(12) UK Patent Application (19) GB (11) 2 122 718 A

(21) Application No **8218512**
(22) Date of filing **25 Jun 1982**
(43) Application published **18 Jan 1984**
(51) INT CL[3] **F16F 13/00**
(52) Domestic classification **F2S** 101 410 411 AA **U1S** 1820 1990 2010 F2S
(56) Documents cited
EPA 0053401
EPA 0014742
GB 1581935
GB 1393145
GB 1312130
GB 0811748
GB 0755808
(58) Field of search **F2S**
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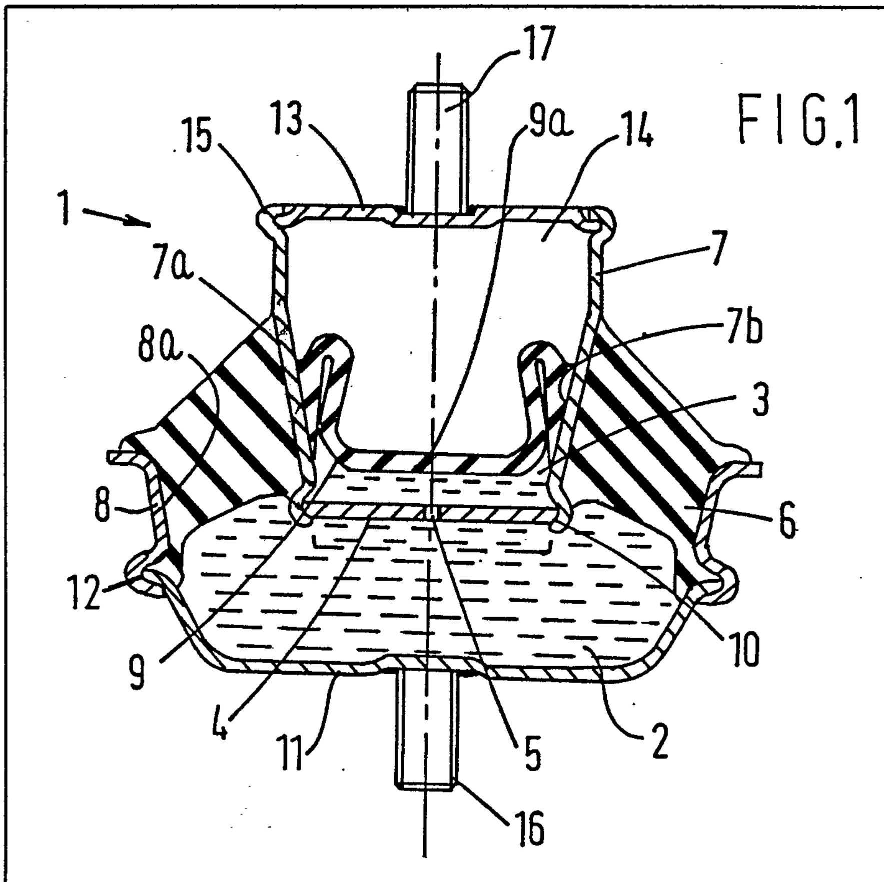
(54) Fluid damped resilient mountings

(57) A resilient mounting comprises main 2 and auxiliary 3 fluid chambers between which a restricted flow of damping fluid can take place, the auxiliary chamber 3 being bounded at least in part by a flexible membrane 9 of convoluted profile in the unloaded condition (as shown) so that fluid displaced from the main chamber 2 is accommodated without stretching the membrane 9. Preferably the membrane 9 is formed in a first profile (Fig. 2) corresponding to that which it adopts in the static load condition and is deflected to said convoluted profile in the unloaded condition. Preferably the membrane 9 is also convoluted in the first profile so that fluid displaced due to both the static load and dynamic working loads is accommodated (Fig. 3) without stretching the membrane 9. The avoidance of tensile stresses in the membrane 9 improves the fatigue life thereof.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

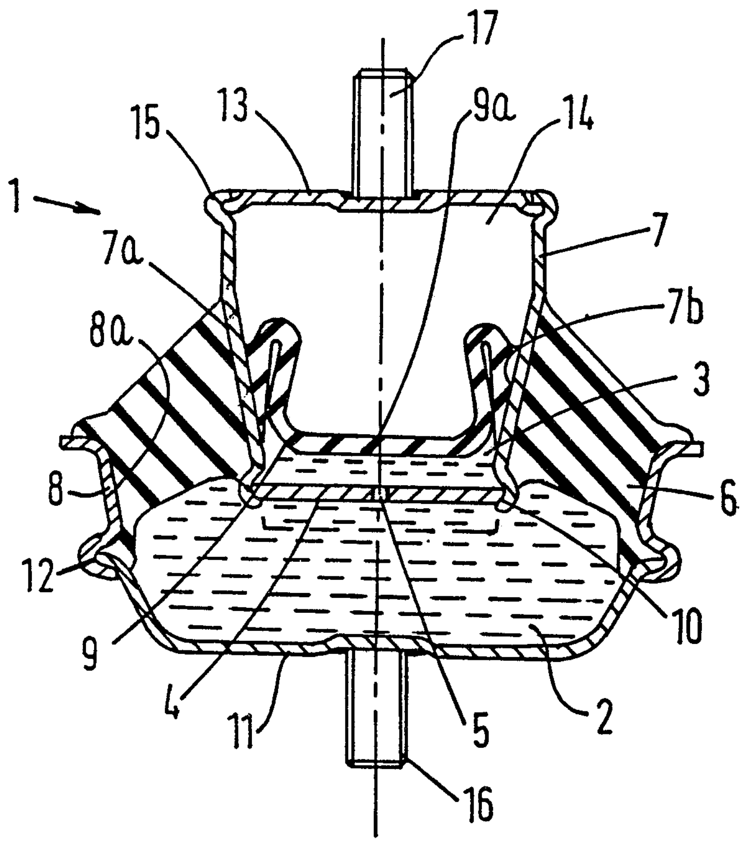


FIG.1

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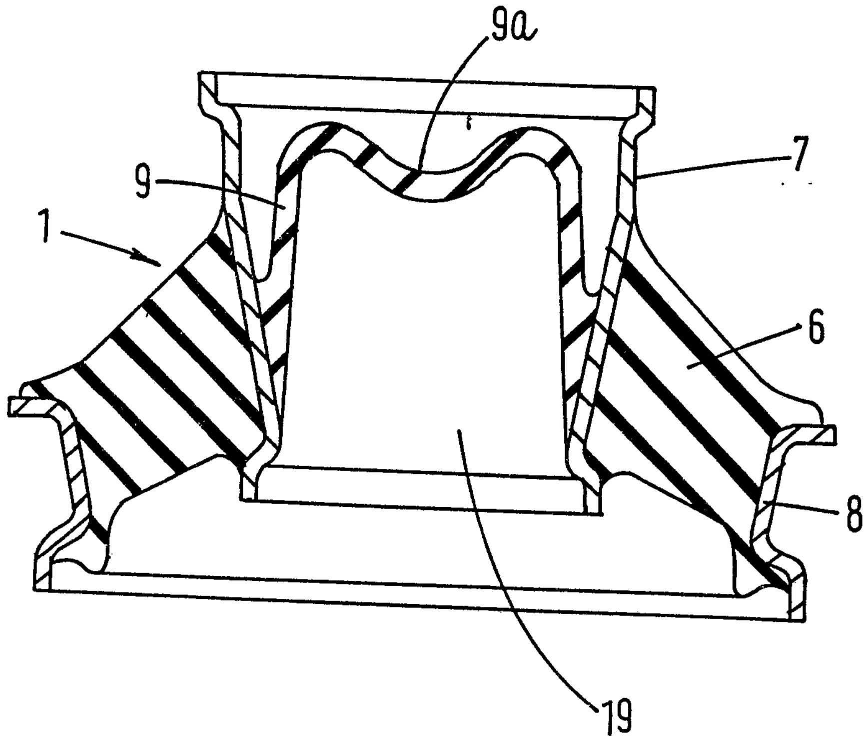

FIG.2

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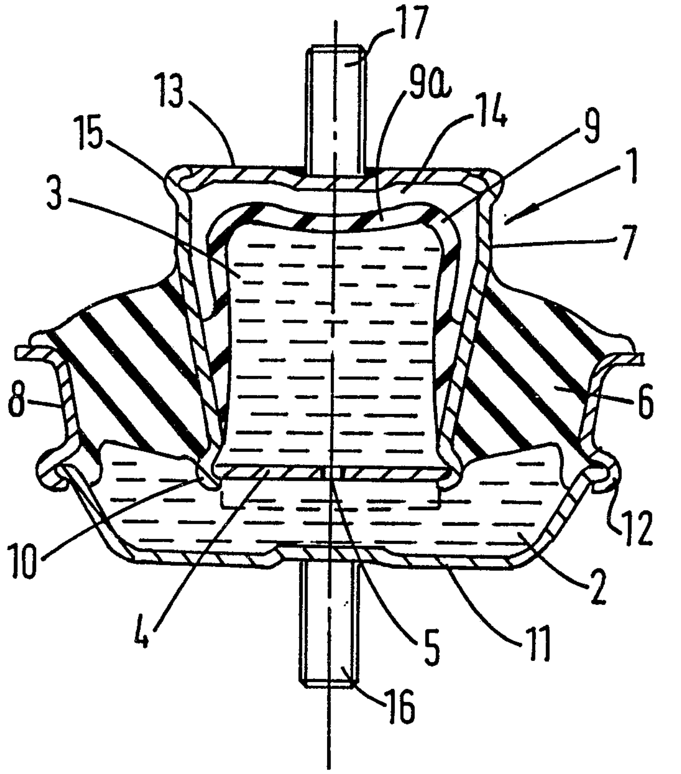

FIG.3

SPECIFICATION

Improvements in or relating to resilient mountings

This invention concerns improvements in or relating to resilient mountings for connecting two components which are movable relative to each other and in particular, though not exclusively, to a resilient mounting for mounting a motor vehicle engine.

According to the present invention a resilient mounting for connecting two components which are movable relative to each other comprises main and auxiliary fluid chambers which in use of the mounting contain a damping fluid between which a restrictive flow of fluid can take place upon relative movement between said components wherein the auxiliary chamber is defined at least in part by a flexible membrane of convoluted profile in the unloaded condition.

The provision of the flexible membrane of convoluted profile in the unloaded condition of the mounting enables fluid displaced from the main chamber to be accommodated by unfolding of the membrane to increase the volume of the auxiliary chamber up to a predetermined limit without stretching the membrane and thereby not subjecting it to high tensile stresses.

Preferably the membrane is constructed to accommodate the fluid displaced from the main chamber under the static load and more preferably the volume displaced under both the static load and the dynamic loads encountered in use without any significant stretching thereof.

Preferably the main and auxiliary chambers are separated by a partition wall which may be rigid or flexible and which contains one or more throttling apertures for controlling the flow of fluid between the chambers.

Preferably the auxiliary chamber is contained within a rigid inner support member which is adapted for connection to one of the two components to be connected.

Preferably the main chamber is defined at least in part by an elastomeric spring which acts between an external surface of the inner support member and an inner surface of an outer support member which is adapted for connection to the other of the two components to be connected. Preferably said external and internal surfaces are of frusto-conical shape.

Preferably the partition wall is positioned at the inner end of the inner support member.

The flexible membrane may be annular having a centre region thereof deflected towards the partition wall in the unloaded condition and movable away from the partition wall to increase the volume of the auxiliary chamber. The membrane may have other convoluted constructions in the unloaded condition so as to provide an auxiliary chamber the volume of which is variable.

Preferably the membrane, inner support member, spring and outer support member are formed as an integral fully bonded unit. Preferably the membrane as moulded has a profile substantially similar to that which it adopts under static loading of the mounting and is deflected to a convoluted profile in the unloaded condition. As a result when the mounting is installed and subjected to the static load it reverts substantially to its as moulded profile and is therefore substantially free of tensile stresses. Preferably the membrane as moulded is of convoluted profile to enable the volume contained therein to be increased beyond the as moulded volume without stretching the membrane. For example the membrane may be generally cup-shaped as moulded with a recessed or concave portion in the base.

Preferably the inner and outer support members are provided with respective and plates having means for attachment to the components. Conveniently the end plate attached to the outer support member completes the main fluid chamber and the end plate attached to the inner support member forms a space within the inner member on the opposite side of the membrane to the auxiliary chamber. Such space may have a volume in the unloaded condition of the mounting substantially equal to the amount by which the auxiliary chamber may increase in volume without stretching the membrane thereby providing a positive limit to deflection of the membrane. The space may be closed or open to atmosphere.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings wherein:—

Figure 1 shows in vertical section a mounting according to the present invention in the unloaded condition;

Figure 2 shows in vertical section a fully bonded unit forming part of the mounting shown in Figure 1; and

Figure 3 shows in vertical section the mounting of Figure 1 in the static loaded condition.

The resilient mounting 1 shown in Figure 1 of the accompanying drawings comprises main and auxiliary fluid chambers 2 and 3 respectively each containing hydraulic damping fluid, e.g. silicone, and separated by a rigid partition wall 4 having a central aperture 5 to permit a restricted flow of damping fluid between the chambers 2, 3.

Main chamber 2 is defined at least in part by an annular rubber spring 6 acting between and bonded to confronting external and internal frusto-conical surfaces 7a and 8a respectively of rigid inner and outer support members 7 and 8 and auxiliary chamber 3, contained within the inner support member 7, is defined at least in part by an annular rubber membrane 9 bonded at the peripheral edge thereof to the internal frusto-conical surface 7b of the inner support member 7.

The rigid partition wall 4 separating the main and auxiliary chambers is positioned at the narrower inner end of the internal support member 7 and secured by deforming the end of the support member 7 to form an annular groove 10 in which the peripheral edge of the partition wall 4 is received.

An annular end plate 11 positioned at the narrower outer end of the outer support member 8 completes the main chamber 2 and is secured by deforming the end of the support member 8 to form an annular groove 12 in which the peripheral edge of the end plate 11 is received.

An annular end plate 13 positioned at the wider outer end of the inner support member 7 forms a space 14 within the support member 7 and is secured by deforming the end of the support member 7 to form an annular groove 15 in which the peripheral edge of the end plate 13 is received. Space 14 is open to atmosphere through one or more apertures (not shown) formed in end plate 13.

Each end plate 11 and 13 is provided with an integral axial extending shank 16 and 17 respectively which is externally threaded for securing each end plate to a respective one of two components to be connected.

Referring now to Figure 2 there is shown an integral fully bonded unit 18 consisting of the membrane 9, inner support member 7, spring 6 and outer support member 8 to which the partition wall 4 and end plates 11 and 13 may subsequently be attached by deforming the end portions of the supporting members as abovedescribed.

In the as moulded condition of unit 18 membrane 9 has a generally cup-shaped profile in which base 9a is adjacent the outer end of the inner support member. The internal volume 19 defined by the membrane 9 which in use contains the damping fluid is less than the internal volume of the inner support member and the centre region of the base 9a is of recessed or concave profile such that the centre region may deflect in use to increase the internal volume 19 beyond the as moulded volume without greatly stretching the membrane and therefore without generating significant tensile stresses therein.

On assembly membrane 9 is deflected from its as moulded profile to the convoluted profile shown in Figure 1 in which base 9a is adjacent to the inner end of the inner support member by applying a predetermined axial load to one of the support members to compress spring 6 and reduce the volume of main chamber 2 prior to the introduction of the damping fluid through a suitable inlet (not shown) in end plate 11. As a result on releasing the axial load spring 6 returns to its original shape increasing the volume of main chamber 2 and damping fluid is drawn from the auxiliary chamber into the main chamber simultaneously deflecting the membrane 9 from its as moulded profile to the convoluted profile shown in Figure 1.

In use of the mounting, for example as a resilient mounting for a vehicle engine in which end plate 13 is secured to the vehicle engine (not shown) and end plate 11 is secured to the vehicle body (not shown) or vice versa relative axial movement between the inner and outer support members such as to compress spring 6 simultaneously reduces the volume of the main chamber 2 and forces damping fluid through the throttling aperture 5 in the partition wall 4 into the auxiliary chamber 3 where it is accommodated by deflection of the membrane 9 to increase the volume of the auxiliary chamber 3.

In a preferred arrangement the mounting 1 abovedescribed is constructed so that under static loading of the mounting the volume of damping fluid forced through the aperture 5 into the auxiliary chamber 3, deflects the membrane 9 to the position shown in Figure 3 in which the membrane has a profile substantially similar to that in the as moulded condition of the unit 18 shown in Figure 2. As a result tensile stress levels generated in the membrane 9 are kept to a minimum under static loading.

Furthermore, it is to be noted from Figure 3 that the base 9a of membrane 9 is still of recessed or concave profile under static loading such that deflection of membrane 9 may occur to increase further the volume of the auxiliary chamber to accommodate fluid forced through the aperture 5 due to variations in the dynamic loads produced by vibrational movement of the engine without significantly stretching the membrane. As a result tensile stress levels generated in the membrane 9 are also kept to a minimum under dynamic loading.

It will be readily appreciated from the foregoing that the provision of a membrane having a convoluted profile in the unloaded condition which is capable of accommodating displaced fluid without being significantly stretched not only improves the fatigue life of the membrane by avoiding high tensile stressing thereof but also enables maximum use to be made of the space available in the inner support member for containing fluid displaced from the main chamber since the inner support member does not have to have an internal volume significantly greater than the as moulded volume of the membrane to allow stretching of the latter under both static and dynamic loads to increase the volume of the auxiliary chamber.

Finally it will be understood the invention is not restricted to the mounting or method of assembly abovedescribed which may be modified in a number of ways. For example, the membrane 9 may have any convoluted profile, e.g. a bellows type profile, which enables the volume of the auxiliary chamber to be varied without significantly stretching the membrane. The deflection of the membrane from its moulded profile on assembly may be such that it reverts substantially to its as moulded profile under any desired applied load e.g. the static load as abovedescribed, the maximum static and dynamic load to which it may be subjected in use or any intermediate load. The increase in volume of the auxiliary chamber which may occur without significantly stretching the membrane may be controlled either by ensuring the volume of space 14 does not greatly exceed such increase in volume or by providing an end stop to limit axial movement between the support members such that the volume of fluid displaced from the main chamber does not greatly exceed such increase in volume. The partition wall 4 may have more than one throttling aperture 5 and the or each aperture may be constructed to provide any required damping characteristic. Further the partition wall 4 may be rigid as described or flexible and may be fixed as described or mounted for movement relative to the inner support member in known manner. The support members 7, 8 may be made from metal or any other suitable material e.g. reinforced plastics. Similarly spring 6 and membrane 9 may be made from any elastomeric material compatible with the damping fluid which may also be of any known type. The required convoluted profile for membrane 9 in the unloaded condition of the mounting may be achieved by methods other than the preloading of the mounting abovedescribed. For example with end plate 11 unattached the membrane may be deflected to the required profile by a former prior to introducing the damping fluid. The rubber spring 6 may contain a reinforcement e.g. one or more metal plates or other substantially inextensible material. The inner and/or outer members 7 and 8 may be adapted for connection to a component by means other than shanks 16 and 17 e.g. end plates 11 and 13 may be adapted to include holes or studs for attaching the end plate to a component.

CLAIMS

1. A resilient mounting for connecting two components which are movable relative to each other comprises main and auxiliary fluid chambers which in use of the mounting contain a damping fluid between which a restricted flow of fluid can take place upon relative movement between said components wherein the auxiliary chamber is defined at least in part by a flexible membrane of convoluted profile in the unloaded condition.

2. A mounting according to Claim 1 wherein the membrane is constructed and arranged to accommodate fluid displaced from the main chamber up to a predetermined load without any significant stretching of the membrane.

3. A mounting according to Claim 2 wherein the membrane as formed has a profile different to the convoluted profile adopted in the unloaded condition whereby the membrane returns substantially to its as formed profile under said predetermined load.

4. A mounting according to Claim 2 or Claim 3 wherein said predetermined load is the static load in use of the mounting.

5. A mounting according to any one of the preceding claims wherein the auxiliary chamber is contained within a rigid inner support member adapted for connection to one of the two components to be connected.

6. A mounting according to Claim 5 wherein the main chamber is defined at least in part by an elastomeric spring which acts between an external surface of the inner support member and an internal surface of an outer support member adapted for connection to the other of the two components to be connected.

7. A mounting according to Claim 6 wherein said internal and external surfaces are frusto-conical.

8. A mounting according to Claim 6 or Claim 7 wherein the inner and outer support members, elastomeric spring and membrane are formed as an integral fully bonded unit.

9. A mounting according to any one of the preceding claims wherein the main and auxiliary chambers are separated by a partition wall constructed and arranged to control the flow of fluid between the chambers.

10. A mounting according to Claim 9 wherein the partition wall has at least one aperture therein for the passage of damping fluid between the chambers.

11. A mounting according to any one of the preceding claims including means to prevent the fluid displaced from the main chamber to the auxiliary chamber exceeding a predetermined value.

12. A resilient mounting substantially as hereinbefore described.

13. A resilient mounting substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1984. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.