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M. G. CREIGHTON
ADJUSTABLE CONNECTOR FOR WELL CASINGS HAVING
VARIABLY COENGAGED ROTATION PREVENTION MEANS

2,899,218

2 Sheets-Sheet 1

Fig. 1.

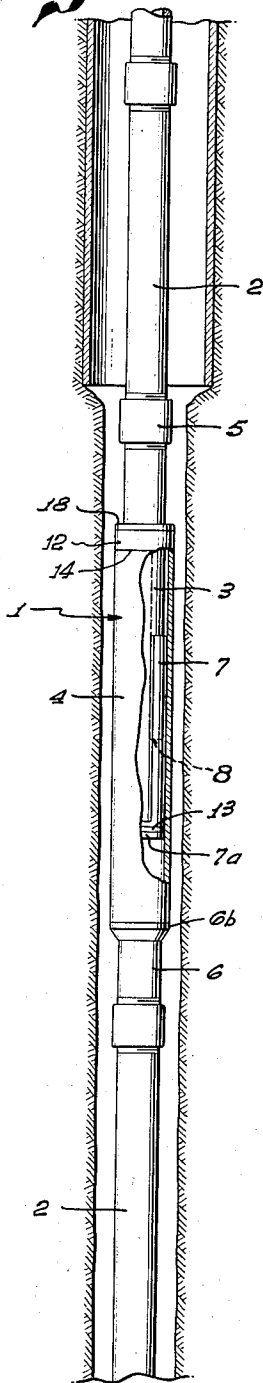


Fig. 2.

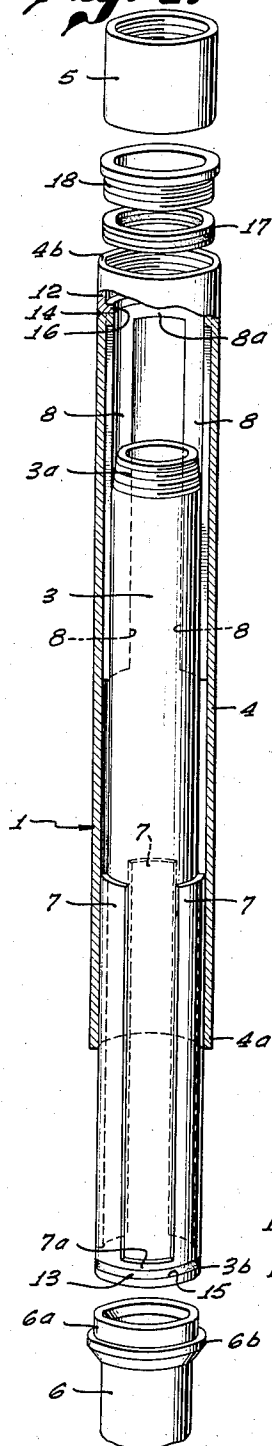
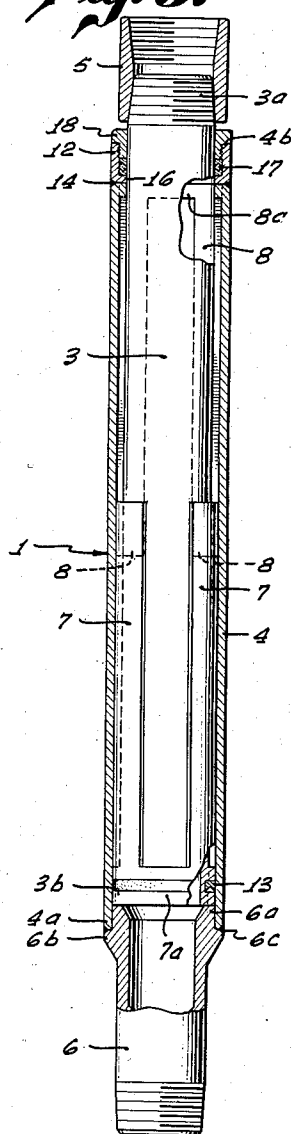


Fig. 3.



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Fig. 4.

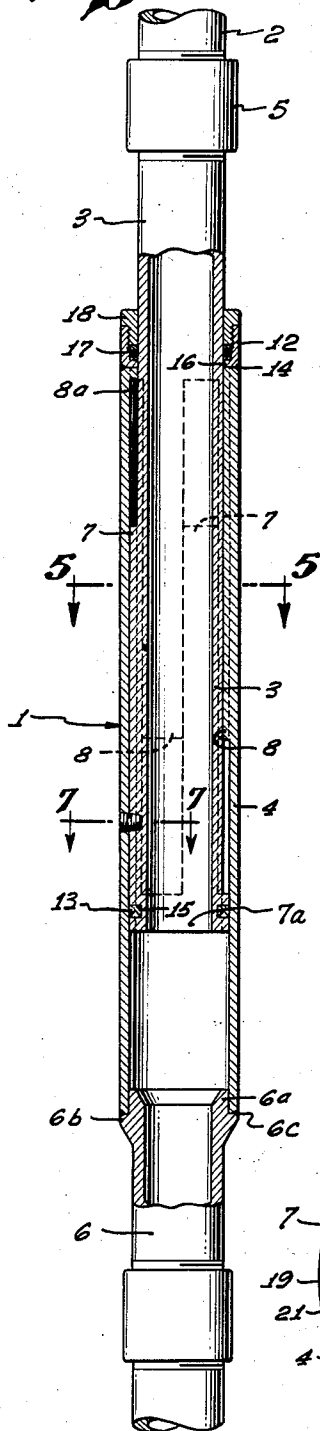


Fig. 5.

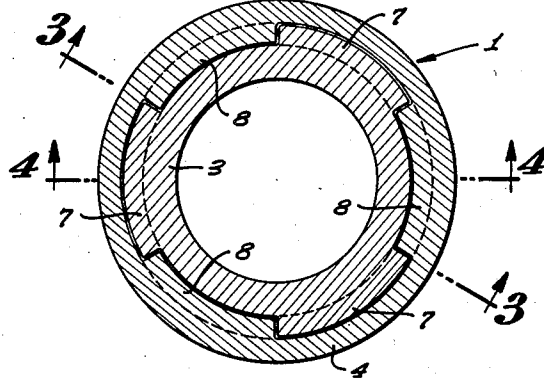


Fig. 6.

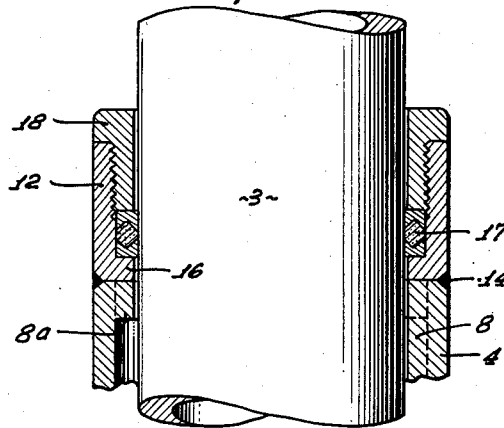
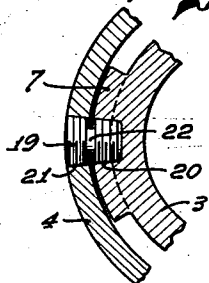


Fig. 7.



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ADJUSTABLE CONNECTOR FOR WELL CASINGS HAVING VARIABLY COENGAGED ROTATION PREVENTION MEANS

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3 Claims. (Cl. 285—302)

This invention relates to apparatus for protecting the casing string in an oil well from being damaged by forces developed in the string incident to movement of the earth through which the string passes or incident to any other factor which may cause excessive compression or tension in the string.

It is an object of this invention to provide an improved apparatus of this character which includes a connector constructed and arranged to provide a flow passage there-through, and so that when coupled between sections of a casing string it will prevent the aforementioned forces from damaging the string.

It is another object of this invention to provide a connector such as described, in which the sections of the casing string connected thereby, are subject to relative axial movement and wherein novel means is provided for preventing relative rotative movement between the connected sections without interfering with such relative axial movement.

It is another object hereof to provide in a connector such as described, a novel sealing arrangement which isolates from the flow passage through the connector, the means for preventing relative rotation between the connected sections of the string, thereby preventing fluid, drilling mud, sand, cementitious material, and other foreign matter from interfering with the relative axial movement between the connected sections.

It is a further object hereof to provide a connector such as described which at all times will maintain the connected sections of the casing string subject to joint rotative movement whereby the desired manipulation of the string may be effected at the top of the well without requiring preliminary adjustment of the connector.

An additional object of this invention is the provision of a coupling or connector such as described, wherein a pair of tubular members telescopically connected to permit relative axial adjustment thereof, are held by novel means against relative rotative movement throughout the extent of such axial adjustment.

It is a further object hereof to provide a connector such as described wherein the telescopically related tubular members are provided with splines and sealing means in an arrangement such that the splines are disposed between opposed surfaces of the tubular members to prevent relative rotative movement between the tubular members and wherein the sealing means provide fluid-tight seals for excluding the aforementioned foreign matter from entering between such surfaces and thereby interfering with the relative axial adjustment of the tubular members.

Another object is the provision of an adjustable coupling or connector such as described, wherein splines are arranged on the telescopically connected tubular members of the connector in such a manner as to serve as effective reinforcing elements as well as to maintain these members locked together for joint rotative movement in all positions of axial adjustment of the tubular members.

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A further object is the provision of a coupling or connector such as described, wherein the splines are provided on the exterior of the inner tubular member or mandrel of the connector and the interior of the outer tubular member or body of the connector, in such positions that upon relative axial movement of the mandrel and body in a direction away from one another, the splines are moved toward one another to increase the amount of lineal engagement or overlap of the respective splines, thereby reinforcing and increasing the rigidity of the coupling as it is lengthened.

It is another object of this invention to provide a connector such as described wherein means forming a fluid-tight seal between the body and the mandrel is carried by the mandrel below the splines on the mandrel and wherein a second means forming a fluid tight seal between the body and the mandrel is carried by the body above the splines on the body, thereby enclosing the splines between the seals to exclude foreign matter from entering the space between the seals in all positions of relative axial adjustment of the mandrel and body.

This invention possesses many other advantages and has other objects which may be made more easily apparent from a consideration of one embodiment of the invention. For this purpose there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this 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:

Fig. 1 is a side elevation, partly in section, of a connector embodying the present invention shown connected in the casing string of an oil well;

Fig. 2 is an exploded perspective view, partly in elevation, of the connector showing the manner in which the same is assembled;

Fig. 3 is a sectional view of the assembled connector, taken on the line 3—3 of Fig. 5, but showing the mandrel in elevation and partly broken away;

Fig. 4 is a sectional view of the connector, taken on the line 4—4 of Fig. 5, with parts shown in elevation, and the mandrel and body held in predetermined positions by a shear pin;

Fig. 5 is a cross sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is an enlarged fragmentary vertical sectional view, partly in elevation, showing one of the seals between the mandrel and the body of the connector; and

Fig. 7 is a sectional view, on an enlarged scale, taken on the line 7—7 of Fig. 4.

Referring more specifically to the accompanying drawing, it will be seen that apparatus embodying the present invention constitutes an axially adjustable connector 1, one or more of which may be connected in a casing string 2 of an oil well.

The connector 1 comprises a tubular mandrel 3 telescopically mounted in a tubular body 4 whereby the mandrel and body are relatively axially movable.

A coupling member 5 on the upper end of the mandrel 3 provides for connection of the mandrel with one section of the casing string 2, whereas a coupling member 6 on the lower end of the body 4 provides for connection of the body with another section of the string. These coupling members are applied after the mandrel and body are telescopically assembled, in a manner which will be hereinafter fully described.

In order that the casing string readily may be manipulated as desired from the top of the well, means are provided for preventing relative rotative movement be-

tween the mandrel 3 and the body 4 throughout the extent of relative axial adjustment of the mandrel and body. This means includes splines 7 on the exterior of the lower part of the mandrel 3 interengaged with splines 8 on the upper part of the interior of the body 4.

One practicable way to provide the splines 7 and 8 consists in making longitudinal and transverse cuts in a single section of well casing or tubing of appropriate length, wall thickness and diameter, in such a manner that the longitudinal cuts divide the section into two spline units each comprising longitudinal portions angularly spaced about the axis of each section and joined to an annular band forming one end of each unit. These longitudinal portions constitute the splines 7 and 8 integral with the annular bands 7a and 8a respectively.

After these spline units are formed, they are mounted upon the exterior of the mandrel 3 and upon the interior of the body 4 respectively, and button welded thereto in predetermined positions. For the sake of clarity of illustration, the button welding is not shown and the splines and associated bands are shown as integral with the mandrel and body respectively, except for dotted lines which indicate the joint of the splines and bands with the mandrel and body. However, it should be noted that the splines may be formed on the body in any suitable manner provided they permit of relative axial adjustment between the body and mandrel and prevent relative rotative movement between the mandrel and body throughout the extent of such axial adjustment.

The arrangement of the splines 7 and 8 is such that the length thereof with respect to the length of the mandrel 3 and body 4 determines the extent of relative axial adjustment permitted of the mandrel and body. As here shown, the splines 7 extend along substantially the lower half of the mandrel, whereas the splines 8 extend along substantially the upper half of the body 4. In this connection, it is to be understood that the relative lengths of the mandrel, body and splines may be varied depending upon the axial adjustment stroke desired in the particular connector made in accordance with this invention.

Fig. 2 illustrates one way in which the mandrel 3 and body 4, together with associated parts, may be assembled. In this method of assembling the connector, the end 3a of the mandrel is inserted through the end 4a of the body and into the latter in such a manner that the free ends of the splines 7 will be disposed between free ends of the splines 8. When, as shown in Fig. 3, the ends of the splines 7 extend but a short distance between the ends of the splines 8, the connector is in fully collapsed or retracted position and a minimum overlap or interengagement of the splines is effected. The end 3a of the mandrel then extends beyond the end 4a of the body, whereas the other end 3b of the mandrel 3 is disposed in inwardly spaced relation to the lower end 4a of the body 4. With the mandrel and body in these relative positions, the coupling member 5 and the coupling member 6 are applied to the ends 3a and 4a of the mandrel and body respectively, thereby completing the assembling of the connector.

The coupling member 5 is threaded onto the end 3a of the mandrel in a manner such that a portion of the member 5 is disposed for making a threaded connection with a section of the casing string above the connector.

The coupling 6 is provided with a reduced end portion 6a which is extended into the end 4a of the body 4. An annular shoulder 6b is provided by this reduction of the coupling and is disposed in abutting relation to the end 4a of the body and welded thereto as at 6c. The outer end of the coupling 6 is externally screw threaded to provide for connection thereof with that part of the casing string which is disposed below the connector.

The inner end of the reduced portion 6a of the coupling member 6 acts as a stop for the band 7a on the mandrel. Thus, it will be seen that when the mandrel 3 and body 4 are in fully collapsed or retracted position, the band 7a will abut the inner end of the reduced portion 6a of the coupling member 6.

It should be noted that the annular bands 7a and 8a act as stops to limit the extension adjustment of the connector, as these bands will be contacted by the free ends of the splines 8 and 7 respectively, when the body and mandrel are fully extended relative to one another.

It is desired to prevent drilling mud, cementitious material, sand and other foreign matter which passes through the flow passage in the connector, from entering between the opposed surfaces of the mandrel 3 and body 4. The presence of such foreign matter between these opposed surfaces may interfere with the relative axial adjustment of the body and mandrel. Accordingly, sealing means are provided between the mandrel 3 and body 4 to isolate the splines 7 and 8 from the flow passage and form fluid-tight seals which will exclude mud, sand and other foreign matter from entering between the opposed surfaces of the mandrel and body, thereby preventing the possibility of an accumulation of such matter between the splines with resultant interference with the axial adjustment between the body and mandrel. The sealing means also prevents fluid and foreign matter from entering the connector from exteriorly of the connector as well as prevents leakage from the connector into the well bore.

As here shown, the sealing means are axially spaced on the connector for the purpose and in the manner hereinbefore noted. One way in which the sealing means may be arranged consists in providing one sealing means on the mandrel 3 below the splines 7, and mounting the other sealing means on the body 4 above the splines 8.

The sealing means on the body 4 includes a collar 12 welded as at 14 on the upper end of the body and provided at its lower end with an annular internal shoulder 16. Suitable sealing elements 17 are confined between a gland nut 18 and the shoulder 16 for sealing engagement with the collar and mandrel respectively.

The sealing means on the mandrel 3 includes a sealing ring 13 mounted in an annular groove 15 in the band 7a at the lower ends of the splines 7, for sealing engagement with this band and the body 4 respectively.

It will now be apparent that with the sealing means axially spaced in this manner the objects and advantages hereinbefore stated are obtained in a particularly efficacious manner.

Upon relative axial movement of the mandrel and body from fully collapsed position, the axial interengagement of the splines 7 and 8 increases. Accordingly, when the connector is lengthened the splines increasingly overlap and therefore increasingly reinforce the connector.

Assuming that the casing is on bottom in the well and the connector is in fully collapsed position, as in Fig. 3, the mandrel 3 is then limited to upward movement relative to the body 4 inasmuch as the band 7a on the mandrel abuts the inner end 6a of the coupling 6 on the body 4, thereby preventing downward movement of the mandrel. However, the mandrel may be moved upwardly relative to the body 4, and in so moving the splines 7 on the mandrel move relative to the splines 8 on the body. This adjustment may be effected from the top of the well by lifting the casing string to dispose the mandrel and body in such relative positions that axial movement of the body and mandrel may take place in either direction to prevent damage of the casing string in the event of earth movements such as may be caused by an earthquake or subsidence.

If desired, the mandrel 3 and body may be set in any desired relative positions by the use of frangible means. As shown in Fig. 4, frangible means in the form of a shear pin 19 is passed through the body 4 and into the

mandrel to hold the mandrel and body in such positions that following the shearing of the pin, approximately the same amount of relative axial movement between the mandrel and body may take place in either direction.

As shown in Fig. 7, the shear pin 19 is in the form of a tapered screw threaded plug screwed into threaded openings 20 and 21 in the mandrel 3 and body 4 respectively. The pin is provided with an annular groove 22 intermediate its ends to form a weak point at which the pin will shear. The pin is screwed into the openings 20 and 21 so as to dispose the groove 22 in a position such that when the pin shears, the portions remaining in the mandrel and body, respectively, will not interfere with relative axial movement between the mandrel and body.

It will now be apparent that with a connector mounted in a string, as shown in Fig. 1, or Fig. 4, provision is made for relative axial movement between the body and the mandrel in either direction to prevent damage of the string, as a result of excessive compression or tension forces developed in the string responsive to earth movements or other causes.

If the connector is used without a shear pin, the mandrel 3 and body 4 may move to fully extended position during the running of the casing string and connector thereon into the well. However, when the string bottoms in the well, the part thereof above the connector may be lowered and then set in a position to dispose the mandrel and body, for example, in the position shown in Fig. 1. In this position the mandrel and body are relatively movable in compression or tension substantially the same extent in either direction to compensate for pressure against the casing string incident to shifting of the strata through which the string passes or to earth movements or other causes. The relative positions in which the mandrel and body may be set by manipulating the casing string, obviously may be varied as desired.

If the connector is used with the shear pin, for example, as shown in Fig. 4, manipulation of the string to set the mandrel and body in predetermined positions is not necessary, as the shear pin will maintain the body and mandrel in the desired position until forces are developed in the string which will shear the pin and cause such relative movement between the body and mandrel as will prevent damage of the casing string.

What is claimed is:

1. An axially adjustable connector for operation as a section of a casing string in an oil well comprising: a tubular body member having a bore therethrough and having one end adapted to be connected with a section of a casing string; a mandrel member having one end adapted to be connected with another section of the casing string; said members being telescopically connected for relative axial movement; splines on the interior surface of said body member and the exterior surface of said mandrel member, respectively; said splines extending from an intermediate portion to the distal end portion of each of said members, respectively; the unsplined portion of the interior surface of said body member being of a uniform diameter substantially the same as the external diameter of said splined portion of said mandrel member throughout the axial length thereof; said splines on said members being of substantially the same length and arranged so that the proximal ends thereof overlap in minimum overlapping engagement when said body and mandrel are fully collapsed; said overlapping engagement increasing in proportion to relative axial movement of said members from collapsed position to a maximum overlapping engagement when said members are fully extended; radially projecting annular elements at said distal end portions of said members; said elements being joined to said splines and being engageable by said proximal ends to limit axial movement between said members; the annular element on said mandrel member having an outer diameter substantially the same as the diameter of said unsplined portion of said body member and being

slidable in said unsplined portion; and sealing means at said distal end portions of said members forming axially spaced fluid seals between said members; the sealing means at said distal end portion of said mandrel member being carried by said annular element thereon.

2. An axially adjustable connector for operation as a section of a casing string in an oil well comprising: a tubular body member having a bore therethrough and having one end adapted to be connected with a section of a casing string; a mandrel member having one end adapted to be connected with another section of the casing string; said members being telescopically connected for relative axial movement; splines on the interior surface of said body member and the exterior surface of said mandrel member, respectively; said splines extending from an intermediate portion to the distal end portion of each of said members, respectively; the unsplined portion of the interior surface of said body member being of a uniform diameter substantially the same as the external diameter of said splined portion of said mandrel member throughout the axial length thereof; said splines on said members being arranged so that the proximal ends thereof overlap in minimum overlapping engagement when said body and mandrel are fully collapsed; said overlapping engagement increasing in proportion to relative axial movement of said members from collapsed position to a maximum overlapping engagement when said members are fully extended; radially projecting elements at said distal end portions of said members; the proximal ends of the splines on one of said members being engageable with the radially projecting element on the other of said members to limit axial movement between said members; the radially projecting element on said mandrel member having an outer diameter substantially the same as the diameter of said unsplined portion of said body member and being slidable in said unsplined portion; and sealing means at said distal end portions of said members forming axially spaced fluid seals between said members; the sealing means at said distal end portion of said mandrel member being carried by said element thereon.

3. An axially adjustable connector for operation as a section of a casing string in an oil well comprising: a tubular body member having a bore therethrough and having one end adapted to be connected with a casing string; a mandrel member having one end adapted to be connected with another section of the casing string; said members being telescopically connected for relative axial movement; radially extending and axially elongated coengaged means on the interior surface of said body member and the exterior surface of said mandrel member, respectively, extending from an intermediate portion to the distal end portion of each of said members, respectively, for preventing relative rotation of said body member and said mandrel member; the interior surface of the proximal portion of said body member being of a uniform diameter approximately the same as the external major cross section of the distal portion of said mandrel member throughout the axial length thereof; said means on said members being of substantially the same length and arranged so that the proximal ends thereof overlap in minimum overlapping engagement when said body and mandrel are fully collapsed; said overlapping engagement increasing in proportion to relative axial movement of said members from a collapsed position to a maximum overlapping engagement when said members are fully extended; radially projecting annular elements at said distal end portions of said members; said elements being joined to said means on said members and being engageable by said proximal ends to limit axial movement between said members; the annular element on said mandrel member having an outer diameter substantially the same as the inner diameter of said proximal portion of said body member and being slidable in said proximal portion; and sealing means at said distal end portions of said members forming axially spaced fluid seals between said members; the sealing means at

said distal end portion of said mandrel member being
carried by said annular element thereon.

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