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

(11) **EP 1 607 250 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.01.2010 Bulletin 2010/02

(21) Application number: **05104711.6**

(22) Date of filing: **01.06.2005**

(51) Int Cl.:
B60G 17/015 *(2006.01)* ***F16F 9/42*** *(2006.01)*
H02K 41/02 *(2006.01)*

(54) **Self cooling actuator**

Selbstkühlendes Stellelement

Actionneur autorefroidie

(84) Designated Contracting States:
DE GB

(30) Priority: **17.06.2004 US 870521**

(43) Date of publication of application:
21.12.2005 Bulletin 2005/51

(73) Proprietor: **BOSE CORPORATION**
Framingham,
Massachusetts 01701-9168 (US)

(72) Inventors:
- **Breen, John J.**
  Framingham, MA 01701-9168 (US)
- **Parison, James A.**
  Framingham, MI 01701-9168 (US)

(74) Representative: **Brunner, Michael John et al**
Gill Jennings & Every LLP
Broadgate House
7 Eldon Street
London EC2M 7LH (GB)

(56) References cited:
EP-A- 0 604 028 **DE-A1- 10 205 771**
US-A- 5 573 088

- **PATENT ABSTRACTS OF JAPAN vol. 016, no. 452 (M-1313), 21 September 1992 (1992-09-21) & JP 04 159113 A (MAZDA MOTOR CORP), 2 June 1992 (1992-06-02)**

EP 1 607 250 B1

Printed by Jouve, 75001 PARIS (FR)

Description

TECHNICAL FIELD

[0001] The description relates to active suspension systems.

BACKGROUND

[0002] Active suspension systems for motor vehicles typically include actuators coupled to the wheels of the vehicle. In response to instructions from a controller, these actuators control the attitude of the motor vehicle's body.

[0003] One type of actuator is an electromagnetic actuator in which current through a coil generates a magnetic field that causes movement of an armature coupled to the wheels. This coil current is provided by power electronic circuits. The currents in both the coil and the circuits generate heat.

[0004] Because of the harsh environment in which they operate, the components of the actuator, including the power electronic circuits, are enclosed in a protective housing. Because the power electronics are confined in a small enclosed space, the need to dissipate heat becomes more significant.

[0005] JP04-159113 on which the preamble to claim 1 is based and DE10205771 disclose an actuator for an active suspension system having an armature moveable within a housing.

[0006] According to the present invention, there is provided an actuator for an active suspension system, the actuator comprising:

an armature; and
a housing enclosing the armature, the housing having an interior volume that varies in response to movement of the armature, characterised in that
the housing defines a first aperture through which air passes in response to movement of the armature;

wherein the housing further defines a wall forming a second aperture through which air passes in response to movement of the armature; and
walls defining a labyrinth extending between the first and second apertures.

[0007] In response to movement of the armature, air is either drawn into the interior through the first and second apertures or expelled from the interior through the first and second apertures. Alternatively, in response to movements of the armature, air is drawn into the housing through the first aperture and expelled through the second aperture.

[0008] In other embodiments, electronic circuitry for effecting movement of the armature is disposed within the interior of the housing.

[0009] An optional filter is placed in the labyrinth thus formed.

[0010] Optional first and second one-way valves can be disposed to allow admission of air into the housing interior through the first aperture and expulsion of air from the housing interior through the second aperture. The second one-way valve can also be disposed to allow expulsion of water from the housing interior through the second aperture.

[0011] In other embodiments, the housing includes a first portion coupled to the armature; and a second portion coupled to the first portion. The first portion can include a flexible portion joined to the second portion. The first portion can, for example, include bellows. Other embodiments include those in which the first portion of the housing includes a moveable portion, and those in which the second portion is a rigid portion.

[0012] The first portion can include a first cylinder and the second portion can include a second cylinder. In this case, the first and second cylinder have different radii so that one of the first and second cylinders can slide into the other in response to movement of the armature. Or, the first portion can include a piston head and the second portion can include a cylinder sized to accommodate the piston head. The piston head and the cylinder together define a volume that changes in response to movement of the armature.

[0013] In other embodiments, the first portion defines a second aperture through which air moves in response to movement of the armature.

[0014] In other embodiments, the second portion defines both a second aperture through which air moves in response to movement of the armature and a first aperture. The second portion can optionally define a labyrinth between the first and second apertures.

[0015] Other embodiments of the invention include those in which a first one-way valve is disposed to allow admission of air into the housing interior through the first aperture. A second one-way valve can then be disposed to allow expulsion of air from the housing interior through the second aperture.

[0016] In some embodiments of the invention, increasing the interior volume includes causing air to be drawn into the housing through a first aperture. Decreasing the interior volume includes causing air to be expelled from the housing through the first aperture.

[0017] In other embodiments of the invention, increasing the interior volume includes causing air to be drawn into the housing through a first aperture. Decreasing the interior volume includes causing air to be expelled from the housing through a second aperture. One way to cause air to be drawn into the aperture is to cause a first one -way valve sealing the first aperture to open. The expulsion of air from the housing can then include causing the opening of a second one-way valve that seals the second aperture.

[0018] Other embodiments of the invention include those in which water is expelled from the housing through the second aperture by decreasing the interior volume of the housing.

[0019] In other embodiments of the invention, changing the interior volume, either by increasing or decreasing it, can include passing current through a coil in the housing. The actuator in this case has a moveable armature coupled to a flexible portion of the housing.

BRIEF DESCRIPTION OF DRAWINGS

[0020] One example of an actuator in accordance with the present invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 shows an actuator in which air enters and exits the housing through the same aperture;
FIG. 2 shows a one-way valve sealing an intake aperture; and
FIG. 3 shows a one-way valve sealing an exhaust aperture.

DETAILED DESCRIPTION

[0021] An adaptive suspension system for a motor vehicle includes four electromagnetic actuators 10 mounted in each of the four corners of the motor vehicle. In response to signals from a controller, the actuators 10 apply forces to dynamically control the separation between a vehicle chassis and the road surface. These forces collectively control the attitude of the chassis relative to the road surface.

[0022] An exemplary actuator 10, which is shown in FIG. 1, converts electrical energy into mechanical energy in response to a signal provided by a controller (not shown). This signal is received by components mounted on circuit boards 12 con tained within the actuator 10. In response to the control signal, components on the circuit boards 12 cooperate to generate a current through coils 14 that are disposed to magnetically couple to a magnetic armature 16. The coils 14 may be further surrounded by ferrous materials such as steel. This current causes the armature 16 to move along a longitudinal axis of the coils 14. The controller may be inside or outside the enclosure. A suitable actuator 10 is that disclosed in U.S. Patent 4,981,309, the contents of which are incorporated herein by reference.

[0023] The illustrated actuator 10 is intended to operate in an environment laden with dust, moisture, pieces of flying gravel, and occasional animal parts. To enable reliable operation in such a harsh environment, the actuator 10 is provided with a protective housing 18 that encloses the circuit boards 12, the coils 14, and the armature 16.

[0024] An upper portion 20 of the housing 18 forms a rigid bell that protects the circuit boards 12 and the coils 14. The bell has an opening 22 that is attached to a flexible lower portion 24 of the housing 18. A stop plate 26 integrated with the armature 16 is coupled to one end of the flexible lower portion 24. The upper and lower portions 20, 24 together form a generally tubular structure. The lower portion 24 of the housing 18 is axially flexible. In the illustrated embodiment, the lower portion 24 includes bellows that expand and contract in response to axial movement of the armature 16.

[0025] As a result of ohmic losses, the current flowing in the coils 14 and in the various electronic components on the circuit boards 12 generate heat. Because these heat-generating elements are enclosed in the housing 18, the temperature within the housing 18 may rise to levels that might cause premature failure of components.

[0026] As the armature 16 moves downward, in an intake stroke, the bellows expand and draw cool air through an inner aperture 28 and an outer aperture 30 separated by a labyrinth occupied by a filter 32. Preferably, the inner aperture 28 is adjacent to the circuit boards 12, so that the cool filtered air passes immediately over the circuit boards 12. As the armature 16 moves upward, in an exhaust stroke, the bellows contract, forcing warm air out though the inner and outer apertures 28, 30.

[0027] As shown in FIG. 1, the outer aperture 30 is below the inner aperture 28. This relationship enables any water that enters or condenses within the labyrinth to drip outward, away from the housing 18.

[0028] In the embodiment shown in FIG. 1, air enters and exits the housing 18 through the same apertures 28, 30. This configuration has disadvantages. First, any moisture in the incoming air may condense inside the housing 18. When it does so, it will tend to collect on the stop plate 26. Second, during the exha ust stroke, the bellows blow across the circuit boards 12, air that has already passed over the circuit boards 12 at least once. Such air will generally be warmer than the air drawn in from the outside during the intake stroke. As a result, the average temperature of air passing over the circuit boards 12 is higher than it would be if only fresh outside air passed over the circuit boards 12. These disadvantages are overcome in the embodiment shown in FIGS. 2 and 3, in which air enters and exits the housing 18 through different apertures.

[0029] FIG. 2 shows an inner aperture 28 that is sealed by an intake valve 34. The intake valve 34 is a one-way flap or check valve that is oriented to allow outside air to enter the housing 18 but to prevent air from exiting the housing 18. Conversely, an exhaust aperture in the stop plate 26 is sealed by an exhaust valve, shown in FIG. 3. The exhaust valve, like the intake valve 34, is a one-way flap, or check valve. However, its orientation is such that air is permitted to exit, but not to enter, the housing 18. The placement of the exhaust aperture at the stop plate 26 is advantageous because the stop plate 26 is at the lowest point on the actuator 10. As a result, gravity causes any accumulated moisture to collect on the stop palate 26 and to drain out of the housing 18 through the exhaust aperture. However, the exhaust aperture need not be at the actuator's lowest point.

[0030] Alternatively, the housing 18, can be formed by having the armature 16 and the stop plate 26 function as a piston arm and piston head respectively. The stop plate

26 would then fit snugly inside a cylinder. In this case, the interior volume of the housing, which is defined by walls of the cylinder and the stop plate, again changes volume in response to movement of the armature 16.

[0031] In a housing 18 having an intake valve 34 and an exhaust valve 36 as shown in FIGS. 2 and 3, the intake stroke draws air into the housing 18 and across the circuit boards 12, as discussed in connection with FIG. 1. However, during the exhaust stroke, air exits the housing 18 through the exhaust aperture.

[0032] The configuration shown in FIGS. 2 and 3, in which air enters and exits the housing 18 through different apertures, offers at least two advantages. First the average air temperature at the circuit boards 12 will be lower. As a result, the air will cool the circuit boards 12 more effectively. Second any water condensing inside the housing 18 will be able to exit the housing 18 through the exhaust aperture. This expulsion will occur automatically during the exhaust stroke, as the exhaust valve 36 opens.

[0033] In the embodiments described herein, the interior volume of the housing 18 changes because bellows expand and contract in response to movement of the armature 16. However, other structures can be used to change the volume of the housing. For example, the armature 16 may be coupled to a first rigid cylinder that slides into and out of a second rigid cylinder. In this case, the volume enclosed by the first and second cylinders would also change in response to movement of the armature.

[0034] It is to be understood that while the invention has been described in conjunction with the detailed description thereof, the foregoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are within the scope of the following claims.

Claims

1. An actuator (10) for an active suspension system, the actuator comprising:

an armature (16); and
a housing (18) enclosing the armature, the housing having an interior volume that varies in response to movement of the armature, **characterised in that**
the housing defines a first aperture (30) through which air passes in response to movement of the armature;

wherein the housing further defines a wall forming a second aperture (28) through which air passes in response to movement of the armature; and
walls defining a labyrinth (32) extending between the first and second apertures.

2. An active suspension system comprising an actuator as recited in claim 1.

3. A motor vehicle having an active suspension system as recited in claim 2.

4. The actuator (10) of claim 1, further comprises:

a first portion (18) coupled to the armature (16); and
a second portion coupled to the first portion, wherein a volume enclosed by the first and second portions varies in response to movement of the armature (16),

wherein the first portion comprises a moveable portion; and
wherein the first portion comprises a first cylinder and the second portion comprises a second cylinder, the first and second cylinder having different radii such that one of the first and second cylinders can slide into the other in response to movement of the armature.

5. The actuator (10) of claim 4, wherein the first portion (18) comprises bellows.

6. The actuator (10) of claim 5, wherein the first portion further comprises a stop plate (26) configured to move in response to movement of the armature, whereby the stop plate couples the first portion to the armature.

7. The actuator (10) of claim 6, wherein the stop plate (2 6) defines the second aperture through which air passes in response to movement of the armature.

8. The actuator (10) of claim 5, wherein the armature comprises a stop plate (26) coupled to the bellows.

9. The actuator (10) of claim 8, wherein the stop plate (26) defines a second aperture through which air passes in response to movement of the armature (16).

10. The actuator (10) of claim 9, further comprising:

a first one-way valve (34) associated with the first aperture, the first one-way valve being configured to allow admission of air into the housing interior through the first aperture; and
a second one-way valve (36) associated with the second aperture, the second one way valve being configured to allow expulsion.of air from the housing interior through the second aperture.

11. The actuator (10) of claim 5, further comprising a

stop plate (26) defining the second aperture, the stop plate being coupled to the bellows.

12. The actuator (10) of claim 4, wherein the first portion (18) comprises a flexible portion joined to the second portion.

13. The actuator (10) of claim 4, wherein the second portion comprises a rigid portion.

14. The actuator (10) of claim 4, wherein the first portion comprises a piston head (26) and the second portion comprises a cylinder sized to accommodate the piston head, the piston head and the cylinder defining a volume that changes in response to movement of the armature (16).

15. The actuator (10) of claim 4, wherein the first portion defines a second aperture through which air passes in response to movement of the armature;
a first one-way valve (34) associated with the first aperture, the first one-way valve being configured to allow admission of air into the housing interior through the first aperture; and
a second one-way valve (36) associated with the second aperture, the second one-way valve being configured to allow expulsion of air from the housing interior through the second aperture.

16. The actuator (10) of claim 1, further comprising electronic circuitry (12) for effecting movement of the armature, the electronic circuitry disposed within the interior volume of the housing.

17. The actuator (10) of claim 16, further comprising a filter (32) disposed in the labyrinth.

18. The actuator (10) of claim 16, further comprising:

a first one-way valve (34) associated with the first aperture, the first one-way valve being configured to allow admission of air into the housing interior through the first aperture.

19. The actuator (10) of claim 18, further comprising:

a second one-way valve (36) associated with the second aperture, the second one-way valve being configured to allow expulsion of air from the housing interior through the second aperture.

20. The actuator (10) of claim 19, wherein the second one-way valve (36) is disposed to drain fluid from the interior volume of the housing.

21. The actuator (10) of claim 1, wherein the first and second apertures are configured such that, in response to a first movement of the armature, air is drawn into the interior through the first aperture, and in response to a second movement of the armature, air is expelled from the interior through the second aperture.

22. The actuator (10) of claim 1, wherein the housing comprises a first portion coupled to the armature; and a second portion coupled to the first portion;
wherein the interior volume is enclosed by the first and second portions and varies in response to movement of the armature,
wherein the second portion defines a second aperture through which air passes in response to movement of the armature, and defines the first aperture; and
wherein the second portion defines the labyrinth between the first and second apertures.

Patentansprüche

1. Stellmotor (10) für einen aktiven Aufhängungsmechanismus, der Folgendes umfasst:

einen Anker (16) und
ein den Anker umschließendes Gehäuse (18), das ein Innenvolumen aufweist, welches aufgrund der Bewegung des Ankers variiert, **dadurch gekennzeichnet, dass**
das Gehäuse eine erste Öffnung (30) definiert, durch die aufgrund der Bewegung des Ankers Luft strömt,

wobei das Gehäuse des Weiteren eine Wand definiert, die eine zweite Öffnung (28) bildet, durch die aufgrund der Bewegung des Ankers Luft strömt, und Wände, die ein Labyrinth (32) definieren, zwischen der ersten und der zweiten Öffnung verlaufen.

2. Aktiver Aufhängungsmechanismus, der einen Stellmotor nach Anspruch 1 umfasst.

3. Kraftfahrzeug mit einem aktiven Aufhängungsmechanismus nach Anspruch 2.

4. Stellmotor (10) nach Anspruch 1, der des Weiteren Folgendes umfasst:

einen ersten Abschnitt (18), der mit dem Anker (16) gekoppelt ist, und
einen mit dem ersten Abschnitt gekoppelten zweiten Abschnitt, wobei ein von dem ersten und dem zweiten Abschnitt eingeschlossenes Volumen aufgrund der Bewegung des Ankers (16) variiert,

wobei der erste Abschnitt einen beweglichen Ab-

schnitt umfasst und
wobei der erste Abschnitt einen ersten Zylinder und der zweite Abschnitt einen zweiten Zylinder umfasst, die jeweils verschiedene Radien aufweisen, so dass der erste oder der zweite Zylinder aufgrund der Bewegung des Ankers in den jeweils anderen Zylinder gleiten kann.

5. Stellmotor (10) nach Anspruch 4, bei dem der erste Abschnitt (18) einen Balg umfasst.

6. Stellmotor (10) nach Anspruch 5, bei dem der erste Abschnitt des Weiteren eine Anschlagplatte (26) umfasst, die so konfiguriert ist, dass sie sich aufgrund der Bewegung des Ankers bewegt, wodurch sie den ersten Abschnitt mit dem Anker koppelt.

7. Stellmotor (10) nach Anspruch 6, bei dem die Anschlagplatte (26) die zweite Öffnung definiert, durch die aufgrund der Bewegung des Ankers Luft strömt.

8. Stellmotor (10) nach Anspruch 5, bei dem der Anker eine mit dem Balg gekoppelte Anschlagplatte (26) umfasst.

9. Stellmotor (10) nach Anspruch 8, bei dem die Anschlagplatte (26) eine zweite Öffnung definiert, durch die aufgrund der Bewegung des Ankers (16) Luft strömt.

10. Stellmotor (10) nach Anspruch 9, der des Weiteren Folgendes umfasst:

ein zur ersten Öffnung gehörendes erstes Rückschlagventil (34), das so konfiguriert ist, dass durch die erste Öffnung Luft in den Innenraum des Gehäuses eingelassen werden kann, und
ein zur zweiten Öffnung gehörendes zweites Rückschlagventil (36), das so konfiguriert ist, dass Luft durch die zweite Öffnung aus dem Innenraum des Gehäuses ausgetrieben werden kann.

11. Stellmotor (10) nach Anspruch 5, der des Weiteren eine Anschlagplatte (26) umfasst, die die zweite Öffnung definiert, wobei die Anschlagplatte mit dem Balg gekoppelt ist.

12. Stellmotor (10) nach Anspruch 4, bei dem der erste Abschnitt (18) einen flexiblen Abschnitt umfasst, der mit dem zweiten Abschnitt verbunden ist.

13. Stellmotor (10) nach Anspruch 4, bei dem der zweite Abschnitt einen steifen Abschnitt umfasst.

14. Stellmotor (10) nach Anspruch 4, bei dem der erste Abschnitt einen Kolbenboden (26) und der zweite Abschnitt einen Zylinder umfasst, welcher so bemessen ist, dass er den Kolbenboden aufnehmen kann, wobei der Kolbenboden und der Zylinder ein Volumen definieren, das sich aufgrund der Bewegung des Ankers (16) ändert.

15. Stellmotor (10) nach Anspruch 4, bei dem der erste Abschnitt eine zweite Öffnung definiert, durch die aufgrund der Bewegung des Ankers Luft strömt,
ein zur ersten Öffnung gehörendes erstes Rückschlagventil (34), das so konfiguriert ist, dass durch die erste Öffnung Luft in den Innenraum des Gehäuses eingelassen werden kann, und
ein zur zweiten Öffnung gehörendes zweites Rückschlagventil (36), das so konfiguriert ist, dass Luft durch die zweite Öffnung aus dem Innenraum des Gehäuses ausgetrieben werden kann.

16. Stellmotor (10) nach Anspruch 1, der des Weiteren elektronische Schaltungen (12) zum Bewirken einer Bewegung des Ankers umfasst, die im Innenvolumen des Gehäuses angeordnet sind.

17. Stellmotor (10) nach Anspruch 16, der des Weiteren einen Filter (32) umfasst, welcher in dem Labyrinth angeordnet ist.

18. Stellmotor (10) nach Anspruch 16, der des Weiteren Folgendes umfasst:

ein zur ersten Öffnung gehörendes erstes Rückschlagventil (34), das so konfiguriert ist, dass durch die erste Öffnung Luft in den Innenraum des Gehäuses eingelassen werden kann.

19. Stellmotor (10) nach Anspruch 18, der des Weiteren Folgendes umfasst:

ein zur zweiten Öffnung gehörendes zweites Rückschlagventil (36), das so konfiguriert ist, dass Luft durch die zweite Öffnung aus dem Innenraum des Gehäuses ausgetrieben werden kann.

20. Stellmotor (10) nach Anspruch 19, bei dem das zweite Rückschlagventil (36) so angeordnet ist, dass Fluid aus dem Innenvolumen des Gehäuses abgelassen werden kann.

21. Stellmotor (10) nach Anspruch 1, bei dem die erste und die zweite Öffnung so konfiguriert sind, dass aufgrund einer ersten Bewegung des Ankers durch die erste Öffnung Luft in den Innenraum gesaugt und aufgrund einer zweiten Bewegung des Ankers durch die zweite Öffnung Luft aus dem Innenraum ausgetrieben wird.

22. Stellmotor (10) nach Anspruch 1, bei dem das Gehäuse einen mit dem Anker gekoppelten ersten Ab-

schnitt und einen mit dem ersten Abschnitt gekoppelten zweiten Abschnitt umfasst,
wobei das Innenvolumen von dem ersten und dem zweiten Abschnitt eingeschlossen ist und aufgrund der Bewegung des Ankers variiert,
wobei der zweite Abschnitt eine zweite Öffnung definiert, durch die aufgrund der Bewegung des Ankers Luft strömt, und die erste Öffnung definiert und
der zweite Abschnitt das Labyrinth zwischen der ersten und der zweiten Öffnung definiert.

Revendications

1. Actionneur (10) pour un système de suspension adaptative, l'actionneur comportant :

un induit (16) ; et
un logement (18) renfermant l'induit, le logement ayant un volume intérieur qui varie en réponse au mouvement de l'induit, **caractérisé en ce que**
le logement définit un premier orifice (30) au travers duquel de l'air passe en réponse au mouvement de l' induit ;

dans lequel le logement définit par ailleurs une paroi formant un deuxième orifice (28) au travers duquel de l'air passe en réponse au mouvement de l'induit ; et
des parois définissant un labyrinthe (32) s'étendant entre le premier orifice et le deuxième orifice.

2. Système de suspension adaptative comportant un actionneur selon la revendication 1.

3. Véhicule à moteur ayant un système de suspension adaptative selon la revendication 2.

4. Actionneur (10) selon la revendication 1, comportant par ailleurs :

une première partie (18) accouplée à l'induit (16) ; et
une deuxième partie accouplée à la première partie, dans lequel un volume renfermé par la première partie et la deuxième partie varie en réponse au mouvement de l'induit (16),

dans lequel la première partie comporte une partie mobile ; et
dans lequel la première partie comporte un premier vérin et la deuxième partie comporte un deuxième vérin, le premier vérin et le deuxième vérin ayant différents rayons de sorte que l'un du premier vérin et du deuxième vérin peut coulisser dans l'autre en réponse au mouvement de l'induit.

5. Actionneur (10) selon la revendication 4, dans lequel la première partie (18) comporte des soufflets.

6. Actionneur (10) selon la revendication 5, dans lequel la première partie comporte par ailleurs une plaque de butée (26) configurée pour se déplacer en réponse au mouvement de l'induit, ce par quoi la plaque de butée accouple la première partie à l'induit.

7. Actionneur (10) selon la revendication 6, dans lequel la plaque de butée (26) définit le deuxième orifice au travers duquel de l'air passe en réponse au mouvement de l'induit.

8. Actionneur (10) selon la revendication 5, dans lequel l'induit comporte une plaque de butée (26) accouplée aux soufflets.

9. Actionneur (10) selon la revendication 8, dans lequel la plaque de butée (26) définit un deuxième orifice au travers duquel de l'air passe en réponse au mouvement de l'induit (16).

10. Actionneur (10) selon la revendication 9, comportant par ailleurs :

un premier clapet de non-retour (34) associé au premier orifice, le premier clapet de non-retour étant configuré pour permettre l'admission d'air dans l'intérieur du logement au travers du premier orifice ; et
un deuxième clapet de non-retour (36) associé au deuxième orifice, le deuxième clapet de non-retour étant configuré pour permettre l'expulsion d'air en provenance de l'intérieur du logement au travers du deuxième orifice.

11. Actionneur (10) selon la revendication 5, comportant par ailleurs une plaque de butée (26) définissant le deuxième orifice, la plaque de butée étant accouplée aux soufflets.

12. Actionneur (10) selon la revendication 4, dans lequel la première partie (18) comporte une partie flexible jointe à la deuxième partie.

13. Actionneur (10) selon la revendication 4, dans lequel la deuxième partie comporte une partie rigide.

14. Actionneur (10) selon la revendication 4, dans lequel la première partie comporte une tête de piston (26) et la deuxième partie comporte un vérin dimensionné pour accueillir la tête de piston, la tête de piston et le vérin définissant un volume qui change en réponse au mouvement de l'induit (16).

15. Actionneur (10) selon la revendication 4, dans lequel la première partie définit un deuxième orifice au tra-

vers duquel de l'air passe en réponse au mouvement de l'induit ;
un premier clapet de non-retour (34) associé au premier orifice, le premier clapet de non-retour étant configuré pour permettre l'admission d'air dans l'intérieur du logement au travers du premier orifice ; et un deuxième clapet de non-retour (36) associé au deuxième orifice, le deuxième clapet de non-retour étant configuré pour permettre l'expulsion d'air en provenance de l'intérieur du logement au travers du deuxième orifice.

16. Actionneur (10) selon la revendication 1, comportant par ailleurs des circuits électroniques (12) pour effectuer le mouvement de l'induit, les circuits électroniques étant disposés dans le volume intérieur du logement.

17. Actionneur (10) selon la revendication 16, comportant par ailleurs un filtre (32) disposé dans le labyrinthe.

18. Actionneur (10) selon la revendication 16, comportant par ailleurs :

un premier clapet de non-retour (34) associé au premier orifice, le premier clapet de non-retour étant configuré pour permettre l'admission d'air dans l'intérieur du logement au travers du premier orifice.

19. Actionneur (10) selon la revendication 18, comportant par ailleurs :

un deuxième clapet de non-retour (36) associé au deuxième orifice, le deuxième clapet de non-retour étant configuré pour permettre l'expulsion d'air en provenance de l'intérieur du logement au travers du deuxième orifice.

20. Actionneur (10) selon la revendication 19, dans lequel le deuxième clapet de non-retour (36) est disposé pour évacuer du fluide en provenance du volume intérieur du logement.

21. Actionneur (10) selon la revendication 1, dans lequel le premier orifice et le deuxième orifice sont configurés de sorte que, en réponse à un premier mouvement de l'induit, de l'air est aspiré dans l'intérieur au travers du premier orifice, et en réponse à un deuxième mouvement de l'induit, de l'air est expulsé depuis l'intérieur au travers du deuxième orifice.

22. Actionneur (10) selon la revendication 1, dans lequel le logement comporte une première partie accouplée à l'induit ; et une deuxième partie accouplée à la première partie ;
dans lequel le volume intérieur est renfermé par la première partie et la deuxième partie et varie en réponse au mouvement de l'induit,
dans lequel la deuxième partie définit un deuxième orifice au travers duquel de l'air passe en réponse au mouvement de l'induit, et définit le premier orifice ; et
dans lequel la deuxième partie définit le labyrinthe entre le premier orifice et le deuxième orifice.

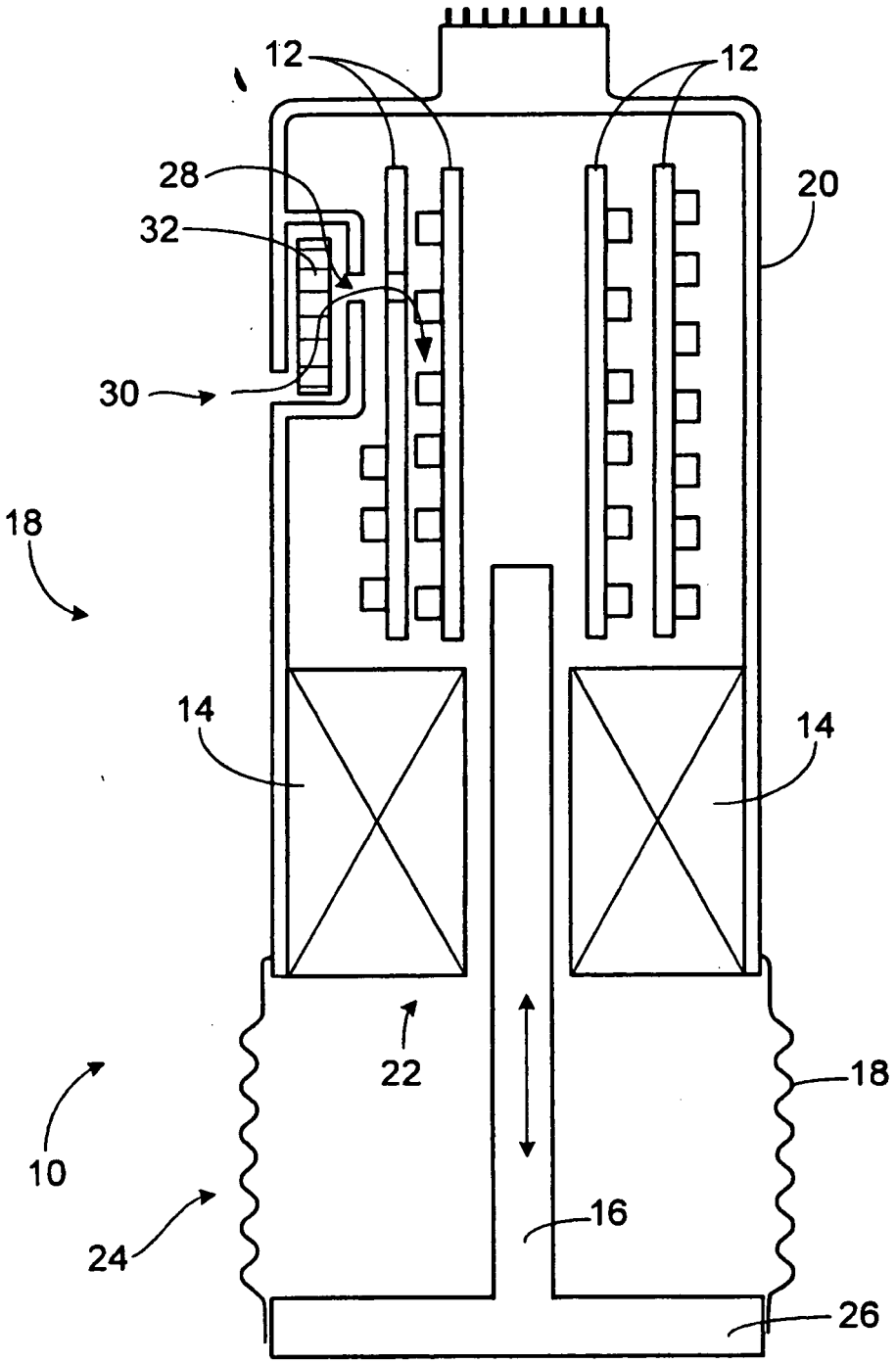

FIG. 1

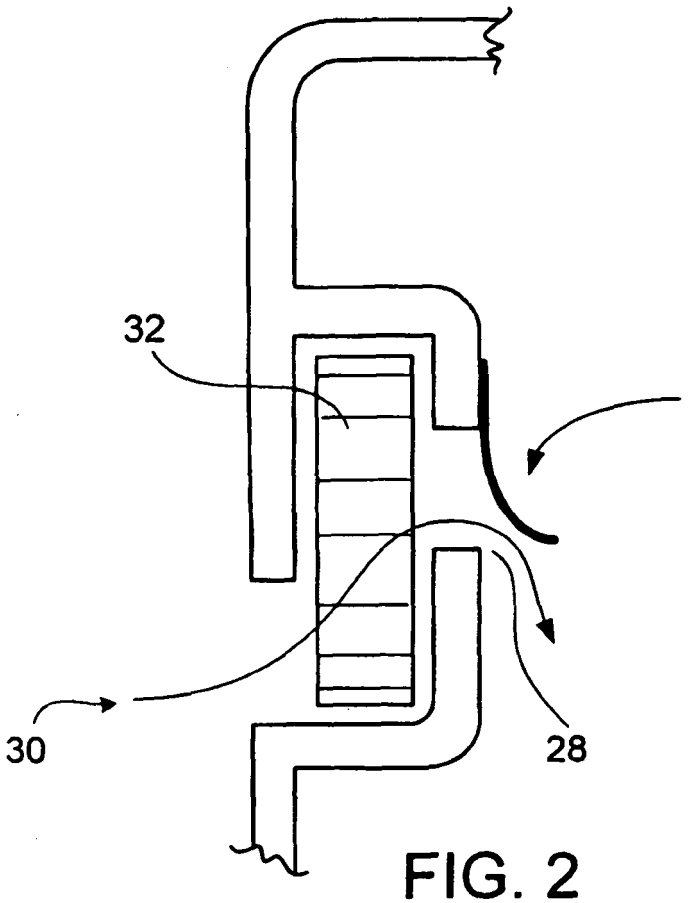

FIG. 2

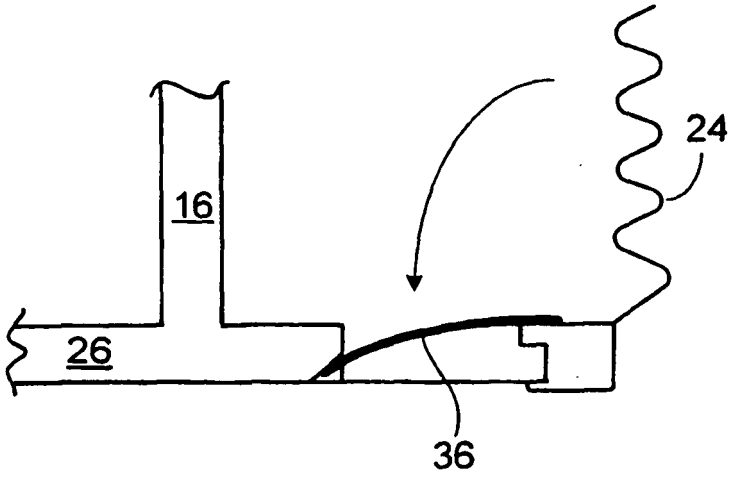

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 4159113 A **[0005]**
- DE 10205771 **[0005]**
- US 4981309 A **[0022]**