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FLUID FLOW RESPONSIVE MEANS

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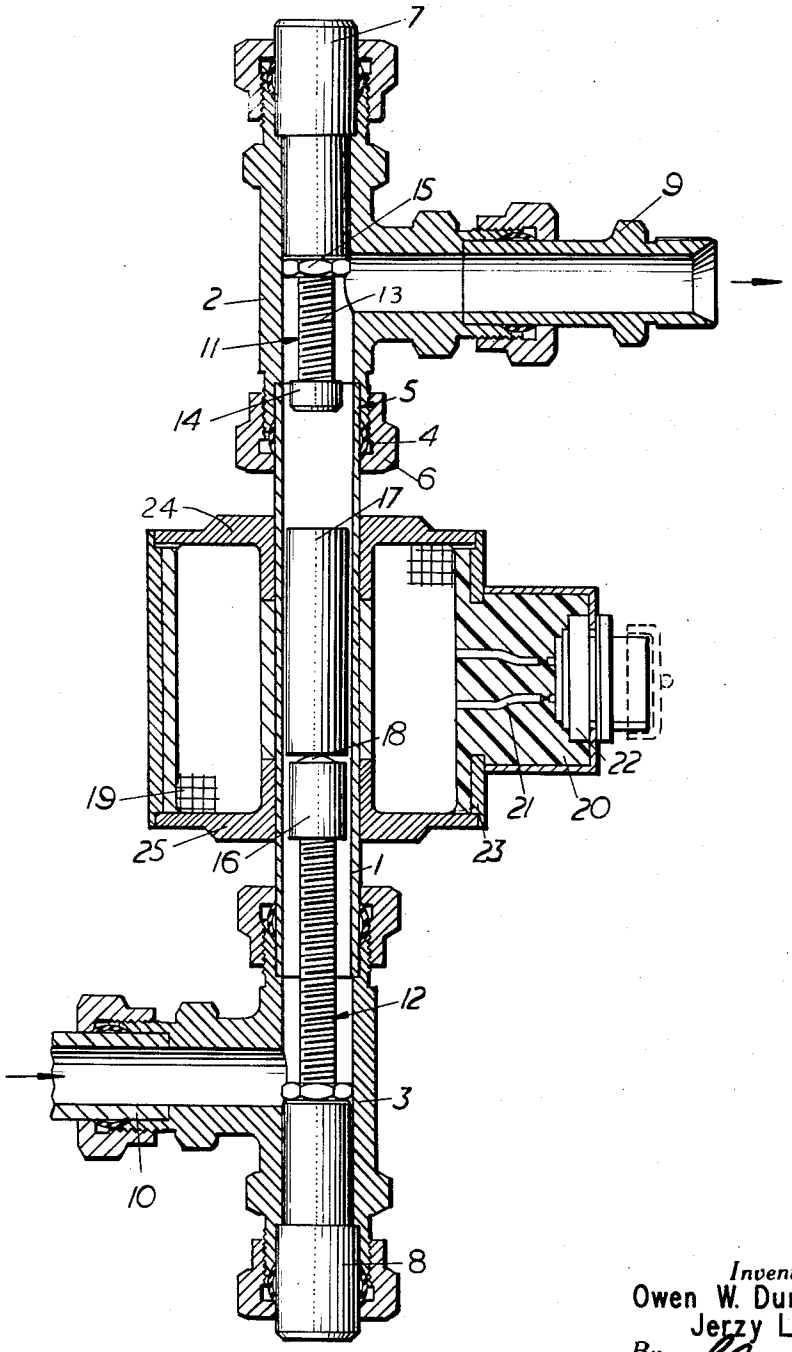

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FLUID FLOW RESPONSIVE MEANS

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This invention relates to fluid flow responsive means. In some applications of such means the necessity arises of effecting an indication or/and a control over the fluid flow when the flow, after starting, rises to a predetermined value and when the flow falls to a relatively low value. For this purpose a differential relay connected across an orifice in the fluid flow path may be used. However, an orifice suitable for producing the necessary pressure difference at the low value of flow is liable to result in a pressure drop which is intolerably high at the predetermined value. In addition, an orifice of small size is liable to become blocked with the result that the diaphragm of the differential relay may be subjected to a differential pressure equal to the working pressure of the fluid. If this differential pressure is very large it may necessitate the use of a diaphragm so robust as to be insensitive.

According to the present invention there is provided fluid flow responsive means having an armature or plunger arranged to be subjected to a force due to pressure drop across the armature of fluid flowing within a flow path and tending to move the armature from a first to a second position, the movement of the armature being influenced by current flow in an associated winding. The arrangement is such that a fluid flow may be established to exert a force sufficient to move the armature from its first to its second position against an electro-magnetic force derived from a current flowing in the winding and such that the armature will return to its first position when the fluid flow is reduced to a lower value.

According to the present invention there is also provided fluid flow responsive means having a tubular flow path, an armature in the form of a plunger movable in the flow path between a first and a second position and so disposed that fluid may flow past it and establish a differential pressure across it that tends to move the armature from its first to its second position. A winding is arranged so that, upon energisation, it exerts an electromagnetic force upon the armature which opposes movement of the armature from its first position and decreases as the armature moves from its first to its second position. The arrangement is such that a differential pressure may be established across the ends of the armature to move the armature from its first to its second position in opposition to the effect of the electro-magnetic force derived from the current flowing in the winding and such that the armature will return to its first position upon the fluid flow being reduced to a lower value.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawing and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

By way of example an embodiment of the invention will now be described with reference to the accompanying drawing, partially in section in which the figure represents pressure-responsive means in axial cross-section.

The pressure-responsive means shown in the drawing includes a straight vertical stainless steel tube 1 connected at each end to one of the two opposite limbs of

a T-junction 2 and 3, respectively. The wall of tube 1 may be too thin to take a screw thread so that the connection between the tube 1 and the junction is effected by a mild steel coupling denoted by the registered trademark "Ermeto." This coupling includes a deformable metal ring 4 of which one end lies in a convergent recess between the tube 1 and the annular inner surface 5 of the limb of the junction. An inwardly flanged ring 6 is screwed on to the outer end of the limb of the junction, so that the flange forces the ring 4 into sealing contact with the tube 1. The inner edge of the ring 4 is made sharp to facilitate its biting into the tube 1 and so providing a more certain seal.

The other of the two opposite limbs of each junction 2 and 3 is closed by a plug 7 and 8, respectively, while the remaining limb of the junction 2 is provided with an outlet extension 9 and that of the junction 3 is provided with an inlet extension 10. Seals between the plug 7 and the extension 9 and the junction 2, and between the plug 8 and the extension 10 and the junction 3 are effected by couplings similar to those connecting the tube 1 to the junctions.

Each of the plugs 7 and 8 carries a stop member, 11 and 12 respectively, extending into the tube 1. The stop member 11 is made of brass and comprises a threaded shaft 13 having a buffer 14 at its outer end; the position within the tube 1 of the buffer 14 is determined by the extent to which the shaft 13 is screwed into the plug 7 and a lock nut 15 is provided to secure the position of the shaft 13. The lower stop member is similar to the member 11 except that its shaft is longer and its buffer 16 is longer and projects further into the tube 1 and is made of mild steel.

Contained within the tube 1 between the stops 11 and 12 is a mild steel cylindrical plunger 17. Since the opposite limbs of each junction 3 and 2 are aligned, the armature or plunger 17 may be introduced by removing the closure plug from one junction or the other. It fits in the tube 1 with a clearance of approximately a sixteenth of an inch. When the tube 1 is vertical and no fluid is flowing through it, the plunger 17 rests on a brass cap 18 fitted to the upper end of the buffer 16.

Outside the tube 1, extending for most of the combined lengths of the buffer 16 and the plunger 17 is a winding 19. The winding 19 is sealed in resin 20 and connected by leads 21 passing through the resin 20 to a socket 22. The resin 20 is contained within a magnetic casing 23 which includes a pole piece 24 and 25 at each end, the pole pieces overlapping the combined extent of the buffer 16 and the plunger 17.

The buffer 16 and the plunger 17 are both of magnetic material so that the plunger 17 acts as a movable armature. Were the plunger 17 to rest directly on the buffer 16, when the apparatus is not in use, there would be a tendency for dirt to collect on the end of the buffer 16 so that a slight but indeterminate gap would exist between the buffer 16 and the plunger 17. The variable extent of the gap would cause variations in the performance of the apparatus and for this reason the brass dome-shaped cap is introduced to provide a gap of fixed width.

In using the appartus shown in the drawing, the winding 19 is connected to a source of alternating current of constant value which will induce in the plunger 17 an electromagnetic force tending to retain it in position. However, the fluid, to which the apparatus is to respond, is caused to flow between the inlet extension 10 and the outlet extension 9. This flow creates a pressure drop, dependent upon the rate at which the fluid enters the tube 1, across the plunger 17 tending to move it upwardly and so to act against the effect of the current in the winding 19. When the rate of flow reaches a certain value, dependent upon

the current flowing in the coil, the pressure difference will cause the plunger 17 to rise. Movement of the plunger 17 will reduce the electro-magnetic force acting on it so that the effect of the fluid will be to carry it into contact with the upper buffer 14. It will remain there until the rate of flow falls sufficiently for the force exerted by the pressure drop across the plunger 17 to be overcome by gravity and the reduced electro-magnetic force exerted on the plunger 17 by the current in the winding 19.

It will be realised that there are only two stable positions of the plunger 17. It will remain at its lower first position until the rate of flow is sufficient to raise it slightly when it will move positively to its upper, second position. It will remain there until the flow drops sufficiently to be overcome by the electro-magnetic force when it will move back positively to its first position.

The rate of flow at which the plunger 17 will fall can be altered by adjusting the position of the shaft 13 in the plug 7 and that at which it will rise by adjusting the position of the shaft of the stop 12 in the plug 8. Replacement of the plunger 17 by one having a greater or a smaller clearance within the tube 1 will also alter the rate of flow at which the plunger 17 will rise and fall.

The flow-responsive means described is especially useful in connection with the flow of oil to an oil burner or of the flow of fluid heater cleaner to a lance which is intended to be retracted should the flow of fluid fall below a safe value. Should the flow of oil or heater cleaner fall to too low a value, then the means can be used to produce an appropriate indication or a control. One particular embodiment of the flow-responsive means described was adjusted so that the plunger 17 would rise when the oil flow reached the rate of 450 pounds per hour and drop when the flow fell to 150 pounds per hour.

Various means may be used for detecting which of its extreme positions the plunger 17 occupies. In some cases, the steel tube 1 may be replaced by a transparent tube. An electrical arrangement may, however, be readily provided. For this purpose, a resistor may be included in series with the winding 19 so that a signal, represented by the current, will occur across the resistor which will depend upon which of its extreme positions is occupied by the plunger 17. The signal may be rectified and applied to a trigger circuit adapted to distinguish between the signal derived when the plunger 17 is in its first position and that derived when the plunger is in its second position.

The plunger 17 that has been described is of smooth cylindrical form and a clearance is established between it and the tube 1. Alternatively the plunger 17 may overall be more closely fitting than this but have longitudinal recesses in its outer surface to enable fluid to flow past it.

While in accordance with the provisions of the statutes there is illustrated and described herein a specific embodiment of the invention, those skilled in the art will understand that changes may be made in the form of the invention covered by the claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of the other features.

What is claimed is:

1. A fluid flow responsive means comprising a fluid flow path, a magnetic armature movably positioned in said flow path and arranged for fluid flow thereover, stop means arranged to limit the movement of said armature within said fluid flow path to a first position and a second position and a magnetic force, producing means disposed about said armature and operating to maintain said armature in said first position until a first predetermined flow rate is achieved, said armature when in said first position being substantially within the influence of said magnetic force, said fluid flow producing a pressure drop across said armature, said armature arranged to be moved by said pressure drop at said first predetermined flow rate against said magnetic force from said first position to said second position where said armature is substantially out of the influence of said magnetic force, said armature being maintained in said second position by said fluid flow until the flow rate falls below a second predetermined flow rate, said armature arranged to be returned to said first position by said magnetic force when said fluid flow falls below said second predetermined flow rate, said second predetermined flow rate being less than said first predetermined flow rate.

2. A fluid flow responsive means comprising a tubular fluid flow path, a magnetic armature movably positioned in said flow path and arranged for fluid flow thereover, stop means arranged to limit the movement of said armature within said fluid flow path to a first position and a second position, and an electro-magnetic winding for producing a magnetic force disposed around said tubular flow path and about said armature in said first position, said magnetic force operating to maintain said armature in said first position until a first predetermined flow rate is achieved, said armature when in said first position being substantially within the influence of said magnetic force, said fluid flow producing a pressure drop across said armature, said armature arranged to be moved by said pressure drop at said first predetermined flow rate against said magnetic force from said first position to said second position where said armature is substantially out of the influence of said magnetic force, said armature being maintained in said second position by said fluid flow until the flow rate falls below a second predetermined flow rate, said armature arranged to be returned to said first position by said magnetic force when said fluid flow falls below said second predetermined flow rate, said second predetermined flow rate being less than said first predetermined flow rate.

3. A fluid flow responsive means comprising a tubular fluid flow path, a first stop means and a second stop means defining a first and a second position in said flow paths, a magnetic armature movably positioned in said flow path between said first and said second positions and arranged for fluid flow thereover, and an electro-magnetic winding for producing a magnetic force disposed around said tubular flow path about said armature in said first position, said magnetic force operating to maintain said armature in said first position until a first predetermined flow rate is achieved, said armature when in said first position being substantially within the influence of said magnetic force, said fluid flow producing a pressure drop across said armature, said armature arranged to be moved by said pressure drop at said first predetermined flow rate against said magnetic force from said first position to said second position where said armature is substantially out of the influence of said magnetic force, said armature being maintained in said second position by said fluid flow until the flow rate falls below a second predetermined flow rate, said armature arranged to be returned to said first position by said magnetic force when said fluid flow falls below said second predetermined flow rate, said second predetermined flow rate being less than said first predetermined flow rate, said first and second stops being independently adjustable with respect to said electro-magnetic winding to independently vary said first and said second predetermined flow rates.

4. A fluid flow responsive means comprising a tubular fluid flow path, a first stop means and a second stop means defining a first and a second position in said flow path, a magnetic armature movably positioned in said flow path between said first and said second positions and arranged for fluid flow thereover, an electro-magnetic winding for producing a magnetic force disposed around said tubular flow path about said armature in said first position, said magnetic force operating to maintain said armature in said first position until a first predetermined flow rate is achieved, said armature when in said first position being substantially within the influence of said magnetic force, said fluid flow producing a

pressure drop across said armature, said armature arranged to be moved by said pressure drop at said first predetermined flow rate against said magnetic force from said first position to said second position where said armature is substantially out of the influence of said magnetic force, said armature being maintained in said second position by said fluid flow until the flow rate falls below a second predetermined flow rate, said armature arranged to be returned to said first position by said magnetic force when said fluid flow falls below said second predetermined flow rate, said second predetermined flow rate being less than said first predetermined flow rate, said first and second stops being independently adjustable with respect to said electro-magnetic winding to independently vary said first and said second predetermined flow rates, and means for indicating the presence of said armature in said first and second positions.

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