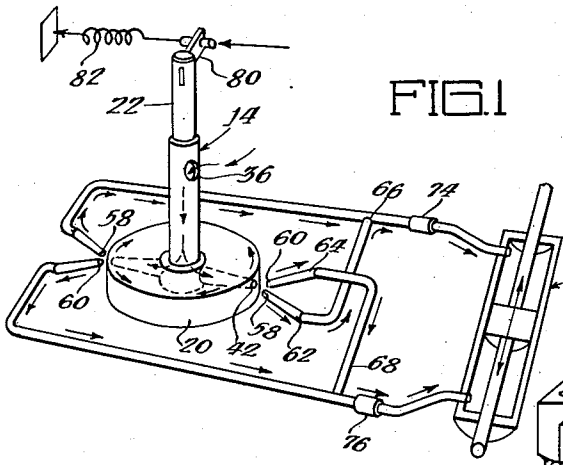
Sept. 15, 1959 B. L. CALLENDER ET AL 2,904,057

HYDRAULIC RELAY

Filed Aug. 4, 1958

FIG. 1



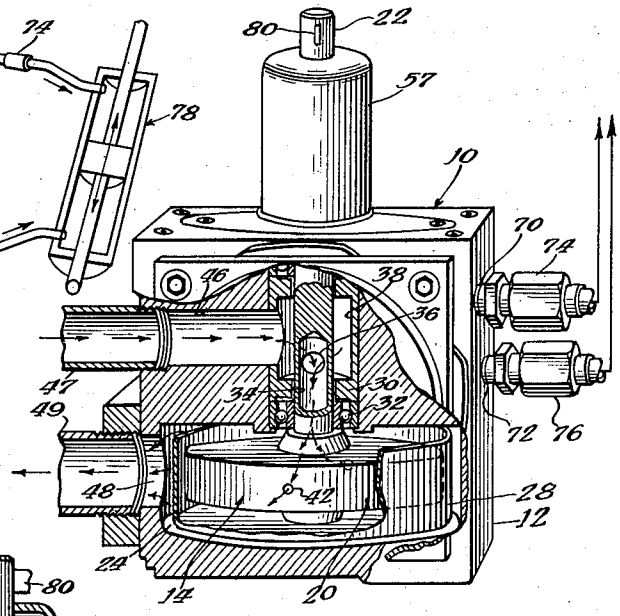
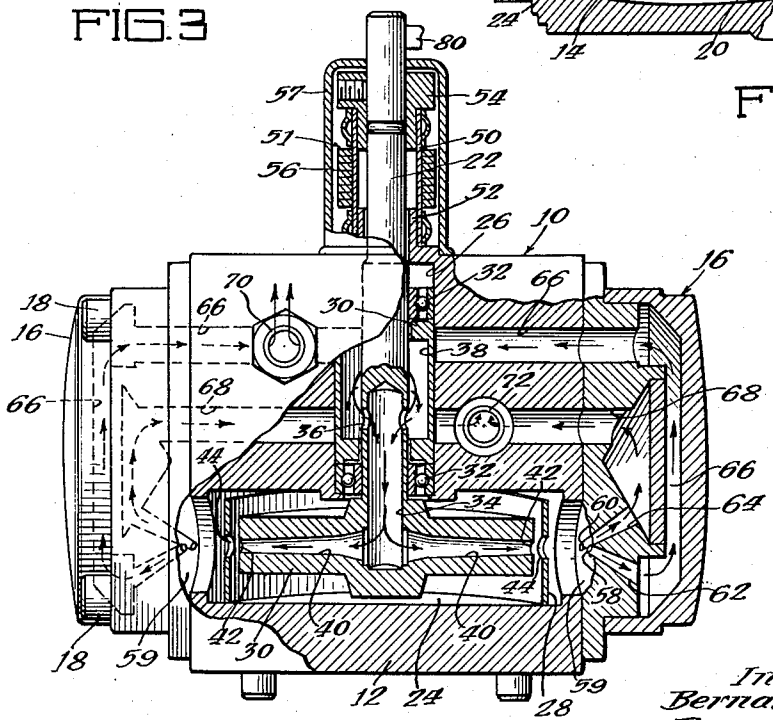


FIG. 2

FIG. 3



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HYDRAULIC RELAY

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7 Claims. (Cl. 137—83)

This invention relates to a hydraulic relay and more particularly to a relay which utilizes the jet pipe principle of hydraulic amplification and which has dual jet pipe orifices arranged to provide balanced jet action.

In the co-pending application of Bernard L. Callender, Serial Number 600,497, filed July 27, 1956, now Patent 2,849,013, issued August 26, 1958, a hydraulic relay is disclosed which incorporates a multiple jet pipe arrangement. The present invention, while utilizing a multiple jet pipe arrangement, incorporates additional features to provide a hydraulic relay which represents an improvement over hydraulic relays of the prior art. More specifically, the hydraulic relay of the invention includes: a disc-like rotor structure in which dual jet pipe orifices are arranged to provide dynamic balance; a shield which reduces extraneous torque loads caused by liquid turbulence; a flexible shaft seal which imposes no load upon shaft rotation effort; and an overall simple, compact, rugged structural arrangement.

The object of this invention is to provide a hydraulic relay which utilizes the jet pipe principle of hydraulic amplification.

A more specific object is to provide a hydraulic relay having a dual jet pipe orifices arranged to provide balanced jet action.

Another object of the invention is to provide a hydraulic relay with good dynamic balance of major moving components, reduction of torque loads due to liquid turbulence, and a shaft seal which imposes no load upon shaft rotation effort.

Further objects are to provide a hydraulic relay having a structural arrangement which is simple, compact and rugged.

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

Fig. 1 is a schematic illustration showing the hydraulic circuiting provided in the relay of the invention;

Fig. 2 is a perspective view broken away, illustrating an embodiment of the invention; and

Fig. 3 is the same, slightly enlarged, taken at approximately 90° from the orientation of the Fig. 2 illustration.

Referring now to the drawing, the numeral **10** identifies a hydraulic relay illustrative of an embodiment of the invention, which relay includes a housing **12**, a duel jet pipe rotor **14**, and end cap assemblages **16**, removably affixed to the housing by fastening means such as screws **18**. The rotor **14** has a disc-like portion **20** and an integral stem, or shaft, portion **22**, the latter being suspended in the housing **12** to provide rotary movement of the rotor. The disc-like portion of the rotor **14** is arranged within a circular first chamber **24** formed in the housing, while the shaft portion **22** is arranged to extend through a second chamber **26** formed in the housing and to project beyond the upper surface thereof. Surrounding the portion **20** of the rotor **14** and in spaced relation thereto as well as in spaced relation to the side wall of the chamber **24**, is a shield **28** formed of a

thin plate, the upper edge of which is spaced from the upper surface of the chamber. The rotor shaft **22** passes through a sleeve, or spacer **30**, which separates a pair of ball bearings **32**. There is no contact between shaft **22** and spacer **30**.

The lower end of the rotor shaft **22** is formed with a passageway **34**, the upper end of which connects via openings **36** with a chamber **38**, formed in the sleeve **30**. The lower end of the passageway **34** connects with tapered passageways **40** arranged in axial alignment in the disc-like rotor portion **20**, which passageways **40** serve to provide dual jets. The end of each passageway **40** defines an orifice **42**, each orifice being arranged in alignment with one of a pair of holes **44** diametrically formed in the shield **28**. An inlet passageway **46** is formed in the housing **12** whereby pressurized liquid may be delivered from an inlet pipe **47** to the chamber **38**, while an outlet passageway **48** is formed in the housing whereby liquid may flow from the chamber **24** into an outlet pipe **49**.

Surrounding the upper end of the shaft **22** is a liquid seal means **51** formed of a flexible tube **50**, preferably made of a plastic material, one end of the tube being secured in liquid tight manner to a circular protrusion **52** of the housing **12**, while the other end is secured in liquid tight manner to a sleeve **54** affixed in liquid tight manner to the shaft **22**. A plurality of washers **56** are arranged about the tube **50**, to re-inforce the tube against rupture which could be caused by the pressure of the liquid escaping from the chamber **38**, past the sleeve **30** and the upper bearing **32** during relay operation. A cap, or cover, **57** surrounds the liquid seal means **51**. It will be appreciated that the liquid seal means **51** will impose no load upon shaft rotation effort.

A pair of receiver means, each of which includes two apertures **58** and **60**, are arranged in the end cap assemblages **16**, which apertures define the end of passageways **62** and **64** respectively, forming part of passageway means **66** and **68** respectively which lead to outlets **70** and **72** respectively. The latter are arranged to receive pipe couplings **74** and **76** and associated pipes, or hoses, for conduction of pressurized liquid to a device, such as a cylinder and piston assembly **78** being controlled, or operated by the relay. Slight rotation of the rotor **14**, will bring rotor orifices in alignment with either apertures **58**, or apertures **60** of the receiver means depending upon the direction of rotation thereof.

An arm **80** may be secured to the exposed end of the shaft **22** whereby a torque, developed in response to a signal from a controlled means, may be applied to the rotor **14** for the rotation thereof. An adjustable set point counterbalance spring **82** may be affixed to the arm **80**.

The operation of the relay is generally similar to that disclosed in the co-pending application of Bernard L. Callender now Patent 2,849,013. Pressurized hydraulic medium, such as oil, is delivered to the chamber **38**, flows into rotor passageway **34**, and leaves the rotor as a jet stream via each of the orifices **42**. The jet streams pass through the holes **44** of the shield **28** and impinge upon the receiver means **59**. Pressurized hydraulic fluid is thus admitted to the passageways **62** and **64** for conduction to the controlled means, such as the cylinder and piston assembly **78**. When the rotor **14** is positioned so that the dual jets are in neutral position, i.e., midway between the apertures **58** and **60**, hydraulic pressure in the passageways **62** and **64** will be equal. When the rotor **14** is rotated so that the dual jets are closer to either aperture **58** or aperture **60**, the pressure in passageways **62** and **64** will be unequal, thus provided a pressure differential for operation of the controlled means **78**. The hydraulic fluid which is not jetted into either passageway

62 or 64, collects in chamber 24, and passes out of the relay via outlet pipe 49. The shield 28 affords protection to the rotor 14 against the turbulence of the unused liquid flowing out of chamber 24, thus reducing extraneous torque loads upon the rotor.

It will be apparent from the foregoing that a relay made according to principles of the invention will achieve the objectives set forth hereinbefore.

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

What is claimed is:

1. A relay comprising in combination, a housing, a rotor in the housing arranged for relative rotary motion therewith, said rotor being formed with at least two passageways each having an orifice for directing flow of pressure fluid from the rotor, said housing being formed with a passageway arranged to conduct pressure fluid to the rotor passageways, receiver means arranged in the housing and of like number to the rotor orifices, each of said receiver means having at least one aperture arranged to receive pressure fluid from a contiguous orifice, passageway means connecting said receiver apertures with pressure fluid outlets formed in the housing, a shield arranged about the periphery of the rotor and being formed with openings in the region of the receiver means, and a pressure fluid drain outlet formed in the housing.

2. A hydraulic relay comprising in combination, a housing, a disc-like rotor in the housing arranged for relative rotary motion therewith, said rotor having two passageways in axial alignment, each of said passageways having an orifice on the peripheral surface of the rotor, said housing being formed with a passageway arranged to conduct pressurized hydraulic medium to the rotor passageways, a pair of receiver means arranged in the housing, each of said receiver means having a pair of apertures each of which is arranged to receive pressurized hydraulic medium from a contiguous orifice in the rotor, passageway means connecting a first aperture of each receiver means with a first outlet formed in the housing, passageway means connecting a second aperture of each receiver means with a second outlet formed in the housing, a shield arranged about the periphery of the rotor and in spaced relation thereto, said shield having a pair of openings each being in the region of a receiver means, and a hydraulic medium drain leading from the region of the outer surface of the shield to a drain outlet formed in the housing.

3. A hydraulic relay comprising in combination, a housing, a rotor assembly including a disc-like rotor and an axially arranged shaft, said rotor being formed with two radially arranged passageways in axial alignment, each of said passageways terminating in an orifice formed on the peripheral surface of the rotor, said shaft being formed with a passageway connecting with the passageways of the rotor, said housing being formed with first and second chambers, said rotor being arranged in the first chamber, said shaft being arranged substantially in the second chamber and having openings connecting the passageway thereof with the second chamber, passageway means formed to conduct pressurized hydraulic fluid to the second chamber, a pair of receiver means in the housing, each of said receiver means having a pair of apertures each of which is arranged to receive pressurized hydraulic fluid which is jetted from a contiguous orifice in the rotor, passageway means connecting a first aperture of each receiver means with a first outlet formed in the housing, passageway means connecting a second aperture of each receiver means with a second outlet formed in the housing, a shield arranged about the periphery of the rotor and in spaced relation to the rotor and to the surface of the first chamber adjacent the rotor periphery, said shield having diametrically arranged openings in the region of the receiver means, and a hydraulic fluid drain leading from the first chamber to a drain outlet formed in the housing.

4. A hydraulic relay according to claim 3, wherein a sealing means is arranged to prevent leakage of hydraulic fluid from the second chamber and about the shaft, said sealing means including a flexible tube affixed at one end to said shaft and at the other end to said housing, and a plurality of washer-like elements arranged on the tube to resist expansion of the tube under hydraulic pressure.

5. A hydraulic relay according to claim 3, wherein end cap assemblages are affixed to said housing, said end cap assemblages being formed with passageways which provide a portion of the passageway means leading from the apertures to the first and second outlets.

6. A hydraulic relay according to claim 3, wherein a sleeve is arranged in said second chamber, said sleeve having a chamber adapted for communication with the passageway formed in said shaft, and is also open to the passageway means conducting pressurized hydraulic fluid to the second chamber.

7. A hydraulic relay according to claim 3, wherein the upper edge of said shield is spaced from the upper surface of the first chamber.

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