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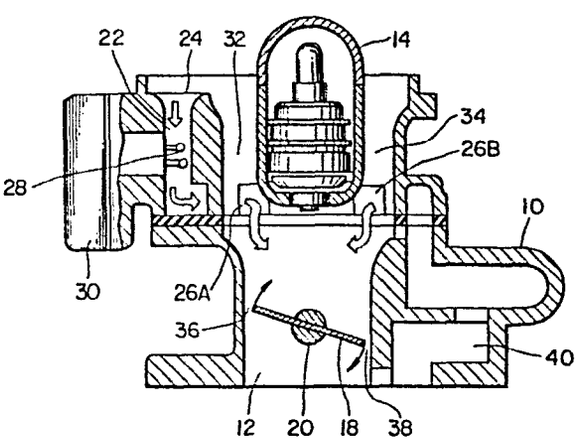
(54) Throttle valve assembly.

(57) A throttle valve assembly having a throttle valve (18) in an air passageway (12) and a fuel injection valve (14) supported by a support arm (16) in the air passageway in a position upstream of the throttle valve, the support arm splitting the air passageway into two portions (32, 34). A bypass passageway (22) having a thermal type air flowmeter (28) mounted therein has an inlet (24) opening in the air passageway in a position upstream of the fuel injection valve, and outlets (26A, 26B) opening in the two portions (32, 34) of the splitted air passageway, respectively, whereby a correct value of the flow rate of air flowing through the air passageway can be measured.

FIG. 2



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THROTTLE VALVE ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to a throttle valve assembly comprising a throttle valve, and a fuel injection valve and a thermal type air flowmeter located in a position upstream of the throttle valve.

One type of throttle valve assembly known in the art comprises a throttle valve and a fuel injection valve upstream of the throttle valve. In recent years, proposals have been made, as disclosed in Japanese Patent Application Laid-Open No. 73858/82, for example, to use another type of throttle valve assembly which comprises a thermal type air flowmeter in addition to the throttle valve and fuel injection valve.

In the throttle valve assembly described in the publication referred to hereinabove, an air passageway is splitted into two portions by a support arm supporting the fuel injection valve. In this construction, the thermal type air flowmeter has an outlet which opens in one of the two portions of the splitted air passageway. This arrangement has raised the problem that, since the flow rates of air flowing through the two air passageway portions differ from each other depending on the condition of operation of the engine, difficulties are experienced in obtaining a correct value for the flow rate of air flowing through the throttle valve. More specifically, even if the

flow rate of air flowing through the air passageway remained constant, the proportion of the flow rate of air flowing through one of the two air passageway portions to the flow rate of air flowing through the other air passageway portion would vary depending on the degree of opening of the throttle valve. Thus, even if the flow rate of air flowing through the throttle valve remained unchanged, the flow rate of air monitored by the thermal type air flowmeter might show a variation in spite of the fact that there is no change in the flow rate of air actually.

SUMMARY OF THE INVENTION

This invention has as its object the provision of a throttle valve assembly which makes it possible to accurately determine at all times the flow rate of air flowing through the air passageway.

The outstanding characteristic of the invention enabling the aforesaid object to be accomplished is that the thermal type air flowmeter has outlets opening in the two portions of the splitted air passageway, respectively, so that the flow rates of air flowing through the two air passageway portions can be measured to obtain a correct value for the flow rate of air flowing through the air passageway.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a top plan view of the throttle valve assembly comprising one embodiment of the invention;

Fig. 2 is a sectional view taken along the line II-II in Fig. 1; and

Fig. 3 is a diagrammatic representation of the relation between the degree of opening of the throttle valve and the output of the thermal type air flowmeter.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figs. 1 and 2 show the throttle valve assembly comprising one embodiment of the invention. As shown, the throttle valve assembly comprises a main body 20, and an air passageway 12 formed in the main body 10.

Located in the air passageway 12 is a fuel injection valve 14 supported by a support arm 16 comprising a pair of arm elements in which a fuel supply passageway and a fuel discharge passageway are formed for supplying a fuel to the fuel injection valve 14 and discharging the fuel therefrom.

A throttle valve 18 secured to a throttle valve stem 20 is disposed in the air passageway 12 in a position downstream of the fuel injection valve 14.

The support arm 16 and throttle valve stem 20 are superposed one above another so as to vertically align with each other as viewed in a direction of the air flow through the air passageway 12.

Located parallel to the air passageway 12 is a bypass passageway 22 which is also formed in the main body 10. The bypass passageway 22 has an inlet 24 opening in the air passageway 12 in a position upstream of the fuel

injection valve 14, and at least two outlets 26A and 26B opening in an annular gap defined between the fuel injection valve 14 and a wall of the air passageway 12.

Located midway in the bypass passageway 22 is a thermal type air flowmeter 28 which supplies an output to a monitoring circuit 30 to measure the rate of flow of air flowing through the bypass passageway 22.

Based on the measurement of the flow rate of air flowing through the bypass passageway 22, the flow rate of air flowing through the air passageway 12 is determined and thus the amount of fuel to be injected through the fuel injection valve 14 is decided.

In deciding the amount of fuel to be injected through the fuel injection valve 14, calculation is done by a computer, not shown.

Attention is directed, in this connection, to the arrangement in which the two outlets 26A and 26B of the bypass passageway 22 open in two portions of the air passageway 12 or a first upstream air passageway portion 32 and a second upstream air passageway portion 34, respectively, into which the air passageway 12 is splitted by the support arm 16.

The outlets 26A and 26B of the bypass passageway 22 is positioned such that a line connecting the center of each of the outlets 26A and 26B with the center axis of the air passageway 12 and a line A-A extending through the center axis of the support arm 16 form an angle θ equal to each other.

In the throttle valve assembly of the aforesaid construction, even if the flow rate of air flowing through the air passageway 12 is constant, the degree of opening of the throttle valve 18 may vary depending on the condition of operation of the engine. For example, at high loads and at low loads, the degree of opening of the throttle valve 18 will show a variation because of a difference in the rpm. of the engine, even if the flow rate of air flowing through the air passageway 12 is the same.

When the degree of opening of the throttle valve 18 shows a variation, the proportion of the flow rate of air flowing through an upper crescent-shaped air passageway portion 36 defined between the throttle valve 18 and the wall of the air passageway 12 to the flow rate of air flowing through a lower crescent-shaped air passageway portion 38 also defined between the throttle valve 18 and the wall of the air passageway 12 will show a variation, with the result that the flow rates of air flowing through the first upstream air passageway portion 32 the second upstream air passageway portion 34 will also show a variation.

In the throttle valve assembly of the aforesaid construction, if the bypass passageway 22 opened only in one of the first and second upstream air passageway portions 32 and 34, the flow rate of air flowing through the bypass passageway 22 would show a variation depending on the degree of opening of the throttle valve 18 even if the flow rate of air flowing through the air passageway 12 remained

constant.

For example, assume that the bypass passageway 22 only opens in the first upstream air passageway portion 32. When experiments were conducted with the structure, the results has been obtained in which the relation between the degree of opening of the throttle valve 18 and the ratio of outputs of the thermal type air flowmeter 28 to correct values of the flow rate of air flowing through the bypass passageway 22 when the flow rate of air remains at a predetermined level, is such that, as represented by a line ●-●-● shown in Fig. 3, the outputs of the thermal type air flowmeter 28 become larger in the smaller degree of opening of the throttle valve 18 even if the flow rate of air remains constant. This would show that the flow rate of air flowing through the upper crescent-shaped air passageway portion 36 is high until the degree of opening of the throttle valve 18 becomes 30 degrees or thereabouts.

The results of similar experiments conducted with the throttle valve assembly according to the invention in which the outlets 26A and 26B of the bypass passageway 22 open in the first and second upper air passageway portions 32 and 34, respectively, have shown that outputs of the thermal type air flowmeter 28 represent substantially correct values for the flow rates of air flowing through the air passageway 12, as represented by a line o-o-o shown in Fig. 3.

From the foregoing description, it will be appreciated that the throttle valve assembly according to

the invention enables a substantially correct value to be obtained for the flow rate of air flowing through the air passageway 12 based on the output of the thermal type air flowmeter to thereby make it possible to obtain a correct value for the amount of fuel to be injected through the fuel injection valve 14.

WHAT IS CLAIMED IS:

1. A throttle valve assembly comprising: a main body (10) having an air passageway (12) formed therein; a throttle valve (18) fixed to a throttle valve stem (20) arranged in said air passageway in such a manner as to extend substantially at a right angle to an air flow through said air passageway; a fuel injection valve (14) arranged in said air passageway in a position upstream of said throttle valve; a support arm (16) supporting said fuel injection valve; a bypass passageway (22) having an inlet (24) opening in said air passageway in a position upstream of said fuel injection valve and an outlet (26A) opening in an annular gap defined between said fuel injection valve and a wall of said air passageway; and a thermal type air flowmeter (28) located midway in said bypass passageway, characterized in that said air passageway (12) is splitted into two portions (32, 34) by said support arm (16) in the vicinity of said fuel injection valve (14), and said outlet (26A) is positioned to open in one (32) of said two portions of the splitted air passageway, and said bypass passageway (22) has another outlet (26B) opening in the other (34) of said two portions of the splitted air passageway.

2. A throttle valve assembly as claimed in claim 1, characterized in that said support arm (16) and said throttle valve stem (20) are superposed one above another so as to vertically align with each other as viewed in a direction of the air flow through said air passageway (12).

3. A throttle valve assembly as claimed in claim 1, characterized in that said outlets (26A, 26B) of said bypass passageway (22) opening in said two portions (32, 34) of the air passageway (12), respectively, are located symmetrically with respect to the axis of said support arm (16).

4. A throttle valve assembly as claimed in claim 1, characterized in that said bypass passageway (22) is formed in said main body (10).

FIG. 1

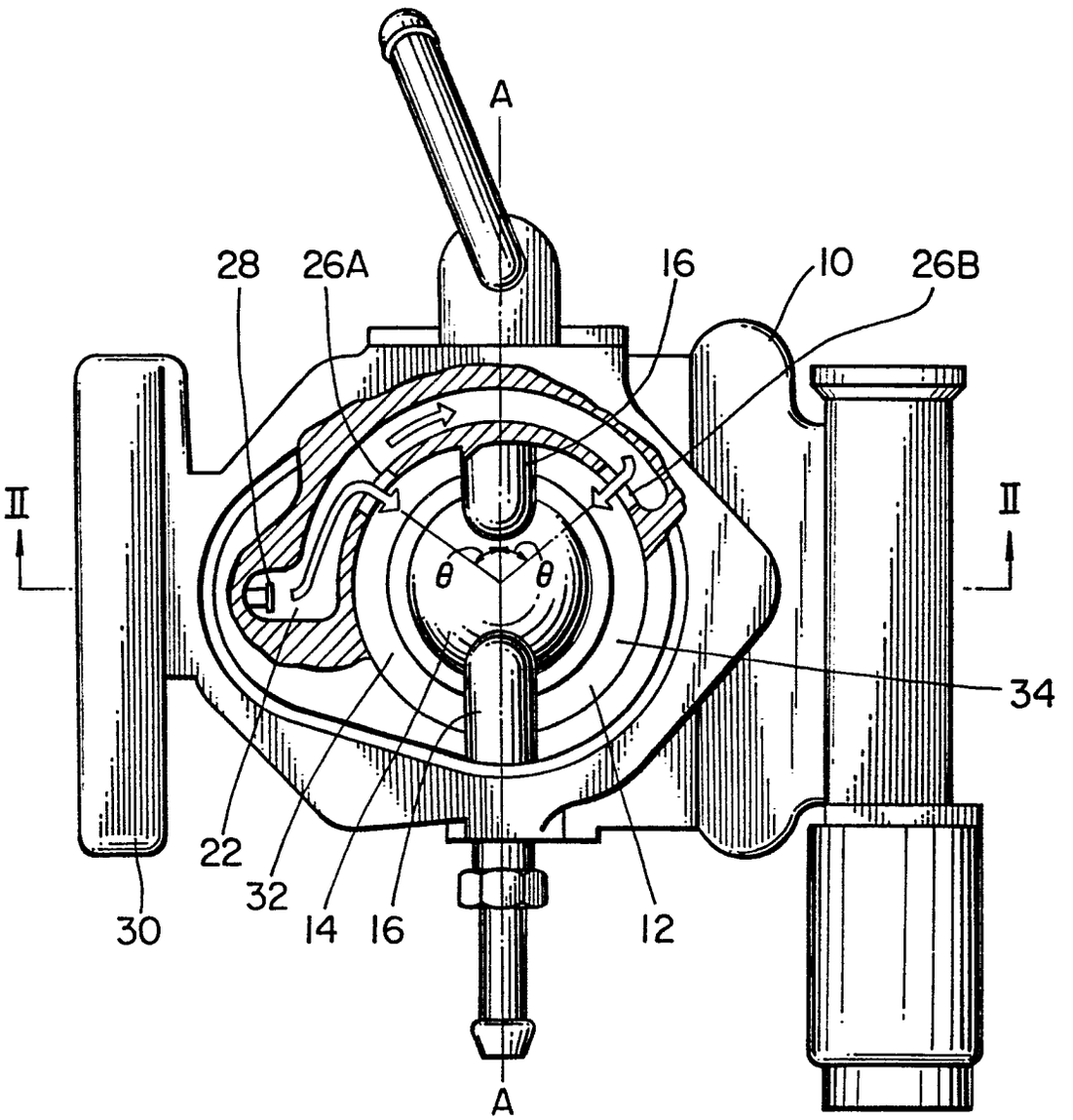


FIG. 2

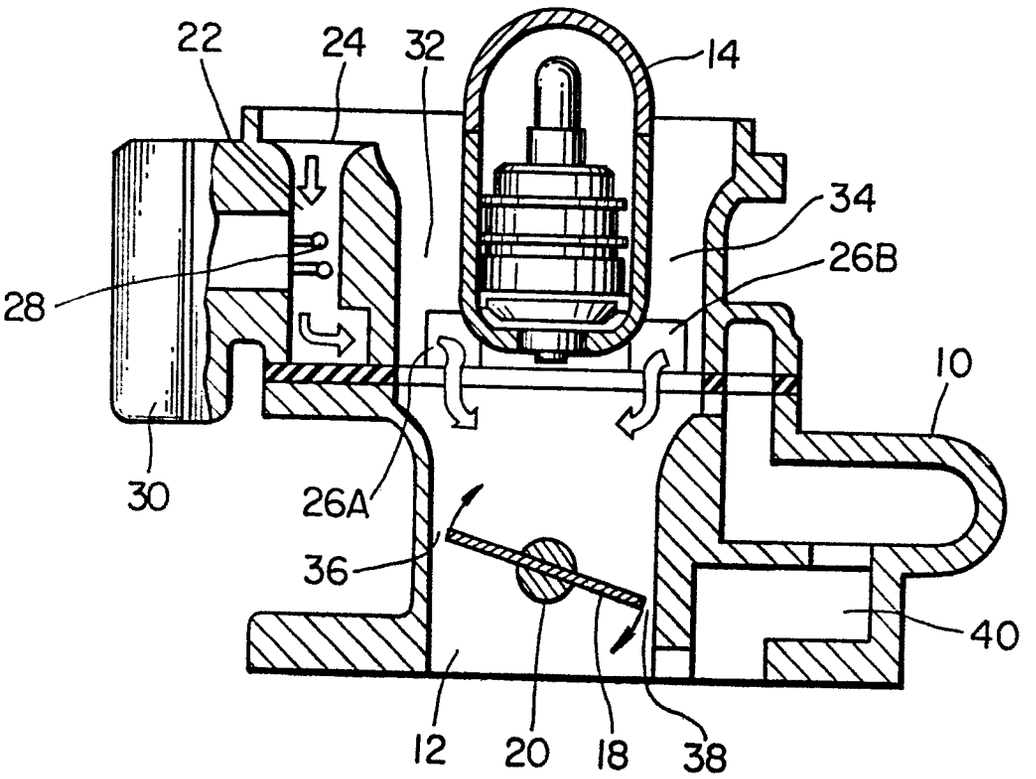
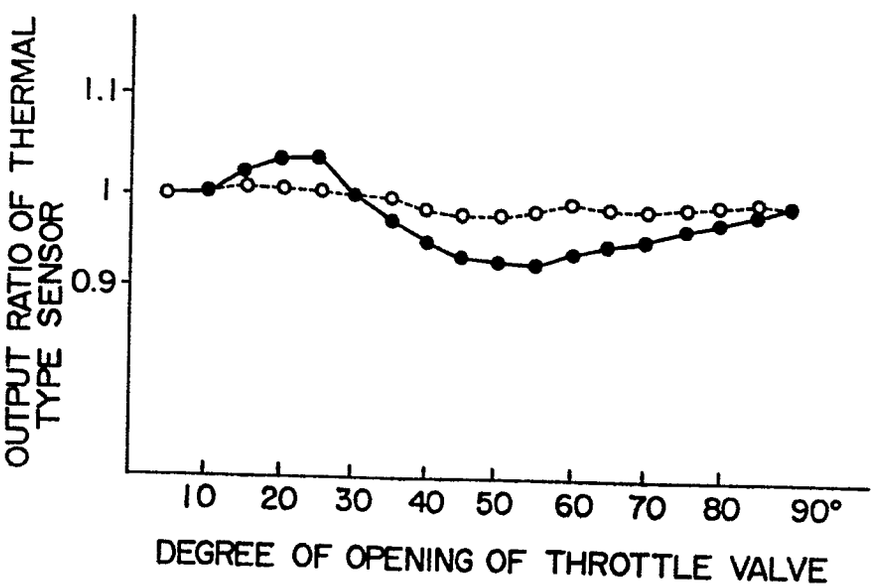

22
24
32
14
34
26B
28
10
30
26A
36
40
12
20
18
38

FIG. 3


OUTPUT RATIO OF THERMAL TYPE SENSOR
1.1
1
0.9
10
20
30
40
50
60
70
80
90°
DEGREE OF OPENING OF THROTTLE VALVE