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JET PIPE NOZZLE ARRANGEMENT

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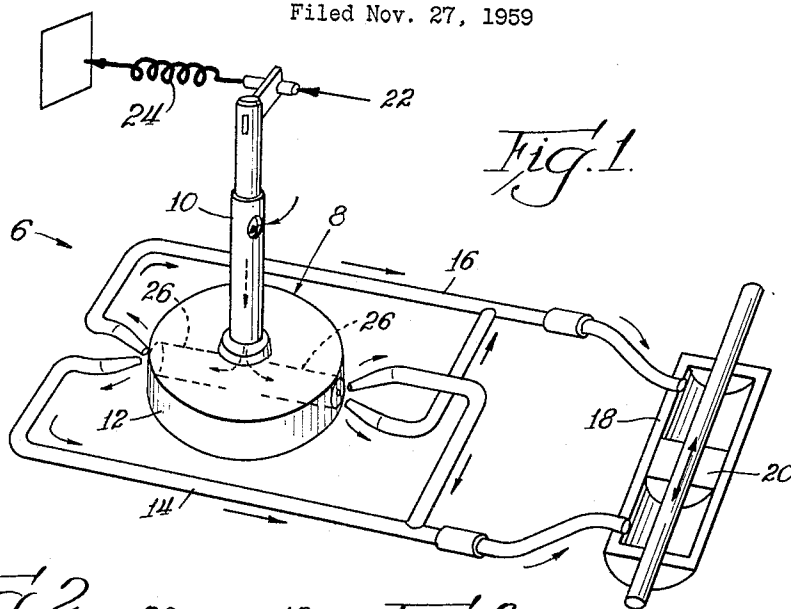


Fig. 1.

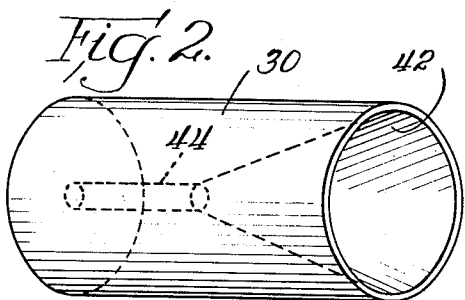


Fig. 2.

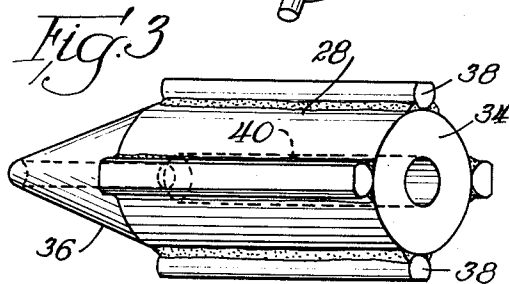


Fig. 3.

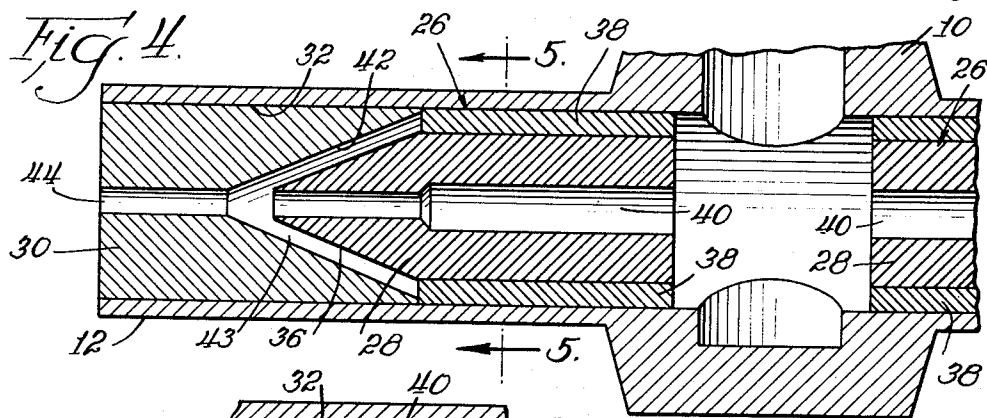


Fig. 4.

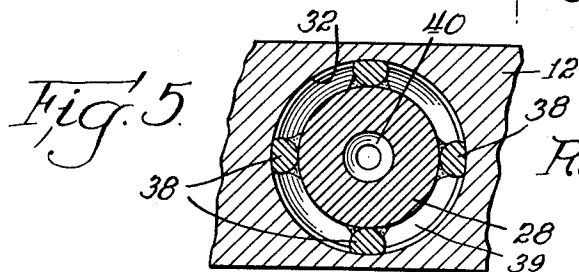


Fig. 5.

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JET PIPE NOZZLE ARRANGEMENT

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6 Claims. (Cl. 239-552)

This invention relates to hydraulic jet pipe relay regulators and more particularly to a nozzle arrangement therefor.

In the usual type of jet pipe regulator, as exemplified by Patent 2,724,397, issued November 22, 1955, the jet pipe tube is relatively long, thus providing laminar type flow resulting in a smooth liquid stream out of the nozzle. As a result, the maximum recovery pressure remains substantially constant regardless of viscosity changes in the fluid issuing from the jet pipe. However, in the case wherein the jet pipe tube is relatively short, as exemplified by Patent 2,904,057, issued September 15, 1959, maximum recovery pressure may vary greatly with variation of viscosity of the jet pipe fluid.

The subject invention provides a solution to the problem of stabilizing maximum recovery pressure with viscosity variation in the case of hydraulic regulators having relatively short jet pipes. More particularly, the subject invention discloses a nozzle arrangement which functions to produce a laminar type flow in a relatively short jet pipe, whereby maximum recovery pressure is stabilized even though change of viscosity occurs in the jet pipe fluid.

The main object of this invention is to provide a nozzle arrangement which produces laminar type flow in a relatively short jet pipe, whereby maximum recovery pressure is stabilized even though viscosity changes occur in the jet pipe fluid.

A further object is to provide a jet pipe nozzle arrangement which is simple in structure, of low cost, and which will provide long and trouble-free service.

These and further objects and features of the invention will become more apparent from the following description and the accompanying drawings wherein:

FIG. 1 is a schematic perspective view of portions of a jet pipe regulator incorporating an embodiment of the invention;

FIGS. 2 and 3 are perspective views of components of the nozzle arrangement of the invention;

FIG. 4 is a cross-section view of an assembly of the nozzle arrangement of FIGS. 2 and 3; and

FIG. 5 is a cross-section view as seen from line 5-5 in FIG. 4.

Referring now to the drawing, the numeral 6 identifies a combination of elements representing essential components of a hydraulic jet pipe relay regulator of the type disclosed in Patent 2,904,057. Briefly, the combination illustrated in FIG. 1 comprises a rotor assemblage 8 including a partially hollow shaft 10 to which is affixed at the lower end a disc-like head 12, and a pair of conduit, or liquid conducting passageways 14, 16, each of which has open ends disposed in close proximity to the head 12 the other end of the passageways leading to opposite ends of a cylinder 18, in which is slidably arranged a piston 20. The cylinder and piston are not actually part of the regulator 6, but rather a combination served thereby. The shaft 10, is rotatably positioned by a signal input means 22 arranged at the top end thereof, which input means includes an adjustable set-point counterbalance spring 24. The head 12, includes a pair of axially disposed nozzle arrangements 26, whereby hydraulic liquid entering the shaft 10, is jetted toward the open ends of the passageways 14, 16, resulting in the positioning, or driving of piston 20 in accord-

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ance with the angular position of the rotor assemblage 8 relative to the ends of the passageway openings, all as more fully described in Patent 2,904,057.

The nozzle arrangement 26, with which this disclosure is primarily concerned, comprises a rear nozzle 28, and a front nozzle 30, both of which are fitted in axial alignment within a bore 32 formed in the rotor head 12 normal to the axis of the shaft 10. Each rotor head 12 includes two nozzle arrangements 26, the inner ends of which are spaced apart a given distance, as best seen in FIG. 4.

The rear nozzle 28, is cylindrical in form, one end 34 being flat, the other end 36 being tapered. Four rod, or spacer members 38, are affixed to the outer surface of the nozzle 28, with the axis of the rods being parallel to the axis of the nozzle. The purpose of the rods 38, is to position the body of the nozzle concentric with and in spaced relation to the bore 32, to thereby provide narrow arcuate spaces 39 about the body of the nozzle 28, through which jet pipe liquid may pass. A multi-diameter passageway 40 is provided in the center of the nozzle 28.

The front nozzle 30 is cylindrical in form and has a tapered opening 42 at one end which connects with an axially arranged passageway 44 extending through and opening at the other end of the nozzle. When the nozzles 28 and 30 are assembled in the bore 32, as best seen in FIG. 4, a cone-like volume 43 is provided between the tapered surfaces 36 and 42 respectively. Hence, jet pipe liquid flowing from the inner region of the shaft 10 through the spaces 39 and cone-like volume 43, and outward through the short passageway 44, is strictly confined, reducing turbulence and assuming laminar flow characteristics, with the result that maximum recovery pressure is stabilized even though viscosity changes occur in the jet pipe fluid. It will be noted that the thickness of the liquid flow path through the nozzle arrangement is relatively narrow in comparison to the overall length thereof. For all practical purposes, the proportions illustrated will be found satisfactory.

The foregoing description has been given in detail without thought of limitation since the inventive principles involved are capable of assuming other forms without departing from the spirit of the invention or the scope of the following claims.

What is claimed is:

1. A nozzle arrangement comprising a plurality of cylindrical nozzle elements for arrangement in a bore, a first of said elements being formed with an outer tapered end and having a passageway therethrough, a second of said elements being formed with an inner tapered end the apex of which intersects a passageway extending through said second element, said first element being positioned to provide a uniform spacing between its tapered end and the inner tapered surface of the second element, and a plurality of spacer means affixed to the outer surface of the first element for maintenance thereof concentric with the bore and at a uniform distance therefrom, said passageway through said first of said elements and the passageways between said plurality of spacer means being arranged to communicate with the portion of said bore remote from said second of said elements, said passageways between said spacer means being substantially rectilinear.

2. A nozzle arrangement comprising two cylindrical nozzle elements for arrangement in a bore, the first of said elements being formed with an outer tapered surface leading to a point at one end of the element and having a passageway therethrough, the second of said elements being formed with an axially arranged passageway leading from one end and intersecting an inner end of a tapered surface that increases in diameter toward the

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other end of the element, said nozzle elements being positionable to provide a uniform spacing between the respective tapered surfaces thereof, and a plurality of substantially rectilinear spacer means affixed to the outer surface of the first element for maintenance thereof concentric with the bore and at a uniform distance therefrom, said passageway through said first of said elements and the passageways between said plurality of spacer means being arranged to communicate with the portion of said bore remote from said second of said elements.

3. A nozzle arrangement comprising two cylindrical nozzle elements for arrangement in a bore, the first of said elements being formed with an outer tapered surface leading to a point at one end of the element and having a passageway therethrough, the second of said elements being formed with an axially arranged passageway leading from one end and intersecting an inner end of a tapered surface that increases in diameter toward the other end of the element, said nozzle elements being positionable to provide a uniform spacing between the respective tapered surfaces thereof, and a plurality of rod means affixed to the outer surface of the first element and parallel with the axis thereof for maintaining the first element concentric with the bore and at a uniform distance therefrom, said passageway through said first of said elements and the passageways between said plurality of rod means being arranged to communicate with the portion of said bore remote from said second of said elements.

4. A nozzle arrangement according to claim 3, wherein said passageway through said first of said elements extends axially the entire length thereof.

5. A nozzle arrangement comprising an outer element and an inner element located therewithin, said inner element being formed with a tapered first outer surface adjacent one end thereof and a substantially cylindrical second outer surface, said outer element being formed

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with a tapered first inner surface, a substantially cylindrical second outer surface, and a passage communicating from the small end of said first inner surface to an end of said outer element, and support means for maintaining said first outer and inner surfaces in uniformly spaced relation, said support means being so arranged as to produce irrotational flow therebetween.

6. A nozzle arrangement comprising an outer element and an inner element located therewithin, said inner element being formed with a tapered first outer surface adjacent one end thereof and a substantially cylindrical second outer surface, said outer element being formed with a tapered first inner surface, a substantially cylindrical second outer surface, and a passage communicating from the small end of said first inner surface to an end of said outer element, and support means for maintaining said first outer and inner surfaces in uniformly spaced relation, said support means defining substantially rectilinear passages therebetween.

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