will be prevented by the overlapping fingers 66, 70 of the lower flow preventing sleeves 61, 62, which sleeves are preferably made of a malleable metal, such as mild steel. If desired, aluminum or copper could be used effectively.

Not only is the packing structure 24 expanded outwardly into firm engagement with the wall of the well bore C, but appropriate seals are also provided to insure against leakage around the exterior of the rubber packing elements. It is to be noted that when expanded against the casing, the packing rings 50, 51, 52 provide upwardly facing lip seal elements 73, 74, 75 against which fluent material, or the pressure thereabove, can act. This pressure will tend to expand the lip portions 73, 74, 75 of the packing rings 50, 51, 52 outwardly into firmer sealing engagement with the wall of the well bore, insuring against leakage between the latter and the rubber-like packing ring structure 24.

In the event that the packing structure 24 is disposed opposite a cavity in the well bore, a limit is provided on the extent of outward expansion of the entire structure. Thus, the cylinder 26 can move downwardly toward the lower abutment 14 to the extent limited by engagement of the cylinder head 25 with the upper end of the spacer sleeve 72. This will impose a definite limit on the extent of outward expansion of the packing rings 50, 51, 52. However, the maximum extent of expansion is more than sufficient to insure the proper sealing of the structure 24 against the wall of the well bore C in which the apparatus is normally used. When the spacer sleeve 72 is used, the cylinder head will engage the upper end of the sleeve 72 before the sleeve ports 47 move below the piston 27, assuming that the piston shear screws 28 have not as yet been disrupted. This condition will occur in situations wherein the cylinder 26 has engaged the stop sleeve 72 before the shearing pressure of the piston screws 28 has been reached. With the cylinder head 25 engaging the stop sleeve 72, no additional force can be imposed on the packing structure 24. However, the fluid pressure can be increased within the cylinder space 39 to the extent sufficient to shear the piston screws 28, since the cylinder cannot

move downwardly to any further extent. Upon shearing of the screws 28, the piston is elevated hydraulically to its position above the sleeve ports 47, thereby establishing communication from the interior of the tubular member 11, through its ports 23, cylinder space 39, and sleeve ports 47 to the annulus D around the apparatus.

The inventor claims:

1. In a well packer: a supporting member; upper, intermediate and lower pliant, elastic packing rings disposed around said member; said upper and intermediate packing rings each having a downward and inwardly inclined expander surface; said intermediate and lower rings having tapered surfaces engageable with and companion to said upper ring and intermediate ring expander surfaces, respectively; said upper ring having an upper tapered surface inclined in an upward and inward direction; and a metallic, non-expandable annular member having a lower surface companion to and engaging said upper tapered surface, said annular member being movable downwardly along said supporting member to shift said packing rings longitudinally with respect to each other to cause said expander surfaces to engage said companion tapered surfaces and expand said intermediate and lower rings outwardly.
2. In a well packer: a supporting member; a plurality of pliant, elastic packing rings disposed around said member adjacent one another; one of said rings having a tapered expander surface; an adjacent ring having a companion tapered surface against which said expander surface can bear; said one ring having a second tapered surface inclined in the opposite direction to said expander surface; and a metallic, non-expandable annular member on said supporting member having a surface engageable with and companion to said second tapered surface, said annular member being movable along said supporting member to shift said packing rings longitudinally with respect to each other to cause said expander surface to move within said companion surface on said adjacent ring and expand said adjacent ring outwardly.
3. In a well packer: a supporting member; upper, intermediate and lower pliant, elastic packing rings disposed around said member; said upper and intermediate packing rings each having a downward and inwardly inclined expander surface; said intermediate and lower rings having tapered surfaces engageable with and companion to said upper ring and intermediate ring expander surfaces, respectively; said upper ring having an upper tapered surface inclined in an upward and inward direction; a lower abutment on said supporting member below and adjacent said lower ring; and a metallic, non-expandable annular member on said supporting member having a lower surface companion to and engaging with said upper tapered surface, said annular member being movable downwardly along said supporting member toward said lower abutment to shift said packing rings longitudinally with respect to each other to cause said expander surfaces to engage said companion tapered surfaces and expand said intermediate and lower rings outwardly.
4. In a well packer: a supporting member; a plurality of pliant, elastic packing rings disposed around said member adjacent one another; one of said rings having a tapered expander surface; an adjacent ring having a companion tapered surface against which said expander surface can bear; an abutment on said supporting member; an expansible metallic packing flow preventing device on said abutment engaging said adjacent ring; said device comprising an inner sleeve having a circumferentially continuous portion and fingers surrounding said adjacent ring, and an outer sleeve having a circumferentially continuous portion and fingers surrounding and in staggered relation to the fingers of said inner sleeve; and means on said supporting member engaging said one of said rings and movable toward said abutment to expand said fingers of the inner and outer sleeve and shift said packing rings

longitudinally with respect to each other to cause said expander surface to move within said companion surface and expand said adjacent ring outwardly.

5 5. In a well packer: a supporting member; upper, intermediate and lower pliant, elastic packing rings disposed around said member; said upper and intermediate packing rings each having a downward and inwardly inclined expander surface; said intermediate and lower rings having tapered surfaces engageable with and companion to said upper ring and intermediate ring expander surfaces, respectively; an abutment on said supporting member below said lower ring; an expansible metallic packing flow preventing device on said abutment engaging said lower ring; and means on said supporting member engaging said upper ring and movable toward said abutment to expand said device and shift said packing rings longitudinally with respect to each other to cause said expander surfaces to engage said companion tapered surfaces and expand said intermediate and lower rings outwardly.

20 6. In a well packer: a supporting member; upper, intermediate and lower pliant, elastic packing rings disposed around said member; said upper and intermediate packing rings each having a downward and inwardly inclined expander surface; said intermediate and lower rings having tapered surfaces engageable with and companion to said upper ring and intermediate ring expander surfaces, respectively; an abutment on said supporting member below said lower ring; an expansible metallic packing flow preventing device on said abutment engaging said lower ring, said device comprising an inner sleeve having a circumferentially continuous portion and inclined fingers surrounding and contacting a companion expander surface on said lower ring, and an outer sleeve having a circumferentially continuous portion and inclined fingers surrounding and in staggered relation to the fingers of

the inner sleeve; and means on said supporting member engaging said upper ring and movable toward said abutment to expand said fingers of said inner and outer sleeves and to shift said packing rings longitudinally with respect to each other to cause said expander surfaces to engage said companion tapered surfaces and expand said intermediate and lower rings outwardly.

7. In a well packer: a supporting member; a pliant, elastic packing disposed around said member; an abutment on said member adjacent one end of said packing; a metallic inner sleeve carried by said abutment and having fingers surrounding said packing; a metallic outer sleeve carried by said abutment and having fingers surrounding and in staggered relation to the fingers of the inner sleeve; and means on said supporting member engaging said packing and movable toward said abutment to expand said fingers of said inner and outer sleeves and to expand said packing.

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