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(54) IMPROVEMENTS IN OR RELATING TO ARRANGEMENTS COMPRISING A STRUCTURAL MEMBER FROM WHICH A ROTATING MACHINE IS SUSPENDED BY MEANS OF A SUSPENSION DEVICE

(71) We, AUTOMOBILES PEUGEOT, a French Body Corporate, residing at 75 Avenue de la Grande Armée, 75016 Paris (France), do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:–

The present invention relates to an arrangement comprising a structural member from which a rotating machine is suspended by means of a suspension device, and is more particularly applied to the suspension of an internal combustion engine in an automobile vehicle.

Any rotating machine having such a lack of balance and suspended elastically to avoid transmission of vibrations, undergoes a displacement of constant amplitude and phase as a function of the frequency, as long as said latter remains greater than twice the natural frequency of the machine on its supports, which, moreover, is always the case if the suspension is well done.

The elastic suspension elements therefore transmit forces proportional to their stiffness.

It is an object of the invention to remedy the above drawback by creating an arrangement comprising a structural member from which a rotating machine is suspended by means of a suspension device in which the forces transmitted by the elastic suspension elements are eliminated.

According to the present invention there is provided an arrangement comprising a structural member from which a rotating machine is suspended by means of a suspension device, the device comprising at least one elastic support to the machine and to the structural member and defining a first chamber which is filled with liquid and which communicates with a second chamber which is likewise filled with liquid and which is closed by a flexible wall that is attached to the machine, and the rotating machine including driving means which, in use of the machine, are adapted to subject the flexible wall to periodic displacement, the frequency and phase of which displacement are equal to those of the rotating machine.

Such an arrangement enables the vibration and humming level in the interior of a vehicle fitted with an engine suspended by means of the device according to the invention, to be considerably improved.

Hereinafter are given two applications of the arrangement according to the invention to the suspension of a four-cylinder, line engine, for which the frequency of the parasitic vibrations is double the speed of rotation of the crankshaft.

The invention will be more readily understood on reading the following description with reference to the accompanying drawings, in which:

Fig. 1 shows a section through a first embodiment of a suspension device in an arrangement according to the invention;

Fig. 2 is a view in section of a second embodiment of a suspension device (in an arrangement) according to the invention, and

Fig. 3 is a partial section along line 3-3 of Fig. 2.

Referring now to the drawings, Fig. 1 shows a portion of the housing 1 of a thermal engine which rests on a structural element 2 of an automobile vehicle, via an elastic support 3. This latter is constituted by an elastomeric block 4 which is adhered to two fittings 5 and 6 and defining a first closed chamber 7.

Said first chamber 7 communicates via a conduit 8 with a second chamber 9 defined by a casing 10, a rigid wall 11 and an elastic wall 12 which is adhered to a central push rod 13. The casing 10 is fixed to the housing 1 through which the push rod 13 passes.

This latter abuts on a cam 14 rotated so as to supply two impulses to the push rod 13 per revolution of the crankshaft of the engine. This cam 14 may therefore comprise, in practice, four lobes and may be fast with the cam shaft of the engine if said latter operates in a four-stroke cycle.

The casing 10 and the wall 11 are connected together by a fitting 15 which delimits with an elastic wall 16 and the wall

11 a third chamber 17 communicating with the second chamber 9 through a calibrated aperture 18 made in the wall 11.

The first chamber 7, conduit 8, second chamber 9 and third chamber 17 are completely filled with a liquid, by means of a filling device 19 and a drain device 20.

It is seen that, in the device which has just been described, the cam 14 transmits periodic movements to the push rod 13. These movements vary the volume of the second chamber 9 which, due to the virtual incompressibility of the liquid, brings about displacements of the fitting 5 of the support 3 with respect to the fitting 6.

The amplitude of the displacement of the push rod 13 is calculated so as to obtain a displacement of the fitting 5 in the direction of compression of the support 3 equal to the displacement of the engine in the same direction, the two movements being in phase.

Due to the compensation of the displacements of the engine by the deformations of the support 3, by the hydraulic pressure prevailing in the first chamber 7, any strain on the structural element 2 is avoided.

The purpose of third chamber 17 is to limit the variations in pressure in the circuit under the effect of the forces undergone by the support to bear the engine and the forces resulting from the vibrations coming from the road.

Upon application of the weight of the engine on the support 3, the elastic deformation of the wall 16 limits the rise in pressure of the liquid in the circuit, this enabling the cam 14 and the push rod 13 to be given reduced dimensions and to reduce wear thereof.

Similarly, the wall 16 is elastically deformed under the effect of the forces originating from the road. To this end, the aperture 18 is so calibrated as to allow free passage of low frequencies, lower than 15 Hz resulting from the vibrations from the road, and to be virtually non-transmissive when the circuit receives from the push rod 13 vibrations of a frequency of 30 Hz-200 Hz, (this corresponding to an operating range of the engine of 900-6000 r.p.m.).

It will be noted that the position of the third chamber 17 is not critical and that it may communicate via the aperture 18 with any point of the circuit constituted by the first chamber 7, conduit 8 and second chamber 9.

In the alternative embodiment shown in Fig. 2, the wall 12 is adhered to a central rod 25 which acts as a movement or stroke limiter between the rigid wall 11 and a plate 26.

This latter defines, with the casing 10 and wall 12, an additional chamber 27 connected by two conduits 28, 29, to a bearing of the camshaft 31.

This camshaft 31 comprises a first central channel 32, supplied with pressurized oil by the oil pump of the engine (not shown), and a second central discharge channel 33.

The channel 32 terminates in two perpendicular bores 34, each end of which communicates successively, in the course of rotation of the camshaft 31, with conduit 28.

The channel 33 extends from two perpendicular bores 35, each end of which communicates successively, in the course of rotation of the camshaft 31, with conduit 29.

The relative arrangements of the conduits 28, 29 and bores 34, 35 are such that the communication of the additional chamber 27 with the discharge channel 33 alternates with the communication of the same chamber 27 with the pressurised channel 32.

This results in alternate movements of the wall 12 which, in turn, results in displacements of the fitting 5 with respect to fitting 6 of support 3.

As in the first embodiment, these movements are provided to be in phase with those of the engine and of the same amplitude.

WHAT WE CLAIM IS:

1. An arrangement comprising a structural member from which a rotating machine is suspended by means of a suspension device, the device comprising at least one elastic support attached to the machine and to the structural member and defining a first chamber which is filled with liquid and which communicates with a second chamber which is likewise filled with liquid and which is closed by a flexible wall that is attached to the machine, and the rotating machine including driving means which, in use of the machine, are adapted to subject the flexible wall to periodic displacements, the frequency and phase of which displacements are equal to those of the rotating machine.

2. An arrangement as claimed in claim 1, wherein the second chamber is defined by a casing, a rigid wall and said flexible wall, which is constituted by elastic material whose periphery is rigidly connected to said casing.

3. An arrangement as claimed in either one of claims 1 and 2, wherein said machine being an internal combustion engine, the periodic displacements of said flexible wall are caused by the means which comprise a driving device that is adapted to be connected to the crankshaft of said engine.

4. An arrangement as claimed in claim 3, wherein the driving means for displacing said flexible wall comprises a push rod to which said wall is adhered at its centre, said push rod abutting on a cam which, in use, is adapted to be rotated by the crankshaft of the engine so as to furnish said push rod with two impulses per revolution of the crankshaft.

5. An arrangement as claimed in claim

4, wherein said cam has four lobes and is integral with the camshaft of the engine.

6. An arrangement as claimed in claim 3, wherein the driving means for displacing the flexible wall comprises an additional chamber, with a deformable wall which is defined by the face of said flexible wall opposite the second chamber, said additional chamber being supplied with fluid by a fluid impulse generator synchronized with the crankshaft of the engine.

7. An arrangement as claimed in claim 6, wherein said fluid impulse generator is constituted by a bearing of the camshaft of the engine, said camshaft comprising a first central channel supplied with pressurised oil by the oil pump of the engine and a second central discharge channel, said first and second channels terminating in two perpendicular bores, each end of which communicates successively, in the course of rotation of the camshaft, respectively with a first and a second connection conduits with the additional chamber.

8. An arrangement as claimed in either one of claims 6 and 7, wherein said flexible wall is adhered to a central rod for limiting the stroke between the rigid wall defining the second chamber and a plate forming the end wall of the additional chamber opposite the elastic wall.

9. An arrangement as claimed in claims 6 and 7, wherein said first and second conduits open in said plate.

10. An arrangement as claimed in any one of the preceding claims, further comprising a device for limiting the variations in pressure of the fluid under the effect of forces imparted to the support of said machine.

11. An arrangement as claimed in claim 10, wherein the limiting device comprises a damping chamber defined by an elastic wall and said rigid wall of the second chamber, said damping chamber communicating with said second chamber by an aperture made in said rigid wall, said aperture being calibrated in order to allow passage of fluid impulses of low frequences, resulting from the vibrations coming from the ground and transmitted through the first chamber of said elastic support, and to block the impulses whose frequency is greater than a predetermined value.

12. An arrangement comprising a structural member from which a rotating machine, is suspended by means of a suspension device substantially as hereinbefore described with reference to and as shown in Fig. 1 of the accompanying drawings.

13. An arrangement comprising a structural member from which a rotating machine, is suspended by means of a suspension device substantially as hereinbefore described with reference to and as shown in Figs. 2 and 3 of the accompanying drawings.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 3

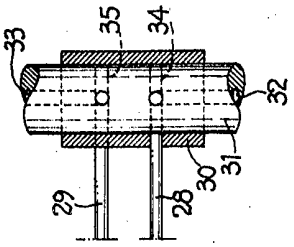

FIG. 2

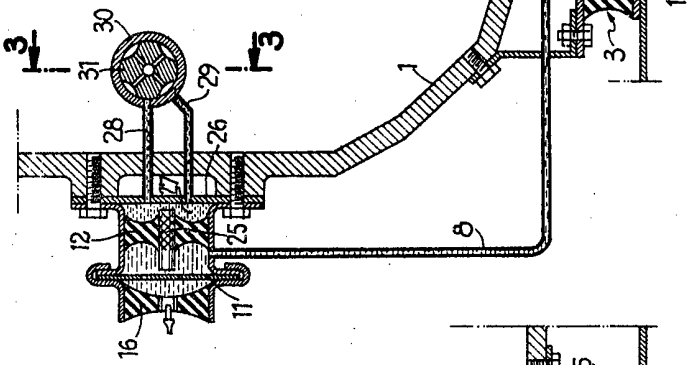

FIG. 1