

Aug. 29, 1961

J. A. MISCOVICH
HYDRAULIC MONITOR

2,998,199

Filed Nov. 12, 1958

4 Sheets-Sheet 1

FIG. 1

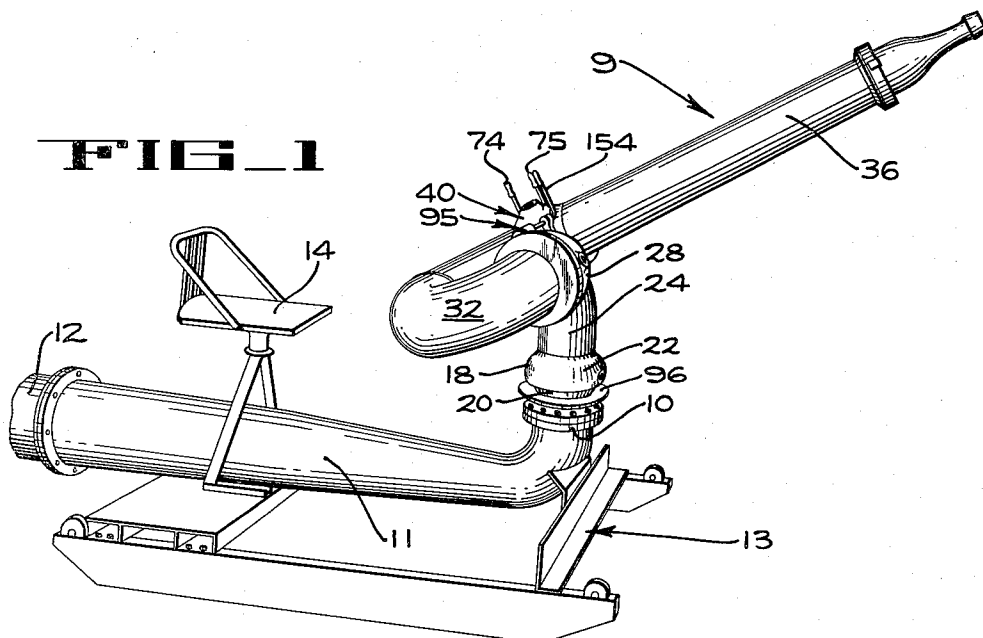
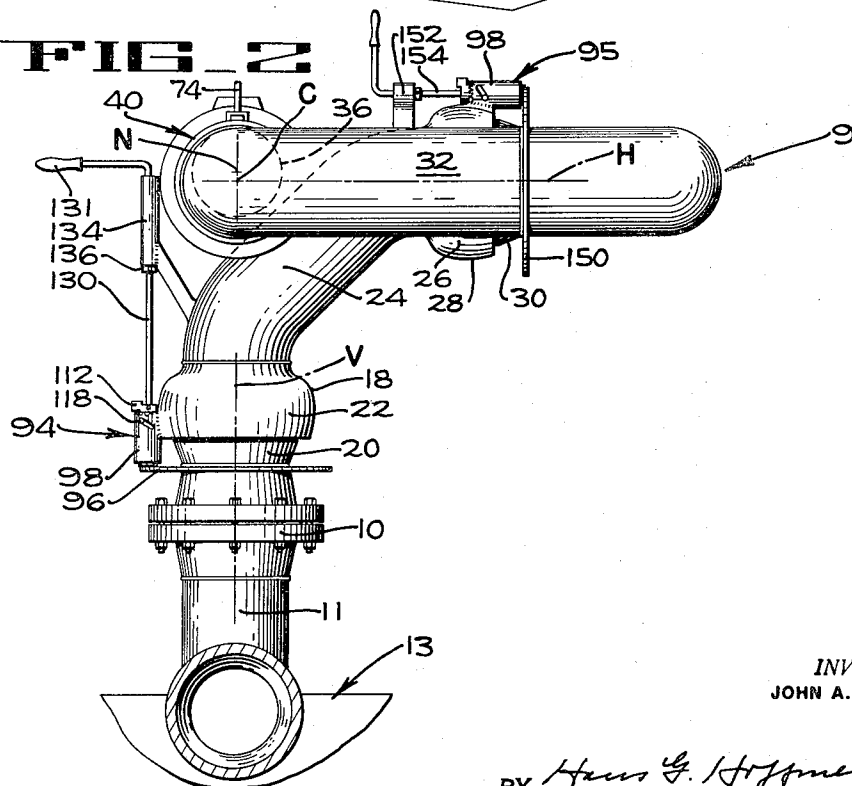


FIG. 2



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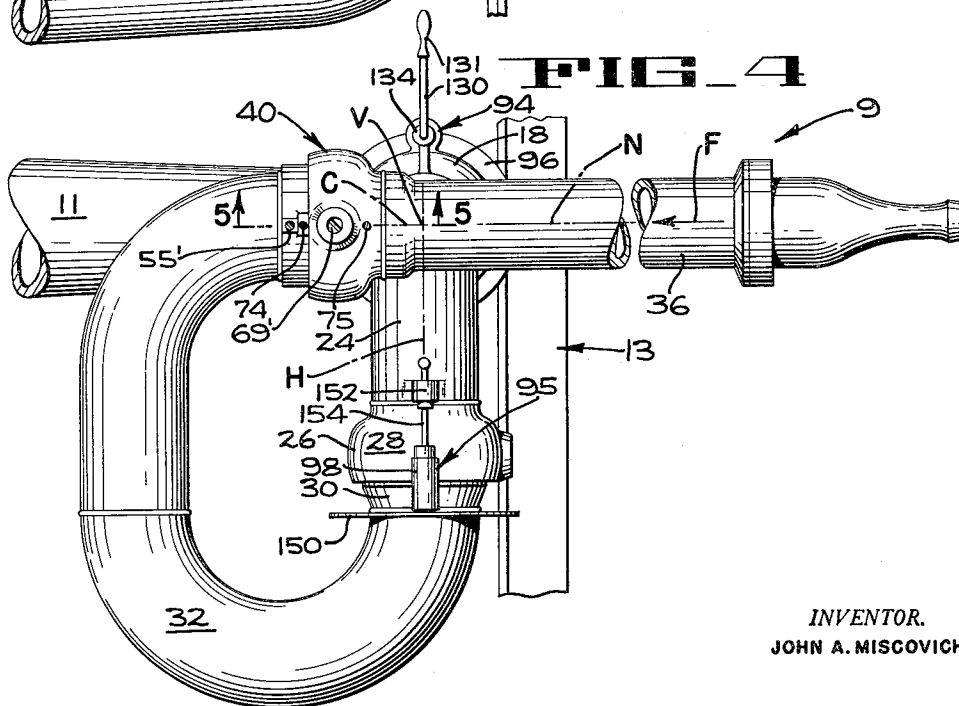
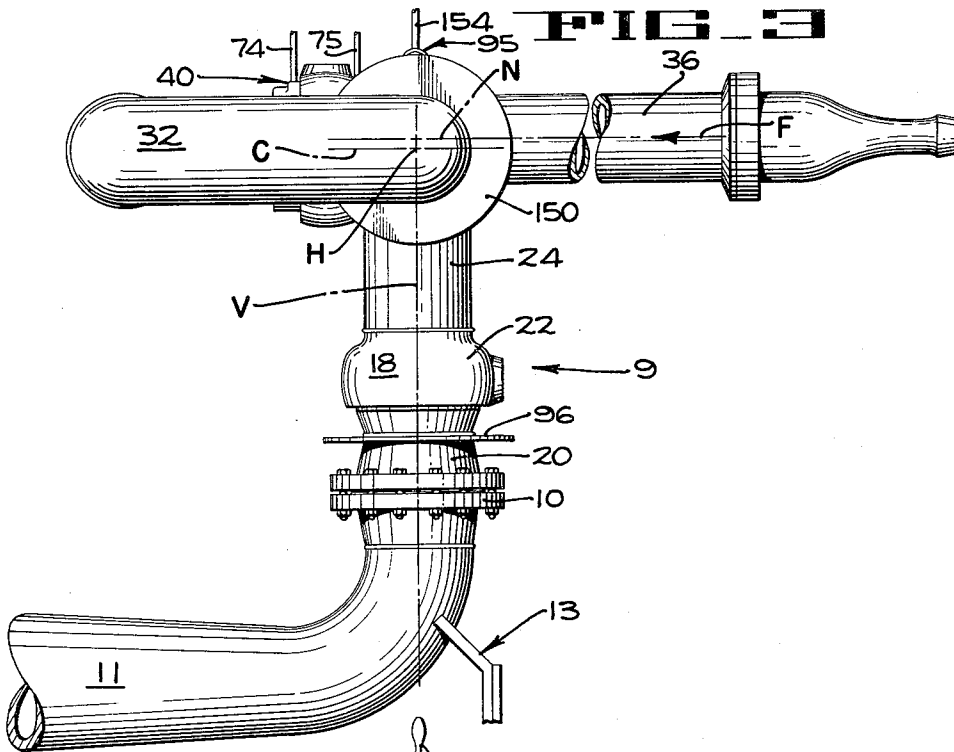
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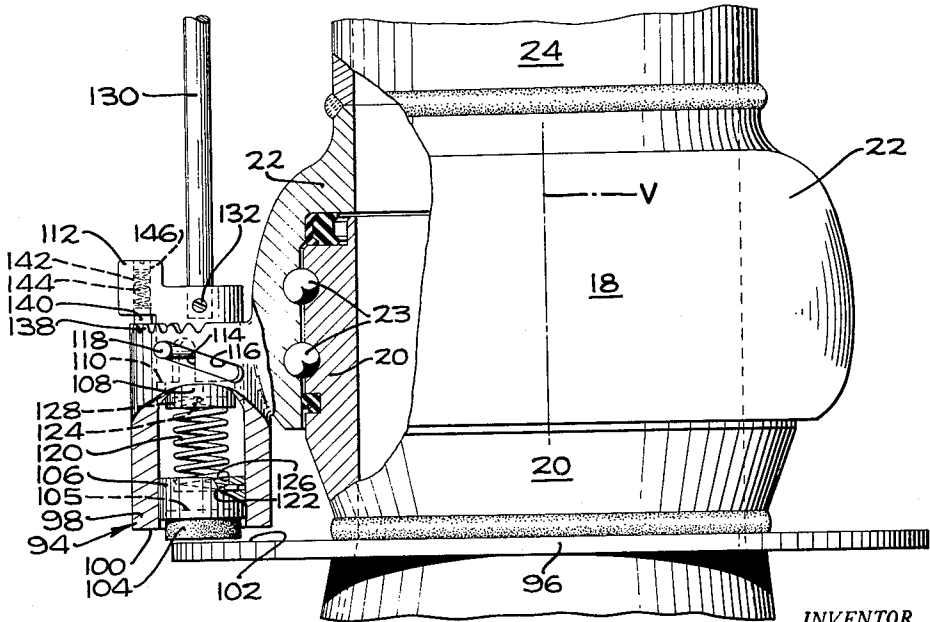
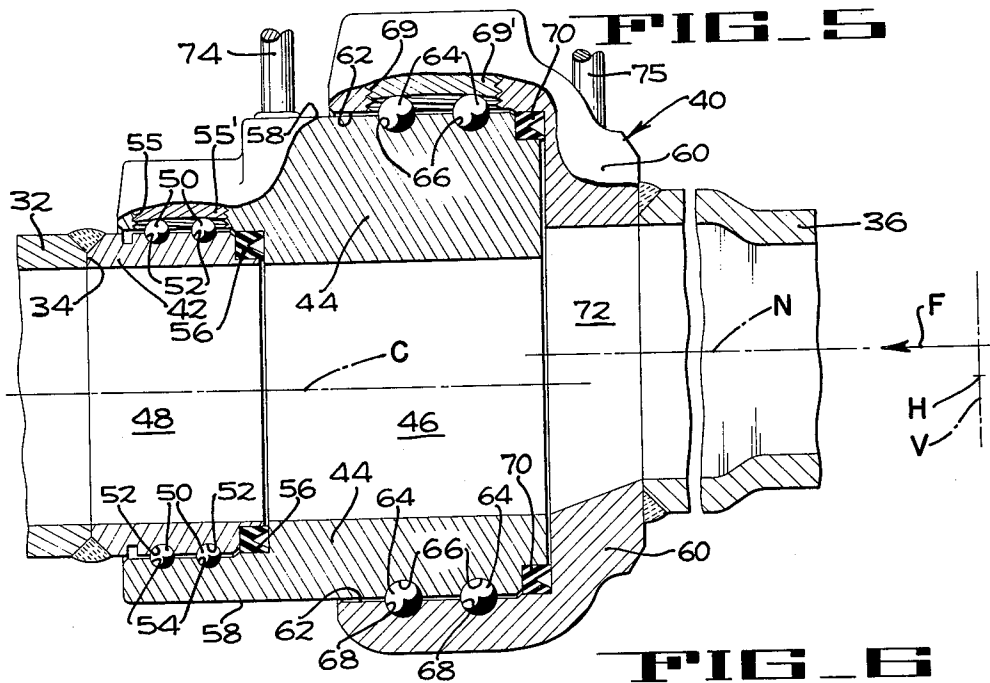
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4 Sheets-Sheet 4

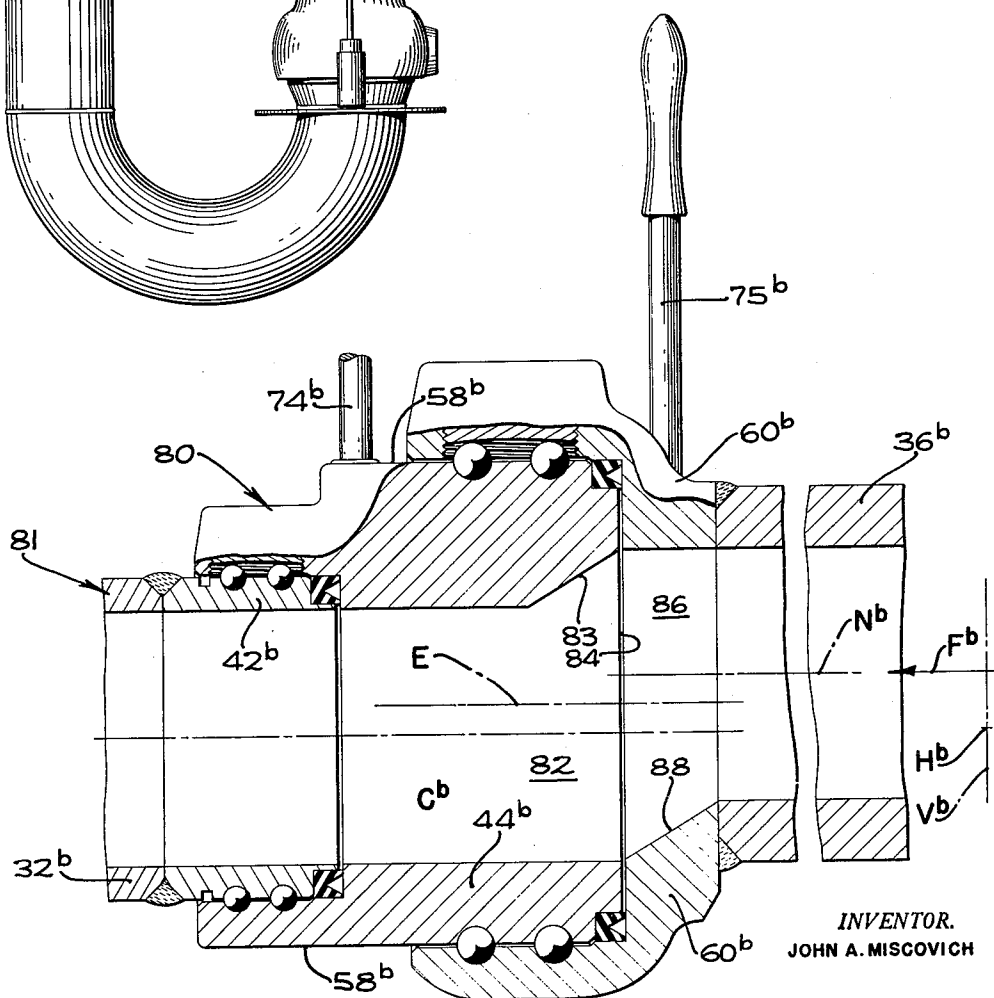
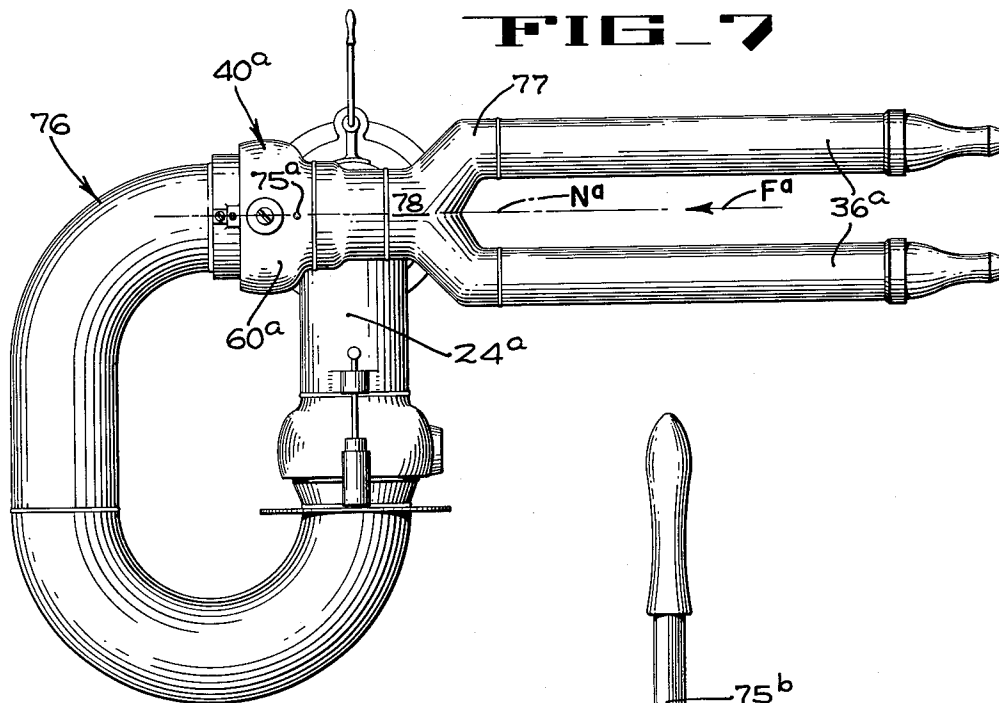


FIG 8

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2,998,199

HYDRAULIC MONITOR

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Filed Nov. 12, 1958, Ser. No. 773,364

9 Claims. (Cl. 239-587)

The present invention appertains to hydraulic monitors of the type used in placer mining and fire fighting and more particularly relates to hydraulic monitors arranged to utilize the reaction force of liquid discharged therefrom to change the direction of discharge of said liquid about two angularly related axes.

One object of the present invention is to provide an improved hydraulic monitor.

Another object is to provide an improved hydraulic monitor arranged to utilize the reaction force of liquid being discharged therefrom for changing the direction of discharge of the jet by pivoting the nozzle about both a vertical and a horizontal axis.

Another object is to provide an improved hydraulic monitor arranged to utilize the reaction force of liquid discharged therefrom to swing the nozzle simultaneously about two angularly related axes or independently about either axis.

Another object is to provide an improved hydraulic monitor arranged to utilize the nozzle reaction force to swing the nozzle and also arranged to shift the line along which the nozzle reaction force acts so that it intersects the pivot axes of the nozzle at their point of intersection, and thus to prevent the nozzle reaction from exerting any turning moment upon the nozzle.

Another object is to provide an eccentric swivel joint adaptable for use either in a hydraulic monitor for achieving the herein stated objects or as an eccentric swivel joint to rotatably interconnect pipe sections having axes which are offset from but are in parallel relation to each other.

These and other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings, in which:

FIG. 1 is a perspective of the hydraulic monitor of the present invention.

FIG. 2 is a partly broken away enlarged rear elevation of the monitor of FIG. 1 with the discharge nozzle directly horizontally.

FIG. 3 is a side elevation of the apparatus of FIG. 2.

FIG. 4 is a plan of the apparatus of FIGS. 2 and 3.

FIG. 5 is an enlarged axial section taken along lines 5-5 of FIG. 4, showing the eccentric swivel joint that forms a part of the monitor of FIGS. 1-4.

FIG. 6 is an enlarged elevation of a portion of the apparatus shown in FIG. 2, certain parts being broken away.

FIG. 7 is a plan of a modified form of the monitor of the present invention.

FIG. 8 is an enlarged axial section of a modified form of the eccentric swivel joint used with the monitor of the present invention.

The hydraulic monitor 9 (FIG. 1) of the present invention is an improvement over that disclosed in the United States patent to Miscovich, No. 2,612,402, dated September 30, 1952. The improved monitor 9 is mounted on an upstanding, horizontally disposed, flanged end 10 of a penstock 11 connected to a pipe line 12 which supplies water under pressure to the monitor 9. The penstock 11 is welded to a skid type frame 13, and a swivel chair 14 is mounted on the frame 13 in a position adjacent the controls of the monitor.

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The monitor 9 comprises a vertical swivel joint 18 (FIGS. 1-4 and 6) of conventional design, having a lower, flanged, male section 20 bolted to the flanged end 10 of the penstock 11, and an upper, female section 22 rotatably mounted on the lower section 20 by ball bearings 23 (FIG. 6) for free rotation about a vertical axis V. A 90° elbow 24 is welded to the upper section 22 of the swivel joint 18 and to the female section 26 of a horizontal swivel joint 28. The male section 30 of the horizontal swivel joint 28 is free to rotate relatively to the female section 26 about a horizontal axis H which intersects the vertical axis V. A 270° elbow 32 is welded at one end to the rotatable section 30 and terminates in a circular discharge end 34 the central axis C of which intersects the axes V and H at their point of intersection. The 90° elbow 24 can be rotated 360° about the vertical axis V, whereas the 270° elbow 32 can be rotated somewhat more than 90° about the horizontal axis H.

The above described parts of the monitor 12 are substantially identical to and operate in the same way as corresponding parts of the hydraulic monitor disclosed in the herein referred to Miscovich patent. The present improvement resides in the structure which is used to connect a liquid discharge nozzle 36 to the end 34 of the 270° elbow 32 and the combination thereof with the mounting of the nozzle 36 which imparts thereto freedom of movement about one or more axes. This connecting structure is an eccentric, three section swivel pipe joint 40 (FIGS. 3, 4 and 5) which is arranged to move the axis N of the nozzle 36, along which the reaction force F of the jet discharged from the nozzle 36 acts, in selected positions parallel to but offset from the central axis C of the discharge end 34 of the 270° elbow 32. When the nozzle axis N is offset from either the vertical axis V or the horizontal axis H, the nozzle reaction F applies a torque to the rotatable parts of the monitor. This torque is applied about the axis from which the axis N is offset, urging the discharge end of the nozzle 36 to swing in the direction of such offsetting. For example, when the nozzle axis N is offset above the horizontal axis H as indicated in FIG. 3, the torque acts about the axis H, urging the discharge end of the nozzle 36 upwardly, and when the axis N is offset to one side of the vertical axis, the torque generated by the nozzle reaction F urges the discharge end of the nozzle to swing toward that same side. It is to be understood that when the monitor is in normal use, the nozzle reaction F is of considerable magnitude, and, therefore, ample to cause movement of the nozzle and the parts of the apparatus that are free to rotate therewith, to turn in the manner indicated, and thus to alter the direction of the jet issuing from the nozzle.

The eccentric swivel joint 40 (FIG. 5) comprises a tubular inner swivel joint section in the form of a sleeve 42 which is rigidly connected at one end to the discharge end 34 of the 270° elbow 32 and is concentric therewith. A tubular eccentric 44 or intermediate joint section, having a bore 46 concentric with and of the same diameter as the bore 48 of the sleeve 42, is mounted for rotation on the sleeve 42 by means of ball bearings 50. The ball bearings 50 are arranged in two rows in mating annular grooves 52 and 54 in the outer surface of the sleeve 42 and in the inner surface of the eccentric 44, respectively. An access opening 55 in one side of the eccentric 44 provides means for inserting the ball bearings 50 into, and for removing them from, the grooves 52 and 54; and a ball retainer plug 55' screwed into the opening 55 prevents accidental escape of the ball bearings. An annular seal 56 is fitted between the sleeve 42 and the eccentric 44 to provide a fluid tight seal therebetween. Whereas the axis of the bore 46 of

the eccentric 44 coincides with the axis C of the outer end of the 270° elbow, an outer cylindrical surface 58 of the eccentric 44 is eccentrically disposed relatively to the axis C but is concentric with the axis N of the nozzle 36. The nozzle 36 is welded to a tubular bell housing 60 in a position which is concentric relative to a counterbore 62 of the housing 60. The counterbore 62 is fitted over the cylindrical surface 58 of the eccentric 44 and is mounted for rotation thereon by means of ball bearings 64 which ride in annular grooves 66 and 68 in the surface 58 and in the counterbore 62, respectively. An access opening 69, provided with a ball retainer plug 69' is provided for the purpose of inserting the ball bearings 64 into, and of removing them from, the grooves 66 and 68. An annular seal 70 is disposed between the eccentric 44 and the bell housing 60 to prevent leakage of fluid therebetween. The bore 72 in the housing 60 is large enough to prevent objectionable restriction of fluid passing therethrough for all positions of the eccentric 44 relative to the housing 60.

It will be understood, therefore, that the sleeve 42, the tubular eccentric 44, and the bell housing 60 cooperate with each other to define the three part swivel pipe joint 40. The sleeve 42 constitutes the inner, or fluid-receiving section of this swivel joint, the bell housing constitutes the outer, or fluid-discharging section, and the tubular eccentric 44 constitutes an intermediate joint section. A handle 74 is secured to the intermediate section 44 for the purpose of rotating the same relatively to the sleeve 42. A similar handle 75 is secured to the housing 60 for the purpose of preventing movement of the same relative to the intermediate section 44 when the latter is rotated about the inner section 42.

The eccentricity of the swivel joint 40 causes the nozzle 36 to be positioned so that the nozzle axis N, and hence the reaction force F, are at all times offset from either the horizontal axis H or the vertical axis V, or are offset from both of these axes at the same time. When the handle 74 is directed vertically upward or vertically downward, the force F intersects the vertical axis V and is offset a maximum distance from the horizontal axis H. With the handle 74 positioned in this way, the force F will cause or tend to cause the nozzle 36 of the monitor 9 to pivot upward or downward, respectively, about the horizontal axis H but not about the vertical axis V. Similarly, when the handle 74 is directed horizontally to the right or to the left (FIG. 2), the force F will cause, or tend to cause, pivotal movement of the nozzle 36 about the vertical axis V to the right or to the left, respectively, but not about the horizontal axis H. When the handle 74 is positioned between the horizontal and the vertical positions, the force F will be directed so as to pivot or tend to pivot the monitor 9 about both the horizontal axis H and the vertical axis V at the same time and toward the side to which the handle points.

It is to be understood that the single nozzle 36 of the monitor 9 disclosed in FIGS. 1, 2 and 3 can be rotated about its axis N without in any way affecting the operation of the same. In this particular installation, therefore, rotation is not required between the housing 60 (FIG. 5) and the eccentric intermediate joint section 44 and hence interconnection permitting relative rotation between these parts of the swivel joint 40 can be eliminated and the nozzle 36 can be secured directly on the joint section 44. However, with the modified form of the invention shown in FIG. 7, wherein a monitor 76 having a pair of nozzles 36a connected together and to the eccentric swivel joint 40a by a T 77 is disclosed, it is desired that these nozzles be maintained at all times in their side by side horizontal planar alignment as shown in FIG. 7. For use with this monitor 76, therefore, a swivel joint 40a which corresponds to the eccentric swivel joint 40 (FIG. 5) to the extent that it includes the rotatable connection between the eccentric interme-

mediate section 44 and the outer section 60, must be used. The handle 75a can be used to prevent rotation of the nozzles 36a (FIG. 7) about the axis Na between and parallel to both nozzles, which coincides with the central axis of the stem 78 of the T 77, or, rotation preventing means such as an arm (not shown) can be used to pivotally interconnect a 90° elbow 24a with either the outer joint section 60a of the swivel joint 40a or the T 77 to prevent rotation of the nozzles. Obviously, the resultant force Fa from the two nozzles 36a acts along said axis Na. Parts of the monitor 76 which correspond to certain ones of the monitor 9 (FIGS. 1, 2, 3 and 4) have been assigned the same numerals followed by the suffix "a."

Another modified form 80 of the eccentric swivel joint of the invention is shown in FIG. 8. This swivel joint 80 is intended to be used in a monitor 81 like the monitor 9 (FIG. 1) except that the joint 80 is used in place of the joint 40 (FIG. 5). The joint 80 likewise, is a three section joint, and is in many ways similar to the swivel joint 40. Therefore only the distinctive features of the swivel joint 80 will be described in detail. Those parts of the eccentric swivel joint 80 which are similar to parts of the eccentric swivel joint 40 will be assigned to the same numerals followed by the suffix "b."

An inner section 42b (FIG. 8), an intermediate section 44b and an outer section 60b of the eccentric swivel joint 80 are connected to each other in the same way as are the corresponding parts of the eccentric swivel joint 40 (FIG. 5). The bore 82 (FIG. 8) of the intermediate section 44b is beveled at 83 at its downstream end 84 to provide a flow passage which cooperates with the bore 86 of the outer joint section 60b which is also beveled as at 88, to allow fluid to pass therethrough without being unduly restricted. An outer cylindrical surface 58b of the intermediate section 44b is concentric with an axis E which is parallel to but offset from the central axis Cb of the inner joint section 42b. A nozzle 36b is secured, as by welding, to the outer joint section 60b in such a way that the nozzle axis Nb is parallel to but, when the parts are positioned as shown in FIG. 8, is spaced from the axis E a distance equal to the spacing of the axis E from the central axis Cb of the inner section 60b. Handles 74b and 75b are secured to the intermediate section 44b and the outer section 60b, respectively, for the purpose of rotating these sections relatively to each other, or for holding either joint section stationary while the other is being rotated.

It can readily be seen that the location of the axis Nb of the nozzle 36b relatively to the central axis Cb of the 270° elbow 32b provides the maximum amount of eccentricity when the two handles 74b and 75b extend in the same radial direction. When the handles 74b and 75b extend in diametrically opposite directions the axis of the nozzle Nb coincides with the central axis Cb, and under these circumstances the reaction force Fb of the nozzle 36b intersects the horizontal axis Hb and the vertical axis Vb of the monitor 81 of which it is a part at their point of intersection. Thus the reaction force does not create any torque about either pivot axis, and does not have any tendency to swing the nozzle 36 in any direction.

If it is desired to keep the nozzle from moving horizontally while moving it vertically, the handles 74b and 75b are moved equal amounts but in opposite directions from their positions shown in FIG. 8. If movement along the horizontal axis Hb is desired with no movement about the vertical axis Vb, the handles 74b and 75b must first be moved to a position where they extend the same direction and in a horizontal plane. The handles 74b and 75b are then rotated equal amounts in opposite directions to accomplish the above described horizontal movement of the nozzle.

In order to assist in preventing erratic pivotal movement of the monitor 9 (FIGS. 2, 4 and 6) and to control the rate of pivotal movement of the same, friction

brakes 94 and 95 are provided for the vertical swivel joint 18 and the horizontal swivel joint 28, respectively. Since both brakes 94 and 95 are identical, the following description of the brake 94 associated with the vertical joint 18 will suffice for both. Although the brakes 94 and 95 will be described only in connection with the monitor 9, it is to be understood that similar brakes can be used with the monitor 76 (FIG. 7) and the monitor 81 (FIG. 8).

As best shown in FIG. 6, the brake 94 comprises an annulus 96 welded to the male section 20 of the swivel joint 18 in a plane which is perpendicular to the axis V of the swivel joint 18. A tubular brake housing 98 is welded to the female section 22 of the swivel joint 18 with its axis parallel to the axis V. One end 100 of the housing 98 terminates immediately adjacent a braking surface 102 of the annulus 96. A cylindrical brake shoe 104 of material having a high coefficient of friction is secured, as by cementing, in a recess 105 formed in a plunger 106 that is slidable in the housing 98. A brake actuator 108 is slidable in a tubular portion 110 of a drive member 112 and the tubular portion 110 is rotatable in, and about the axis of, the housing 98. The tubular portion 110 is provided with a slot 114 extending in an axial direction from one end thereof, and the housing 98 is provided with a slanted, or spiral, slot 116 which is angled over the slot 114. A pin 118 is rigidly secured to the brake actuator 108 and projects radially outward through the slots 114 and 116. Thus it can be seen that rotation of the drive member 112 and the actuator 108 causes the actuator to move axially in the housing 98. A helical compression spring 120 is positioned with its ends 122 and 124 seated in recesses 126 and 128 in the plunger 106 and in the brake actuator 108, respectively. Axial movement of the actuator 108, therefore, causes the spring 120 to force the brake shoe 104 against the braking surface 102 with different amounts of resilient pressure.

A control rod 130 having a radially projecting handle 131 is rigidly secured to the driving member 112 by a set screw 132 and is journaled in a bracket 134 (FIG. 2) which is welded to the 90° elbow 24 adjacent the vertical swivel joint 18. A collar 136 is locked on the arm 130 to prevent axial movement of the arm 130. Thus, rotation of the arm 130 causes rotation of the driving member 112 (FIG. 6) and the brake actuator 108 which results in forcing the brake shoe 104 against the braking surface 102 of the annulus 96.

In order to hold the rod 130 and controlled parts in any one of a number of optionally selectable positions, a serrated edge 138 of the tubular brake housing 98 cooperates with a pin 140 axially slidable in a hole 142 in the driving member 112. A spring 144 in the hole 142 is disposed between a plug 146, threaded in one end of the hole, and the pin 140 to urge the pin 140 into engagement with selected depressions in the scalloped edge 138 with sufficient force to hold the rod 130 in selected position until the rod is intentionally pivoted to another position.

The control rod 130 can be moved to force the brake shoe 104 against the braking surface 102 with sufficient force to prevent motion between the shoe 104 and the annulus 96, or the rod can be adjusted so as to permit rotation of the annulus 96 relative to the shoe 104 but at a limited rate. It is apparent, therefore, that the brake 94 can be regulated to maintain complete control of relative pivotal movement of the parts of the monitor on opposite sides of swivel joint 18.

The brake 95 (FIG. 2) cooperates with an annulus 150 which is welded to the 270° elbow 32. The tubular brake housing 98 of the brake 95 is welded to the portion 26 of the horizontal swivel joint 28. A bracket 152 which corresponds to the bracket 134 is welded to the 90° elbow 24 adjacent the horizontal swivel joint 28, and a control rod 154 which corresponds to the rod 130

is rotatably mounted in the bracket 152. The brake 95 operates with relation to the horizontal axis H in the same way as the brake 94 operates with relation to the vertical axis V.

Although a description of the operation of the different parts has been included with the description of the construction and arrangement of parts, a résumé of the overall operation of the monitor 9 when using the eccentric swivel joint 40 and the operation of the monitor 81 when using the eccentric swivel joint 80 will be here included.

If it is desired to swing the monitor 9 (FIG. 2) horizontally about the vertical axis V, but not about the horizontal axis H, the brake 95 is first locked by proper manipulation of the control rod 154 to prevent rotation about the horizontal axis H. The handle 74 is then pivoted to the right (FIG. 2) if it is desired to pivot the monitor to the right or clockwise as viewed in FIG. 4. If motion of the monitor in the opposite direction is desired the handle 74 is pivoted to the left (FIG. 2). The rate of pivotal movement about the vertical axis V can be regulated either by controlling the amount of horizontal offset of the nozzle axis N from the central axis C by proper manipulation of the handle 74, or by controlled actuation of the brake 94.

Swinging of the handle first to one side and then to the other side of the vertical will cause the nozzle 36 of the monitor 9 to swing back and forth about the vertical axis V, thereby causing the jet discharged from the nozzle 36 to swing horizontally back and forth in a sector-shaped pattern. If it is desired to alter the elevation of the sector-shaped pattern, it is necessary only to momentarily release the brake 95 at a time when the handle 74 is positioned in an attitude other than horizontal. If the handle 74 is directed upwardly, the discharge end of the nozzle 36 will move upwardly and, conversely, if this handle is directed downwardly, the discharge end of the nozzle 36 will move downwardly.

Whereas the operation described in the two preceding paragraphs is concerned with movement of the monitor 9 primarily about the vertical axis V, it is apparent that similar movements about the horizontal axis H can be accomplished by corresponding manipulation of the brakes 94 and 95 and by movement of the handle 74 above and below a horizontal plane.

The overall operation of the eccentric swivel joint 80 (FIG. 8) with the monitor 81 is similar to that described in connection with the eccentric swivel joint 40 (FIG. 2). However, since the swivel joint 80 (FIG. 8) operates about two eccentric axes E and Nb, it makes it possible to exercise a control over the amount of eccentricity of the nozzle axis Nb relative to the central axis Cb, and, therefore, to regulate the more precisely the speed at which the monitor will respond to movement of the control handle 74b.

Although each of the eccentric swivel joints 40 (FIG. 5) and 80 (FIG. 8) has been described as a part of a hydraulic monitor if it is to be understood that the eccentric swivel joints can be used with other apparatus. For example, the swivel joints can be used to connect two parallel but misaligned pipes.

While several embodiments of the present invention have been shown and described, it will be understood that various changes and modifications can be made without departing from the spirit of the invention or the scope of the appended claims.

Having thus described the present invention and the manner in which the same is to be used, what is claimed as new and desired to be protected by Letters Patent is:

1. A hydraulic monitor comprising a liquid discharge nozzle having an axis along which a nozzle reaction force acts when liquid is discharged from the nozzle, means mounting said nozzle for pivotal movement about a pivot axis, an eccentric swivel joint rotatably mounting said nozzle on said mounting means for rotary movement

of the nozzle about an axis parallel to said nozzle axis and intersecting said pivot axis whereby the line of action of the nozzle reaction can be shifted from one side of said pivot axis to the other to reverse the direction of the torque generated by the nozzle reaction about said pivot axis, and means for supplying liquid under pressure to said nozzle.

2. A hydraulic monitor comprising a liquid discharge nozzle having an axis along which a reaction force acts when liquid is discharged from the nozzle, means mounting said nozzle for pivotal movement about a pivot axis, an eccentric swivel joint rotatably mounting said nozzle on said mounting means for rotary movement of the nozzle about a first axis parallel to said nozzle axis or about a second axis also parallel to said nozzle axis but spaced from said first axis, said first axis intersecting said pivot axis whereby rotation of the nozzle about said first axis is effective to dispose the nozzle axis optionally on either side of the pivot axis to cause pivotal movement of said nozzle in selected direction about said pivotal axis by the nozzle reaction, said second axis being offset from said pivot axis whereby rotation of the nozzle about said second axis is effective to vary the distance that the nozzle axis is offset from said first axis and thereby regulate the magnitude of the torque exerted by the nozzle reaction about said pivot axis.

3. A hydraulic monitor comprising a liquid discharge nozzle having an axis along which a reaction force acts when liquid is discharged from the nozzle, means mounting said nozzle for pivotal movement about a pivot axis, an eccentric swivel joint rotatably mounting said nozzle on said mounting means for rotary movement of the nozzle about a first axis parallel to said nozzle axis or about a second axis also parallel to said nozzle axis but spaced from said first axis, said first axis intersecting said pivot axis whereby rotation of the nozzle about said first axis is effective to dispose the nozzle axis optionally on either side of the pivot axis to cause pivotal movement of said nozzle in selected direction about said pivot axis by the nozzle reaction, said second axis being offset from said pivot axis whereby rotation of the nozzle about said second axis is effective to vary the distance that the nozzle axis is offset from said first axis and thereby to regulate the magnitude of the torque exerted by the nozzle reaction about said pivot axis, and brake means connected to said pivotal mounting means and arranged to control the rate of pivotal movement of said nozzle about said pivot axis.

4. A hydraulic monitor comprising a liquid discharge nozzle having an axis along which a reaction force acts when liquid is discharged from the nozzle, means for supplying liquid under pressure to said nozzle, means mounting said nozzle for pivotal movement about two intersecting pivot axes, an eccentric swivel joint rotatably mounting said nozzle on said mounting means for rotary movement of the nozzle about a first axis and about a second axis both of which are parallel to and spaced from each other, said first axis intersecting said two pivot axes at their point of intersection, said second axis being coincident with said nozzle axis, and means connected to said swivel joint for rotating said nozzle about said first axis to dispose the nozzle with the line of action of the nozzle reaction in position for the nozzle reaction to apply a turning moment to said nozzle about one of said intersecting pivot axes.

5. A hydraulic monitor comprising a liquid discharge nozzle having an axis along which a reaction force acts when liquid is discharged from the nozzle, means for supplying liquid under pressure to said nozzle, means mounting said nozzle for pivotal movement about two intersecting pivot axes, an eccentric swivel joint rotatably mounting said nozzle on said mounting means for rotary movement of the nozzle about a first and a second axis which are parallel to and spaced from each other, said

first axis intersecting said two pivot axes at their point of intersection, said second axis being coincident with said nozzle axis, and means connected to said swivel joint for rotating said nozzle about said first axis to dispose the nozzle with the line of action of the nozzle reaction offset from both of said intersecting pivot axes of said mounting means.

6. In a hydraulic monitor, an eccentric swivel joint adjustably connecting two tubular members having central axes, said swivel joint comprising a sleeve secured to one of said members and having an axis coincident with said central axis of said one tubular member, a tubular eccentric mounted for free rotary movement on said sleeve about the axis thereof and having an outer cylindrical surface formed about an axis which is in spaced parallel relation with the axis of said sleeve, said eccentric having a bore concentric with the bore of said sleeve, a housing journaled on said cylindrical surface for free rotary movement thereabout and having the other tubular member secured thereto with its axis coincident with the axis of said cylindrical surface, and means providing a liquid seal between said sleeve and said eccentric and between said eccentric and said housing in all positions of rotary movement therebetween.

7. In a hydraulic monitor, an eccentric swivel joint adjustably connecting two tubular members having central axes, said swivel joint comprising a sleeve secured to one of said members and having an axis coincident with said central axis of said one tubular member, a tubular eccentric mounted for rotation on said sleeve about the axis thereof and having an outer cylindrical surface formed about an axis which is in spaced parallel relation with the central axis of said sleeve, a housing journaled on said cylindrical surface and having the other tubular member secured thereto with its axis parallel to the axis of said cylindrical surface and spaced therefrom a distance equal to the spacing of the last mentioned axis from the axis of said sleeve, means for freely rotating said eccentric and said housing independently of each other, while maintaining their axial disposition, and means providing a liquid seal between said sleeve and said eccentric and between said eccentric and said housing irrespective of the rotational dispositions thereof.

8. An eccentric swivel joint comprising a sleeve having a bore, a tubular eccentric having a bore concentric with said sleeve bore journaled on said sleeve for rotation about an axis coinciding with the axis of the sleeve and having an outer cylindrical surface eccentric with respect to said sleeve and said bores, a housing having a sleeve portion journaled on said cylindrical surface, a tubular member secured to said housing concentrically with respect to said cylindrical surface and having a bore eccentric to said bores of the sleeve and the eccentric, means providing a liquid tight seal between said sleeve and said tubular eccentric and between said tubular eccentric and said housing, and means for freely rotating said tubular eccentric and said housing independently of each other while maintaining their axial dispositions and said liquid tight seal therebetween, said last named means including bearings interposed between said sleeve and said tubular eccentric and between said cylindrical surface and the sleeve portion of said housing.

9. A hydraulic monitor comprising an eccentric swivel joint including a tubular inner section mounted for pivotal movement about two intersecting pivot axes with the axis of said tubular inner section intersecting said pivot axes at their point of intersection, a tubular intermediate section mounted for rotary movement about said axis of the inner section, and an outer tubular section mounted on said intermediate section for rotary movement about an axis parallel to and spaced from said axis of the inner joint section, a nozzle mounted on said outer section of the swivel joint with the axis of the nozzle parallel to

said axis of the inner joint section and spaced therefrom a distance equal to the distance between the axis of the inner joint section and the axis of rotation of the outer joint section, and means for connecting said inner joint section to a source of liquid under pressure.

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