Oct. 1, 1946. R. C. BRAITHWAITE ET AL 2,408,603

MECHANICAL RELAY OF THE FLUID JET TYPE

Filed Oct. 9, 1943

FIG. 1.

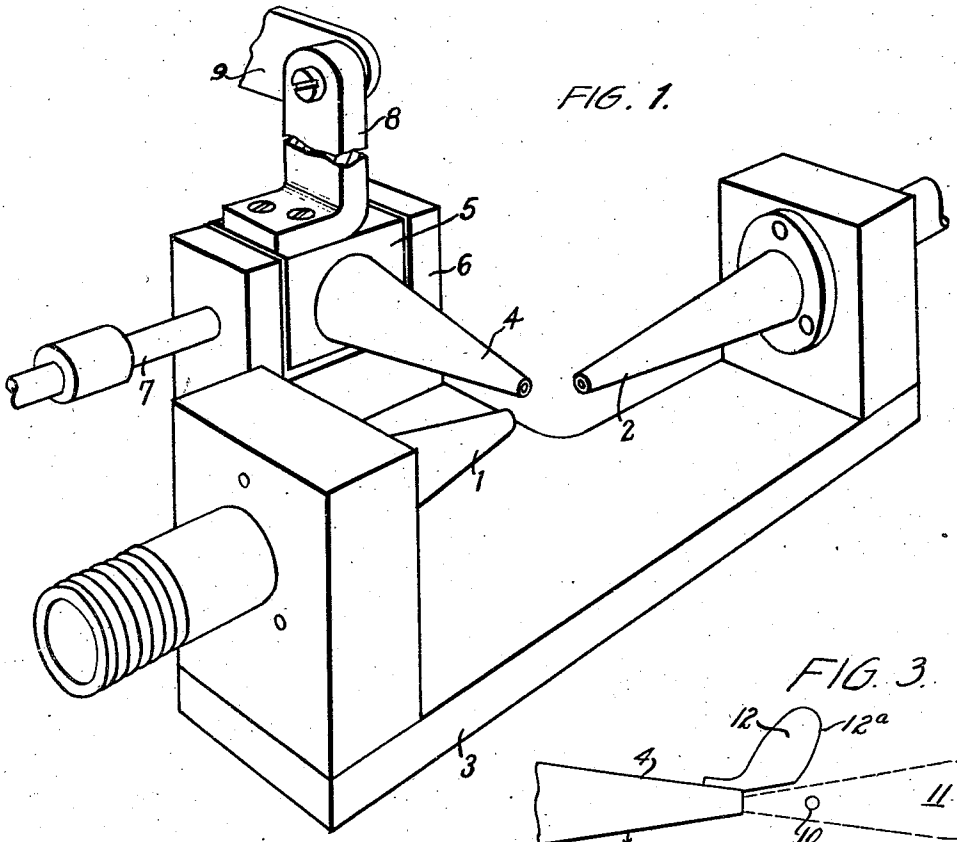


FIG. 3.

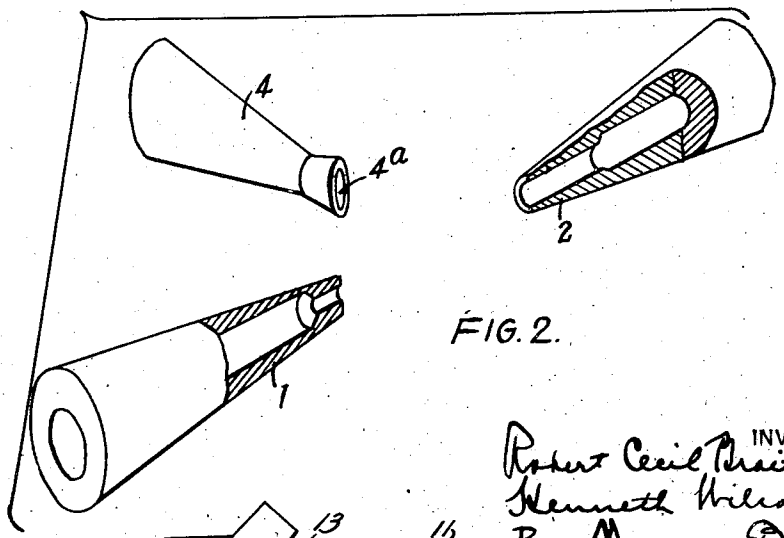
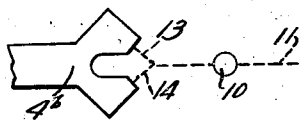


FIG. 2.

FIG. 4.



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Patented Oct. 1, 1946 2,408,603

UNITED STATES PATENT OFFICE

2,408,603

MECHANICAL RELAY OF THE FLUID JET TYPE

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Application October 9, 1943, Serial No. 505,708
In Great Britain May 28, 1940

4 Claims. (Cl. 137—111)

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This invention relates to mechanical relays of the fluid jet type and has for its object to reduce the reaction imposed upon the controlling member of the relay.

A relay of the type referred to comprises a nozzle to which air or other fluid is continuously supplied, usually at constant pressure, and another nozzle or other orifice which receives fluid from the jet issuing from the aforementioned nozzle. The nozzle and orifice are usually enclosed in a casing having an outlet port and sometimes provided with means whereby the pressure within the casing may be controlled.

In certain applications of mechanical relays, and particularly fluid jet type relays it is a requirement that the controlling force or torque for initiating relay action shall be a minimum or, in other words, that there shall be the least possible reaction from the fluid jet issuing from the supply nozzle upon the controlling device or the measuring device in order to minimize disturbance of the force which effects control. For example the measuring device may be a Bourdon tube or aneroid barometer. In the known relays of the type referred to the reaction on the controlling member has been kept sufficiently low for certain uses by causing the measuring or controlling device either to deflect the axis of the nozzle which is supplied with fluid whereby the jet of fluid impinges to a greater or less extent upon the stationary receiving orifice, or in another arrangement the nozzle and receiving orifice are relatively fixed and the control is effected by means of a vane or baffle which is variably interposed in the fluid jet. The fluid variably received by the receiving orifice may actuate for example, a piston or bellows member which in turn may effect control of some other apparatus.

It has been discovered that in the case of the movable jet type of relay the aforesaid reaction is still too high for certain uses of the relay and this has been found to be due to the fact that the jet of fluid tends to bring the jet back into alignment with the receiving orifice. Also when using a vane or baffle type of control it has not been found possible sufficiently to reduce the reaction by designing the shape or nature of the vane or baffle to remove the reaction whilst obtaining reliable results. It has been found in practice that in either of said types of relays, and more particularly in the type employing a tilting nozzle from which the jet issues, a false and undesirable load is imposed on the delicate instrument tilting such nozzle, or moving the vane interposed in the fluid jet, due it is believed, to rebounding of the fluid

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from the end face of the receiving nozzle, and possibly also to eddy currents, the tendency of which influence is to re-centralize the nozzle from which the jet issues. These defects have been alleviated by the present invention in which the control is effected by varying the quantity of fluid which enters the receiving nozzle by means which, for certain particularly delicate types of mechanism, is most conveniently in the form of a third or controlling nozzle mounted in a novel manner which avoids disturbing or objectionable reaction thereon.

According to the present invention the reaction of the fluid jet issuing from the supply nozzle upon the controlling member is reduced to a very small value without loss of controlling accuracy by deflecting said jet from alignment with the receiving orifice by means of another jet which is supplied from a movably mounted deflecting or controlling nozzle so as variably to impinge upon the main jet of fluid issuing from the supply nozzle. Reaction from the fluid jet issuing from the supply nozzle upon the jet from the deflecting or controlling nozzle is minimized by mounting the deflecting nozzle to move about an axis which is so disposed with respect to the direction of efflux from the supply nozzle that this efflux produces no torque of the deflecting nozzle about its axis of movement.

A graduated control of the main jet between the supply and receiving nozzles by the deflecting jet may be attained either by shaping the deflecting or controlling nozzle so that it gives a fantail flow for which purpose this nozzle may have a flattened or slit-like orifice, or by using two jets impinging upon one another in the manner used in certain forms of acetylene gas burners for illumination.

In certain applications of a relay embodying the invention it may occur that the necessity for having the minimum reaction on the measuring device only arises over a certain range of movement of that device, for instance very near to its normal zero position, while major deflections may occur under initial starting or abnormal conditions, when much greater reaction is relatively unimportant. According to a feature of the invention, therefore, the control nozzle may also carry a vane or baffle which normally does not come within the field of the main jet but with large deflections is brought into action and then assumes control of the main jet.

In carrying out the invention the direction of axis of the controlling nozzle may be at right angles to the axis of the main jet and movable

about an axis which is parallel with the main jet, or which is at right angles to the axis of the main jet, in which latter case the controlling jet is normally at right angles to the main jet and moves in a plane containing both jets.

A relay in accordance with the invention may have associated with it any known or convenient form of anti-hunting device. Thus the activity of the servo device initiated by movement of the controlling nozzle about its axis may be made either to tend to restore the position of this nozzle towards its previous position or to move the remainder of the apparatus carrying the main nozzle and receiving orifice to follow up the movement of the controlling nozzle.

The invention will now be described with reference to the accompanying drawing, which is somewhat diagrammatic and in which:

Figure 1 is a perspective view of a fluid jet relay in accordance with the invention.

Figure 2 is a similar view of the three jets showing the formation thereof.

Figure 3 is a diagrammatic view showing the controlling nozzle in elevation and provided with a vane or baffle for controlling the main jet.

Figure 4 is a diagrammatic view of a two-jet nozzle for controlling the main jet.

In the drawing **1** is the nozzle to which the fluid is continuously supplied under constant pressure, whilst **2** is the receiving nozzle or orifice, these members **1** and **2** being mounted on a base member or carrier **3**. At **4** is shown the third nozzle which in the example illustrated provides a jet at right angles to the fluid jet passing between the nozzle **1** and orifice **2**. The nozzle **4** is mounted on a member **5** carried in a bracket **6** and rotatable with respect thereto about an axis coaxial with the pipe **7** through which the pressure fluid is supplied to the nozzle **4**. The member **5** is rocked about its axis of rotation by means of an arm **8** and link **9**, the latter being connected to the measuring instrument or other controlling member.

The nozzle **1** and receiving orifice **2** may have interior forms such as illustrated in Fig. 2 whilst the nozzle **4** may have an elongated mouth **4a** to give a fan-tail type of jet. Figure 3 shows such a nozzle provided with a vane or baffle for controlling the main jet. In this figure, the small circle **10** represents the jet normally passing from the fixed nozzle **1** to the fixed nozzle **2**. At **11** is represented in dotted lines the fan-tail jet obtained by flattening the nozzle **4** as at **4a** in Fig. 2, and at **12** is shown the added vane, which may be soldered to the movable nozzle **4** and which is particularized by the shaped edge **12a** such that when the nozzle is deflected considerably in the direction of the arrow, the main jet **10** will be sliced, so to speak, to a varying amount by the vane **12**.

Figure 4 shows another arrangement employing a nozzle **4b** similar to that of an acetylene gas burner and which produces two jets **13** and **14** which are at an angle, for example, of 90° with respect to one another, these jets impinging upon one another to produce a fan-tail flow which is presented edgewise to the main jet **10**.

We claim:

1. A mechanical relay of the fluid jet type, comprising a pair of fluid jet nozzles arranged in substantially axial alignment and facing one another whereby pressure fluid supplied to one nozzle produces a fluid jet therefrom which normally tends to enter the orifice of the other nozzle, and a third nozzle arranged with its axis substantially at right angles to and in proximity to said jet whereby pressure fluid supplied to said third nozzle produces a fluid jet which impinges upon the first-mentioned jet, said third nozzle being so movably mounted relatively to said pair of nozzles as to cause its jet to variably impinge upon the first-mentioned jet in accordance with the movements imparted to said third nozzle and to thereby vary the amount of fluid entering said orifice of said other nozzle.

2. A relay as claimed in claim 1, wherein said third nozzle is movable about an axis which is so disposed with respect to the direction of efflux of the jet from one of said pair of nozzles that the latter jet produces no torque on said third nozzle about its axis of movement.

3. A relay as claimed in claim 1, wherein said third nozzle is formed to produce a fan-tail jet.

4. A relay as claimed in claim 1, including a vane associated with said third nozzle and movable into the field of the jet from one of said pair of nozzles upon large deflections of said third nozzle.

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