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R. D. FISHER ET AL

2,010,587

JOINT FOR CONNECTING PARTS OF WELL DRILLING AND WELL PUMPING EQUIPMENT

Filed April 7, 1933

2 Sheets-Sheet 1

Fig. 1.

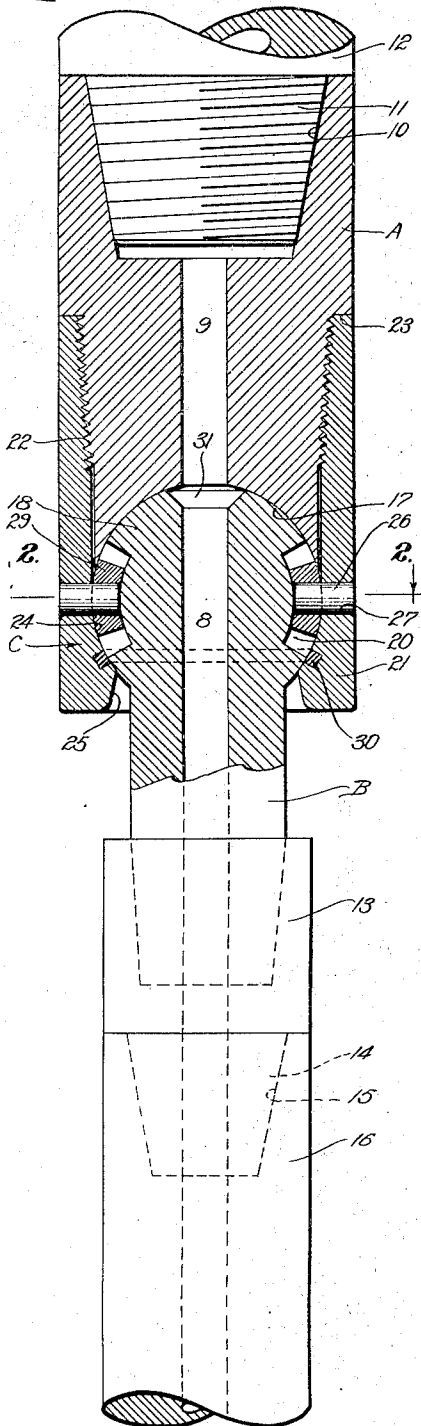


Fig. 2.

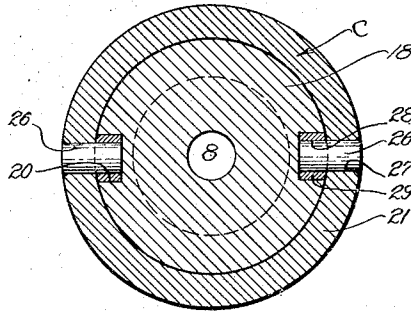
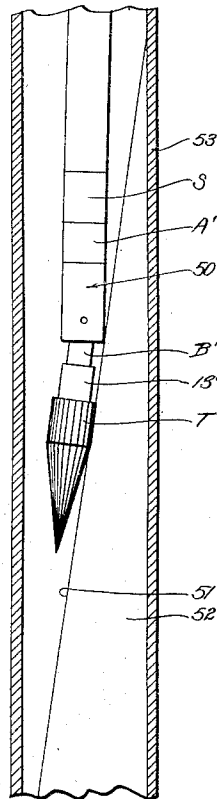


Fig. 3.



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2 Sheets-Sheet 2

Fig. 4.

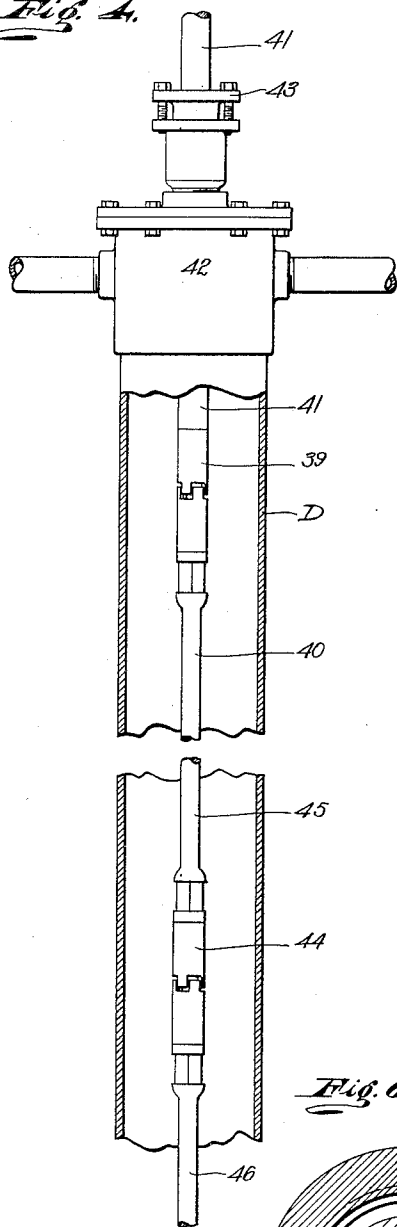


Fig. 5.

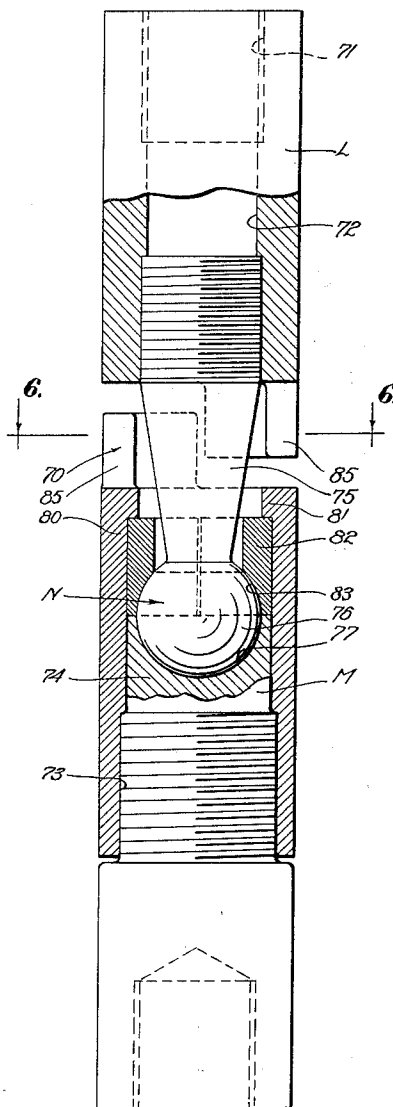
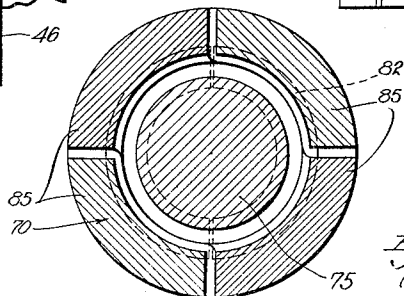


Fig. 6.



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UNITED STATES PATENT OFFICE

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JOINT FOR CONNECTING PARTS OF WELL
DRILLING AND WELL PUMPING EQUIP-
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2 Claims. (Cl. 285—95)

This invention relates to a joint, and relates more particularly to a joint for connecting parts of a drilling or fishing string, or parts of a sucker or pump rod. It is a general object of the present invention to provide a simple, practical and dependable joint for connecting parts of the character mentioned, that is adapted to permit limited universal or angular motion between the connected parts.

During the course of drilling with the rotary method, it often becomes desirable to operate or guide a tool out of longitudinal alignment with its operating string, for example, it is sometimes desired to side-track or divert a tool from the well bore by a whip-stock, or the like. It has been common practice to directly or rigidly attach the tool to the operating string or drill pipe, so that the string is forced to bend as the tool is diverted, and therefore has excessive and undesirable eccentric or gyratory motion as it rotates. Another example of where it is desirable to cause or allow a tool to operate out of alignment with its operating string is where an attempt is made to fish a lost object from a well bore when the object is located at one side of the bore or is in a position where it is not possible to bring a fishing tool into engagement with it because of the inability of the operating string carrying the tool to flex sufficiently to provide for the proper engagement of the tool with the lost object.

In the pumping of an oil well, the well pump is usually operated by a string of sucker rods rigidly connected by couplings and reciprocated by a walking beam or other mechanism at the surface. At the upper or surface end of the string of sucker rods there is a section termed the "polished rod" which passes through a packing device or packing gland on the tubing head. The polished rod usually has a certain amount of lateral movement caused by the action of the walking beam or actuating mechanism, which lateral movement of the polished rod causes the packing device, the polished rod and the other parts to be subjected to excessive strains and wear. Further, if a well is not straight, constant and undesirable bending or flexing of the sucker rod occurs as the well is pumped, resulting in more or less quick fatigue of the metal of the sucker rod and consequent breaking of the sucker rods, a condition sometimes so severe that it is impossible economically to pump the well.

An object of the invention is to provide a joint for connecting parts of a drilling or fishing string, or for connecting a tool with such a string, or for connecting parts of a sucker string or for connect-

ing such drilling or fishing string or string of sucker rods to the customary actuating means at the surface of the well, that permits limited universal or angular movement between the connected parts and that is adapted to dependably and effectively transmit longitudinal and rotational strains.

Another object of the invention is to provide a joint of the character mentioned that is adapted to effectively conduct the circulating fluid between the connected parts of a drilling or fishing string. In accordance with the present invention, the sections of the joint are provided with fluid passages that remain in communication at all times, and operate to conduct the circulation fluid between the connected parts of the string.

Another object of the invention is to provide a joint of the character mentioned that is small and compact and that does not present or necessitate any projecting enlargements or parts on or in the string.

Another object of the invention is to provide a joint of the character mentioned that may be easily and quickly interposed or connected between parts such as we have mentioned above.

A further object of the invention is to provide a joint of the character mentioned that is effective in operation and simple and inexpensive of manufacture.

Other objects and features of the invention will be better and fully understood from the following detailed description of typical forms and applications of the invention, throughout which description, reference is had to the accompanying drawings, in which:

Fig. 1 is a longitudinal detailed sectional view of a form of the joint provided by the present invention illustrating it connected between parts of a well drilling or well pumping string. Fig. 2 is a transverse detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is a fragmentary vertical detailed sectional view of a portion of a well bore illustrating a form of the joint provided by the invention connecting a side-tracking tool with an operating string. Fig. 4 is a fragmentary vertical detailed sectional view of the upper end portion of a well, illustrating a form of the joint provided by the invention connecting together parts of a string of pump rod or sucker rod operating in the well. Fig. 5 is a longitudinal detailed sectional view of a form of the invention adapted for connecting parts of a string of pump rods or sucker rods, and Fig. 6 is an enlarged transverse detailed sectional view taken as indicated by line 6—6 on Fig. 5.

The joint provided by the present invention is adapted to be embodied in forms for use in connection with sucker rods and/or drill pipe of various characters, sizes, etc. In the drawings we have illustrated typical embodiments of the invention and applications of the invention, it being understood that the invention is not to be taken as limited or restricted to the specific forms or applications illustrated in the drawings and about to be described, but is to be taken as including any features or modifications that may fall within the scope of the claims.

The form of flexible or universal joint provided by the invention and illustrated in Figs. 1 to 4 inclusive of the drawings, includes, generally, two sections A and B adapted to be connected between two parts of a drilling or fishing string, or a pumping string, and a connection C between the sections A and B for transmitting longitudinal and rotational strains between the sections and that allows universal or tilting motion between the sections.

The section A, which we will term the upper section, is provided at its upper end with means for facilitating its connection with the part in connection with which the joint is to be used. In the particular case illustrated in the drawings, a tapered screw-threaded socket 10 is provided in the upper end of the section A to receive the threaded pin 11 on a part 12 of the string. Means is provided on the lower section B for connecting with the string or with a tool operated by the string. In the particular form of the invention illustrated in the drawings, a connecting member or sub 13 is screw-threaded on the lower end portion of the section B and has a tapered pin 14 adapted to be threaded into a socket 15 in the tool or part 16 of the string. In the drawings we have illustrated the section B as being somewhat smaller in external diameter than the section A, it being understood that the sections A and B may be proportioned and related as found most desirable or practical. It is a feature of the application of the invention to drilling or fishing strings that the sections A and B of the joint are adapted to pass or conduct circulation fluid between the parts 12 and 16. Central longitudinal fluid passages 9 and 8 are provided in the sections A and B, respectively. The lower end of the passage 9 is in communication with the upper end of the passage 8 at all times, as will be subsequently described, so that the joint is operable to maintain circulation between the parts 12 and 16.

The connection C between the sections A and B includes a socket or seat 17 in one section, and a head 18 on the other section for cooperating with the seat. In the form of the invention disclosed in the drawings, the section A is the female section being provided with the seat or socket 17, and the section B is the male section having the head 18 for cooperating with the seat. The socket or seat 17 is provided in the lower end of the upper section A and has spherical concaved walls. The walls of the seat 17 are preferably of less than 90° vertical arcuate extent. The head 18 is in the nature of a spherical enlargement on the upper end of the section B and is shaped and proportioned to have effective bearing engagement with the walls of the seat 17. Two diametrically opposite vertical or longitudinal recesses or grooves 20 are provided in the head 18. The grooves 20 have vertical parallel side walls and their end walls are curved about the same center as the surface of the head 18. The recesses or grooves 20 are located so that a line passing through

points midway between their ends and through the axis of curvature of the head 18 is at approximately 90° to the longitudinal axis of the joint.

The connection C between the sections A and B includes a retaining member or collar member 21 on the section A cooperating with the head 18 to retain it in cooperation with the seat 17. The member 21 is tubular, and has a threaded connection 22 with the section A. The member 21 may be of the same external diameter as the upper portion of the upper section A and its upper end may abut against a downwardly facing shoulder 23 on the section. In accordance with the invention, the member 21 projects downwardly below the lower end of the section A and is provided at its interior with a spherically curved concaved surface 24. The surface 24 of the member 21 cooperates with the head 18 below the horizontal center of the head. It will be apparent how the cooperating of the surface 24 of the member 21 with the head 18 effectively maintains the head in cooperation with the seat 17, but allows relative tilting or swinging of the sections A and B. The surface 24 is preferably comparatively large so that the member 21 has substantial bearing engagement with the spherical enlargement or head 18. The opening 25 in the lower end of the member 21 passes the body portion of the section B and has downwardly and outwardly flared walls. In practice, the opening 25 passes the body portion of the section B with considerable clearance so as to permit limited relative tilting or angular movement of the sections A and B.

Two diametrically opposite trunnions or pins 26 project inwardly from the inner wall of the member 21 at the upper end of the curved surface 24. The pins 26 extend through radial or transverse openings 27 in the walls of the member 21 and are welded or otherwise fixed to the member. The inner end portions of the trunnions or pins 26 extend into openings 28 in shoes or blocks 29. The blocks 29 are slidable longitudinally in the grooves 20 and the pins 26 are adapted to rotate or pivot in the openings 28 of the blocks. The blocks 29 are shaped and proportioned to slidably operate in the recesses or grooves 20. The outer sides of the blocks 29 may be flush with and of the same curvatures as the surface of the head 18 so as to be adapted to slidably operate on the surface 24. In accordance with the invention, the blocks 29 are shorter than the grooves 20, so that the sections A and B may have relative tilting or angular motion in a plane parallel with the grooves 20, or in other words, may have tilting or angular motion about an axis diametric of the spherical enlargement 18, and at right angles to the longitudinal axes of the pins 26. Pins 26, in being pivoted in the openings 28, allow the sections A and B to swing or tilt relative to one another, about an axis including the axes of the pins. As the sections A and B may pivot or tilt relative to one another about crossed axes, they may have relative angular motion in all directions. The relative tilting or angular motion of the sections A and B is limited by engagement between the body portion of the section B and the walls of the opening 25.

The invention includes means for packing or sealing between the head 18 of the section B and the member 21. In the specific embodiment of the invention illustrated in the drawings, packing 30 is carried in an annular groove in the lower end portion of the spherical concaved surface 24 and is adapted to seal with or pack against the surface of the spherical head 18. It will be ap-

parent that the fluid passages 9 and 8 remain in register or communication when the sections A and B are in alignment or substantial alignment. The extent of relative angular motion or relative tilting of the sections A and B is so related to the positions and proportions of the passages 9 and 8 so that the lower end of the passage 9 remains in communication with the upper end of the passage 8 when the sections are tilted or inclined relative to one another, to the greatest extent of the limited angular motion. To insure the proper communication between the fluid passages 9 and 8, and the unrestricted flow of circulation fluid in all positions the upper portion 31 of the passage 8 is enlarged and has upwardly flaring walls extending to the surface of the head 18.

It is believed that the operation of the joint described will be readily understood from the foregoing detailed description. The spherical enlargement or head 18 of the section B is at all times in bearing engagement with the seat 17 so that heavy compression strains may be effectively and dependably transmitted between the sections A and B. The surface 24 of the member 21 remains in bearing engagement with the surface of the spherical head 18 below the horizontal center of the head so that tensile strains are transmitted between the sections A and B through the member 21. Torsional or rotational strains are transmitted between the body sections A and B through the trunnions or pins 26 and sliding blocks 29. From the above it will be seen that the joint is capable of transmitting heavy longitudinal and rotational strains, and is thus well suited for use in a drilling string, a fishing string, or a string of sucker rods. The blocks 29 being slidable in the grooves 20 and the pins 26 being rotatable in the openings 28, provide for the free relative tilting or angular motion between the sections A and B in all directions. The spherical head 18 cooperating with the seat 17 and the surface 24, does not in any way interfere with the relative angular motion between the sections A and B, but remains in cooperative engagement with the seat 17 and surface 24 at all times, so that longitudinal pressures may be transmitted through the joint. The fluid passages 9 and 8 remain in communication at all times, so that circulation of fluid through the joint may be maintained. The packing 30 prevents the entrance of foreign matter or solid material in the joint, and positively prevents the leakage of fluid between the head 18 and the member 21.

Fig. 3 of the drawings illustrates a joint 50 provided by the present invention connecting a tool T with the lower end of an operating string S of drill pipe, or the like. The tool T is in the nature of a tap or milling tool, and is illustrated in engagement with the inclined upper surface 51 of a whip stock 52. The surface 51 of the whip stock is adapted to divert the tool T so that it may cut through the casing 53. In the particular case illustrated, the joint 50 directly connects the tool T with the lower end of the operating string S. The upper section A' of the joint is directly connected with the lower end of the string S, and the sub 13^a on the lower end of the section B' is directly connected with the tool T. During the side-tracking or diverting of the tool T by the whip stock 52, the sections A' and B' are adapted to tilt or incline relative to one another so that the tool T may be readily sidetracked by the whip stock without subjecting the string S to severe bending strains.

The form of the invention illustrated in Figs. 5 and 6 of the drawings is intended primarily for connecting parts of a string of pump rods or sucker rods and includes generally, two sections L and M adapted to be connected between parts of the string of sucker rods, a connection N between the sections L and M for transmitting longitudinal strains between the sections and for allowing limited angular or universal movement between the sections, and means 70 for transmitting rotational strains between the sections.

The section L, which we will consider the upper section, is provided at its upper end with suitable means for connecting with a part of a string of sucker rods. In the particular case illustrated in the drawings, a threaded socket or box 71 is provided in the upper end of the section M for receiving the pin of a pin member of a sucker rod joint. The section L may be tubular, that is, a central longitudinal opening 72 may extend downwardly through it from the lower end of the socket 71 to the lower end of the section. The section M is provided at its lower end with suitable means for facilitating its connection with a part of the string of pump rod or sucker rod. We have illustrated a screw threaded socket 73, in the lower end of the section M adapted to receive the pin of a pin section of a sucker rod joint. The upper end portion 74 of the section M is of reduced diameter and is preferably of round cross section.

The connection N is adapted to transmit longitudinal strains between the body sections L and M and is such that it allows limited relative angular or universal movement between the sections. The connection N includes a stem 75 on the upper section L. The stem 75 is screw threaded into the lower end of the opening 72 and projects downwardly from the lower end of the section L. The projecting portion of the stem 75 is round in cross section and tapers downwardly as illustrated in the drawings. A spherical enlargement or head 76 is provided on the lower end of the stem 75. The head 76 cooperates with a spherically concaved seat 77 in the upper end of the section M. The seat 77 is formed to effectively cooperate with the surface of the spherical enlargement 76 and is sufficiently deep to receive a substantial portion of the head. The connection N includes means for retaining the head 76 in cooperation with the seat 77 and for transmitting tensile strains between the sections L and M. A sleeve or collar member 80 is screw-threaded on the reduced portion 74 of the section M and projects upwardly from the upper end of the section. An upwardly projecting radial flange 81 is provided on the upper end of the member 80. A split bushing or ring 82 is arranged within the member 80 between the shoulder 81 and the upper end of the section M. An internal spherically concaved seat or surface 83 is provided in the lower end portion of the ring 82 to cooperate with the head 76. It will be apparent how the ring 82 maintains the head 76 in proper cooperation with the seat 77 and transmits tensile strain between the head and the member 80 on the section M. In practice, the ring 82 is related to the head 76 and stem 75 to allow or permit substantial angular or universal movement between the sections L and M.

The means 70 for transmitting rotational or torsional strains between the sections L and M includes cooperating lugs or projecting parts 85 on the lower end of the section L and the up-

per end of the member 80. The projecting parts 85 are equally or symmetrically spaced and preferably have flat radial sides. The lugs or projecting parts 85 of the section L and member 80 are related so as to mesh or fit one between the other and operate to prevent relative rotation of the sections L and M and to transmit torsional strains between the sections. The cooperating parts 85 are proportioned and related so as to allow considerable universal or angular movement between the sections L and M.

It is believed that the utility and practicability of the embodiment of the invention illustrated in Figs. 5 and 6 of the drawings will be readily understood from the foregoing detailed description. The head 76 in cooperating with the seat 77 is adapted to effectively transmit compression strains between the sections L and M. The ring 82 engaging the upper portion of the head 76 retains the head in cooperation with the seat 77 and provides for the transmission of tensile strains between the sections L and M. The cooperation of the head 76 with the seat 77 and surface 73 is such that the sections L and M may have angular or universal movement relative to one another. The angular or relative tilting motion of the sections L and M is limited by engagement of the stem 75 with the internal surface of the flange 81. The cooperating projecting parts 85 on the lower end of the section L and the upper end of the member 80 cooperate to transmit rotational or torsional strains between the sections L and M but are proportioned and related to one another to allow the desired relative angular or universal movement between the sections.

In Fig. 4 of the drawings, we illustrate an application of the invention wherein one of the joints 39 of the invention connects the upper section or length 40 of sucker rod with the polished rod 41. The polished rod 41 operates or reciprocates through a tubing head 42 and a packing device or packing gland 43 on the head. The string of pump rod or sucker rod extends downwardly through the well tubing D and its lower end is operatively connected with the well pump (not shown). A flexible or universal joint 44 of the character provided by the invention is shown connecting two lengths or sections 45 and 46 of the string of sucker rod at a point some distance below the head 42. The joint 39 connecting the polished rod 41 with the upper section 40 of the pumping rod is adapted to flex in the event that there is any lateral movement during reciprocation of the rod so that the polished rod 41, the packing device 43, etc., are not subjected to heavy strains or excessive wear. The joints 39 and 44 and any other flexible joints that may be embodied in the string will, because of the universal angular movement provided for, permit any flexing due to crookedness of the well bore or tubing, or to the pumping action, to be taken up in the joints rather than by bending of the sucker rods, thus eliminating fatigue of the rods and the consequent breaking of the rods due to strain or crystallization of the metal of the sucker rods. Furthermore, the presence of the

joints will prevent contacting of the string of pump rod with the tubing C in the event that the well bore or tubing D is crooked, or in the event that the string of sucker rod has a tendency for lateral movement in the tubing. The joints dependably and effectively connect the sections of the pump rod, as they are capable of transmitting both rotational and longitudinal strains between the connected parts during reciprocation of the string.

While we have illustrated only two typical forms and applications of the joint provided by the invention, it will be apparent that the joint is adapted to be employed in connecting various tools with an operating string, and may be interposed in a fishing string, operating string, or string of pump rod at any suitable points. Further, the invention may be modified or designed for use in any specific situation or for use in connection with various equipment.

Having described only typical preferred forms of our invention, we do not wish to be restricted to the specific forms or applications herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims.

Having described our invention, we claim:

1. A joint for connecting parts of a drilling or pumping string including, two body sections adapted to be connected to parts of the string, a spherically curved enlargement on one section cooperating with a spherically concaved seat in the other section whereby the sections may have relative angular movement, the sections having fluid passages whose ends register at the contacting surfaces of the enlargement and seat, a member threaded on said other section and cooperating with the enlargement to retain the enlargement in cooperation with the seat so that the surfaces of the enlargement and seat are maintained in continuous contact around the ends of the passages, there being diametrically opposite longitudinal grooves in the enlargement, blocks slidable in the grooves, pins on the said member pivotable in openings in the blocks to transmit rotational strains between the sections, and means for sealing between the enlargement and the said member.
2. A joint for use in a tubular well drilling or pumping string including, two sections, means on the sections for connecting them with parts of the string, one section having a spherically concaved seat, a spherically curved head on the other section for cooperating with the seat, whereby the sections may have relative angular movement, the members having registering fluid passages, a member detachably connected with the first mentioned section and cooperating with the head to hold it in working cooperation with the seat, there being recesses in the head, pins on the member, parts on the pins operating in the recesses, and packing on the member sealing with the head.

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