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(54) **Air bypass valve in throttle body**

(57) An objective of the present invention is to provide an air bypass control device in which a characteristic of supplying by pass air with respect to an opening change of a plunger can be set linearly, and variation of the bypass air can be prevented. A control groove 1 is provided at a plunger guide hole 16 along a longitudinal axis direction X-X of the hole 16, and opened on a side wall 16a of the plunger guide hole 15. A first bypass air passage 14a connected with an intake passage 11a on the upstream side from a throttle valve is opened toward and connected with the control groove 1. A second bypass air passage 14b connected with an intake passage 11b on the downstream side from the throttle valve is opened toward and connected with the plunger guide hole 16, which is placed lower than the control groove 1. A plunger 18 is movably provided in the plunger guide hole 16, so as to move along the longitudinal axis direction X-X of the hole 16. The plunger 18 controls opening and closing of the control groove 1.

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an air bypass control device used in a throttle body for controlling an amount of air flowing toward an engine. In the device, both of intake passages on the upstream side and the downstream side from a throttle valve communicates with a bypass air passage bypassing the throttle body, and a plunger controls opening and closing of an opening area of the bypass air passage.

Description of the Conventional Art

[0002] A conventional air bypass control device in a throttle body is described with Figure 7.

[0003] A throttle body 10 has an intake passage 11 which is provided through in the throttle body 10. The intake passage 11 is opened and closed by a throttle valve 13 screwed to a throttle valve shaft 12 which is rotatably supported to the throttle body 10 and provided across the intake passage 11.

[0004] Thereby, the intake passage 11 is divided to an intake passage 11a and an intake passage 11b by the throttle valve 13, where the intake passage 11a is on the upstream side from the throttle valve 13, and the intake passage 11b is on the downstream side from the throttle valve 13. The intake passage 11a on the upstream side communicates with an air cleaner or the like on the atmospheric side which is not illustrated in the drawings. The intake passage 11b on the downstream side communicates with an engine which is not illustrated in the drawings through an intake pipe.

[0005] Thus, an amount of air corresponding to an opening area of the intake passage 11 is supplied to the engine, where the opening area is controlled by the throttle valve 13. A bypass air passage 14 makes the intake passage 11a and the intake passage 11b communicate with bypassing the throttle valve 13, where the intake passage 11a is on the downstream side from the throttle valve 13, and the intake passage 11b is on the downstream side from the throttle valve 13. An amount of bypass air flowing in the bypass air passage is controlled by the following air bypass control device.

[0006] A control device main body 15 has a plunger guide hole 16 having a circular cross section, an escape hole 17, and an actuator mounting hole 30, and these are coaxially and continuously provided from the lower part toward the upper part.

[0007] A first bypass air passage 14a having a circular cross section is opened on a side wall 16a of the plunger guide hall 16. The upstream of the first bypass air passage 14a communicates with the intake passage 11a on the upstream side from the throttle valve 13.

[0008] Further, a second bypass air passage 14b is opened on a bottom part 16b of the plunger guide hole 16. The downstream of the second bypass air passage 14b communicates with the intake passage 11b on the downstream side from the throttle valve 13.

[0009] That is, the bypass air passage 14 is formed by the first and second bypass air passages 14a, 14b.

[0010] In addition, the upstream and the downstream are indicated in the direction of air flowing.

[0011] A cylindrical plunger 18 is slidably provided in the plunger guide hole 16, and moves along the longitudinal axis direction of the plunger guide hole 16. The first bypass passage 14a opened on the side wall 16a of the plunger guide hole 16 is controlled to open and close by the plunger 18. An actuator 19 is for moving the plunger 18 provided in the plunger guide hole 16 along the longitudinal axis direction of the plunger guide hole 16. The actuator 19 includes a PTC heater 22, a thermal-conductive member 23, a wax element 24, and an operation body 25 in a space formed with an actuator case 20 and a cover 21. The heat-conductive member 23 is for conducting heat of the PTC heater 22 to the wax element 24. A thermal expansion/contraction member such as an olefin, a paraffin or the like, is sealed inside the wax element 24, and volume change of the thermal expansion/contraction member is outputted as a stroke change through an output lever 24a. The operation body 25 is provided facing to the output lever 24a and moved synchronously with the output lever 24a, and a lower end thereof is connected with the plunger 18. The actuator 19 is fixed at the control device main body 15 by inserting the lower end of the actuator case 20 into the actuator mounting hole 30 of the control device main body 15.

Summary of the Invention

[0012] According to the conventional air bypass control device, when the engine does an idling operation, the throttle valve 13 is kept in a totally closed or almost totally closed state, and an amount of idling air needed for the idling operation of the engine is supplied from the bypass air passage 14 corresponding to an atmosphere temperature of the engine.

[0013] That is, when the temperature of the engine and atmosphere is low, the thermal expansion/contraction member in the wax element 24 of the actuator 19 is contracted, and a projection size of the output lever 24a is kept small. Thereby, the plunger 18 keeps a large opening of the first bypass air passage 14a opened on the plunger guide hole 16, and a large flowing amount of idling air is supplied from the second bypass air passage 14b toward the intake passage 11b on the downstream side of the throttle body 13 corresponding to the large opening of the first bypass air passage. Thereby, the engine can start and do a first idling operation at the low temperature.

[0014] On the other hand, when the temperature of the engine and atmosphere is ordinary and high, the thermal expansion/contraction member in the wax element 24 of

the actuator 19 is expanded, and the projection size of the output lever 24a is kept large. Thereby, the plunger 18 keeps a small opening of the first bypass air passage 14a opened on the plunger guide hole 16, and a small flowing amount of idling air is supplied from the second bypass air passage 14b toward the intake passage 11b on the downstream side of the throttle body 13 corresponding to the small opening of the first bypass air passage 14a. Thereby, the engine can start and do the idling operation at the high temperature including the ordinary temperature.

[0015] Here, the relation between the plunger guide hole 16 and the first bypass air passage 14a is noted. As illustrated in Figure 8, the first bypass air passage 14a having the circular cross section is formed through at the side wall 16a having a round face of the plunger guide hole 16.

[0016] The first bypass air passage 14a is machined by a drill. When a cutting edge of the drill having a conical top end contacts with the side wall 16a of the plunger guide hole 16 and penetrates it, the drill may be decentered in of the first bypass air passage 14a into the plunger guide hole 16 (more particularly, in the longitudinal axis direction of the plunger guide hole 16) may be changed.

[0017] Further, the cross sectional shape of first bypass air passage 14a opened in the plunger guide hole 16 may be changed, so that the cross sectional shape may not be formed in the circular shape.

[0018] As described above, when the opening positions and the cross sectional shapes of the first bypass air passage 14a opened in the plunger guide hole 16 are varied by the machining, individual differences are easily generated when the opening of the first bypass air passage 14a is controlled by the plunger 18, and it takes much time for adjusting the differences.

[0019] Further, when the opening position and the cross sectional shape of the first bypass air passage 14a are inspected, these inspection are hard since the first bypass air passage 14a is opened in the plunger guide hole 16.

[0020] Further, as for the plunger 18, a linear lower end surface 18a moves on a circle area of the opening of the circular first bypass air passage 14a to close a part thereof so as to control the amount of air flow. Thereby, a characteristic of the opening area change of the first bypass air passage 14a with respect to the opening degree change (the stroke change) of the plunger 18 is indicated by a nonlinear line as illustrated with the X-X line in Figure 6. So, the opening area of the first bypass air passage 14a is uniquely controlled, and the freedom of setting is low. Thus, it takes much time to determine the opening area control of the first bypass air passage 14a.

[0021] The present invention has been made in order to solve the above-described problems, and a first primary objective of the present invention is to provide an air bypass control device, in which a characteristic of an opening area change of a first bypass air passage with respect to an opening change of a plunger can be linearly set. Further, this air by pass control device can very easily correspond with a characteristic of idling air which is necessary for the engine, and the freedom of supplying bypass air is high.

[0022] Further, a second objective of the present invention is to provide an air bypass control device, in which the variation generated by individual difference of opening timing and an opening area of a first bypass air passage by a plunger is prevented and the bypass air can be controlled stably and uniformly.

[0023] A first aspect of the air bypass control device in a throttle body according to the present invention in order to obtain the above-described objectives is as follows. In the device in which intake passages on the upstream and downstream sides from a throttle valve communicate with a bypass air passage bypassing the throttle valve, and a plunger controls opening and closing of an opening area of the bypass air passage; a control groove is provided at a plunger guide hole for slidably guiding the plunger along the longitudinal axis direction of the plunger guide hole, and is opened toward the plunger guide hole. Furthermore, a first bypass air passage is opened toward the control groove, and a second bypass air passage is opened toward the plunger guide hole, which is placed lower than the control groove.

[0024] Further, in addition to the above-described first aspect, a second aspect of the present invention is an air bypass control device in which the control groove is formed by casting integrally with an actuator mounting hole and a plunger guide hole.

[0025] Furthermore, in addition to the second aspect, a third aspect of the present invention is an air bypass control device in which the control groove is formed to have a small groove width opened toward the plunger guide hole at a groove bottom portion, and to have a large groove width at a groove upper portion.

[0026] According to the first aspect of the present invention, air in the intake passage on the upstream side from the throttle body is supplied into the control groove through the first bypass air passage. The opening of the control groove, which is opened toward the plunger guide hole, is controlled by the plunger slidably provided in the plunger guide hole.

[0027] Thereby, the air is supplied from the first bypass air passage to the second bypass air passage through the plunger guide hole, and the air amount is controlled by the opening of the control groove formed along the longitudinal axis direction of the plunger guide hole. Thus, the characteristic of the opening area change of the control groove with respect to the opening change of the plunger 18 can be linearly set. Thereby, the freedom of setting the amount of idling air can be increased, so that the amount of idling air which is necessary for the engine can be very easily supplied.

[0028] Further, the control groove is formed by a milling process along the longitudinal axis direction of the plung-

er guide hole and thus the groove width and the opening position at the lower end can be precisely and uniformly formed. Thereby, the opening timing and the opening area of the bypass air passage can be formed stably and uniformly without an individual difference, so that the air bypass control device having few variations can be provided.

[0029] Further, the first bypass air passage formed by a drill processing is provided so as to open in the control groove, and not provided directly in the plunger guide hole. Thus, even if decentering of the first bypass air passage is generated when the passage is formed by the drill processing, controlling of the opening area of the control groove by the plunger is not influenced at all, so that the above-described effect is not prevented.

[0030] Further, according to the second aspect of the present invention, the control device main body including the plunger guide hole, an escape hole and the actuator mounting hole, is formed by injection molding of an aluminum die cast material or the like. At this time, the control groove opened in the plunger guide hole is formed by casting integrally with the actuator mounting hole and the plunger guide hole.

[0031] Thereby, the groove width and the position of the opening at the lower end of the control groove opened toward the plunger guide hole can be correctly decided and formed with respect to the actuator mounting hole and the plunger guide hole. Thus, the bypass air having a small individual difference can be supplied stably and uniformly.

[0032] Further, according to the first aspect of the present invention, when the control groove is formed by casting, casting can be very easily carried out. Moreover, the characteristic of the opening area change in a small opening area of the plunger can be made slow, and the characteristic of the opening area change in middle and large opening areas can be made rapid. More particularly, starting ability when the engine is at the low temperature can be improved, and the idling operation having a small fluctuation range can be done when the engine is at the ordinary and high temperatures

BRIEF EXPLANATION OF DRAWINGS

[0033]

Figure 1 is a longitudinal sectional view illustrating one example of an air bypass control device in a throttle body according to the present invention.

Figure 2 is a longitudinal sectional view of only a control device main body taken along the line A-A in Figure 1.

Figure 3 is a cross sectional view taken along the line B-B in Figure 2.

Figure 4 is a longitudinal sectional view illustrating an example of another control device main body used in an air bypass control device in a throttle body according to the present invention.

Figure 5 is a longitudinal sectional view illustrating an example of another control device main body used in an air bypass control device in a throttle body according to the present invention.

Figure 6 is a graph showing the relationship between a plunger opening and an opening area of a bypass air passage.

Figure 7 is a longitudinal sectional view illustrating a conventional air bypass control device in a throttle body.

Figure 8 is a main portions sectional view illustrating a conventional air bypass control device in a throttle body.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0034] Hereinafter, an example of an air bypass control device in a throttle body according to the present invention is described with Figure 1.

[0035] As for same construction parts as those in Figure 7, same codes are used, and descriptions are omitted.

[0036] A control groove 1 is provided in the upper and lower directions toward an actuator mounting hole 30 from near a bottom portion 16b of a plunger guide hole 16. The control groove 1 is provided along a longitudinal axis X-X of the plunger guide hole 16. The control groove 1 is provided at least so as to open on a side wall 16a of the plunger guide hole 16.

[0037] The control groove 1 is illustrated concretely in Figure 2.

[0038] Further, the upstream of a first bypass air passage 14a is opened so as to be connected with an intake passage 11a, where the upstream of the first by pass air passage 14a is on the upstream side from a throttle valve 13, and the downstream of the first bypass air passage 14a is connected toward the control groove 1. The first bypass air passage 14a is illustrated concretely in Figure 3. More particularly, the first bypass air passage 14a is not directly opened on the side wall 16a of the plunger guide hole 16.

[0039] Further, the upstream side of a second bypass air passage 14b is opened on a bottom portion 16b of the plunger guide hole 16, and the downstream side is opened on an intake passage 11b on the downstream side from the throttle valve 13.

[0040] Thereby, when an operation body 25 of an actuator 19 is moved by a temperature change, a plunger 18 is moved synchronously with the operation body 25 along the longitudinal axis X-X of the plunger guide hole 16. So, the plunger 18 variably controls an opening area of the control groove 1 opened on the side wall 16a of the plunger guide hole 16.

[0041] Therefore, when the engine atmosphere temperature is ordinary or high temperature, a thermal expansion/contraction material in a wax element 24 of the actuator 19 is largely expanded so as to largely move

the plunger 18 in the lower direction. Thereby, the opening area of the control groove 1 into the plunger guide hole 16 is kept in a small opening state. Further, the idling air adapting to the ordinary temperature or high temperature state can be supplied from the intake passage 11a on the upstream side from the throttle valve 13 into the intake passage 11b on the downstream side from the throttle valve 13 through the first bypass air passage 14a, the opening S of the control groove 1, the plunger guide hole 16, and the second bypass air passage 14b.

[0042] On the other hand, when the engine atmosphere temperature is low temperature, the thermal expansion/contraction material in the wax element 24 of the actuator 19 is largely contracted so as to largely move the plunger 18 in the upper direction. Thereby, the opening area of the control groove 1 into the plunger guide hole 16 is kept in a large opening state. Then, the idling air adapting to the low temperature state can be supplied from the intake passage 11a on the upstream side from the throttle valve 13 into the intake passage 11b on the downstream side from the throttle valve 13 through the first bypass air passage 14a, the opening S of the control groove 1, the plunger guide hole 16, and the second bypass air passage 14b.

[0043] In the air bypass control device according to the present invention, the control groove 1 is provided on the side wall 16a of the plunger guide hole 16 along the longitudinal axis X-X of the plunger guide hole 16, and opening and closing of the opening of the control groove is controlled by the plunger 18. Thus, the characteristic of the opening area change of the bypass air passage 14 with respect to the opening change of the plunger 18 can be linearly set. Thereby, the freedom of setting the amount of bypass air can be increased, and setting workability can be remarkably improved. The O-O line in Figure 6 shows that the characteristic of the opening area change of the bypass air passage 14 can be linearly set.

[0044] The groove width 1a of the control groove 1 can be arbitrarily changed. Thereby, the characteristic of the opening area change shown with the 0-0 line in Figure 6 can be moved in the upper and lower directions in Figure 6, and the freedom of setting the amount of bypass air can be improved.

[0045] Further, the control groove can be machined by milling at least with respect to the plunger guide hole 16. Thereby, a lower end position 1b of the control groove 1 with respect to the side wall 16a of the plunger guide hole 16 and a groove width 1a can be correctly machined and formed. Further, the first bypass air passage 14a is not opened toward the plunger guide hole 16 but is opened toward the inside of the control groove 1. Thereby, the opening timing and the opening area of the control groove 1 according to movement of the plunger 18 can be made constant. Thus, the variations of the opening timing and the opening area by the individual differences can be prevented, and thereby, the bypass air can be controlled stably and uniformly.

[0046] Further, when a control device main body 15 is injection molded by using an aluminum die cast alloy and a synthetic resin material, the plunger guide hole 16, the actuator mounting hole 30 including the escape hole 17, and the control groove 1 are integrally formed with a core, and the core is upwardly pulled and removed at the time of injection molding. Thereby, the plunger guide hole 16, the escape hole 17, the actuator mounting hole 30 and the control groove 1 can be integrally formed by casting in the control device main body 15. By this way, the groove width 1a and the lower end position 1b of the control groove 1 can be formed more easily and stably with having a small individual difference, in comparison with machining of the control groove 1 by milling. In addition, although the plunger guide hole 16 can be finished by machining process, the groove width 1a and the lower end position 1b of the control groove 1 are not influenced in the machining.

[0047] Further, as illustrated in Figure 4, when the groove width of the control groove 1 is formed to have a small groove width 1d at a groove bottom portion 1c and a large groove width 1f at a groove upper portion 1e, the characteristic of the opening area change of the bypass air passage 14 can be made slow at the small opening area of the plunger opening, and can be made rapid at the large opening area of the plunger opening, as shown with the Δ-Δ line in Figure 6. Thereby, the starting ability at the low temperature can be improved, and a warm-up operation after starting can be sufficiently carried out. Further, the amount of idling air at a time of operation at the ordinary temperature, at which a using frequency is highest, can be kept with high accuracy, so that the idling operation of the engine can be stably done.

[0048] Further, according the above, the characteristic of the opening area change of the bypass air passage 14 can be varied to various kinds of characteristics according to requirement of the engine, so that the air bypass control device having high versatility can be provided.

[0049] Further, according to the above-described control groove, the groove width 1d at the groove bottom portion 1c is formed smaller than the groove width 1f at the groove upper portion 1e, so that the control groove 1 can be formed by casting very easily.

[0050] Further, a groove shape of the control groove 1 illustrated in Figure 4 is formed to have a tapered shape. However, it can be formed to have a stepped shape as illustrated in Figure 5.

[0051] Furthermore, the control device main body 15 can be formed integrally with the throttle body 10, or separately. Further, as for the bypass air passages, the second bypass air passage 14b can be made to communicate with the intake passage 11a on the upstream side from the throttle valve, and the first bypass air passage 14a can be made to communicate with the intake passage 11b on the downstream side from the throttle valve.

Claims

1. A air bypass control device in a throttle body, in which intake passages on the upstream and downstream sides from a throttle valve communicate with a bypass air passage bypassing the throttle valve, and a plunger controls opening and closing of an opening area of the bypass air passage,
wherein a control groove 1 is provided at a plunger guide hole 16 for slidably guiding a plunger 18 along the longitudinal axis direction X-X of the plunger guide hole 16, and is opened toward the plunger guide hole 16,
wherein a first bypass air passage 14a is opened toward the control groove, and
wherein a second bypass air passage 14b is opened in the plunger guide hole 16, which is placed lower than the control groove 1.

2. The air bypass control device in the throttle body as claimed in claim 1,
wherein the control groove is formed by casting integrally with an actuator mounting hole 30 and a plunger guide hole 16.

3. The air bypass control device in the throttle body as claimed in claim 2,
wherein the control groove 1 is formed to have a small groove width 1d opened toward the plunger guide hole 16 at a groove bottom portion 1c, and to have a large groove width 1f at a groove upper portion 1e.

FIG. 1

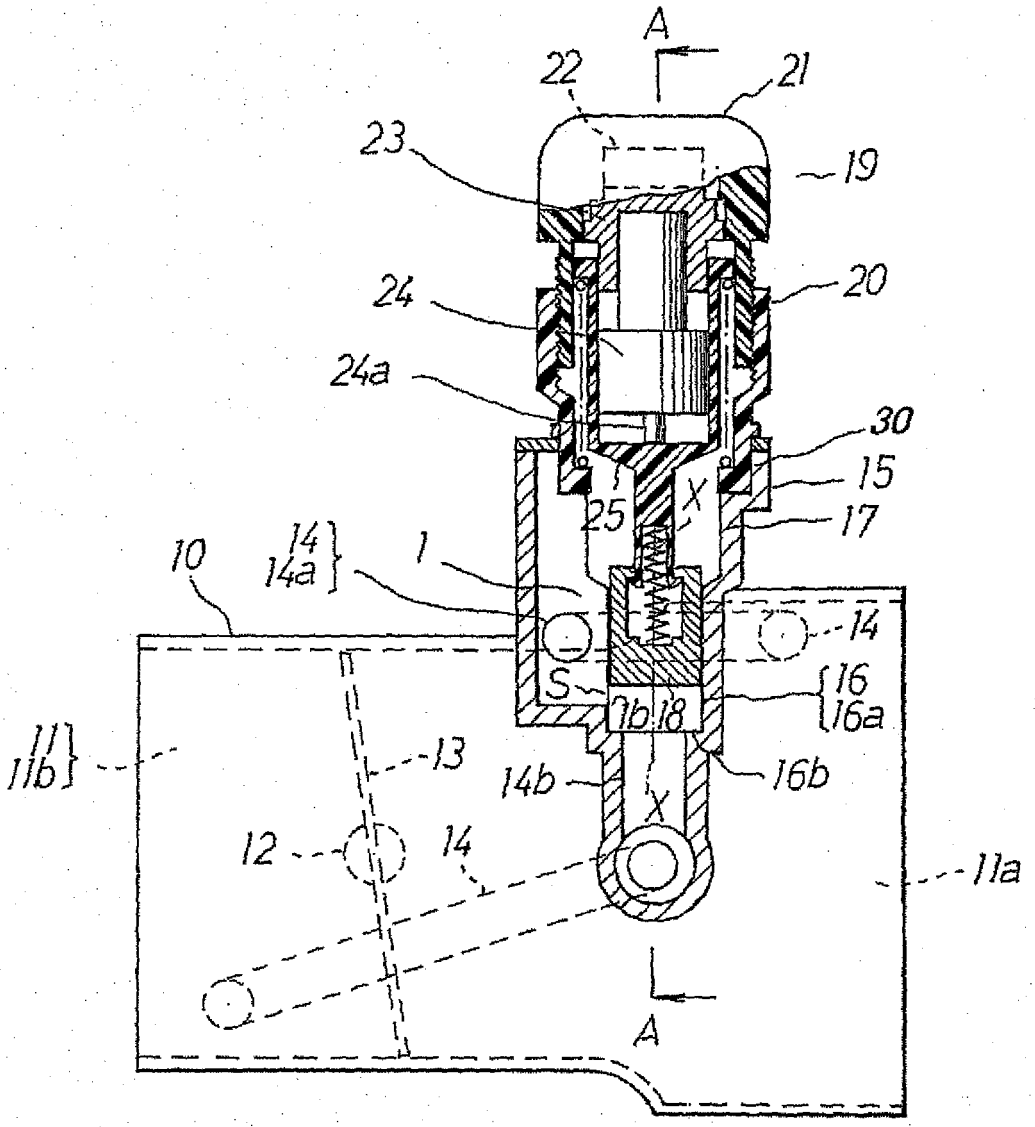

A
22
21
23
19
24
20
24a
30
15
25
X
17
10
14
14a
1
14
S
16
16a
7b
18
11
11b
13
14b
16b
X
12
14
11a
A

FIG. 2

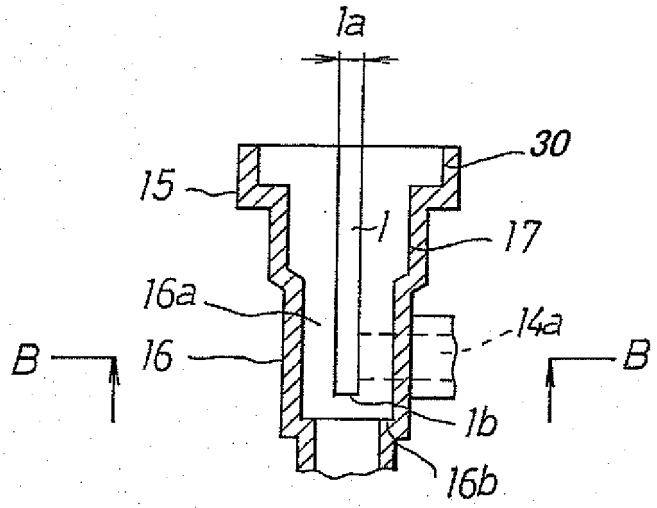


FIG. 3

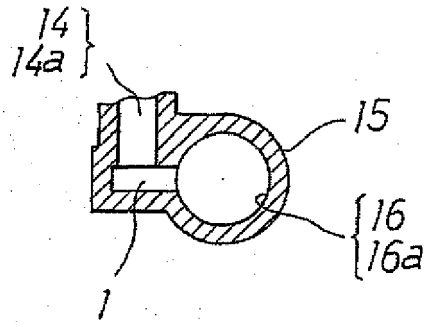


FIG. 4

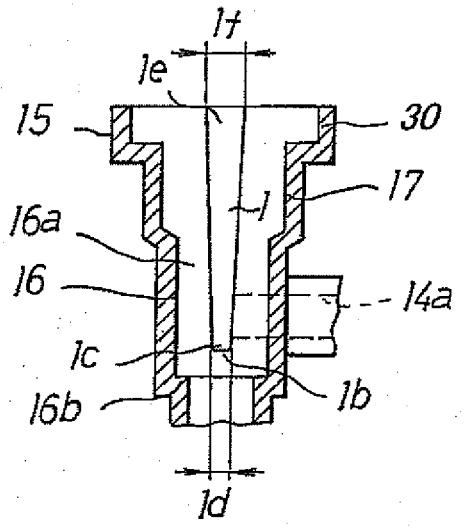

1f
1e
15
30
17
1
16a
16
14a
1c
1b
16b
1d

FIG. 5

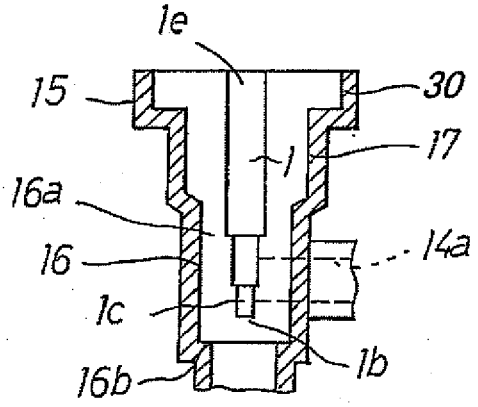

1e
15
30
17
1
16a
16
14a
1c
1b
16b

FIG. 6

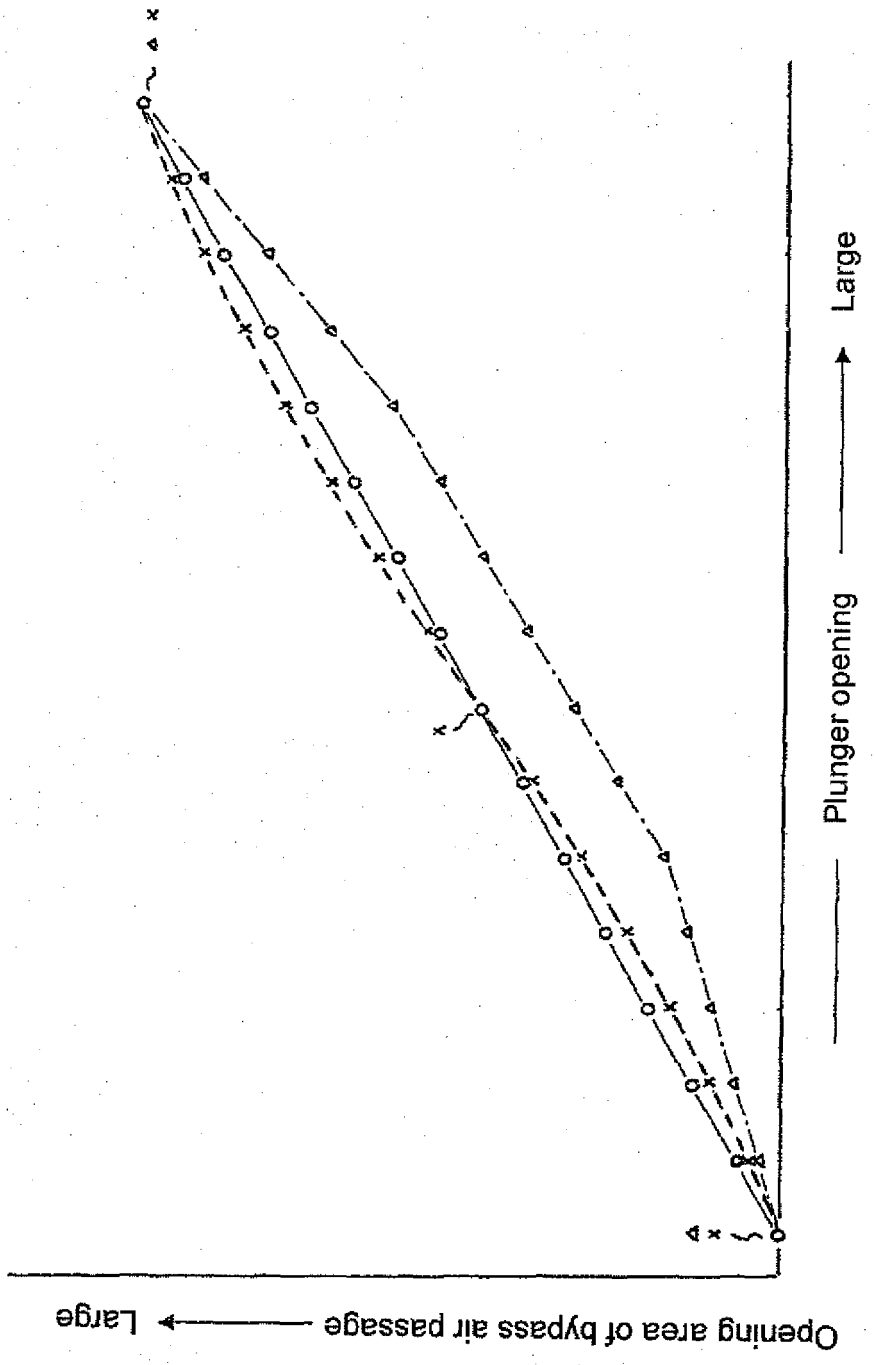
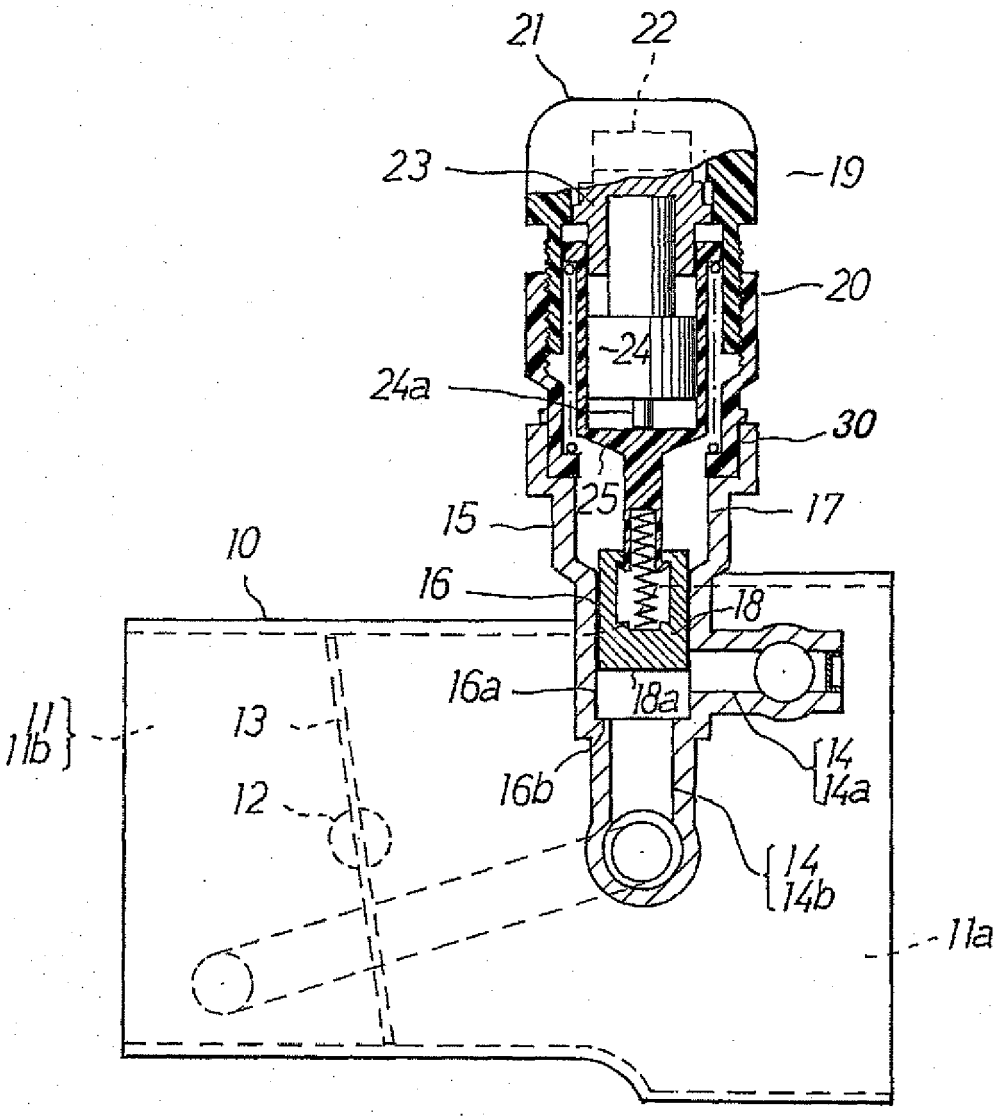

Opening area of bypass air passage
Large
Plunger opening
Large

FIG. 7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24a
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25
15
17
10
16
18
16a
18a
11
11b
13
12
16b
14
14a
14
14b
11a

FIG. 8