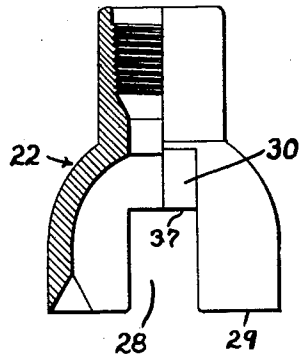
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STEEL CIRCULATING HOSE FOR ROTARY WELL DRILLING SYSTEMS

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FIG. 6.



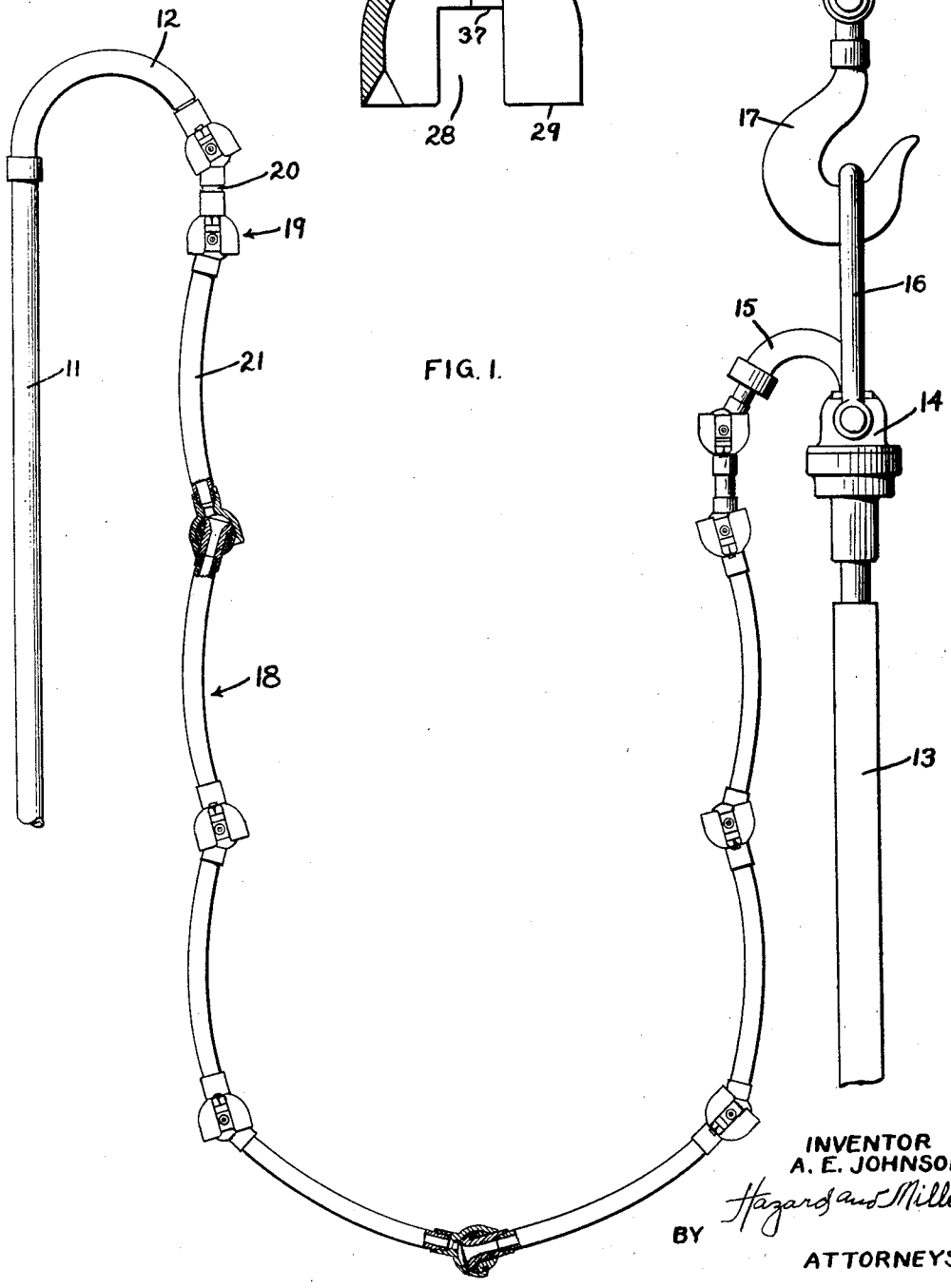


FIG. 1.

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FIG. 2.

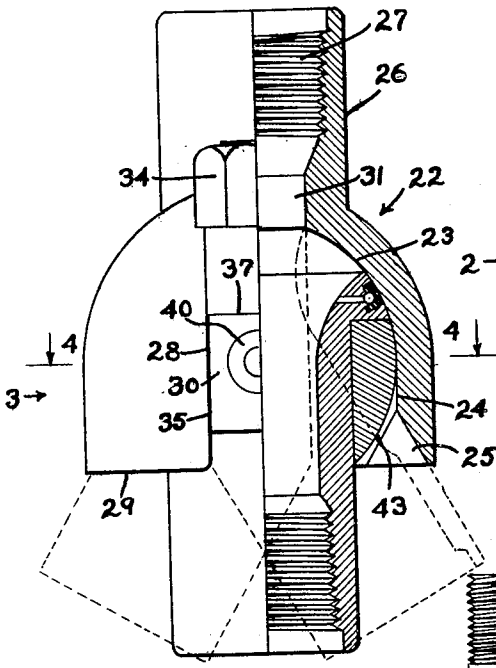


FIG. 3.

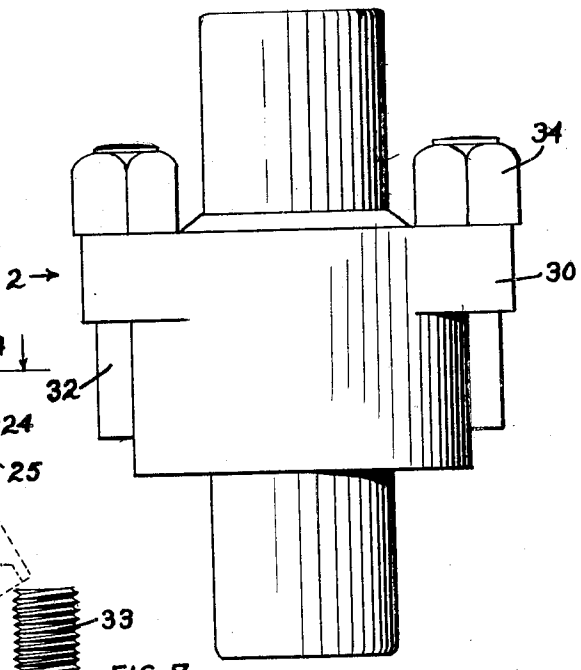


FIG. 7.

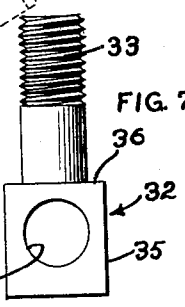


FIG. 8.

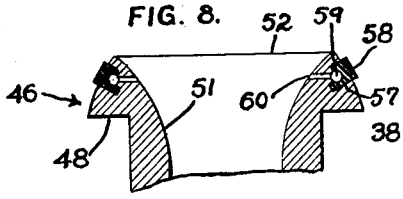


FIG. 5.

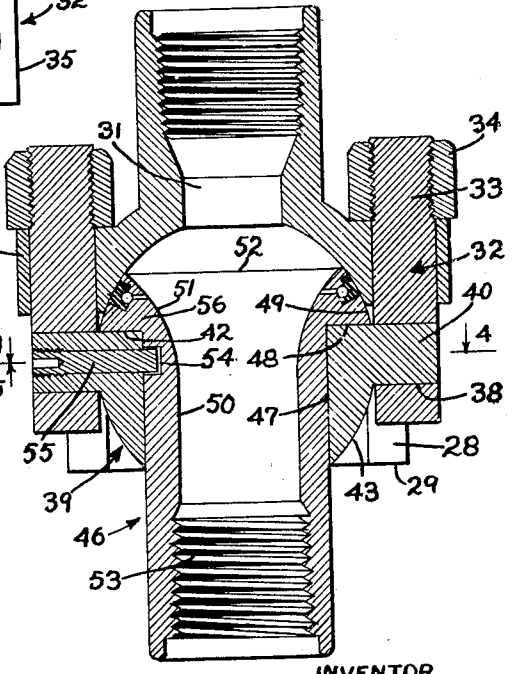
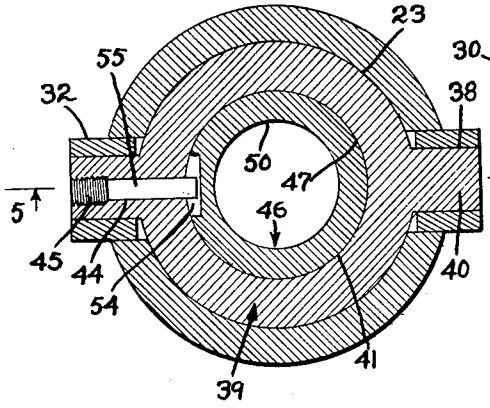


FIG. 4.



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FIG. 9.

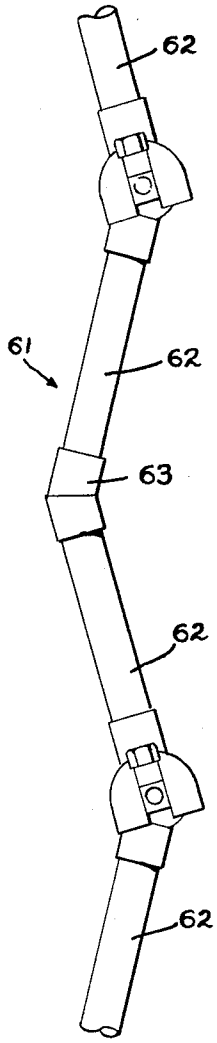


FIG. 10.

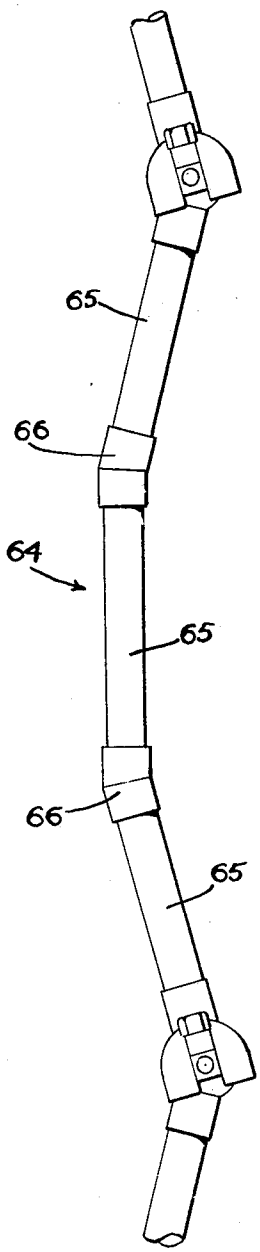
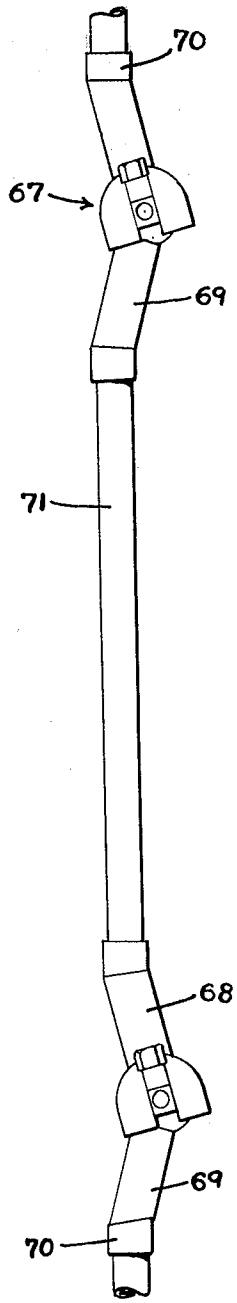


FIG. 11.



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UNITED STATES PATENT OFFICE

1,963,368

STEEL CIRCULATING HOSE FOR ROTARY WELL DRILLING SYSTEMS

Arthur E. Johnson, Huntington Park, Calif.

Application December 18, 1929, Serial No. 415,069

15 Claims. (Cl. 285—93)

My invention pertains to a steel circulating hose for rotary well drilling systems.

In rotary well drilling systems it has been found that the rubber hose used to convey the circulating fluid from the standpipe to the rotary swivel, is unsatisfactory on account of the high hydraulic pressures which it is now customary to use. Therefore I have designed a swivelly jointed steel circulating hose which is to be connected from the standpipe to the swivel. A feature of my invention is in the construction and the manner of operation of this flexible steel hose.

One of the objects of my invention in the swiveling joint of the hose is to provide a swivel which may oscillate in a single plane transversely to the axis of the swivel joint and such swiveling action being such that the resistance to the flow of the hydraulic fluid is materially reduced when the swivel is at an extreme angle to the direction of flow of the fluid.

Another detailed object of my invention in connection with the swivel is the use of an expansible packing such as a rubber ring forming a sealing joint between the female or socket member of the joint and the pin member; such expansible packing being expanded by the hydraulic fluid and forming a liquid-tight seal. In this connection a feature of my invention is the construction of the swiveling joint in the form of a ball and socket joint, but swiveling only in one plane of movement instead of having universal swiveling action.

Another object of my invention is the use of angularly connected or curved pipes between the swivel couplings, these pipes being such that there can be no abrupt bend in the steel hose connecting the standpipe and the swivel and thus giving a comparatively free flow for the hydraulic fluid at the swivel joints and in the pipe. Another feature of having the curved connecting pipes with the swivel connection is that at the lower part of the loop of the flexible steel hose, such lower sections may have a curved formation and thus give a path of comparable low resistance for the flow of the hydraulic fluid. Another detailed feature in connection with the angularly connected or curved joint pipes connecting the swivels and the swivel operating in one plane is that the pipes and the adjoining swivels are always maintained in the proper angular relation one to the other and to the string of hose as a whole.

Another detailed object and feature of my invention is the mounting of the pin or male member of the swivel joint on swivel trunnions to allow a slight rotary motion on the axis of such member, this being done by a pin fitting in a slot and such pin retaining the member in its axial member.

My invention is illustrated in the accompanying drawings, in which,

Fig. 1 is a side elevation showing my steel hose connection between the standpipe and the swivel, with one of the couplings broken open;

Fig. 2 is a partial side elevation and vertical section taken in the direction of the arrow 2 of Fig. 3, of a coupling;

Fig. 3 is a side elevation taken in the direction of the arrow 3 of Fig. 2;

Fig. 4 is a transverse section on the line 4—4 of Figs. 2 or 5, taken in the direction of the arrows;

Fig. 5 is a vertical section on the line 5—5 of Fig. 4 in the direction of the arrows;

Fig. 6 is a partial side elevation and vertical section of the female or socket member of the coupling;

Fig. 7 is a view of the trunnion bolt;

Fig. 8 is a detail section showing the expansion;

Figs. 9, 10 and 11 show modifications of the connection between the couplings.

Referring first to Fig. 1, this illustrates a standpipe 11 which usually extends upwardly on one side of a derrick or at one corner and has a gooseneck 12 at the top. The squared pipe or kelly indicated at 13 is used for connecting to a drill pipe and to give rotary motion thereto. The rotary swivel 14 has a gooseneck 15 connected thereto, the swivel and pipe being held suspended by the bail 16. This swivel is engaged by a hook 17 carried by the traveling block of the well drilling equipment. My hose connection is indicated generally by the numeral 18, having flexible couplings or joints designated generally by the numeral 19. Between certain of these joints there is a straight section of pipe 20 and between other joints there is a curved or angular section of pipe 21.

Referring first in detail to the swivel coupling or joints, this comprises a female or socket member 22 which has a spherical-shaped socket 23, the lower part of this socket being cylindrical as indicated at 24 and on opposite sides has a flared or cut-away portion 25. A nipple section 26 is connected to the socket and has internal screw threads 27 for attaching to the goosenecks or to the connecting pipes. The socket portion has longitudinal slots indicated at 28, on one side, extending upwardly from the lower edge 29 and has a projection 30 on each side to accommodate trun-

nion bolts. This female or socket member has a reduced throat 31 connecting the threaded section and the spherical-shaped socket portion of the member.

Trunnion bolts 32 extend through openings in the lateral extensions 30 of the socket member and have screw threaded ends 33 with clamping nuts 34 thereon. The lower portion of the bolts have flat sides 35 which fit the sides of the slot 28 and have a squared top 36 engaging the underside 37 of the top of the slots 28. These bolts have cylindrical journal openings 38 therethrough for accommodation of the bearing on the trunnion member. This trunnion member designated generally by the numeral 39 has stub axles 40 at each side which fit in the trunnion openings 38 in the bolts 32. The trunnion member has a large cylindrical opening 41 and a flat top 42. The lower portion 43 has a spherical curvature. One of the stub axles has a bore 44 extending axially therethrough, this bore being threaded at one end 45 to accommodate a coupling swivel stop pin hereinunder detailed.

The male or pin member of the swivel joint designated generally by the numeral 46, has an outer cylindrical portion 47 fitting in the cylindrical opening 41 of the trunnion member and has a flat annular shoulder surface 48 which fits on the flat portion 42 of the trunnion member. The upper outside surface 49 is spherical to bear against the spherical portion 23 of the socket member. There is an internal cylindrical bore 50 through the male or pin member, this being flared at 51, the flared portion joining the spherical curved portion 49 at the edge 52. There is a screw threaded section 53 at the opposite end for connecting to pipes or the like.

The male member 46 has a transverse groove 54 in which engages a swiveling stop pin 55. This pin fits in the bore 44 in one of the trunnions 40 and is screw threaded into the threads 45; thus the pin is held in position. The pin allows a slight rotational movement of the male or pin member 46 on its axis. The head portion 56 of the pin member is provided with an annular groove 57 in which is fitted an expansible rubber ring 58. This ring has a groove 59 therein and a series of apertures 60 lead through the head portion 56 to the said groove, so that the hydraulic slushing fluid may enter the groove and expand the rubber packing, thus making a leak-proof seal between the internal spherical socket member and the exterior spherical surface of the pin member. The upper and lower edges of the packing are also expanded against the groove and the packing is pressed outwardly slightly beyond the spherical surface 49 of the head portion 56, thus bringing a metal to rubber contact and effectively preventing leaking of the slushing fluid, although such fluid is being pumped at high pressure.

The swivel joint can only swing or pivot on the trunnion pins 32 swinging on the stub axles 40. The motion therefore of the two sections of the joint can only be in one plane and the tilting is limited by the inclined or outwardly displayed surface 25 of the socket member. The two members may swivel in regard to each other as indicated by the dotted lines in Fig. 2 and in which swiveling action it will be noted that the edge 52 of the pin member can not overlap the throat section 31 of the socket or female member.

In Fig. 1 I illustrate a female or socket member connected to the gooseneck from the standpipe 11 and a male or pin member connected to the gooseneck 15 on the swivel 14, but it is obvious that the parts may be reversed. I find it preferable to use short sections of pipe indicated at 20 connected adjacent the goosenecks and to have rather long sections with a curvature therein, such sections being indicated at 21 between the other coupling elements. These curved sections of pipe at the bottom of the loop occupy a curved position shown in Fig. 1 and thus do not give a sharp angle to the flow of the hydraulic fluid at the loop. It will be noted that the vertically suspended sections of pipe or links of the flexible hose, allow a flow of the slushing fluid without such fluid having to turn a sharp angle, the fluid discharging through the throats 31 into the flared portion 51 of the male or pin member of the coupling.

In Fig. 8 I illustrate in detail the manner in which the rubber packing ring 58 fits in the groove in the tubular pin or male member of the coupling. It will be noted that the rubber extends beyond the spherical bearing surface so that when in contact with the spherical shaped socket member of the coupling and the parts of the coupling are squeezed together by the tightening of the nuts 34, that a water-tight seal is effected and this is independent of the hydraulic pressure in the hose. Therefore when the pumps are stopped there is no danger of leakage of the liquid and manifestly when the pumps are operating and a considerable hydraulic pressure is developed, the rubber ring is expanded due to the pressure of the hydraulic fluid on the back, and forms an effective tight seal no matter how great the hydraulic pressure.

In Figs. 9, 10 and 11 I illustrate a modified construction of the connections between the various couplings. In the construction of Fig. 9 the connecting pipe 61 between two adjacent couplings is formed of two straight pipe sections 62 with an elbow 63, which elbow may be substantially a 30 degree elbow. This may be used with the same type of coupling as shown in the former illustrations. In Fig. 10 the tubular connection 64 between the couplings is provided by three straight sections of pipe 65, joined by elbows 66 which in this case may be 15 degree elbows as two are utilized. This also uses the same type of coupling as in the former illustrations.

In the construction of Fig. 11 the couplings 67 are formed with an elongated nipple portion 68 and 69 on the female or socket member and the pin or male member of the coupling respectively. Each of these nipple ends is illustrated as having a bend 70 which is internally screw threaded to accommodate the connecting pipe. In this case the connecting pipe 71 is illustrated as straight. This type of coupling having the elongated nipples with the straight pipe, also gives an offset functioning somewhat the same as the curved pipes of the former illustrations.

It will be noted that a characteristic feature of my invention is that the sections of the hose which are suspended vertically have the couplings partly rotated to one side, that is with the contacting bearing surfaces non-symmetrical and the flow of hydraulic fluid in passing through a coupling may make a change of direction upwardly, substantially 30 degree, without materially affecting the flow of the fluid. It is to be understood that in hydraulic drilling operations, it is necessary to have the fluid pumped at a high velocity and under considerable pressure and therefore any sharp turns retard this high velocity of flow.

My invention of having the bend or curved

connections between the axis of rotation of the couplings or the bearing surfaces thereof, is that at the bottom of the loop of the hose the couplings are turned so that with the curved or bent sections of the tubular connections between the couplings, an easy flow of the hydraulic fluid may be obtained without any sharp turns. This forms substantially a continuous easy curve from the section of the hose depending from the standpipe and that depending from the swivel.

A characteristic feature of my invention is that the tubular connections between the couplings may be considered as having a bend or a curve or offset from a direct axial line. With this feature the couplings are constructed to swivel in a single plane and the plane of swivel of the couplings is in the same plane as the bend, curve or offset of the tubular connections. It is to be understood that my invention broadly contemplates these connections between the couplings which are adapted to force the couplings to occupy a position to give an easy curve without sharp angles for the flow of the hydraulic fluid.

It will be noted that the three couplings shown at the bottom of the curve in Fig. 1, are shifted to the diametrically opposite position of the coupling suspended in the vertical portion of the pipes and that when the curvature of the hose as a whole changes, due to the moving of the swivel up and down, that in certain positions there will be a direct axial flow of the hydraulic fluid through the couplings. This gives the position of least hydraulic resistance.

In the claims, the description of the tubular connection between the couplings as being bent, is understood to cover the curved pipe, the offset connections made by using straight pipes with elbows or straight pipes having angular bends, or cases in which the couplings themselves have tubular extensions connected to straight or curved pipes.

It will thus be seen that a feature of my invention is that the swivel couplings involving the male or socket member 22 and pin or female member 46 can only oscillate or swivel in one plane but, also, this swiveling action maintains a water tight joint. The curved or bent pipes connecting the adjacent members of the swivel coupling have bends or curves and such bends or curves are in the same plane in which the joints oscillate or swivel and, moreover, the centers of curvature or the centers of the bends are in such a position that when the pipe as a whole forms a loop there is a more or less continuous and even curvature, thereby allowing flow of the slushing fluid without a radical change of direction of such fluid which sets up great resistances to the flow. Therefore, with my type of steel circulating hose the pressure developed by the pump in the hydraulic fluid is delivered without great loss to the drill pipe.

Another characteristic feature of my invention is that the internal flare on the pin member of the coupling always receives the fluid from the throat of the socket member and this flare is of such a curvature that it does not materially reduce the velocity of flow of the pressure of the hydraulic fluid also that where the hose is hanging substantially vertically the fluid follows a slight reverse path at each joint and through the bent or curved connecting pipes, but at the bottom of the loop formed by the sections connected by the standpipe and the rotary swivel the hydraulic fluid has a flow in substantially an even curved path and thus facilitates the flow of such fluid.

Another important feature of my invention is that the female or pin member 46 of the swivel joint may have a slight rotary movement at right angles to the swiveling motion, this being limited by the stop pin 55 operating in the transverse groove 54. This allows the rotary swivel with the kelly to be shifted to one side of the derrick, the slight rotation of each joint accommodating this lateral or twisting movement, and in such movement the hydraulic seal is maintained.

Various changes may be made in the principles of my invention without departing from the spirit thereof as set forth in the description, drawings and claims.

I claim:

1. In a hose, a coupling having a socket member with a spherical bearing surface and lateral slots on opposite sides, a pair of journal elements fitted in the said slots, a tubular pin member having a spherical outer bearing surface to engage that of the socket member, a ring-like trunnion surrounding the said pin and having axles fitting in the said journal element, the said axles limiting the oscillating movement of the said members to a single plane, the socket member having a neck for the flow of the hydraulic fluid, the pin member having a flared end adjacent said neck, the said flare receiving the full discharge through the neck no matter at what angle the said members may be swivelled relative to each other.

2. In a hose a coupling having a socket member and a pin member having a spherical bearing connection with means to form a hydraulically tight joint, bearing members secured to the socket member, a trunnion member connected to the pin member by a cylindrical bearing and having cylindrical axles operating in the bearing members, the said bearing members and axles confining the oscillating or swiveling action of the socket and pin members to a single plane, said socket members having slots through which the axles pass.

3. In a hose as claimed in claim 2, means interconnecting the trunnion member and the pin member having a lost motion to limit to a slight rotation of the pin member on its longitudinal axis relative to the socket member.

4. In a hose a coupling having a tubular socket member having a spherical internal surface and a tubular pin member having an external spherical surface, said surfaces bearing together, with means to form a hydraulically tight joint, a bearing structure connected to the socket member, a trunnion member having a ring encircling the pin member and having a cylindrical and a shoulder bearing therewith and forming a support therefor with axles extending from the trunnion to and mounted in the bearing structure, the bearing structure and the axles confining the swiveling or oscillation of the socket and pin members to a single plane, said socket members having slots through which the axles pass.

5. In a hose as claimed in claim 4, the pin member having a short transverse groove with abutment ends and a stop pin extending through an axle into the said slot whereby the pin member may have a partial rotation on its longitudinal axis in reference to the socket member.

6. In a hose a coupling having a socket member with an internal spherical bearing surface and lateral slots on opposite sides and parallel to the axis of the socket member, a pair of journal elements fitted in said slots, a tubular pin member having a spherical outer surface, said sur-

faces bearing together and having means to form a hydraulically tight joint, a ring like trunnion surrounding and supporting the said pin by a cylindrical and annular shoulder bearing and having cylindrical axles mounted in the journal elements, said axles limiting the oscillating or swiveling action of the socket and trunnion member to a single plane, the pin member having a short transverse groove with abutment ends, and a stop pin extending through one of the axles into said slot for partial rotation of the pin member on its longitudinal axis.

7. In a hose coupling, a socket member and a pin member having a spherical bearing connection with means to form a hydraulically tight joint, a trunnion member having an adjustable connection to the socket member and a journal to swivel the trunnion member in a single constant plane, the pin member being supported and mounted in the trunnion member with cylindrical bearing surfaces and a shoulder to shoulder connection whereby the swiveling of the pin is confined to the same single and constant plane, and means interconnecting the trunnion member and the pin member to limit a partial rotation of the pin member on its axis.

8. In a hose, a coupling having a socket member and a pin member having a spherical bearing connection with means to form a hydraulically tight joint, a trunnion ring surrounding the pin member forming a support therefor with means to limit partial rotation of the pin member on its axis in the trunnion, bolts positively and adjustably connecting the trunnion to the socket member, the trunnion having a swiveling mounting in said bolts to confine the swiveling of the trunnion and of the pin to a single and constant plane in reference to the socket member, said trunnion ring and pin member having a bearing confined within a sphere with the same center and radius as the spherical bearing.

9. In a hose, a coupling having a socket member with an internal spherical bearing surface and lateral slots on opposite sides, a pair of journal elements fitted in said slots and adjustably mounted as regards the socket member, a trunnion ring having axles journaled in the pair of journal elements, a pin member mounted for rotation on its axis in the trunnion ring, said pin member having a spherical outer bearing surface to engage the spherical surface of the socket, the journal mounting of the trunnion ring confining the swiveling of such ring and of the pin to a single and constant plane in reference to the socket member.

10. In a hose coupling having a socket member with an internal spherical bearing surface and lateral slots on opposite sides, a pair of journal bolts fitted in said slots and adjustably mounted therein, a trunnion ring having cylindrical axles journaled in said bolts, a pin member mounted in the trunnion ring, said ring and pin having cylindrical surfaces and right angular shoulders in engagement, the pin having a spherical outer surface to engage that of the socket member, the swiveling of the trunnion ring and pin being confined to a single and constant plane in reference to the socket member.

11. In a hose coupling, a socket member and a pin member having a spherical bearing connection, with means to form a hydraulically tight joint, the pin member having a portion with a cylindrical outside surface extending above and below the transverse diameter of the pin member through the center of the spherical bearing and a flat annular shoulder above said spherical diameter adjacent thereto, a trunnion member having a cylindrical inner surface and a flat annular shoulder to engage respectively the cylindrical portion of the pin and the shoulder of the pin, means for journaling the trunnion member to the socket member whereby the pin may oscillate in a single and constant plane.

12. In a hose coupling as claimed in claim 11, the pin and trunnion member having a complementary groove with a stop pin extending therein to limit the pin to rotate on its longitudinal axis through a limited arc.

13. In a hose coupling as claimed in claim 11, the bearing connection of the trunnion and the socket having adjustable elements to limit to positively adjusting the trunnion and pin in the direction of their longitudinal axes relative to the socket member to align said journaling means with the center of the spherical bearing.

14. In a hose, a coupling having a socket member with a spherical bearing surface and a pair of diametrically opposite longitudinal slots, a pin member having a spherical external bearing and a cylindrical bearing with a bearing shoulder transverse to the axis of said pin, trunnion bolts secured to the spherical member, axles journaled in said trunnion bolts and extending through said slots, the axles having a trunnion member formed integral therewith, said trunnion member having a cylindrical bearing and a shoulder bearing engaging the cylindrical and shoulder bearing of the pin member, said shoulder bearing being located between the center of the sphere of the spherical bearing surface of the socket member.

15. In a hose, a coupling member having a socket member with a throat and a spherical bearing surface, a plurality of slots diametrically opposite, a pair of bolts adjustably mounted on the socket member and having trunnion bearings, a trunnion member having an axle integral therewith, the ends of the axle being mounted in the bearings of said trunnion bolts, the axle forming a diameter of the sphere, a pin member having a throat and an external spherical surface bearing with the spherical surface of the socket and having a cylindrical bearing and a shoulder bearing, the cylindrical bearing engaging a similar bearing in the trunnion member and the shoulder bearing engaging a similar shoulder bearing in the trunnion member, said shoulder bearing being located in a plane above the center of the axles, and the cylindrical bearing extending on opposite sides of the center of the axles.

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