Oct. 19, 1954 M. B. CONRAD 2,692,066

QUICK MOUNTING AND DEMOUNTABLE PRESSURE HEAD

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Fig. 2.

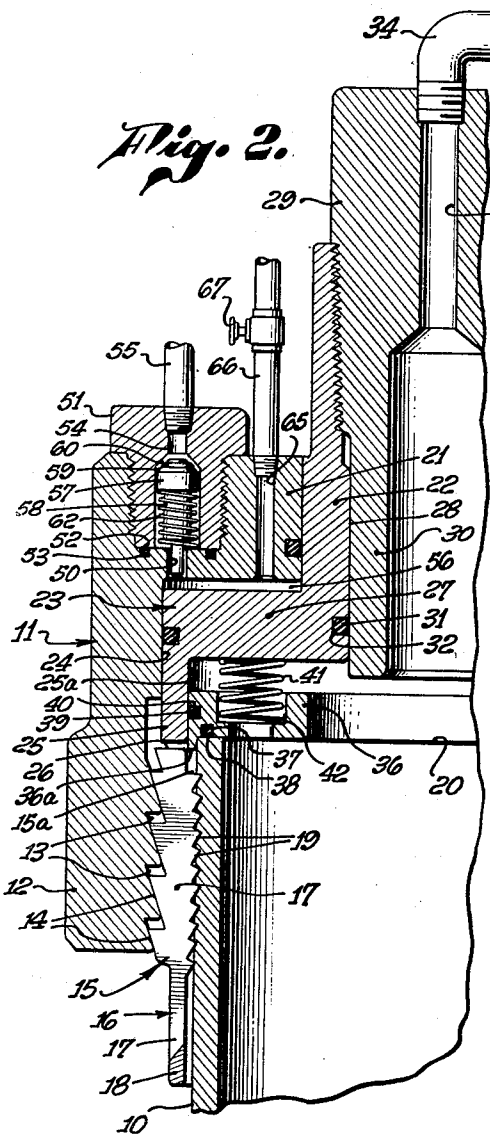
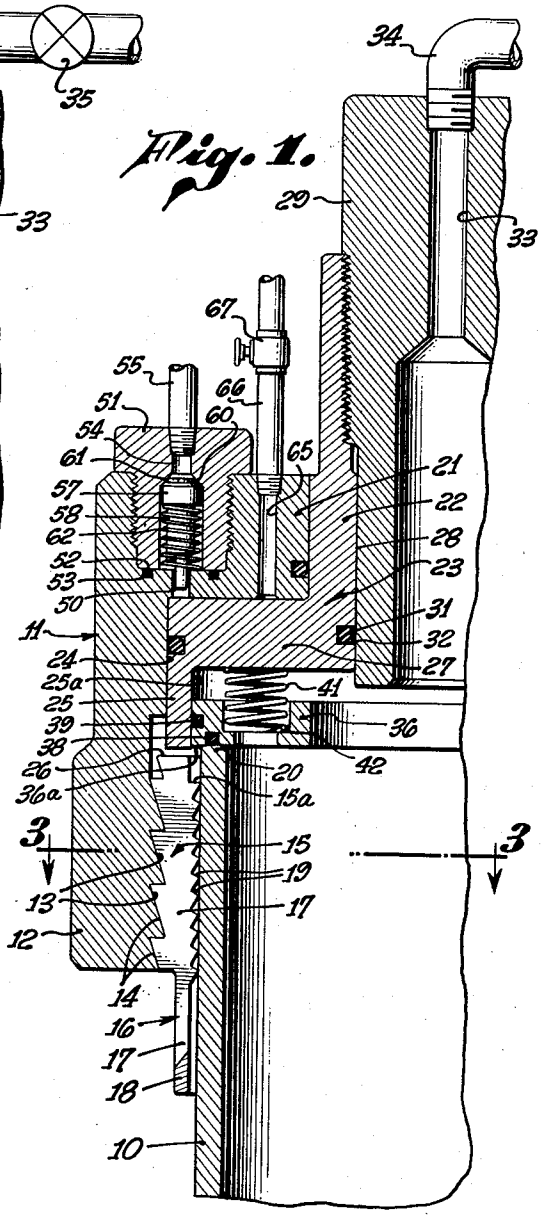


Fig. 1.



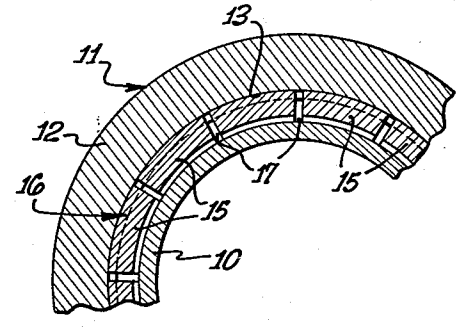


Fig. 3.

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QUICK MOUNTING AND DEMOUNTABLE PRESSURE HEAD

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The present invention relates to heads for tubular members or pressure vessels, such as casing, cylinders, and the like.

An object of the invention is to provide heads that can be mounted on tubular members and dismounted therefrom in a rapid manner.

Another object of the invention is to provide a pressure head that can be easily mounted on and dismounted from a tubular member, and which is capable of withstanding very high pressures.

A further object of the invention is to provide a pressure head capable of being quickly mounted on and dismounted from a tubular member without the necessity for rotating any of the parts, and which is held more securely to the tubular member as the pressure increases.

Yet another object of the invention is to provide a pressure head capable of easy assembly on and disassembly from a tubular member without rotation, and in which the fluid pressure in the tubular member tends to retain the head in leakproof relation to the tubular member.

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 fragmentary longitudinal section through one form of the invention, prior to firm anchoring of the head to a tubular member;

Fig. 2 is a view similar to Fig. 1, illustrating the head firmly secured to the tubular member;

Fig. 3 is a cross-section, on a reduced scale, taken along the line 3—3 on Fig. 1.

In the form of invention disclosed in the drawing, it is desired to provide a removable closure on a tubular member, or pressure vessel, which can be easily mounted on the member, and which can also be readily detached therefrom. The device is so arranged that the pressure within the vessel tends to secure the head more securely to the vessel or member. The tubular member or pressure vessel may be a cylinder, a well casing, a pipe line, or any other device on which it is desirable to have a removable head. If the tubular member is a well casing, then the head

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assembly would be attached to the upper end of the casing string.

As disclosed in the drawing, a head assembly is designed to be slipped longitudinally, and without rotation, over the end portion of a tubular member 10. The head assembly includes an outer housing or cylinder 11 having a longitudinally extending skirt 12 provided with a series of spaced annular cam surfaces 13, which are adapted to engage companion cam surfaces 14 on the outer portion of slips 15 provided on a slip or guide ring or sleeve 16 surrounding the exterior of the tubular member 10, and which are disposed between the latter and the housing or cylinder skirt 12. The slips 15 can shift laterally, the slips being separate from one another, being formed by a plurality of longitudinal and circumferentially spaced cuts 17 made in the ring or sleeve 16. However, one end 18 of the ring or sleeve is left circumferentially continuous, to hold the slip or dog elements 15 together and in alignment with each other. The inner faces of the slips are provided with wickers or teeth 19 that tend to dig into the periphery of the tubular member 10. The wickers or teeth face toward the open end 20 of the tubular member, and, when the housing or cylinder 11 is urged in a direction away from the end 20 of the tubular member, the coacting cam faces 13, 14 tend to urge the teeth 19 more firmly into engagement with the tubular member 10.

The skirt portion 12 of the housing or cylinder is integral with an annular head portion 21 extending inwardly toward the inner skirt 22 of a piston structure 23. This piston is slidable along the inner wall 24 of the housing or cylinder 11, and has an outer skirt 25 extending toward the slips 15, which is adapted to engage their ends 26. The piston head 27 is integral with the inner and outer piston skirts 22, 25, and can also engage the cylinder head 21 under some conditions of operation of the apparatus.

The central bore 28 through the piston 23 may be closed by a central head member 29 threaded into the piston skirt 22 and having a sleeve portion 30 engaged by a seal ring 31 disposed in a groove 32 in the piston, in order to prevent leakage therebetween. The central head 29 may have a central passage 33 establishing communication with the interior of the tubular member 10, and this passage may either be closed completely, or it may have an inlet pipe 34 attached thereto controlled by a suitable valve 35.

Inadvertent leakage of fluid from the tubular member 10 is prevented by providing suitable

seals in the apparatus. Thus, the seal ring 31, previously described, presents leakage of fluid between the central head 29 and the piston 23, whereas an annular pressure plate 36 is disposed across the outer end 20 of the tubular member to prevent leakage along this end, and also along the outer piston skirt 25. This pressure plate has a ring groove 37 in its lower face containing a seal ring 38 that engages the end face 20 of the tubular member, which is preferably made flat. The periphery of the pressure plate 36 is also provided with a seal ring 39 disposed in a peripheral groove 40 and engaging the inner wall of the outer piston skirt 25. It is, therefore, apparent that the closing of the valve 35 leading from the central head passage 33 will completely trap fluid under pressure within the tubular member 10, since the inner piston seal ring 31 precludes leakage of fluid between the central head 29 and piston 23, whereas the gasket ring 38 and peripheral ring 39 on the pressure plate 36 prevent leakage of fluid along the end face 20 of the tubular member 10, as well as between the periphery of the pressure plate 36 and the inner wall 25a of the outer piston skirt 25.

It is to be noted that the gasket ring 38 on the pressure plate 36 engages the end 20 of the tubular member 10 at a radius which is substantially less than the radius of the inner wall 25a of the outer piston skirt 25. Accordingly, the pressure in the tubular member 10 is acting over a differential area of the pressure plate, tending to force the latter inwardly against the end 20 of the tubular member to maintain the gasket seal ring 38 firmly in contact with the end of the tubular member. The differential area is the annular area between the circle of contact of the gasket ring 38 with the end face 20 of the tubular member and the inner wall 25a of the piston skirt. As the pressure in the tubular member increases, the pressure plate is held more firmly against the end face of the tubular member.

When the slip segments 15 are disposed in their full inward position with respect to the outer housing 11, as disclosed in Fig. 1, the teeth 19 lie on a cylindrical curve which is slightly greater than the external diameter of the tubular member 10. For this reason, the entire head assembly can be slipped over the end of the tubular member until the pressure plate 36 engages the tubular member end face 20. Initially, there is a slight engagement between the pressure plate and the tubular member face, imposed by a plurality of circumferentially spaced helical compression springs 41 engaging the piston 23 and also seats 42 formed in the pressure plate. Only one of these springs 41 is disclosed in the drawings, but it is to be understood that a plurality of circumferentially spaced compression springs are so arranged around the apparatus. At this time, pressure should not be provided in the tubular member 10, since the teeth or wickers 19 on the slips or gripping members 15 are not engaging the periphery of the tubular member.

Suitable means may be provided for providing such initial engagement, whereupon the pressure within the tubular member will enhance the gripping action or engagement of the slips against the periphery of the tubular member. Thus, movement of the piston 23 inwardly toward the tubular member 10 and relative to the outer housing or cylinder 11 will cause the outer piston skirt 25 to bear upon the slips 15 and force them longitudinally in a downward direction with respect to the housing or cylinder 11. The

tapered cam faces 13, 14 will then urge the slips 15 inwardly to obtain an initial bite or digging in of the teeth 19 in the periphery of the tubular member or casing 10. After such initial biting action has occurred, fluid under pressure may be supplied in the tubular member through the inlet pipe 34 and central passage 33, or the pressure may be present naturally in the tubular member 10, if it constitutes a well casing disposed in a well bore. Such pressure will act on the piston 23 and tend to urge it longitudinally away from the tubular member 10. The piston, in turn, will tend to move the housing or cylinder 11 in the same direction. However, since the slips 15 are digging into the tubular member 10, such movement tendency of the housing or cylinder will cause the coengaging cam faces 13, 14 to dig the wickers 19 of the slips more firmly into the outer surface of the tubular member, thereby precluding movement of the housing or cylinder in the direction in which it is tending to travel.

Several different modes of obtaining the initial digging in, or bite, of the wickers 19 in the casing 10, and the transmission of the pressure forces between the piston 23 and the outer cylinder 11 may be provided. As disclosed in the drawing, fluid means are available to accomplish these objectives. A fluid inlet passage or port 50 is provided in the cylinder head 21 communicating with the interior of a valve body 51 threaded in the head and into snug engagement with a seal ring or gasket 52 provided in a head groove 53. This valve body 51 has an inlet port or passage 54 communicating with a pressure inlet pipe 55 extending to a suitable source of fluid pressure (not shown). Fluid under pressure can pass from the inlet pipe 55 through the head inlet 54 into the region 56 between the cylinder head 21 and the piston head 27, but such fluid is precluded from flowing in reverse direction. To accomplish this purpose, a check valve is provided in the valve body 51. This check valve includes a valve head 57 having a stem 58 extending therefrom, the head being provided with a tapered portion 59 adapted to engage a tapered seat 60 in the valve body, leakage between the head and seat being precluded by a suitable seal ring 61 on the head adapted to engage the seat. A helical compression spring 62 is disposed around the valve stem 58, seating against the valve head 57 and also against the cylinder head 21.

Fluid under pressure from the inlet 55 will shift the head 57 from its seat 60 against the action of the spring 62, flowing around the head and through the head inlet port 50 into the space 56 between the cylinder head 21 and the piston head 27. Such fluid under pressure urges the piston 23 inwardly toward the end 20 of the tubular member, causing the skirt 25 to shift the slips 15 longitudinally of the cylinder 11 and radially inward into gripping engagement with the exterior of the tubular member. When this action occurs, there is a cylinder space or gap 56 formed between the cylinder head and the piston head, the fluid in this space being prevented from escaping by the closing of the check valve head 57 against its companion seat 60. The cylinder head 21 is also provided with an exhaust port 65 leading to an exhaust line 66, but this exhaust port is normally closed, as by closing a suitable valve 67 provided in the exhaust line. Accordingly, following the initial gripping of the slips 15 with the tubular member or well casing 10, the imposition of pressure within the latter will cause the pressure to act on the piston 23, tending

to urge it in an outward direction. The force imposed on the piston is transmitted through the fluid entrapped in the space 56 between the piston head 27 and cylinder head 21 to the cylinder 11, the piston 23 and cylinder 11, in effect, tending to move as a unit in an outward direction, shifting the cylinder cam elements 13 relatively outward along the companion cam surfaces 14 formed on the slips 15, and urging the latter more firmly into the casing 10. The housing or cylinder 11, of course, can only move to a comparatively slight degree, until the wickers or teeth 19 on the slips take a firm bite into the casing 10. As the pressure increases, the gripping action is correspondingly increased, which precludes the dislodging or removal of the entire head assembly from the end of the tubular member 10, insuring its retention in appropriate position.

When the head assembly is to be removed, the pressure in the tubular member 10 is at first relieved. Thereafter, the exhaust valve 67 is opened, allowing the fluid to bleed from the cylinder space 56 between the cylinder head 21 and piston head 23, the springs 41 urging the piston 23 back to its initial position in engagement with the cylinder head 21, as disclosed in Fig. 1. At this time, there will be a longitudinal space between the end of the outer piston skirt 25 and the slips 15, allowing the outer housing or cylinder 11 and piston 23 to be moved longitudinally, to shift the housing cam surfaces 13 in a downward direction with respect to the slip cam surfaces 14, as seen in Fig. 2, enabling the slips 15 to release themselves from the tubular member 10, whereupon the entire head assembly can be removed from the tubular member. As such withdrawal occurs, the shoulders 15*a* formed near the outer end of the slips 15 will engage a depending outer portion 36*a* of the pressure plate 36 to carry the pressure plate and the springs 41 along with them.

The inventor claims:

1. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; and means engageable with said gripping member and movable longitudinally of said housing to shift said gripping member longitudinally of said housing to cause said cam surfaces to urge said gripping member inwardly into gripping engagement with the tubular member.

2. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; means engageable with said gripping member and movable longitudinally of said housing in one direction to shift said gripping member longitudinally of said housing to cause said cam surfaces to urge said gripping member inwardly into gripping engagement with the tubular member; and means for transmitting a force imposed on said shifting means to said housing to cause said housing to urge said gripping member inwardly into engagement with the tubular member, said force acting on said shifting means and urging said shifting means longitudinally of said housing in the opposite direction.

3. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; means engageable with said gripping member and movable longitudinally of said housing to shift said gripping member longitudinally of said housing to cause said cam surfaces to urge said gripping member inwardly into gripping engagement with the tubular member; and a pressure member adapted to sealingly engage said engaging means and the tubular member, the point of sealing engagement of said pressure member with the tubular member being at a lesser radius from the axis of the head assembly than the point of sealing engagement of said pressure member with said engaging means.

4. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; means engageable with said gripping member and movable longitudinally of said housing in one direction to shift said gripping member longitudinally of said housing to cause said cam surfaces to urge said gripping member inwardly into gripping engagement with the tubular member; means for transmitting a force imposed on said shifting means to said housing to cause said housing to urge said gripping member inwardly into engagement with the tubular member; said force acting on said shifting means and urging said shifting means longitudinally of said housing in the opposite direction; and a pressure member adapted to sealingly engage said engaging means and the tubular member, the point of sealing engagement of said pressure member with the tubular member being at a lesser radius from the axis of the head assembly than the point of sealing engagement of said pressure member with said engaging means.

5. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one

direction; means subject to the pressure of fluid in the tubular member to urge said housing longitudinally of said gripping member in said one direction; said means being engageable with said gripping member; and means for shifting said means in the opposite longitudinal direction to shift said gripping member in such opposite direction and into engagement with the tubular member.

6. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; means subject to the pressure of fluid in the tubular member to urge said housing longitudinally of said gripping member in said one direction; said means being engageable with said gripping member; means for shifting said means in the opposite longitudinal direction to shift said gripping member in such opposite direction and into engagement with the tubular member; and a pressure member adapted to sealingly engage the tubular member and said means which is subject to the pressure of fluid in the tubular member, the point of sealing engagement of said pressure member with the tubular member being at a lesser radius from the axis of the head assembly than the point of sealing engagement of said pressure member with said means which is subject to the pressure of fluid in the tubular member.

7. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; a piston in said housing engageable with said gripping member to shift said gripping member in one direction relative to said housing and inwardly into gripping engagement with the tubular member; and means for feeding fluid under pressure into said housing for action on said piston.

8. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; a piston in said housing engageable with said gripping member to shift said gripping member in one direction relative to said housing and inwardly into gripping engagement with the tubular member; means for feeding fluid under pressure into said housing for action on said piston; and means for entrapping said fluid under pressure within said housing between said housing and piston.

9. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; a piston in said housing engageable with said gripping member to shift said gripping member in one direction relative to said housing and inwardly into gripping engagement with the tubular member; means for feeding fluid under pressure into said housing for action on said piston; means for entrapping said fluid under pressure within said housing between said housing and piston; and means for bleeding such entrapped fluid from said housing.

10. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; a piston in said housing engageable with said gripping member to shift said gripping member in one direction relative to said housing and inwardly into gripping engagement with the tubular member; means for feeding fluid under pressure into said housing for action on said piston; and a pressure member adapted to sealingly engage said piston and the tubular member, the point of sealing engagement of said pressure member with the tubular member being at a lesser radius from the axis of the head assembly than the point of sealing engagement of said pressure member with said piston.

11. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having coengaging cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; a piston in said housing engageable with said gripping member to shift said gripping member in one direction relative to said housing and inwardly into gripping engagement with the tubular member; means for feeding fluid under pressure into said housing for action on said piston; a pressure member adapted to sealingly engage said piston and the tubular member, the point of sealing engagement of said pressure member with the tubular member being at a lesser radius from the axis of the head assembly than the point of sealing engagement of said pressure member with said piston; and means for bleeding such entrapped fluid from said housing.

12. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and

having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having co-engaging tapered cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member in one direction; said cam surfaces tapering inwardly toward the axis of the head assembly in a direction leading away from said transverse structure; a piston in said housing engageable with said gripping member to shift said gripping member longitudinally of the housing in a direction leading away from said transverse structure and inwardly into gripping engagement with the tubular member; and means for feeding fluid under pressure into said housing for action on said piston.

13. In a head assembly for a tubular member: a gripping member having inner teeth adapted to grip the outer surface of the tubular member; a housing surrounding said gripping member and having a transverse structure to extend across the end of the tubular member to close the same; said housing and gripping member having co-engaging tapered cam surfaces to urge said gripping member inwardly against the outer surface of the tubular member upon relative longitudinal movement of said housing and gripping member

in one direction; said cam surfaces tapering inwardly toward the axis of the head assembly in a direction leading away from said transverse structure; a piston in said housing engageable with said gripping member to shift said gripping member longitudinally of the housing in a direction leading away from said transverse structure and inwardly into gripping engagement with the tubular member; means for feeding fluid under pressure into said housing for action on said piston; and a pressure plate engageable with a transverse surface of the tubular member and with said piston; sealing means between said piston and pressure plate; sealing means between said pressure plate and the transverse surface of the tubular member; the radial distance of said piston sealing means from the axis of the head assembly being greater than the radial distance of said tubular member sealing means from such axis.

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