(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 509 782 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **92303379.9**

(51) Int. Cl.[5] : **F02M 35/12**

(22) Date of filing : **15.04.92**

(30) Priority : **17.04.91 JP 110707/91**

(43) Date of publication of application :
21.10.92 Bulletin 92/43

(84) Designated Contracting States :
DE GB

(71) Applicant : **HONDA GIKEN KOGYO KABUSHIKI KAISHA**
1-1, 2-chome Minami-Aoyama Minato-ku Tokyo (JP)

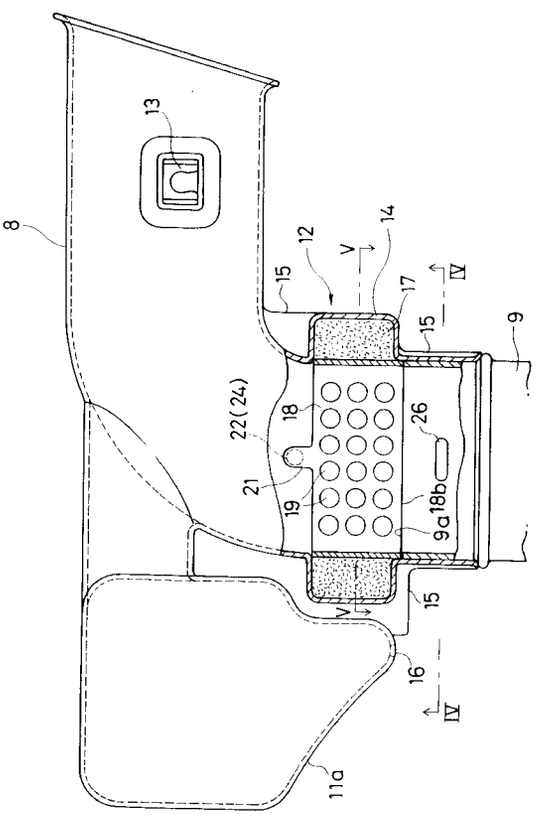
(72) Inventor : **Matsumura, Yasuo**
c/o K.K. Honda Gijutsu Kenkyusho, 1-4-1, Chuo Wako-shi, Saitama-ken (JP)
Inventor : **Niimi, Atsushi**
c/o K.K. Honda Gijutsu Kenkyusho, 1-4-1, Chuo Wako-shi, Saitama-ken (JP)

(74) Representative : **Cheyne, John Robert Alexander Mackenzie et al**
HASELTINE LAKE & CO. Hazlitt House 28, Southampton Buildings Chancery Lane London WC2A 1AT (GB)

(54) Intake noise damping device.

(57) The present invention relates to improvements in an intake noise damping device mounted in the intake system of an engine for motor vehicles. There is mounted an intake noise damping device 12 on the first air duct member side in the vicinity of a connection of the intake duct formed by connecting the first intake air duct member 8 to the second intake air duct member 9. The intake noise damping device comprises a bulged section 14 formed in the first intake air duct member, a sound absorbing material 17 installed in the bulged section, and perforated plate 18 installed along the inside surface of the sound absorbing material. These parts are cylindrical and of an elliptic sectional form. There is provided an engaging projection 22 in the perforated plate at a position of minor axis end a_1. This engaging projection is engaged with an engaging hole 24 provided in the inner surface of the duct member 8, and the end face of the duct member 9 which fits in the duct member 8 contacts the opposite end face of the perforated plate. The perforated plate has a number of holes 19 made in the direction of the minor axis, in its surfaces of large radius of curvature extending from both minor axis ends to both sides in direction of major axis b.

FIG.3



EP 0 509 782 A1

The present invention relates to an intake noise damping device to be mounted in an intake system of an engine of a motor vehicle.

In an engine of a motor vehicle such as an automobile, a motorcycle, etc., an air cleaner is used for filtering the air which enters the engine, the air thus filtered being drawn into a combustion chamber of the engine after it is mixed with fuel in a carburettor. In this air cleaner, noise is generated by the flow of intake air. This noise can sometimes increase to a significant level. At the air inlet of the air cleaner, therefore, is mounted an air duct, in which sound absorbing means may be provided for the purpose of noise reduction.

The sound absorbing means described above, can comprise an intake noise damping device as disclosed in Japanese Laid-Open Utility Model Publication No. 62-101018 (1987), in which a perforated section having a multitude of holes passing through a duct wall is formed in a part of an intake duct, and the outside wall of this perforated section is covered with a filter material, a sound absorbing material, and a hermetically sealing cover respectively.

Japanese Patent Publication No. 1-27253 (1989) discloses an intake noise damping device in which the inside wall of a square section intake air duct is lined with a layer of urethane sound absorbing material and the inside surface of this layer of sound absorbing material is supported by a frame formed of perforated plate or mesh.

However, in the intake noise damping device disclosed in Japanese Laid-Open Utility Model Publication No. 62-101018 described above, holes are formed in a duct body, therefore resulting in lower rigidity of this part. Increasing the wall thickness of this duct in order to compensate for the lower rigidity, however, increases the weight of the part. Since the cover, for the purpose of mounting, is generally split into two halves, the number of component parts required increases, causing easy ingress of water through a clearance between the cover and the duct and through the joint between the two halves of the split cover, possibly lessening the effect of the sound absorbing material. Furthermore, to completely prevent the ingress of water, the sealing member is essential. This however, increases the number of parts, making the mounting operation more difficult.

In the intake noise damping device disclosed in Japanese Patent Publication No. 1-27253 described above, because a sound absorbing material and a perforated plate are installed on the inside wall of the duct, the cross-sectional area of the intake air passage decreases considerably, resulting in limitation of the engine power output.

According to the present invention there is provided, an intake noise damping device mounted in an intake air duct formed by connecting first and second intake duct members. A bulged section is formed in the first intake air duct member in the vicinity of a connection between the first intake air duct member and the second intake air duct member, and in this bulged section is installed a sound absorbing member. Along the inside surface of the sound absorbing material is installed a perforated plate. The second intake air duct member is inserted in the first intake air duct member with the end face thereof in contact with an opposite end face of the perforated plate. The perforated plate is engaged with the first intake air duct through an engaging section formed on this plate.

According to the present invention, various problems of the prior art technique described above can be solved. In addition, the perforated plate can be supported securely in a specific position by contacting the end face of the second intake air duct member with the adjacent end face of the perforated plate. Furthermore, by properly engaging the perforated plate with the first intake air duct member, the assembly of the intake noise damping device is facilitated.

Preferably, the intake air duct members and the perforated plate are cylindrical having an elliptical cross-section, and the perforated plate is provided with an engaging projection which is engaged in an engaging hole formed in the first intake air duct member. Alternatively, the perforated plate may be provided with a hole or recess and the first intake air duct may be provided with a corresponding projection. The engaging projection and hole may preferably be located on an end of the minor axis of the elliptical cross-section of the intake air duct members.

The intake noise damping device of the present invention, having an intake air passage of elliptical cross-section, has little intake resistance, compared with one of polygonal cross-section. In addition, the engagement between the perforated plate and the first intake air duct member is effected by fitting the engaging projection of the perforated plate in the engaging hole in the intake air duct member, thereby facilitating confirming the state of engagement. In addition, the perforated plate can easily be installed in, and removed from, the intake air duct member. Furthermore, since the engaging hole and the engaging projection are located in the position corresponding to an end of the minor axis of the elliptical crosssection that is, in a surface section having a large radius of curvature which approximates to a flat surface, it is possible to easily form the engaging hole in the first intake air duct member with a high degree of accuracy.

A number of holes of the perforated plate are made in a direction of a minor axis of the elliptical crosssection in surface sections of large radius of curvature extending on both sides in a direction of a major axis of the ellipse from positions corresponding to both ends of the minor axis.

Accordingly, it is possible to make a number of holes simultaneously with ease and with a high accuracy in the plate forming a tube of elliptical crosssec-

tion. That is, it is possible to punch all holes at the same time in surface sections of a tube of elliptical cross-section, which surface sections have large radii of curvature and extend in a direction of a major axis, by pressing a set of upper and lower hole forming dies, each having a number of projecting punches arranged in parallel, against the tube from both above and below in a direction of a minor axis of the tube cross-section. Since the surface sections are approximately at right angles with the direction of the minor axis, each punch cuts a hole in the tube nearly perpendicularly to the surface of the tube. Therefore, precision holes can be punched which cause minimal deformation or damage to the perforated section.

For a better understanding of the present invention and to show how it may be carried into effect reference will now be made by way of example to the accompanying drawings, in which:

Fig. 1 is a perspective view showing a part of the interior of an engine compartment of an automobile equipped with an intake noise damping device of the present invention;

Fig. 2 is a front view of an engine compartment section of Fig. 1;

Fig. 3 is a partial cutaway rear view of a first intake air duct member;

Fig. 4 is a sectional view along line IV-IV of Fig. 3;

Fig. 5 is a sectional view taken along line V-V of Fig. 3;

Fig. 6 is a plan view of a perforated plate;

Fig. 7 is an end view of the perforated plate viewed in the direction of an arrow VII of Fig. 6;

Fig. 8 is a sectional view taken along line VII-VII of Fig. 7;

Fig. 9 is a sectional view similar to Fig. 7 showing modified engaging holes; and

Fig. 10 is a sectional view for explaining a method of cutting holes in a plate.

Fig. 1 is a perspective view showing a part of the interior of an engine compartment of an automobile equipped with an intake noise damping device according to the present invention. Fig. 2 is a front view thereof.

In these drawings, reference numeral 1 refers to a wheel housing formed in the side of an engine compartment of a vehicle body; and numeral 2 is a fender or wing panel provided on the outside of the wheel housing 1. In the wheel housing 1 is formed a wheel apron 1a bent inward. Along the inner edge thereof is installed a side frame 3. An air cleaner 4 is mounted astride the wheel apron 1a and the side frame 3 at the front of a damper housing 1b formed in the wheel housing. This air cleaner 4 is composed of a lower case 5 and an upper case 6 removably attached thereto, and a cleaner element not illustrated is mounted inside.

Into the air cleaner 4 is introduced the outside air through an intake air duct 7. This intake air duct 7 consists of a first intake air duct member 8 which opens sidewards, extends across the front of the air cleaner 4, and is bent downwards at the other end, and a second intake air duct member 9 which is connected to the bent lower end of the first intake air duct member 8, passes through the wheel apron 1a upward after going around the lower part of the side frame 3, and is connected to an inlet port 5a formed in the front part of the lower case 5 and opening downward.

The first intake air duct member 8 and the second intake air duct member 9 communicate with resonance chambers 11a and 11b through branch pipes 10a and 10b respectively, so that a noise energy in the intake air duct will be absorbed by resonance of the air in the resonance chambers 11a and 11b. Furthermore, the intake noise damping device 12 of the present invention is mounted to the first intake air duct member 8. This intake noise damping device 12 is located on the first intake air duct member 8 side at the connection between the first intake air member 8 and the second intake air duct member 9 as illustrated. Hereinafter the intake noise damping device 10 will be explained by referring to Figs. 3 to 9.

Fig. 3 is a rear view of the first intake air duct member 8 of Figs. 1 and 2, partly sectioned in the vicinity of the intake noise damping device 12. A numeral 13 denotes a mounting section provided on the back of the first intake air duct member 8. The first intake air duct member 8 is secured on the front surface of the lower case 5 by this mounting section 13. In the intake noise damping device 12, the first intake air duct member 8 is expanded in diameter to form a bulged section 14. The first intake air duct member 8 section of the upstream and downstream sides including this bulged section 14 has an elliptic cross sectional form as shown in Figs. 4 and 5, and is reinforced with ribs 15 projectingly extending lengthwise on both ends of the major axis b. The rib 15 on one side serves also as a stay member for supporting the resonance chamber 11a. A numeral 16 refers to a water drain hole provided in the bottom of the resonance chamber 11a.

The bulged section 14 is filled with a sound absorbing urethane material, fiber material, etc., and along the inner peripheral surface of this sound absorbing material 17 is installed a cylindrical perforated plate 18. This perforated plate 18 also has an elliptic cross sectional form (Figs. 5 and 7), and is provided with a multitude of holes 19. These holes 19, as shown in Fig. 5, are cut in the direction of minor axis a, in surface sections 20 of a large radius of curvature extending to both sides in the direction of a major axis b from both ends a_1, a_1 of the minor axis a.

As shown in Figs. 6 to 8, on the upstream end face 18a of the perforated plate 18 are provided lugs 21 projecting to the upstream side from the center positions of the aforementioned upper and lower surface

sections 20, that is, the positions at both minor axis ends a_1, a_1. This lug 21 has a round engaging projection 22 protruding radially outward; on this projection 22 is formed a slant face 23 facing the upstream side. Furthermore, an engaging hole 24 is provided in a position corresponding to the engaging projection 22 on the inner peripheral surface of the first intake air duct. The perforated plate 18 and the first intake air duct member 8 can be engaged by fitting the engaging projection 22 in the engaging hole 24, the perforated plate 18 being supported in proper position by the first intake air duct member 8. The slant face 23 serves as a guide face when the engaging projection 22 is fitted in the engaging hole 24, thereby facilitating the engagement of these parts. The engaging hole 24 may be a hole passing through the pipe wall of the duct member 8 as shown in Fig. 8, or may be groove formed in the inner wall of the pipe as shown in Fig. 9.

The first intake air duct member 8 and the second intake air duct member 9 are connected by inserting the latter into the former from the downstream side of the intake noise damping device 12 thus formed. A recess 25 is formed in the inside surface of the first intake air duct member 8 and a projection 26 in the outside surface of the second intake air duct member 9 (See Fig. 4). These duct members 8 and 9 are then properly positioned by fitting the projection 26 in the recess 25. At this time the end face 9a of the second intake air duct member 9 contacts the opposite end face 18b of the perforated plate 18, supporting the perforated plate 18 from the downstream side (Fig.3).

According to the intake noise damping device 12 constituted as described above, the number of component parts can be reduced, no water will enter the sound absorbing material 17, and the sectional area of the intake passage will not become smaller to thereby result in a lowered engine power output. Accordingly it is possible to obviate drawbacks inherent to the prior-art intake noise damping device. The intake noise damping device of the present invention further has many advantages.

First, it is possible to securely support the perforated plate 18 in a specific position by engaging the perforated plate 18 with the first intake air duct member 8 with the engaging projection 22 fitted in the engaging hole 24 and by contacting the end face 9a of the second intake air duct member 9 with the opposite end face 18b of the perforated plate 18. It is also possible to facilitate the assembling of the intake noise damping device 12.

Next, since the engagement of the perforated plate 18 with the first intake air duct member 8 is effected by fitting the engaging projection 22 of the perforated plate 18 in the engaging hole 24 of the first intake air duct member 8; therefore the state of engagement of the perforated plate 18 with the first intake air duct member 8 can easily be confirmed by hand feel and also the perforated plate 18 can easily be installed to, and removed from the first intake air duct member 8. Particularly, when the engaging hole 24 is a through hole as shown in Fig. 8, the engaging projection 22 thus engaged in the engaging hole 24 is visible from outside; and also the perforated plate 18 can be removed simply by pushing the engaging projection 22 from outside. That is, the confirmation of engagement between the engaging projection and the engaging hole and the removing operation can be carried out easily. Furthermore the engaging projection 22 and the engaging hole 24 are provided in the position corresponding to the end of the minor axis a, that is, in a surface section approximate to a flat surface of large radius of curvature , and accordingly the machining of these parts, particularly the forming of the engaging hole 24 in the first intake air duct member 8 can be effected with ease and with higher precision. Also, the intake air passage, having an elliptic cross section, has less intake resistance as compared with an intake passage of polygonal cross section.

Furthermore, the holes 19 provided in the surface section 20 of the perforated plate 18 can easily be made at one time with a high accuracy as shown for example in Fig. 10. In Fig. 10, a numeral 27 is a die having the same elliptic sectional form as the perforated plate 18. All that is required to make the holes 19 is to insert a material plate 18′ to be punched over the die 27, and then to press a set of upper and lower dies 28 against the material plate 18′ from above and below in the direction of the minor axis. The die 28 has many punches 29 projecting in parallel and corresponding to the holes 19 to be cut. All of the holes 19 are punched simultaneously with these punches 29. The part where the holes 19 are cut, that is, the surface section 20, extends in the direction of major axis with a large radius of curvature, at an angle close to a right angle with the direction of minor axis over the whole surface. Each of the punches 29 cuts a hole 19 with a high accuracy in the material plate 18′ nearly at a right angle with the surface. According to the present invention, the holes 19 thus produced are short, which dose not require long projection of these punches 29. The punches 29, therefore, are hardly subject to damage and deformation.

As is apparent from the above description, according to the present invention, the intake sound damping device requires a small number of component parts, no water will enter the sound absorbing material, and moreover, the sectional area of the intake passage will not become so small as to lower engine power output.

Furthermore, it is possible to securely support the perforated plate in a specific position and to easily perform the assembling of the intake noise damping device.

The perforated plate can be installed easily in and removed from, the intake air duct. Further it is possible

to easily confirm the state of engagement of the perforated plate and the intake air duct member and also to easily process the engaging hole and the engaging projection with a higher accuracy. In addition the intake air passage has little intake resistance.

It is possible to cut a number of holes at the same time in a material plate having an elliptic cross section with ease and with a high accuracy.

Claims

1. An intake noise damping device mounted in an intake air duct formed by connecting first and second intake air duct members, comprising: a bulged section (14) formed in said first intake duct member (8) in the vicinity of a connection between said first intake air duct member and said second intake air duct member (9); a sound absorbing material (17) installed inside of said bulged section; and a perforated plate (18) installed along the inner surface of said sound absorbing material, said second intake air duct member being fitted in said first intake air duct member with an end face (9a) thereof in contact with an opposite end face (18b) of said perforated plate.

2. An intake noise damping device as claimed in claim 1, wherein said perforated plate is engaged with said first intake air duct member by an engaging means.

3. An intake noise damping device as claimed in claim 2, wherein said engaging means is provided on the upstream side of said perforated plate.

4. An intake noise damping device as claimed in claim 2, wherein said engaging means comprises a first engaging element (22) formed on said perforated plate and a second engaging element (24) formed in said first intake air duct member.

5. An intake noise damping device as claimed in claim 4, wherein the second engaging element (24) comprises an engaging hole which passes through a wall of said first intake air duct member and the first engaging element comprises an engaging projection (22) which protrudes outwardly from the engaging hole when engaged.

6. An intake noise damping device as claimed in claim 4 or 5, wherein said engaging projection has a sloping guide face (23).

7. An intake noise damping device as claimed in any one of the preceding claims, wherein inner peripheral surfaces of said first and second intake air duct members and said perforated plate have the same cross-sectional form to constitute a continuous air passage.

8. An intake noise damping device as claimed in any one of the preceding claims, wherein the first and second intake air duct members and the perforated plate are cylindrical and have an elliptical cross-section.

9. An intake noise damping device as claimed in claim 8 when appendant to any one of claims 4 to 6, wherein the first and second engaging elements are located at a position corresponding to an end (a_1) of a minor axis (a) of the said elliptical cross-section.

10. An intake noise damping device as claimed in claim 8, wherein the perforated plate is provided with a plurality of holes formed through sections (20) of the perforated plate which have a large radius of curvature.

11. An intake noise damping device as claimed in any one of the preceding claims, wherein the outer surface of the first intake air duct member is provided with an outwardly projecting rib (15) which extends from a downstream side end opening of the first intake air duct member to said bulged section.

12. An intake noise damping device as claimed in any one of the preceding claims, wherein the first intake air duct member communicates with a resonance chamber (11a) on the upstream side of the bulged section.

13. An intake noise damping device as claimed in any one of the preceding claims, wherein a resonance chamber (11a) is provided close to the bulged section and the resonance chamber and bulged section are connected to each other by a rib (15) provided on an outer surface of the first intake air duct member.

14. An intake noise damping device as claimed in any one of the preceding claims, wherein the first intake air duct member extends vertically in the vicinity of the bulged section and the connection between the first and second intake air duct members is positioned below the bulged section.

15. An intake noise damping device as claimed in any one of the preceding claims, wherein the first intake air duct member is an upstream side member for introducing outside air into an intake air duct (7) consisting of the first and second intake air duct members, and is supported by a lower casing (5) of an air cleaner (4) fixed to a vehicle body.

FIG.1

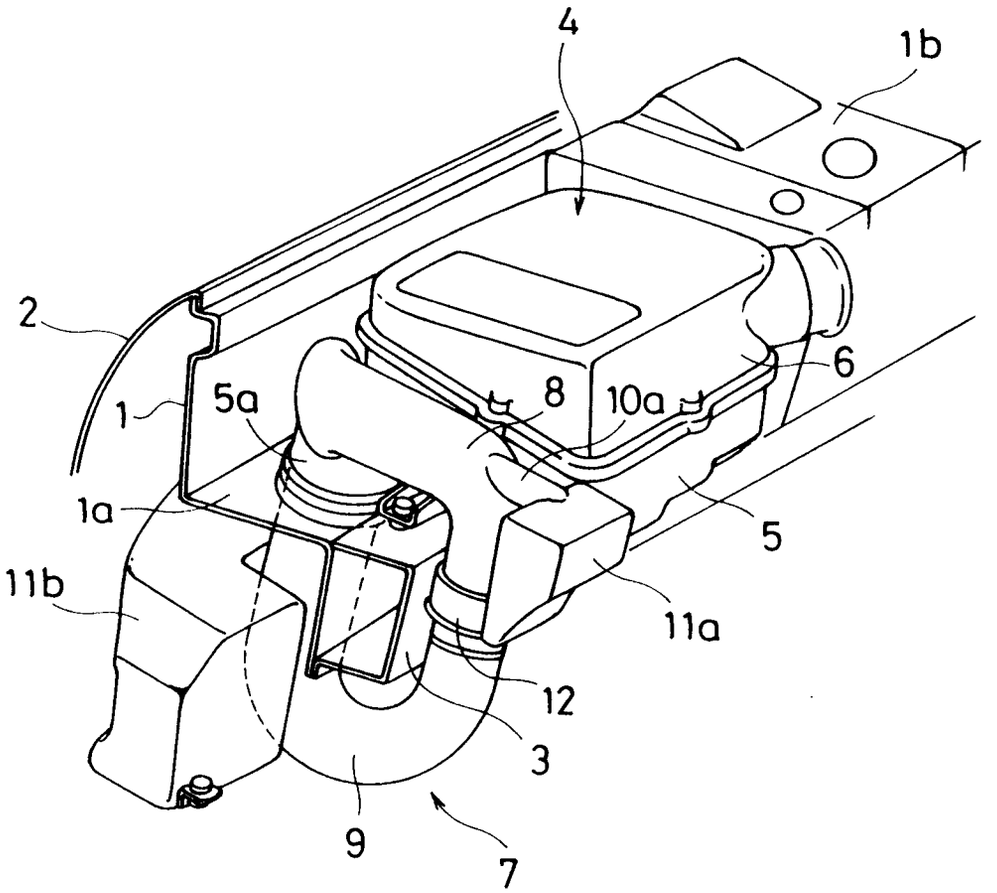


FIG. 2

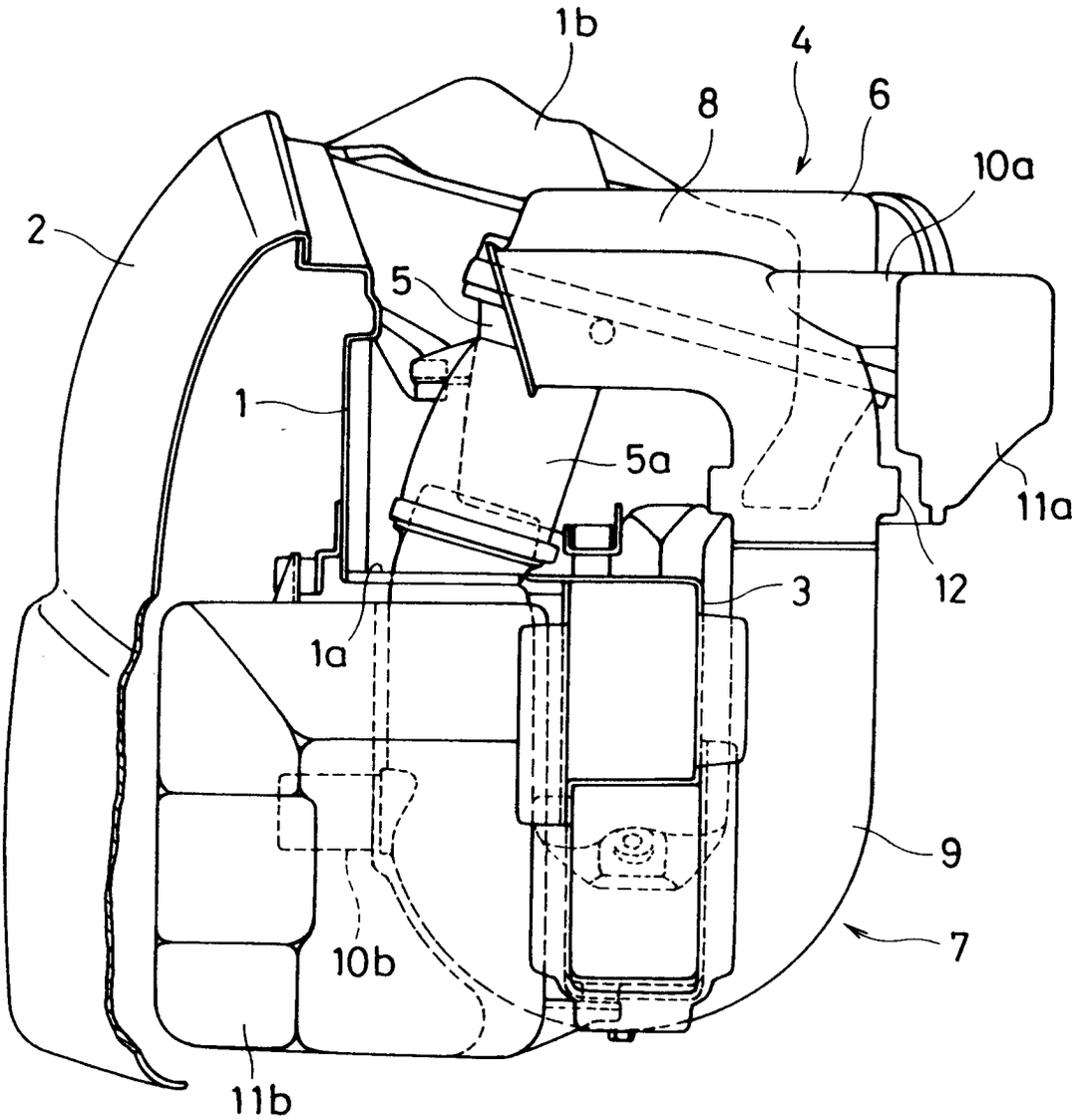


FIG. 3

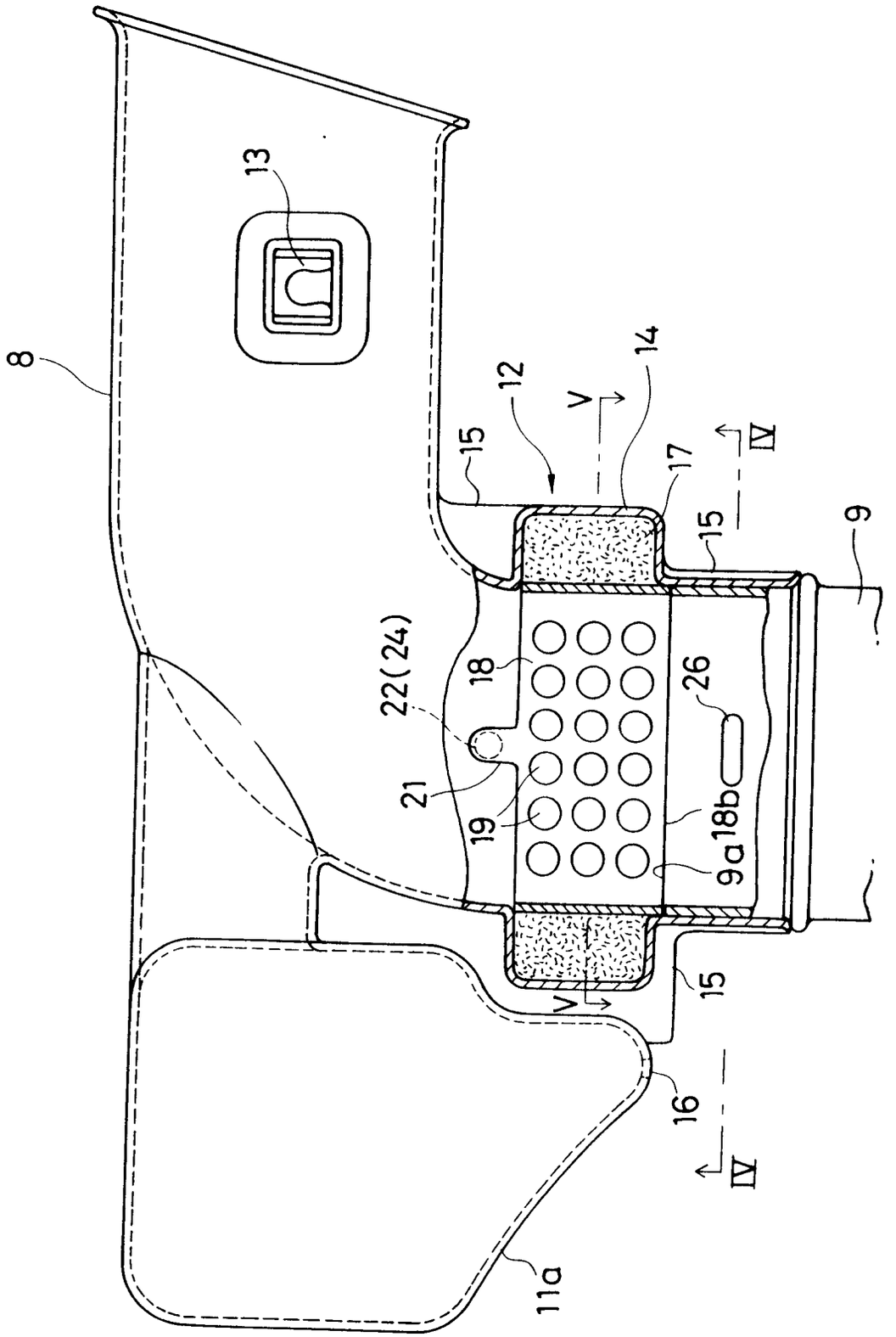


FIG.4

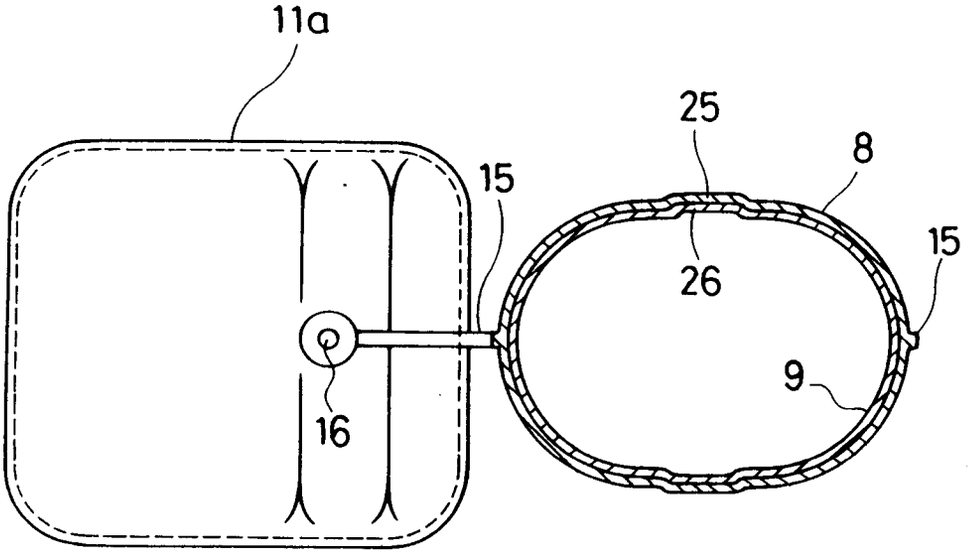


FIG.5

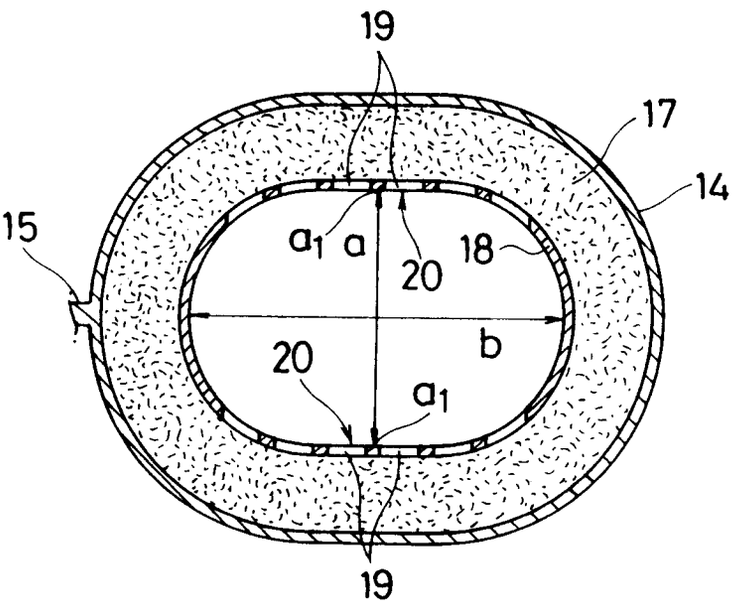


FIG.6

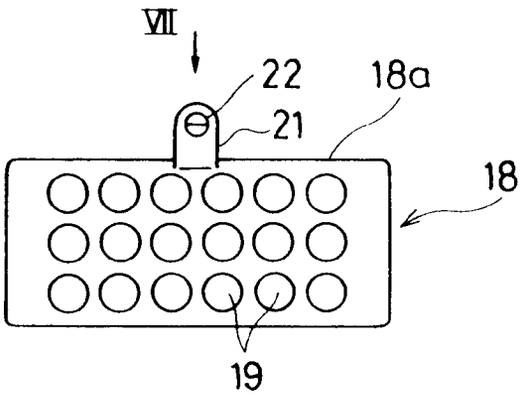


FIG.7

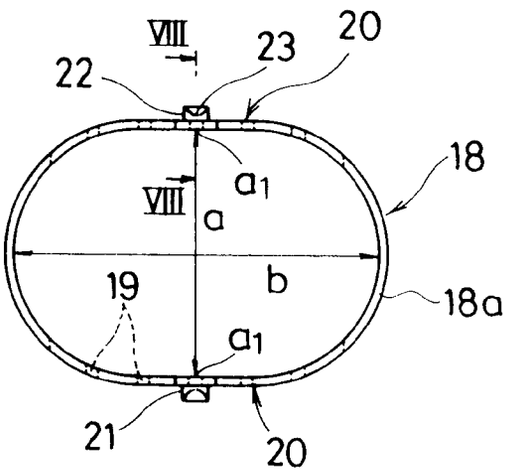


FIG.8

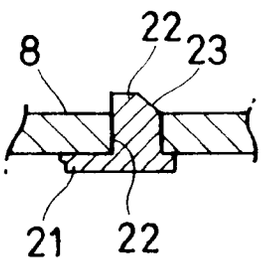


FIG.9

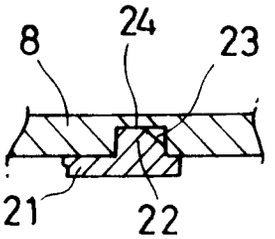
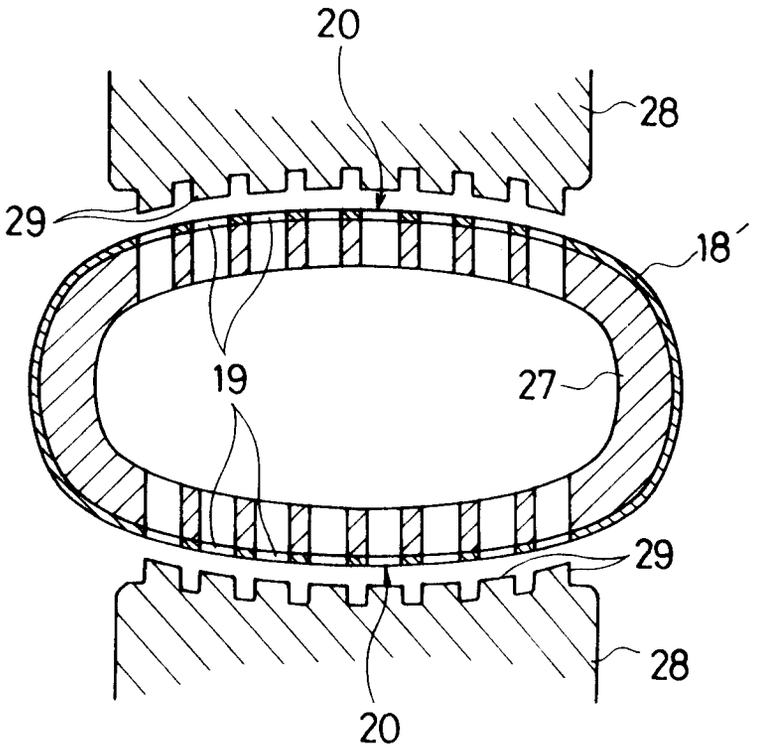


FIG.10



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 3379

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-A-3 531 353 (AUDI) * column 3, line 3 - column 4, line 19; figures * ---	1,2	F02M35/12
A	FR-A-2 393 163 (HONDA) * page 12, line 6 - page 13, line 25 * * page 25, line 2 - page 27, line 23; figures 8,35-47 * -----	1,8,10, 13,15	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F02M F01N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 JUNE 1992	SIDERIS MARIOS

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)