

[54] COMPRESSOR CONSTRUCTION

[75] Inventors: **Takashi Otaki, Okazaki, Yoshiaki Aihara**, Nagoya, both of Japan

[73] Assignee: **Mitsubishi Jukogyo Kabushiki Kaisha**, Japan

[22] Filed: **Sept. 20, 1973**

[21] Appl. No.: **399,046**

[30] **Foreign Application Priority Data**

Oct. 25, 1972 Japan..... 47-10619

[52] U.S. Cl. **417/363; 417/902; 415/119; 248/20**

[51] Int. Cl. **F04b 17/00**

[58] Field of Search **417/902, 363; 415/119; 248/20; 74/5.5**

[56] **References Cited**

UNITED STATES PATENTS

3,185,389	5/1965	Loberg.....	417/363
3,353,415	11/1967	Tiplitz et al.....	74/5.5
3,385,542	5/1968	Enemark et al.	417/363
3,396,908	8/1968	Vind	417/363
3,480,205	11/1969	Hatten	417/363
3,493,168	2/1970	Valbjorn	417/363
3,515,007	6/1970	Cusiter et al.	74/5.5

R25,934 12/1965 Chausson..... 417/363

Primary Examiner—C. J. Husar

Attorney, Agent, or Firm—McGlew and Tuttle

[57] **ABSTRACT**

A compressor comprises a compressor body including a motor having a rotatable rotor which is suspended by one or more spring elements within a closed casing. The lower portion of the compressor mounting extends into a damping liquid contained in the lower part of the casing and the compressor is supported in the liquid on a damper stopper which includes a plurality of radially extending blades arranged around the axis of rotation of the rotor and immersed in the damping liquid. The damper stopper advantageously includes a first disk shaped part with radially extending vanes which engage in a lower annular part having angularly spaced radially extending vanes. The lower part is suspended on a leaf spring at the lower part of the casing and it defines chambers between the vanes which are occupied by the vanes of the part secured to the compressor body. The damping liquid is permitted to escape through small size openings defined in either the disk member secured to the compressor or the disk member arranged therebeneath.

6 Claims, 8 Drawing Figures

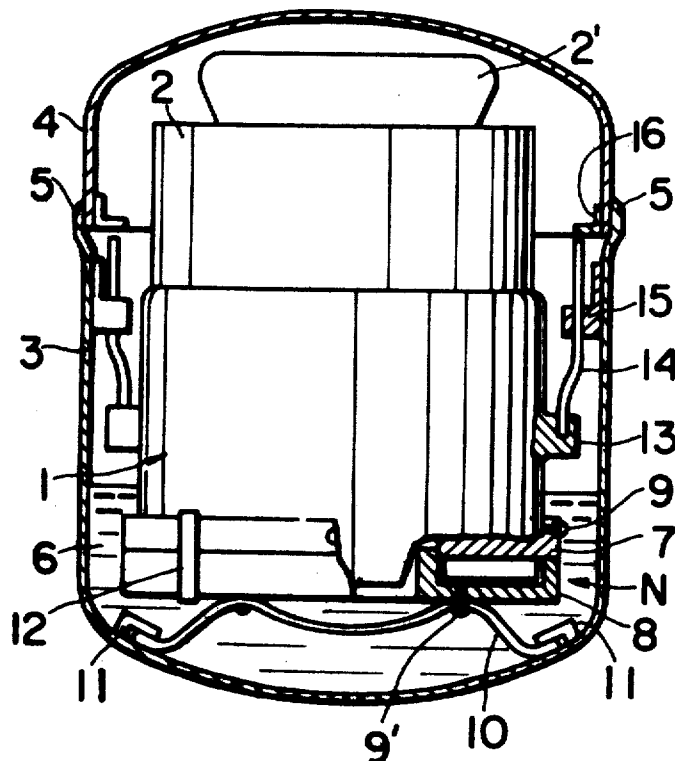


FIG. 1

PRIOR
ART

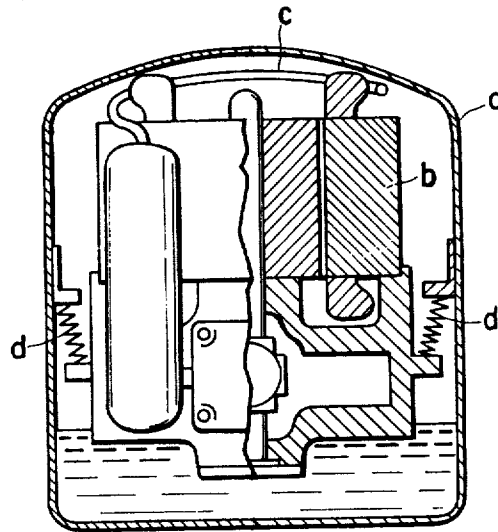


FIG. 2

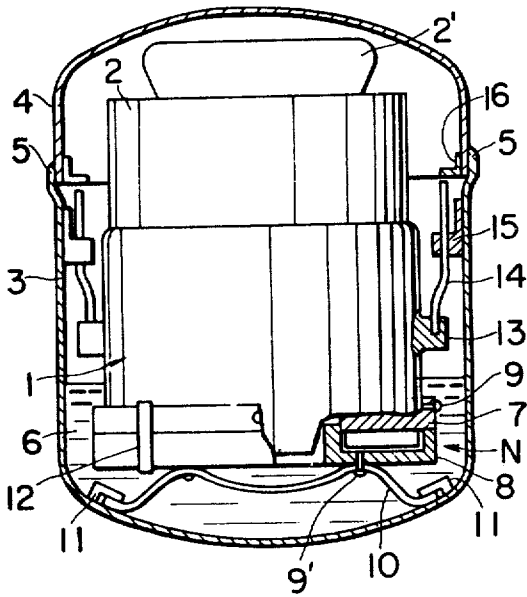


FIG. 3

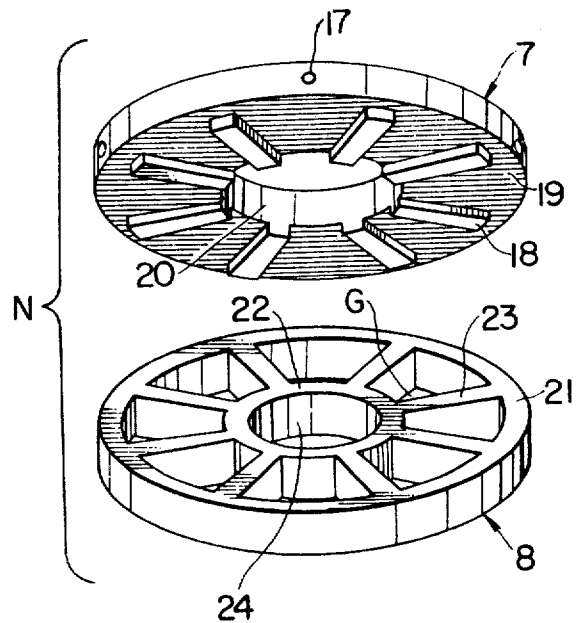


FIG. 4

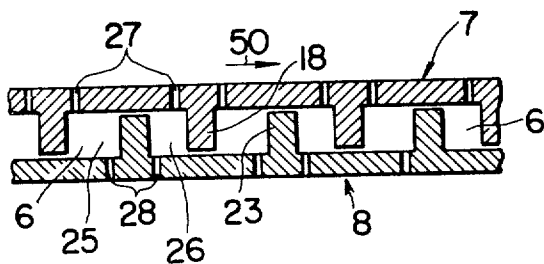


FIG. 5A

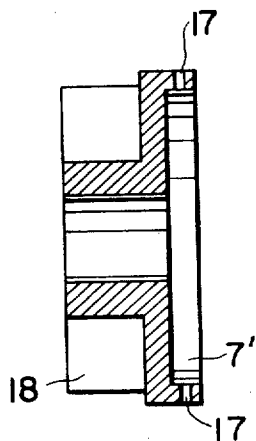


FIG. 5B

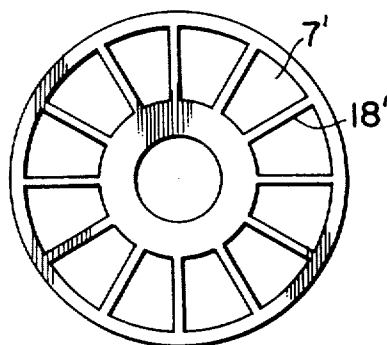


FIG. 6

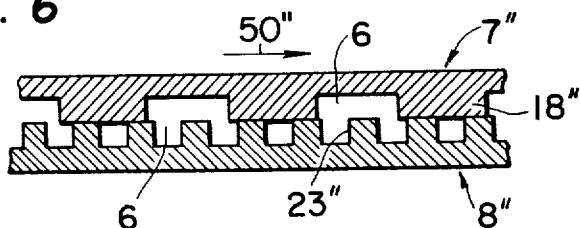
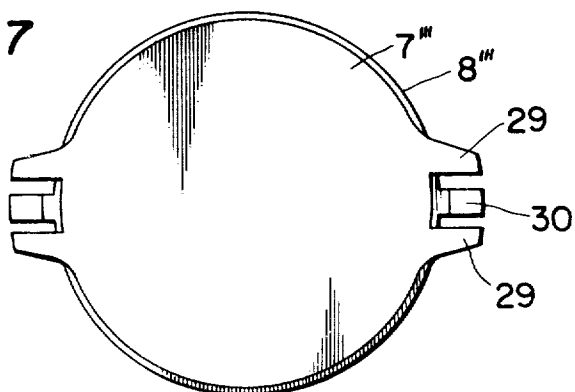


FIG. 7



COMPRESSOR CONSTRUCTION

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates in general to the construction of compressors and, in particular, to a new and useful compressor which is contained in a closed casing and which is suspended on spring elements so that a lower portion thereof rests in a damping liquid on a damper stopper which includes a member having a plurality of radially extending blades arranged around the axis of rotation of the compressor motor.

2. DESCRIPTION OF THE PRIOR ART

A typical known type of enclosed compressor, which is used mainly for heating and cooling operations, includes a motor compressor body which is supported by a so-called shock loop at its upper end and springs arranged along the side which suspend the body within a closed casing so that the lower portion engages into a damping liquid. A disadvantage of the known construction is that the shock loops and the spring elements which suspend the body of the compressor tend to become misaligned or weakened so that the body hits against the casing especially during impact force which is developed at the time of starting or stopping the compressor.

SUMMARY OF THE INVENTION

The present invention provides an improved enclosed compressor which includes an electric motor driven compressor body which is supported by a spring suspension in addition to a support by a damper stopper which engages into the damping liquid. The arrangement is such that the compressor is supported so that during the starting and stopping, the suspension ensures the effective resting of the provocation of sound and vibration from the motor compressor body to the closed casing. In accordance with a preferred arrangement of the invention, the compressor body is supported on a damper stopper which extends into the damping liquid arranged at the bottom of a casing. The arrangement advantageously includes either a single stopper member with radially extending blades which extend radially in respect to the axis of rotation of the motor or a pair of cooperative damper stopper elements.

In the case of the use of the pair of cooperative damper stopper elements, a lowermost element is supported directly on a leaf spring arranged in the bottom of the compressor housing and it includes radially extending blades between which there are formed chambers into which radially extending vanes of a second damper stopper member which is secured to the compressor body extend. The construction is such that even though the motor compressor body is subjected to severe impact during starting and stopping, there is an effective damping of the compressor by the relative movement of the vanes of the one damper stopper member in respect to the blades of the other so that all of the stresses are easily absorbed. The construction is such that no excess stress develops in the closed casing, the supporting springs or the discharge pipes leading from the motor compressor to the casing. The arrangement permits a lowering of the spring constant of the support springs and a marked lessening of the amount of vibration which is propagated from the motor compressor to the casing. Reduced vibration of the casing

means that there is a much lesser vibration of the springs which support the casing and the pipes leading to the outside of the casing housing and this greatly alleviates the problem of strength in these parts. The effect is obtained with the inventive construction not only during starting and stopping but also during operation. Because the supporting springs can be made with a smaller spring constant due to the action of the damper stopper, the coupling between the motor compressor and the closed casing is made sufficiently flexible to produce the effects of arresting propagation of sound and vibration from the motor compressor to the casing and also prevents damage to the respective parts even during operation.

With the two damper stopper elements which rotate relative to each other within the damping liquid such as lubricating oil, the stresses which are developed particularly during starting and stopping are adequately damped by the displacement of the oil within the closed casing. The relative movement which takes place between the vanes of one of the stopper elements and those of the other permits a displacement of the damping liquid and an absorption of the stresses.

Accordingly, it is an object of the invention to provide a compressor construction which includes a closed casing with a motor driven compressor mounted in the casing on support springs and with a damper stopper member secured to the compressor body which includes radially extending vanes or blades which are arranged around the axis of rotation of the motor rotor.

A further object of the invention is to provide an improved compressor construction which includes a motor driven compressor body having a lower end immersed in a damping liquid within a closed housing on a damper stopper assembly which includes a lower member which is resiliently supported on a leaf spring to the bottom of the casing and an upper member secured to the casing body, the members including radially extending blades or vanes which are alternately arranged around the axis of the motor rotor, the vanes having small openings for the passage of damping liquid therethrough during the relative rotative movement of the damper stopper elements secured to the compressor body in respect to the damper stopper element supported on the leaf spring at the bottom of the housing.

A further object of the invention is to provide a compressor construction which is simple in design, rugged in construction and economical to manufacture.

For an understanding of the principles of the invention, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a vertical sectional view of a compressor constructed in accordance with the prior art;

FIG. 2 is a vertical sectional view of a compressor constructed in accordance with the invention;

FIG. 3 is a separated perspective view of the two damper stopper elements supporting the compressor body shown in FIG. 2;

FIG. 4 is a developed vertical sectional view showing the two damper stopper elements interengaged;

FIG. 5A is a vertical sectional view of another embodiment of the damper stopper;

FIG. 5B is a plan view of the damper stopper shown in FIG. 5a;

FIG. 6 is a developed vertical sectional view of still another embodiment of damper stopper; and

FIG. 7 is a plan view of the damper stopper shown in FIG. 6.

DESCRIPTION OF THE PRIOR ART

An example of a known type of enclosed compressor which is used mainly for cooling and heating purposes includes an outer closed casing or housing *a* in which is contained a motor driven compressor body *b*. The body carries a shock loop *c* and is suspended from the casing *a* by springs *d*. In order to permit adequate absorption of sound or vibration produced by the motor compressor body *b* so that it will not be propagated to the closed casing *a*, the shock loop *c* and the spring *d* must be rendered too soft so that the compressor body will be caused to hit against the casing or the shock loop *c* or the springs *d* damaged or broken due to impact force developed at the time of the starting or stopping of the compressor.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring particularly, to FIGS. 2-4, the invention embodied therein comprises a motor driven compressor or compressor body generally designated 1 which includes a driving motor 2 which has a rotor which rotates about a substantially vertical axis. Compressor body 1 comprises the usual cylinder block, crank case, bearings, crank shaft, connecting rod, piston pin, piston, valve and other parts required for gas compression and which are not shown. The rotor of the motor 2 is secured to an end of said crank shaft and it is arranged such that the motor is driven to effect compression when power is delivered to the exciting winding 2'. Although the motor compressor used in the embodiment shown, is of a reciprocating type, it is of course possible to employ a rotary vane type.

In accordance with the invention, the motor compressor body 1 is housed in a closed housing or casing which comprises an upper portion 4 and a lower portion 3 which are welded together around a closing joint 5. Although not shown in the drawings, a gas opening or aperture is provided in the closed casing. The lower part of the motor compressor body 1 is immersed in a lubricating oil or damping liquid 6 contained in the closed housing at the lower portion thereof. In accordance with a feature of the invention the motor body is supported on a damper stopper N which includes two damper stopper elements 7 and 8. One of the damper stopper elements 7 is secured to the compressor body 1, for example, by screws 9 which extend through radially extending opening 17. The other damper stopper element 8 is mounted on a leaf spring 10 having ends which engage into securing lugs 11, 11 at the bottom of the lower housing part 3. Securing screws 9' extend through the leaf spring 10 into the lower damper stopper member 8. The two stopper elements are combined, for example, by encircling clips 12 so that the weight of the compressor body 1 will be conveyed from one damper stopper to the other but so that one damper stopper 7 which is secured to the body 1 may rotate relative to the damper stopper element 8 which is carried by the leaf spring 10. The damper stopper assembly includes an opening arranged centrally thereof

to accommodate a suction port of an oil pump which is disposed below the compressor body 1, but which is not shown. The holding brackets 11 cover both ends of the leaf spring 10 so as to prevent deformation of the spring in the direction of rotation thereof and also in order to provide stoppers for inhibiting any excess elongation of the spring 10. The weight of the motor compressor body 1 and the motor 2 thereof is conveyed to the leaf spring 10 via the damper stopper 8 and to the casing part 3. Thus, the leaf spring 10 constitutes a main spring support system in the vertical direction. The encircling clips 12 do not restrict relative movement of the damper stoppers in the direction of rotation, but they limit the relative movement of the damper stoppers in a vertical direction.

The motor compressor body 1 also carries arms or lugs 13 which are affixed to rod springs 14 and the upper ends of these springs are loosely fitted in spring bearing 15 providing on the lower casing portion 3. The upper casing portion 4 carries stoppers 16 which are located vertically above the respective rod springs 14. Several groups of such arms 13, rod springs 14, spring bearings 15 and stoppers 16 are provided around the circumference of the body 1. Although the movement of the motor compressor body together with the motor 2 which forms a part thereof is limited by the fairly rigid leaf springs 10, the rod springs 14 also act as a regulator of the lateral movement of the body within the casing. In addition the arms 13 and the spring bears 15 operate as stoppers in respect to lateral movement. The springs 14 also act as controls in respect to rotational relative movement between the body 1 and the casing. The rod springs 14 need a relatively low spring constant because it may be determined only by the forces in the lateral direction in the direction of rotation and each rod spring is allowed to make a deformation of an amount sufficient to transmit average torque and operation to the casing 3. When the motor compressor body 1 moves in a vertical direction, the top end of each rod spring 14 abuts against the corresponding stopper 16 to prevent or inhibit any further movement. Thus the rod springs 14 are designed to mainly constitute the spring system along a direction of rotation of the motor compressor.

The gas discharge pipe of the motor compressor body 1 is usually arranged to connect the compressor body 1 and the casing parts 3 or 4 together so that this may also be formed to act as a spring and if its shape is suitably selected it won't exert any influence on the springs 10 and 14.

As seen particularly in FIGS. 3 and 4, the damper stopper elements 7 and 8 are of generally disk-shaped configuration. The element 7 includes a plurality of vanes or blades 18 which extend radially and are arranged around the axis of rotation of the motor rotor. The damper stopper includes an annular portion 19 which is designed to support the weight of the motor compressor body 1 with the motor 2 over the fixed damper stopper element 8. The damper stopper element 7 includes a central opening 20 to permit free passage of oil to the intake port of the oil pump of the motor compressor body 1 and a similar opening 24 is provided in the element 8. The element 8 includes an outer annular portion 21 and an inner annular portion 22 of much smaller diameter which are connected together by the blades or vanes 23. The spaces between the blades 23 define chambers 25 as shown in FIG. 4,

which accommodate the vanes 18 of the movable damper stopper element 7. The vanes 18 of the damper stopper element 7 alternate with the vanes 23 of the stopper 8 and each of the chambers 25 which is provided with lubricating oil openings 27 in the element 7 and 28 in the element 8. When the damper stopper element 7 moves relative to the damper stopper element 8, for example, in the direction as indicated by the arrow 50 in FIG. 4, the damping fluid or lubricating oil in the chambers 25 is displaced so that it moves through the openings 27 or 28 and absorbs the stresses due to the relative movements of the elements 7 and 8. Continued movement of the parts relative to each other will cause the vanes 18 of the element 7 to engage against the vanes 23 of the element 8 and prevent any further movement. The openings 27 and 28 thus provide metering orifices openings for the passage of the damping liquid to absorb the stresses during the relative motion between the elements 7 and 8. The openings 27 and 28 also aid in discharging bubbles in the damping liquid. The damping elements 7 and 8 may of course be other than disk-shaped but may be of any shape which includes the radially extending vane members.

As shown in FIGS. 5A and 5B, only one damper stopper member 7' may be provided and the rod springs are replaced with other springs, e.g., coil springs, which suspend the motor compressor and permit it to move vertically and laterally. In the embodiment shown in FIGS. 5A and 5B, the element 7' is secured directly to the body 1 and the vanes 18' are located directly in the damping fluid 6. Movement of the body 1 with the damping element 7 secured thereto will thus cause the vanes 18' to move in the damping liquid so that the torsional stresses will be absorbed within this liquid.

In the arrangement of FIGS. 6 and 7, there are two damper stopper elements 7'' and 8'' which cooperate similar the embodiments of FIGS. 1 to 4. In the embodiment of FIGS. 6 and 7, however, the vanes 18'' are relatively thick and the vanes 23'' on the element 8'', are relatively narrow. In addition, the vanes are constructed so that they are not arranged alternately but 18'' ride over the surfaces of the vanes 23''.

In the embodiment shown in FIG. 7, stopper elements 29 are contained on the damper stopper member 7'' and stopper elements 30 are contained on the damper stopper member 8''. The spacing between these elements define the limits of the relative movement between the elements 7'' and 8''.

In respect to the embodiment of FIG. 3, in some instances, it is desirable to define radially extending blades 23 directly on the casing 3 or some similar support and without the use of the annular portions 21 and 22.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A compressor construction comprising a closed casing, a motor compressor body arranged within said casing and having a rotor rotatable about an axis of rotation, spring means for supporting said motor compressor body in said casing at a location spaced from the interior of said casing, a damping liquid comprising a lubricating oil contained in the lower portion of said

casing, and damper stopper means connected to said compressor body and including first and second stopper elements, said first stopper element being secured to said compressor body, said second stopper element being supported below said first stopper element within said housing, each of said first and second stopper elements having radially extending blades, the blades of said first stopper member being interengaged between the blades of the second stopper member, the blades of said second stopper member defining chambers therebetween with escape openings for the passage of the damping liquid during the relative movement of said stopper members and the blades thereof and a support spring supporting said second stopper element and mounted in said housing in the damping liquid and being connected to said second and said housing in a manner to prevent rotation of said second element but to permit some vertical movement thereof.

2. A compressor, according to claim 1, wherein the blades of the upper one of said damper stopper elements engage upon the tops of the blades of the lower one of said damper stopper elements and of a size that they are wider than the spacing between the blades of said lower damper stopper element.

3. A compressor construction comprising a closed casing, a motor compressor body arranged within said casing and having a rotor rotatable about an axis of rotation, spring means for supporting said motor compressor body in said casing at a location spaced from the interior of said casing, a damping liquid comprising a lubricating oil contained in the lower portion of said casing, and damper stopper means connected to said compressor body and including said spring means include a lug extending outwardly from a side of said motor compressor body with an upstanding rod spring thereon, said housing having a spring bearing engaged with said upstanding rod spring, said damper stopper means comprising first and second damper stopper elements, one of said elements being secured to said motor compressor body and a leaf spring in the bottom of said housing resiliently supporting the other of said damper stopper elements.

4. A compressor construction comprising a housing, a motor driven compressor body including a driving motor and a rotatable rotor located within said housing, a plurality of rod springs arranged around the circumference of said motor compressor body and secured to said housing holding said motor compressor body at a spaced location from the interior of said housing, a lubrication oil for damping and lubricating said motor in the lower portion of said housing, a damper stopper assembly connected to the bottom of said motor compressor body and located in said lubricating oil and including a first damper stopper element secured to said body and a second damper stopper element rotatably movable in respect to and located below said first damper stopper element, and a leaf spring supporting said second damper stopper element below said motor compressor body and preventing rotation thereof, said first and second damper stopper elements having radially extending blades arranged around the axis of rotation of the rotor.

5. A compressor, according to claim 4, wherein said leaf spring includes ends engaged with the bottom of said housing, and brackets arranged over each end of said leaf spring leaving the outward expansive movement thereof under the weight of said damper stopper,

7

said blades of said first damper stopper being disposed within alternate blades of said second damper stopper, and securing clips holding said first and second damper stopper elements against vertical displacement but permitting relative rotational movement therebetween.

6. A compressor according to claim 4 wherein said blades of said first damper stopper are disposed within alternate blades of said second damper stopper, said blades of said second damper stopper being narrower

8

in width and more in number than said blades of said first damper stopper, said blades of said first damper stopper riding over the surface of said blades of said second damper stopper permitting relative rotational movement between said first and second damper stoppers, said stoppers having openings through said blades permitting the damping liquid to flow out.

* * * * *

10

15

20

25

30

35

40

45

50

55

60

65