

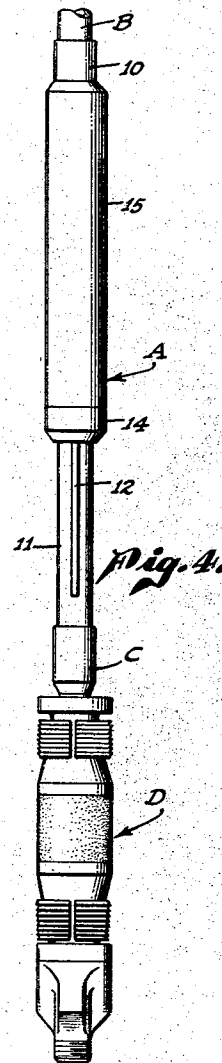
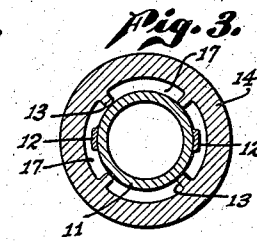
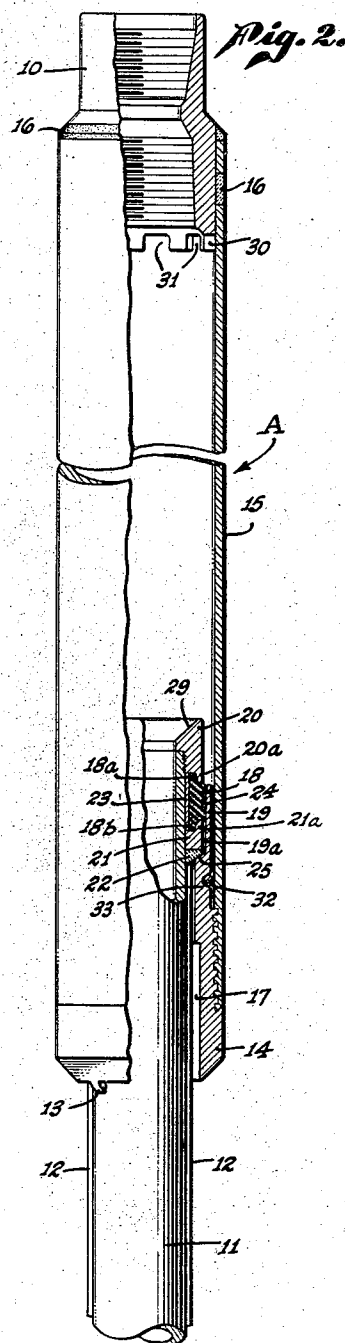
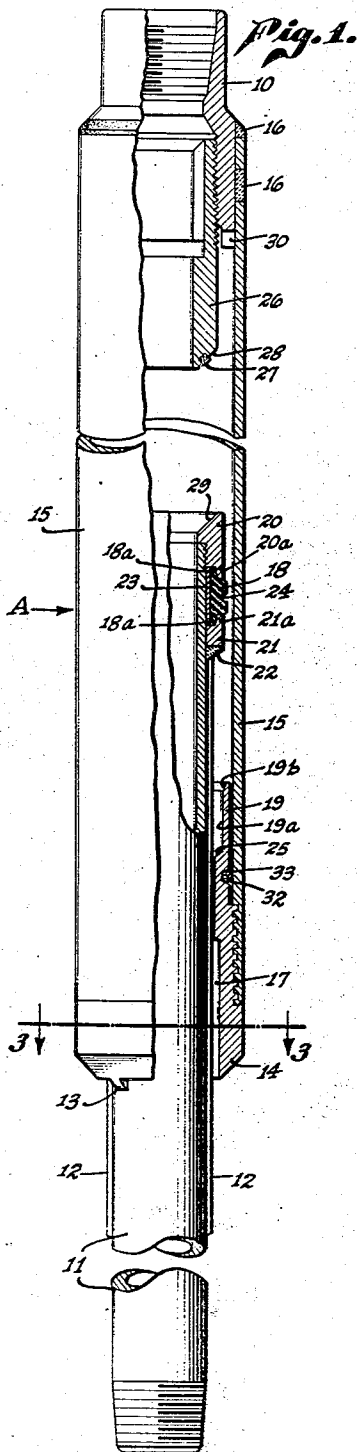
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**2,275,938**

CONTROL VALVE

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## UNITED STATES PATENT OFFICE

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## CONTROL VALVE

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16 Claims. (Cl. 166—1)

This invention relates to control valves, and more particularly to valves of the type forming part of a run-in tubular string connected to a well device, as a cement retainer or other well packer. Such control valves are incorporated in the run-in string preferably near the well device to provide selective control of the passage of fluid from the string through the device or between the annular space around the string and its interior.

This application is a continuation-in-part of my application for "Well packer apparatus," Serial No. 333,491, filed May 6, 1940.

Heretofore, control valves of the character indicated above have been provided with sealing rings engageable with a cooperable seat over only a small sealing area. Not only does this condition prevail, but the sealing rings are so arranged in the control device as to be subjected to the entire strain or load imposed upon the tubular string and well device, causing their permanent deformation and leakage. Accordingly, it becomes an object of the present invention to provide a control valve preferably designed for incorporation in a tubular string, in which a large sealing area is obtained when the valve is closed, and in which the packing member of the valve is not subjected to any tensile or compressive forces in the tubular string.

Still a further object of the invention is to provide a flow control valve capable of being incorporated in a tubular string, in which the valve may be closed either by an extensible movement between its cooperable telescopic elements or by a contractable movement between such elements.

Yet another object of the invention is to provide a telescopic circulation and expansion joint capable of forming part of a run-in string, and having a resilient packing member subjected only to fluid pressure forces which increase the sealing effectiveness of the packing against its cooperable seat.

The invention has other objects that will become apparent from a consideration of the embodiment shown in the drawings accompanying and forming part of the present specification. This form will now be described in detail, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the claims appended hereto.

Referring to the drawing:

Figure 1 is a partial longitudinal and partial sectional view of a circulation and expansion

joint with its valve mechanism illustrated in open position;

Figure 2 is a view similar to Figure 1, with the valve mechanism shown in closed position;

Figure 3 is a transverse section taken along the line 3—3 of Figure 1; and

Figure 4 is an elevation of the invention, disclosed for purposes of example in association with a well packer.

The control valve A, illustrated in the form of a circulation and expansion joint, is incorporated in a tubular string with its upper collar 10 threaded to a joint of tubing B, and with its lower mandrel 11 threadedly connected with a sub C, which, in turn, is detachably secured to a well device D such as a cement retainer or packer, this latter connection usually being effected by means of mating left hand threads (not shown), in order that right hand rotation of the tubular string B can produce disconnection of the sub C from the cement retainer D after the latter has been set in the casing.

The circulation and expansion joint A consists of the aforementioned mandrel 11 provided with a plurality of splines 12 secured thereto for cooperatively forming a telescopic connection with inwardly directed ribs 13 on the interior of a terminal abutment 14 threadedly secured to a cylinder or barrel 15 whose upper end is attached to the collar 10, as by welding material 16. These parts permit relative extensible and contractable longitudinal movement between the mandrel 11 and cylinder 15, and also provide a positive driving interconnection, because of the engagement between the ribs 13 on the abutment 14 and the splines 12 secured to the mandrel 11. It is to be noted, however, that circumferential arcuate clearance 17 is allowed between the splines and ribs to permit passage of fluid therebetween whenever the control valve is in open position.

The mandrel 11 carries a resilient packing ring or sleeve 18 of rubber or equivalent material which is adapted to close the valve device by seating within an upstanding cylindrical sleeve 19 integral with or otherwise secured to the abutment 14. This packing member 18 is attached to the mandrel 11 by being held between an upper head 20 threaded to the mandrel and a lower retainer ring 21 suitably secured to the mandrel, as by welding material 22. The packing member 18 is molded, vulcanized or otherwise attached to a filler and spacer ring 23 surrounding the mandrel, whose opposed ends abut the head 20 and retainer ring 21.

The securing of the packing member 18 to the filler ring 23 prevents its removal from the mandrel 11 under the action of fluid pressure and other forces. As a further precaution against its displacement or loss, the packing member 18 is provided with oppositely directed portions 18a, 18b embraced by respective opposed skirts 20a, 21a on the head and retainer ring directed toward each other. The sealing portion of the packing member 18 between the skirts 20a, 21a extends radially beyond the peripheries of the head 20 and retainer ring 21 in order that it may seat within the upstanding sleeve 19 and have sealing engagement with its inner cylindrical surface 19a. The unrestrained outside diameter of the packing member 18, which is its diameter when out of the sleeve 19, is preferably slightly greater than the internal diameter of the sleeve 19 to ensure their proper sealing engagement, and the upper end 19b of the sleeve is bevelled for the purpose of guiding the packing into the cylindrical portion 19a of the sleeve upon extensible movement between the mandrel 11 and cylinder 15. To allow the packing 18 to adjust itself to better advantage upon being drawn into the sleeve 19, its outer surface can be provided with an intermediate circumferential groove 24, permitting a slight movement of the peripheral portions of the packing material upon its entrance into and removal from the smaller diameter sleeve 19.

As disclosed in Figure 1, the valve device A is in open position, and fluid may pass from the tubular string B into the cylinder 15, through the annular space between the cylinder 15 and mandrel 11, and through the annular passages 17 defined by the splines 12 and ribs 13 to the exterior of the circulation and expansion joint. Of course, with the valve parts in the Figure 1 position, fluid may also be circulated from the exterior to the interior of the device reversely along the path just described. Whenever the valve is to be closed (Figure 2), the cylinder 15 and mandrel 11 are relatively extended, as by elevating the tubular string B, and the packing member 18 moved into the upstanding sleeve 19 until the welding material 22 engages a cooperable seat 25 on the abutment 14. With the parts in this position, fluid cannot pass between the interior and exterior of the valve device, but is forced to move through the device either to or from the cement retainer D.

Pressure acting on the rubber packing member 18 merely tends to compress it in an axial direction and increase its sealing effectiveness over a relatively large cylindrical area against the inner surface 19a of the sleeve 19. It is to be noted that this pressure action is substantially the only force on the rubber packing member 18 since any tensile or compressive strains in the tubular string B are transmitted between the cylinder 15 and mandrel 11 through the abutting retainer ring 21, or its weld 22, and the cooperable inclined annular seat 25 on the abutment 14. As a result, the rubber packing member 18 possesses a long life, and is capable of effectively and efficiently sealing against the cooperable cylindrical seat 19a on the sleeve under very high differential pressures, in excess of 7500 lbs. per square inch.

Whenever the valve device is to be opened, the mandrel 11 is merely moved inwardly of the cylinder 15, the packing member 18 sliding from the upstanding sleeve 19 to permit fluid passage

once again between the mandrel 11 and cylinder 15 and through the arcuate spaces 17.

In the event that it is desired to impose downwardly directed weight on the tubular string B to close the valve device A; that is, to effect its closing upon contractable movement of the cylinder 15 and mandrel 11, a nipple 26 is threaded into the upper collar 10. This nipple is provided with a sealing ring 27 disposed in its lower inclined terminus 28 for engagement with a cooperable inclined seat 29 formed at the upper end of the head 20 secured to the mandrel 11. The telescoping of the mandrel 11 within the cylinder 15 to its fullest extent will engage the inclined head seat 29 with the sealing ring 27 and prevent passage of fluid through the valve device between its interior and exterior.

If such mode of closing the valve device is not required, the nipple 26 can be omitted, in which event complete telescoping of the mandrel 11 in the cylinder 15 will cause the head 20 to engage spaced lugs 30 extending from the lower end of the collar 10. With the parts in this position, passage of fluid between the interior and exterior of the valve device can still occur through the spaces 31 between the depending lugs 30 and between the cylinder 15 and mandrel 11.

As assurance against leakage through the threaded connection between the lower end of the cylinder 15 and the abutment 14, a seal is placed between these parts. This seal may be of any suitable form, in the present instance consisting of a round resilient or elastic packing ring 32 carried in a V-shaped groove 33 in the exterior of the abutment member 14 and engageable with the inner surface of the cylinder 15.

I claim:

1. A control valve, comprising inner and outer members telescopically arranged one within the other and spaced from each other to form a passage establishing communication between the interior and exterior of said members, one of said members having packing means and the other of said members being provided with a substantially cylindrical seating surface adapted to be engaged by said packing means to effect a seal between said members to close said passage while permitting flow of fluid through one of said members into the other of said members, the unrestrained diameter of the seating surface of said packing means being substantially equal to the diameter of said seating surface.

2. A control valve, comprising inner and outer members telescopically arranged one within the other and spaced from each other to form a passage establishing communication between the interior and exterior of said members, one of said members having packing means and the other of said members being provided with a substantially cylindrical seating surface adapted to be engaged by said packing means to effect a seal between said members to close said passage while permitting flow of fluid through one of said members into the other of said members, the unrestrained diameter of the seating surface of said packing means being substantially equal to the diameter of said seating surface, and means for limiting the extent of telescopic movement between said members to determine the position of said packing means with respect to said cylindrical seating surface.

3. A control valve, comprising inner and outer members telescopically arranged one within the other and spaced from each other to form a passage establishing communication between the

interior and exterior of said members, one of said members having packing means and the other of said members being provided with a substantially cylindrical seating surface adapted to be engaged by said packing means to effect a seal between said members to close said passage while permitting flow of fluid through one of said members into the other of said members, the unrestrained diameter of the sealing surface of said packing means being substantially equal to the diameter of said seating surface and different from the diameter of the other of said members adjacent said seating surface.

4. A control valve adapted to be connected to a tubing string or the like, including inner and outer tubular members telescopically arranged one within the other and spaced from each other to form a longitudinal passage therebetween through which fluid may flow along the exterior of said inner member between the interior and exterior of said outer member, the inner member having a substantially cylindrical packing thereon and the outer member being provided with a substantially cylindrical seating surface adapted to receive said packing to close said passage and confine flow of fluid through one member into said other member, the unrestrained diameter of the sealing surface of said packing being substantially equal to the diameter of said seating surface but smaller than the internal diameter of the outer member adjacent said seating surface.

5. A control valve adapted to form part of a tubing string or the like, including inner and outer members telescopically arranged one within the other and spaced from each other to form a longitudinal passage therebetween through which fluid may flow along the exterior of said inner member between the interior and exterior of said outer member, the inner member carrying a substantially cylindrical packing thereon and the outer member being provided with a substantially cylindrical seating surface adapted to receive said packing to close said passage and confine flow of fluid through one member into said other member, the unrestrained diameter of the sealing surface of said packing being substantially equal to the diameter of said seating surface but smaller than the internal diameter of the outer member adjacent said cylindrical surface, and means for transmitting strains between said inner and outer members without subjecting the packing to such strains.

6. A control valve adapted to form part of a tubing string or the like, including inner and outer members telescopically arranged one within the other, the inner member carrying a substantially cylindrical packing thereon and the outer member being provided with a substantially cylindrical seating surface adapted to receive said packing, the unrestrained diameter of the sealing surface of said packing being substantially equal to the diameter of said surface but smaller than the internal diameter of the outer member adjacent said cylindrical surface, and cooperable abutments secured to said inner and outer members for transmitting tensile and compressive strains therebetween without imposing such strains on the packing, said abutment on said inner member being smaller than the diameter of said cylindrical seating surface.

7. A control valve adapted to form part of a tubing string or the like, including an inner member telescopically arranged within an outer member, a head on said inner member, a ring

secured to said inner member, a substantially cylindrical packing held on said inner member between said head and ring, the outer member being provided with a substantially cylindrical seating surface adapted to receive said packing, the unrestrained diameter of the sealing surface of said packing being substantially equal to the diameter of said surface, and means secured to said outer member and adapted to abut said ring to limit the extent of movement of said packing within said cylindrical seating surface, said ring being of smaller external diameter than the diameter of said cylindrical seating surface.

8. A control valve adapted to form part of a tubing string or the like, including an inner member telescopically arranged within an outer member, a head fixed to said inner member, a retainer ring secured to said inner member, a filler ring mounted on said inner member between and engaging said head and retainer ring, a substantially cylindrical packing secured to said filler ring and embraced by said head and retainer ring, the outer member being provided with a substantially cylindrical seating surface adapted to receive and be engaged by said packing, the unrestrained diameter of the sealing surface of said packing being substantially equal to the diameter of said seating surface.

9. A control valve adapted to form part of a tubing string or the like, including an inner member telescopically arranged within an outer member, a head secured to the upper end of said inner member, a retainer ring secured to said inner member below said head, a filler ring mounted on said inner member between and engaging said head and retainer ring, a substantially cylindrical packing secured to said filler ring and embraced by said head and retainer ring, the outer member being provided with a substantially cylindrical seating surface adapted to receive and be engaged by said packing to effect a seal between said members, the unrestrained diameter of said packing being substantially equal to the diameter of said seating surface, and an abutment secured to said outer member below said retainer ring and engageable therewith to limit the extent of extensible movement between said members.

10. A control valve adapted to form part of a tubing string or the like, including an inner member movable longitudinally within an outer member, a head secured to said inner member, a retainer ring secured to said inner member, a filler ring mounted on said inner member between and engaging said head and retainer ring, a packing secured to said filler ring and embraced by said head and retainer ring, and a seat on said outer member adapted to be engaged by said packing to effect a seal between said members.

11. A control valve adapted to form part of a tubing string or the like, including an inner member movable longitudinally within an outer member and spaced therefrom to form an annular passage establishing communication between the interior of said inner member and the exterior of said outer member, and cooperable packing and seating means carried by said members to prevent flow of fluid through said passage between the interior of said inner member and the exterior of said outer member when said members are in both their fully extended and contracted positions.

12. A control valve adapted to form part of a tubing string or the like, including an inner

member movable longitudinally within an outer member and spaced therefrom to form an annular passage establishing communication between the interior of said inner member and the exterior of said outer member, spaced seats on one of said members, and a head on the other of said members between said seats selectively engageable therewith to prevent flow of fluid through said passage between the interior of said inner member and the exterior of said outer member when said members are in both their fully extended and contracted positions.

13. A control valve adapted to form part of a tubing string or the like, including an inner member movable longitudinally within an outer member and spaced therefrom to form an annular passage establishing communication between the interior of said inner member and the exterior of said outer member, longitudinally spaced seats on said outer member, and a double acting head on said inner member between said seats selectively engageable therewith to prevent flow of fluid through said passage between the interior of said inner member and the exterior of said outer member when said members are in both their fully extended and contracted positions.

14. A control valve adapted to form part of a tubing string or the like, including inner and outer members telescopically arranged one within the other, said outer member having a restricted portion therein provided with a generally cylindrical seating surface forming an annular passage with said inner member through which fluids can flow between the interior and exterior of said outer member, and said inner member having a packing movable into said re-

stricted portion for effecting a seal with said seating surface to close said passage.

15. A circulation and expansion joint adapted to be connected to a tubing string and the like, including inner and outer members telescopically arranged one within the other, said outer member having a restricted portion therein provided with a generally cylindrical seating surface forming an annular passage with said inner member through which fluids can flow between the interior and exterior of said outer member, and said inner member having a packing movable into said restricted portion for effecting a seal with said seating surface upon relative extensible movement between said members to close said passage, said packing being of less diameter than the unrestricted portions of said outer member to permit fluid passage between the packing and outer member when said members are in contracted position.

16. A circulation and expansion joint adapted to be connected to a tubing string and the like, including inner and outer members telescopically arranged one within the other, said outer member having a restricted portion therein provided with a generally cylindrical seating surface forming an annular passage with said inner member through which fluids can flow between the interior and exterior of said outer member, and said inner member having a packing movable into said restricted portion for effecting a seal with said seating surface to close said passage, said packing being movable into the unrestricted portions of said outer member to permit fluid passage between the packing and outer member.

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