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2 Sheets-Sheet 1

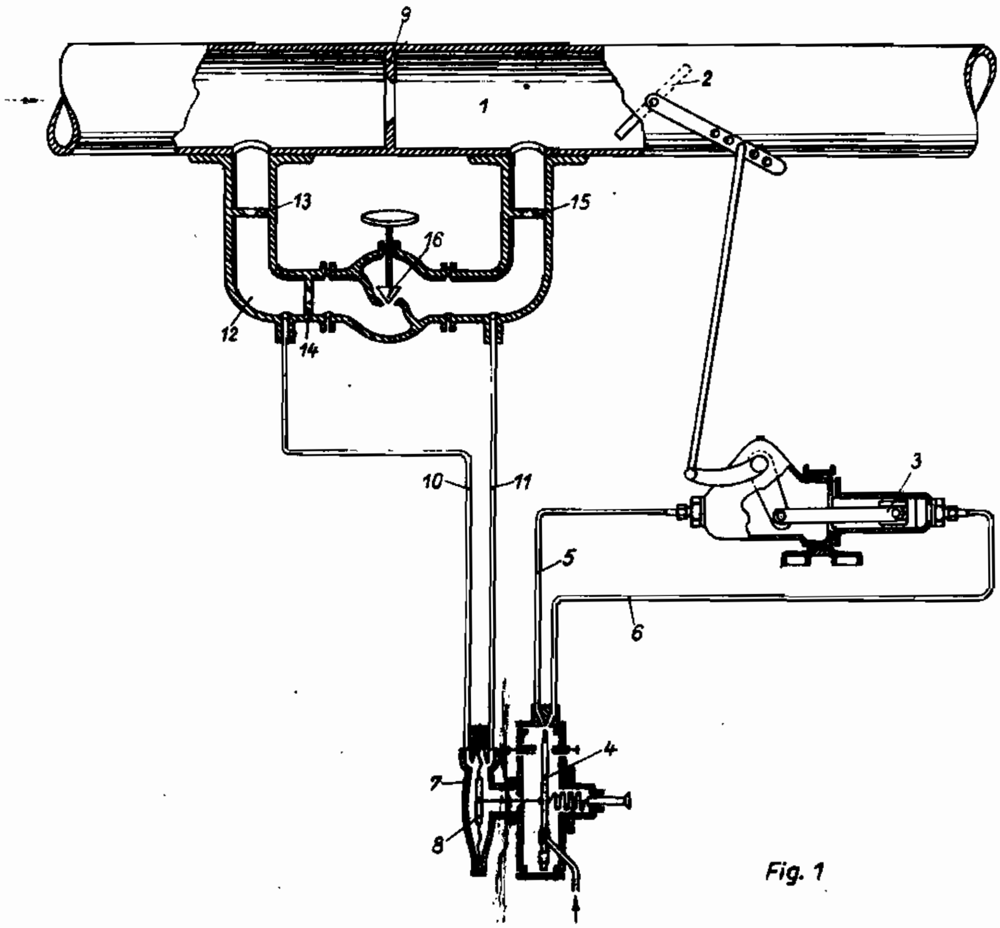

Fig. 1

Am 1949

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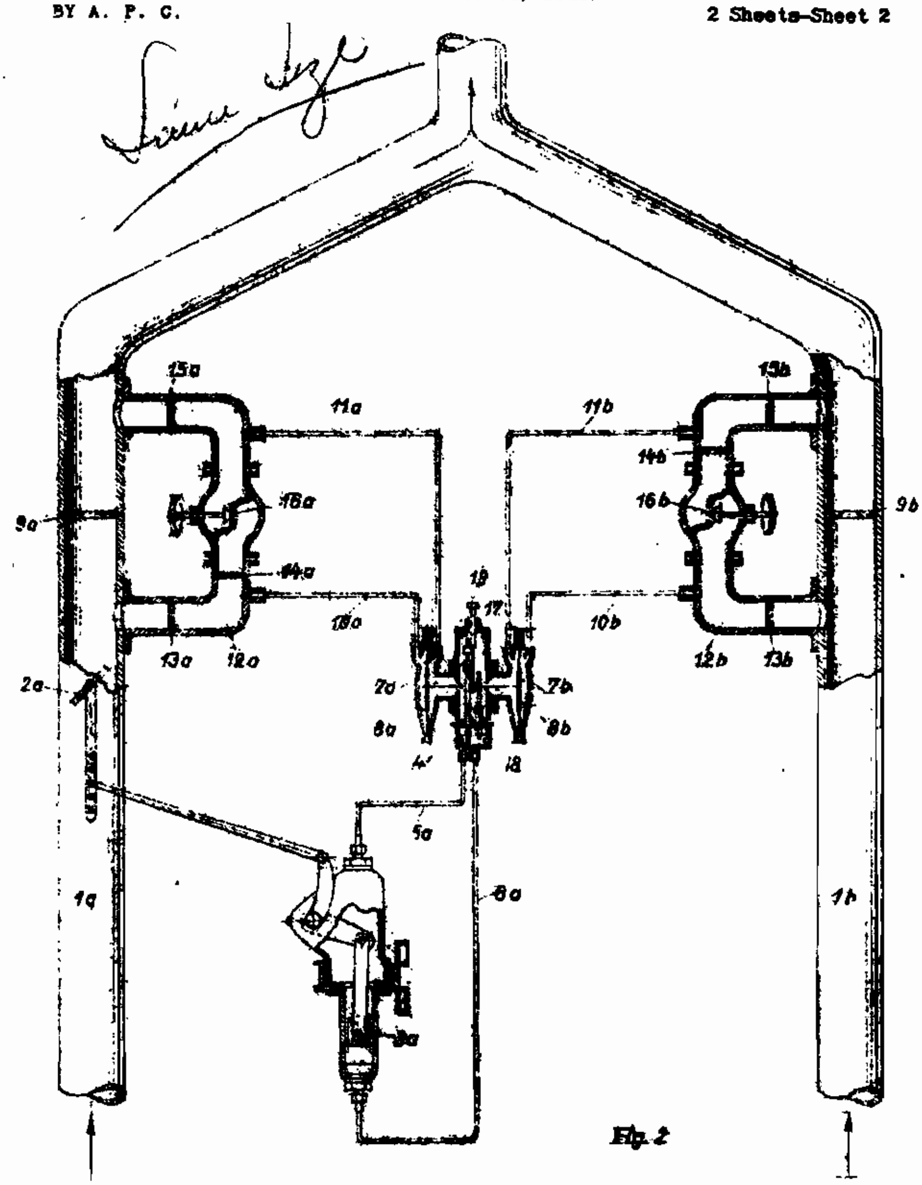

Fig. 2

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DEVICES RESPONSIVE TO THE RATE OF FLOW THROUGH A CONDUIT

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This invention relates to improvements in or relating to devices responsive to the rate of a fluid flow through a conduit.

The devices of this kind comprise a pressure responsive system adapted to be acted upon by the pressure drop at a constriction in the conduit through which the fluid to be measured or regulated flows. As is well known, the pressure drop is a square function of the rate of flow so that upon the rate decreasing to one half the pressure drop decreases to one quarter. Accordingly at small rates, i. e. at a small load the pressure drop is too slight to control a measuring or regulating element. If on the other hand the cross section of the constriction in the conduit is diminished so as to furnish an adequate pressure drop or dynamic pressure even at small loads, the pressure drop increase becomes excessive at great loads. The greater this pressure increase the less is the sensitivity of the pressure responsive system acted upon by said pressure drop. Therefore the variation of the cross section of the constriction cannot lead to a satisfactory solution.

The present invention aims at overcoming these difficulties by providing a shunt communicating with the conduit on both sides of the constriction and a plurality of auxiliary constrictions in said shunt for dividing the pressure drop over the whole length of said shunt or the pressure drop above the main constriction in the conduit in accordance with the number of auxiliary constrictions. In this way one of the respective partial pressure drops may be used to act upon the pressure responsive system, it being understood that such a partial pressure drop may have the same value at a great load as the pressure at the main constriction at a small load.

In order to more fully explain the further aims, objects and advantages of my invention an embodiment thereof will now be described in connection with the annexed drawing in which

Fig. 1 is a sectional view of a controlling system for maintaining constant the rate of flow through a conduit, and

Fig. 2 shows a diagram of a ratio control system comprising two rate responsive devices according to the present invention.

Referring now to the drawings, a gas or liquid flows through a conduit 1 in which a butterfly valve 2 is provided for controlling the flow so as to maintain constant the rate of flow. The valve 2 is operatively connected in any convenient manner to the piston 3 of a servo-motor actuated by any pressure fluid relay—shown in the drawings to be a well known Askania jet pipe relay 4—the jet pipe thereof being deflected in response to a controlling value thereby controlling the pressure difference in the two conduits 5 and 6 leading to both sides of the servomotor as shown in Fig. 1. In the embodiment shown the valve 2 in the conduit 1 is to be controlled in response to the rate of flow. Therefore a pressure responsive system 7 is provided for controlling the jet pipe relay 4 in said system comprising in a well known manner a membrane 8 acted upon by the pressure drop at an orifice plate 9 in the conduit 1. The two chambers separated by the membrane 8 communicate with measuring pressure conduits 10 and 11, respectively, leading to both sides of the orifice plate 8 in the conduit 1.

The device described above operates as follows: Be it assumed that the rate of flow in the conduit 1 increases thereby increasing the pressure drop or dynamic pressure at the orifice plate 9. Accordingly the force exerted by the diaphragm 8 toward the right increases correspondingly and deflects the jet pipe 4 clockwise so that the pressure above the piston 3 increases and the piston is moved downwardly urging the valve 2 towards its closed position until the rate of flow is restored to the predetermined value to be maintained constant.

This value may be chosen at will. However, as explained above, the measuring pressure actuating the membrane 8 and the jet pipe 4 is a square function of the rate in the conduit 1. If for instance the rate value to be maintained constant is doubled the pressure drop at the membrane 8 is increased to the quadruple value, i. e. a value which overloads the membrane.

According to the present invention the following solution is proposed: Two measuring pressure conduits 10 and 11 do not communicate directly in the usual manner with the conduit 1 but with a shunt 12 which in turn communicates with the conduit 1 on both sides of the orifice plate 9. This shunt comprises a plurality of auxiliary orifice plates; in the embodiment are shown three orifice plates 13, 14 and 15. The middle orifice plate 14 is arranged between the measuring pressure conduits 10 and 11. As may be readily understood, the pressure drop at the main orifice plate 9 in the conduit 1 is divided into three partial pressure drops by the three auxiliary constrictions 13, 14 and 15. If the three constrictions have the same cross section, the pressure drop before each of said constrictions amounts to one third of the pressure drop before the orifice plate 9.

The middle constriction 14 is arranged between the two measuring pressure conduits 10 and 11 so that the membrane 8 is acted upon by the partial pressure at 14 provided that the shunt 12 is open. However, if the shunt flow is interrupted by means of a valve 16, the pressure drop at 9 acts upon the diaphragm 8. In this event the conditions are the same as if the conduits 10 and 11 communicated directly with the conduit 1 in the usual manner.

From the foregoing it follows that the valve 16 should be closed as soon as the rate value to be maintained constant is materially decreased and vice versa. Provided that the partial pressure at 14 amounts to one third of the dynamic pressure at 9, the controlling pressure acting upon the membrane 8 remains the same if the rate value to be maintained constant is tripled and at the same time the valve 16 is opened.

It is to be noted that in addition to or instead of the auxiliary constrictions 13 and 15 a short circuited conduit may be provided bridging over the auxiliary constriction 14 and the auxiliary constrictions 13 and 15. It is self-evident that such a short circuited conduit must possess means for shutting off this conduit.

Furthermore the cross section of the auxiliary constrictions may be varied with respect to each other in order to facilitate the adaptation of the control system to the load variations. Therefore I prefer to specially provide easily adjustable orifice plates for the constrictions 13, 14, 15.

Fig. 2 shows another embodiment, i. e. a ratio control system provided for maintaining constant the ratio of the rates of flow through the conduits 1*a* and 1*b*, respectively. In combustion control regulators for instance combustion air flows through the conduit 1*a*, whilst the gas passes through the conduit 1*b*. In order to ensure economical combustion, it is necessary to maintain the most favorable ratio between air and gas.

As shown in Fig. 2 each of the two conduits 1*a* and 1*b* comprises a shunt 12*a*, 12*b*, respectively. The shunts each comprise three auxiliary constrictions 13*a*, 14*a*, 15*a* and 13*b*, 14*b*, 15*b*, respectively, as well as a valve 16*a*, 16*b*, respectively. Accordingly there are two membrane systems 7*a*, 7*b* acting upon a jet pipe relay 4' in opposite directions, said jet pipe relay 4' corresponding to the jet pipe relay 4 in Fig. 1. As in Fig. 1 a servo-motor—3*a*—is provided for adjusting a valve 2*a* in the combustion air conduit 1*a*.

The membrane system 7*a* does not directly engage the jet pipe 4', but an intermediate lever 17 having a fixed axle 18 and being arranged substantially parallel to the jet pipe 4'. The force exerted by the membrane system 7*a* on the intermediate lever 17 is transmitted to the jet pipe 4' by means of a well known so-called ratio slider 19 which permits to vary at will the air—gas ratio to be maintained constant.

The ratio controller as shown in Fig. 2 operates as follows: In the event of a rate increase of the gas or fuel flow in the conduit 1*b*, the pressure drop increases so that the jet pipe 4' is deflected clockwise, thereby displacing the piston of the servo-motor 3*a* to the right and tending to further open the valve 2*a*. Therefore the combustion air flow will likewise be increased in accordance with the increase in the gas or fuel flow.

What is said about the rate responsive device explained with reference to Fig. 1 equally applies to the embodiment shown in Fig. 2. By opening or closing the valves 16*a*, 16*b* in the shunts 12*a*, 12*b* the ratio controller may easily be adapted to the load or the absolute rate of flow in the conduits 1*a*, 1*b*.

Obviously the present invention is by no means restricted to the particular embodiment herein shown and described by way of example only. Many modifications may be made without departing from the spirit of the invention. For instance the principle according to the invention may be likewise utilized for metering instruments of any kind. Furthermore the invention may be used also in cases in which considerable variations in the specific gravity are to be considered in addition to or instead of the rate of flow. In this respect it may be pointed out that the dynamic pressure is dependent not only on the amount of flow passing a constriction but also on the specific gravity.

GUIDO WÜNSCH.