Dec. 12, 1939. E. SCHIMANEK 2,182,933

REGULATION OF INTERNAL COMBUSTION ENGINES

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Fig. 1

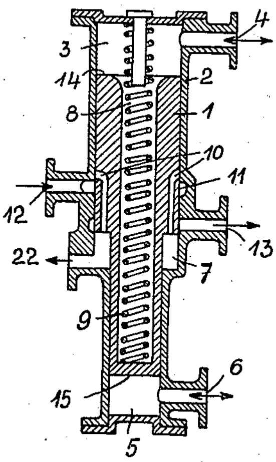


Fig. 2

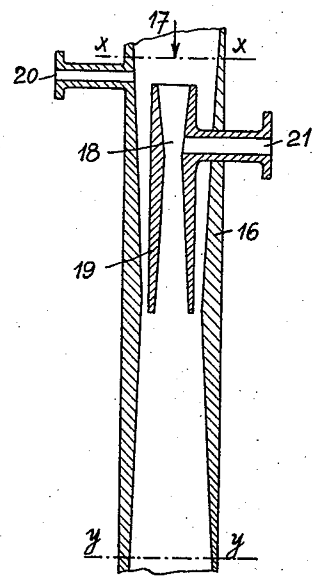
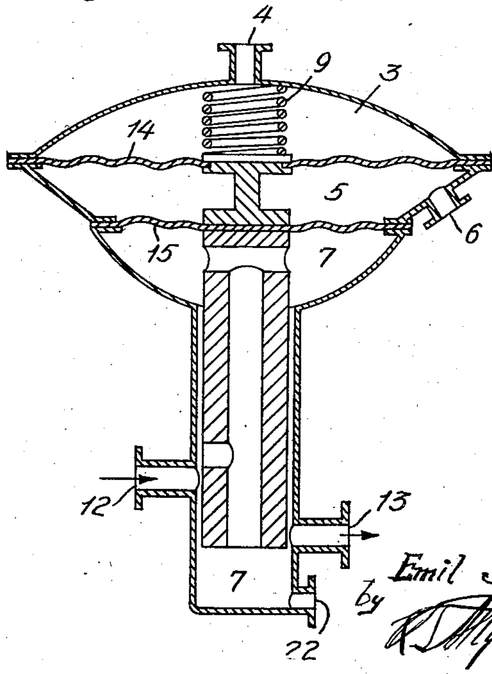


Fig. 3



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REGULATION OF INTERNAL COMBUSTION ENGINES

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2 Claims. (Cl. 123—136)

This invention relates to a method of producing and maintaining a constant liquid or gas pressure in a space independently of the surrounding atmospheric pressure for purposes of regulation in connection with internal combustion engines.

The invention is based on the recognition of the fact that the pressure acting on one of the two smaller effective pressure surfaces of a differential piston or of a differential diaphragm or the like can be kept independent of the pressures acting on the two other pressure surfaces of the piston or the like, if these latter pressures which may themselves be variable remain in a constant ratio to one another and the pressure surfaces acted on by them are so dimensioned that they are to one another in the same, but inverse ratio.

If F_1, F_2 and F_3 be for example the effective pressure surfaces and p_1, p_2 and p_3 the pressures acting on them, the ratio

$$\frac{p_2}{p_1}$$

is to be constant but the ratio

$$\frac{F_1}{F_2}$$

is to be equal to

$$\frac{p_2}{p_1}$$

In this case the products from pressure and surface for these two pressure surfaces F_1, p_1 or F_2, p_2 will be equal to one another and, if the pressures act in opposition to one another, the two forces acting on the two pressure surfaces will balance one another. The pressure p_3 acting on the remaining third pressure surface F_3 of the differential piston or the like can then be suitably adjusted or kept constant by the force of a spring or the like.

In a preferred form of the method according to the invention there are brought to bear on the pressure surfaces of the differential piston or the like, which are to be subjected to the two different pressures with constant ratio, the pressures which occur in a Venturi tube (preferably a double tube) at the critical velocity in the narrowest and in the widest cross-section respectively, whilst the third effective pressure surface of the differential piston or the like is placed under the pressure to be kept constant, the magnitude of which is determined by the effect of a spring or the like.

In the accompanying drawing the invention is diagrammatically illustrated by constructional examples.

Fig. 1 shows one form of the differential pressure member by means of which a delivery of a liquid to an internal combustion engine is maintained at constant pressure.

Fig. 2 shows an arrangement in the induction pipe of the internal combustion engine which may be used in connection with a differential pressure member.

Fig. 3 is another form of the differential pressure member using diaphragms in place of the differential piston construction of Fig. 1.

In Fig. 1 of the drawing 1 is a differential piston which is capable of moving upwards and downwards a few millimetres in the cylinder 2. Into the space 3 above the piston 1 and into the space 5 below the piston there is transmitted through the connections 4 and 6 respectively a gas or liquid pressure, the magnitudes of which pressures are in a constant ratio to one another, which is inversely equal to the ratio of the pressure surfaces 14 and 15. Thus the forces acting on the piston surfaces 14 and 15 will always balance one another, even when the pressures in the spaces 3 and 5 change.

In the interior of the suitably hollow piston 1 is disposed a spring 9 which may consequently be made relatively long or with a suitably large number of convolutions, so that its effect may in view of the small motion of the piston be regarded as practically constant. In the space 7 which is controlled by the third pressure surface of the differential piston a gas or a liquid is enclosed, the pressure of which is dependent (without being dependent on the pressures acting on the two other piston surfaces) only on the pressure of the spring 9.

When the gas or liquid pressure in the space 7 is smaller than the spring pressure, the piston 1 will move downwards and gas or liquid will flow under pressure through the connection 12 and the ring-shaped space 11 through the holes 10, until the pressure of the pressure medium contained in the space 7 has correspondingly risen, so that it balances the pressure of the spring. Should the pressure in the space 7 become too high, the piston 1 is moved upwards and the pressure medium will flow out of the space 7 through the connection into the open, until equilibrium is reestablished.

The arrangement of Fig. 2 shows how, for instance, the two gas or liquid pressures which are in themselves variable, but always maintain the same ratio to one another, for the two spaces

3 and 5 of the differential piston or the like may be produced. The double Venturi tube shown in the drawing may for instance be interposed either in the induction pipe of the engine after the throttle valve, that is between the latter and the engine, *x—x* and *y—y* indicating the limits of the element, or it may be provided at the compressor of an engine, so that the outer tube 16 connects the compression space of the compressor with the suction space or with the atmosphere or with some other space in which a lower pressure prevails than in the compression space of the compressor. In both cases gas flows in the direction of the arrow 17 through the tube 16 forming one Venturi tube and through the second Venturi tube 19. Under the normal operative conditions of the engine, from idle running to full load, the critical velocity always occurs in the narrowest cross-section 18 of the latter Venturi tube, so that the pressure prevailing in the cross-section 18 will theoretically always amount to 0.53 times the pressure prevailing in the tube 16 for instance at the place *x—x*. Actually this proportional number will assume a somewhat greater, but always constant value. This ratio is therefore independent of the specific gravity of the air and of the velocity of flow, consequently of the load on the engine, of its speed of revolution and of all other factors (for instance the extent to which the throttle valve is opened and so on).

Thus, when the pressure at the place *x—x* is conveyed through the connection 20 into the space 5 below the differential piston of Fig. 1 and the pressure at the place 18 through the connection 21 into the space 3 above the differential piston, then, if the ratio of the surfaces 15 and 14 be so selected that it also amounts to a fraction of the pressure ratio, theoretically equal to 0.53, but actually in practice a constant slightly higher than this, equilibrium will prevail between the forces acting on the surfaces 14 and 15 and the pressure in the space 7 will only be dependent on the force of the spring 9. This constant pressure can be conveyed away through the connection 22 and be made use of for regulating purposes in all those cases in which the regulation is to be based on such a constant factor.

Thus, for instance, the admission to an aeroplane engine can be regulated, the constant pressure being brought into suitable relation to the gas pressure determining the admission to the engine.

In Fig. 3 an arrangement is shown, in which a differential diaphragm is used in place of a differential piston. The spaces and connections of this arrangement bear reference numerals corresponding to those of Figure 1.

What I claim is:

1. In apparatus for controlling the pressure of a fluid fuel medium supplied to an engine, an induction pipe having means therein providing pressure differences of a constant ratio when a gaseous medium of varying density flows through the induction pipe, a housing, movable means subject to the action of said pressure differences arranged within said housing and having two surfaces with the area of one surface differing with respect to the area of the other surface in a ratio corresponding to the ratio of the pressure differences so that the forces acting on said movable means balance each other, yieldable means urging said movable means in one direction, said housing having a chamber therein, means carried by the movable means adjacent the chamber and having a surface subjected to the pressure of the fluid medium which is to be rendered constant so as to urge the movable means in a direction opposite to the force of said yieldable means, valve means carried by said movable means for admitting the fluid medium to said chamber when the pressure therein permits the movable means to be moved by the action of the yieldable means, and said chamber having an opening therein for permitting the fluid medium to escape under constant pressure.

2. In apparatus for controlling the pressure of a fluid fuel medium supplied to an engine, an induction pipe having means therein providing pressure differences of a constant ratio when a gaseous medium of varying density flows through the induction pipe, a housing, a piston subject to the action of said pressure differences arranged within said housing and having two surfaces with the area of one surface differing with respect to the area of the other surface in a ratio corresponding to the ratio of the pressure differences so that the forces acting on said piston balance each other, a spring urging said piston in one direction, said housing having a chamber therein, a shoulder carried by the piston adjacent the chamber and having a surface subjected to the pressure of the fluid medium which is to be rendered constant so as to urge the piston in a direction opposite to the force of said spring, valve means carried by said piston for admitting the fluid medium to said chamber when the pressure therein permits the piston to be moved by the action of the spring, and said chamber having an opening therein for permitting the fluid medium to escape under constant pressure.

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