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(54) TORSIONAL DAMPERS

(71) I, DIRK FORKEL, a citizen of the Federal Republic of Germany, of Eichenweg 18, 8520 Elangen, Germany, do hereby declare the invention, for which I pray that a patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement:-

The invention relates to torsional dampers operating with a viscous friction medium and intended to limit the amplitude of vibration and thus the stressing of shafts, particularly of crankshafts in internal combustion engines. Various constructions of such dampers are known and consist basically of a flange member connected rigidly to the shaft and, mounted rotatably or elastically thereon, a flywheel body which, together with corresponding surfaces of the flange, forms narrow clearances which are filled with a highly viscous fluid. The relative movements which occur in the event of torsional oscillations between the flange and the flywheel body, which acts as a mass of inertia, give rise to marked shearing forces in the clearances and therefore to the desired damping effect.

According to the disposition of the flywheel body, so it is possible to differentiate between dampers having an internally disposed flywheel mass in which the flange is constructed as a housing and fully encloses the flywheel ring, and those which have an externally disposed flywheel mass, in which seals are needed between the flange and the flywheel body.

Although the latter-mentioned construction with an external flywheel mass obviously had advantages which are based in the greatly reduced fixed mass of the flange, with the omission of the housing, and the accessibility to the flywheel body, in practice it has hitherto been solely the closed construction with its simple design which has become popular. Nevertheless, this construction does have a number of weaknesses which, particularly in the case of more heavily stressed engines, become increasingly unpleasantly noticeable.

According to the present invention a torsional damper with clearances provided between a flange body and a flywheel body and filled with highly viscous fluid, is characterised in that the clearances are defined by interdigitating plates on the flange body and flywheel body, the plates being curved about an axis of relative rotation of the flange body and flywheel body.

By reason of their curvature, the plates acquire considerable stability of shape and can therefore be manufactured from thin and less resistant material, so that, without increasing the dimensions of the damper, a decided enlargement of gap area can be achieved in a particularly economical manner, while accuracy requirements are greatly reduced.

The two sets of plates can be brought into working relationship simply by relative axial movement of the flange body and flywheel body. Exact axial location is not necessary. In the case of an embodiment which is particularly suitable for manufacture of relatively large quantities, the plates are constructed like the shells of cylinders and are made in various diameters which are graded so that the desired gap width is created between one plate and the next larger plate. These plates are then centered and secured at alternate ends on corresponding faces of the flywheel body and flange body.

In another form of embodiment, which is however suitable only for torsional dampers with an elastic connection between flywheel body and flange, by which the range of oscillation is restricted, the plates do not form cylindrical surfaces but a spiral shape in plan view. Such a spiral plate is secured at one end to a corresponding face of the flywheel body, while a second equivalent member is rotated through half a turn and its other end face is secured to a corresponding face of the flange body and, exactly as in the case of circularly-cylindrical plates, they are pushed axially into one another. The pitch of the spiral, or rather the clear space interval from one turn of the spiral to the next is so dimensioned that, allowing for the thickness of the matching plate which is to be pushed in between, twice the desired gap thickness is created.

In both forms of embodiment, the plates may be made from steel plate or cast by some accurate method. In the case of pressure die cast plates, for example, it is appropriate to produce the plates with a thickness increasing towards the root end, so that, if the second plate is constructed in the same way, the gap thickness is retained over the entire surface of the plate, since both end faces extend slightly conically. Plates made from sheet metal ideally have their ends inserted into slots in the flange or flywheel body and secured. This method is suitable both for cylindrical plates and also for spiral plates. Another possible way of fixing resides in taking cylindrical plates of different diameters and first assembling them together with narrow intermediate rings to serve as spacers, the resultant assembly then being joined to the flywheel body or flange body of the damper. This method is particularly suitable for making up a plate assembly of spiral cross-section, which can here be coiled together in one operation from a strip of sheet metal of the same width as the plate and a narrow spacer strip which is applied on one side, the assembly being secured for example by soldering.

The described embodiments of curved plates can be used both in a damper with an inner flywheel body enclosed by a housing-like flange, and also in dampers with an external flywheel body, and sealing of the clearances between the flywheel body and the flange.

In the first case, the plates are expediently so constructed that their large surface helps to relieve the bearings. To compensate for any temperature-occasioned variation in volume of the damper fluid, there is here expediently on the end face of the flange housing an annular sheet metal membrane, welded on for example by means of two annular seams, and which is connected to the interior of the damper.

In the second case, of a damper with an external flywheel body, no special measures are needed to compensate for volume if the locating and sealing rings, which connect the flywheel body and flange in torsionally elastic fashion and seal the clearances, are in an axial direction so elastically constructed that the enlargement of the clearances in the event of a slight axial displacement can take place without any substantial pressure build-up inside the damper.

In addition to this, in all embodiments, the problem of maintenance and wear-free mounting or guidance of the flywheel body and that of sealing the clearances is preferably resolved in that at least two elastic locating and sealing rings of approximately rectangular cross-section are inserted between flange and flywheel body. In order to minimise the specific loading and generation of heat in these rings, they are of largest possible dimensions and extend over the total width available in the design. The disposition of the locating and sealing rings is furthermore such that, without adversely affecting the elasticity in a peripheral direction, one achieves the necessary greater rigidity required, particularly for radial location of the flywheel body. This can be achieved by disposing the rings between axial faces, i.e. between cylinder faces, but also by locating the rings between radial faces, particularly if the latter extend up to relatively large diameters. A slightly oblique attitude of the rings, i.e. location between conical surfaces, provides, in the case of non-vulcanised-on rubber rings, the additional advantage of very easy fitment in an axial direction.

In principle, two rings can be located symmetrically in respect of a central plane through the damper perpendicular to the axis, whereby both rings serve at the same time the purposes of mounting, locating and sealing. In this respect, the rings can either have their inside diameter applied against the correspondingly constructed part of the flange or may have their outside diameter supporting the flywheel body, or their outside diameter can rest against a corresponding face of the flange while their inside diameter carries a cap-like part of the flywheel body which engages over said inside diameter.

In the case of a non-symmetrical design of oscillation damper, it is substantially only one locating and sealing ring which extends over the entire available width of the damper, which takes over this dual function, while the other ring fulfils only sealing functions and may consequently consist of more elastic material. There may be circumstances in which such asymmetrical design may be more favourable in terms of cost and be particularly advocated if for other reasons the mounting flange of the damper is not to be in the central plane.

In all cases, the elastic rings, in order to improve their locating and guidance properties, can be anisotropically constructed in that they react softly to shearing forces in a peripheral direction but rigidly, in order to accommodate the locating forces, when exposed to forces applied particularly in a radial direction. For example, this can be achieved by the ring being made up from layers of differing hardness, the separating faces laying in radial planes containing the central axis. The rings may also be made up from grades of rubber of different elasticities. Such reinforcements or inlays diminish the elasticity of the ring under radial or axial loading, while under tangential loading the desired elasticity in a peripheral direction is for practical purposes unaffected.

A favourable development from the point of view of production resides in the numerous radially extending reinforcements which are vulcanised into the ring not being introduced individually but being connected in a meanderingly extending strip. In this case, the bends are weakened in that, under tangential thrust, no substantial bending moments can occur. Without this weakening, which may also be provided in the form of prepared breakage places, the elasticity would be undesirably diminished under tangential loading.

Examples of dampers which embody the invention will be described hereinafter, with reference to the accompanying diagrammatic drawings, in which:-

Figure 1 shows a cross-section through curved interdigitating plates;

Figure 2 is a perspective view - in this case axially exploded - of spiral plates;

Figure 3 shows a damper having spiral plates, external flywheel body and biconical locating and sealing rings;

Figure 4 shows an alternative having bilateral symmetrical plates on the flange, in a pressure diecast version;

Figure 5 shows an asymmetrical construction with one broad cylindrical locating and sealing ring, and a further ring which serves only for sealing purposes;

Figure 6 shows a further asymmetrical embodiment having a radial and an axial locating and sealing ring; and

Figure 7 and *Figure 8* are examples of the anisotropic construction of locating and sealing rings.

Figure 1 shows in detail the disposition of the axially interdigitating curved plates 40, each of which is secured at one end to a respective one of the plate carriers 46, which are in turn parts of the flywheel body and flange body respectively. Attachment of circularly cylindrical plates 41 in the upper part of Figure 1 is effected either by means of spacer rings 42, or by concentric fixing slots 45. In the lower part of Figure 1, and not open to differentiation in cross-section, are shown spiral plates 43 which are held by a spiral spacer strip 44 or, in the right-hand half of Figure 1, by spiral grooves 45.

Figure 2 shows in a perspective view and axially exploded the arrangement of the spiral plates 43.

Figure 3 shows an example of a spiral plate damper with an external flywheel body 21 mounted on a support 13 of the flange body 11 through caps 30 and two elastic locating and sealing rings 61, which are in this case disposed between conical surfaces. The inter-engaging spiral plates 43 are held in position by spacer strips 44 and are secured on the part 13 of the flange body or on a cap 30 on the flywheel body, for example by being hard soldered.

Figure 4 shows a damper with circularly cylindrical plates 47 which are bilaterally symmetrical with respect to a central plane of the damper. The plates are made in a pressure diecast material, with the necessary taper, which means that they become thicker towards the central plane. The plate carrier is widened out inwardly towards the flange 11, on both sides of which supports 13 are secured. Two cylindical locating and sealing rings 62 carry on their outside diameter a cylindrical edge 46 of a plate carrier which in this case carries the plates 48 which are likewise produced from pressure diecast material. This plate carrier is secured, at its outside diameter, to the flywheel body 21. Since the plates 48 are likewise provided with a taper at both ends, the gap 52 created between them and the plates 47 is of the same thickness everywhere. The plate carrier at the flywheel body end can, as shown in the right-hand half of the picture, be provided with cooling fins 49 for better heat dissipation.

Figure 5 shows an asymmetrical damper with curved plates 40, in which a broad locating and sealing ring 62 rests on the flange body 11, and carries on its outside diameter a correspondingly shaped cap 30 of the flywheel body. In a further development of the circular and spiral plates, these are, for better cooling, extended outwardly beyond the plate carrier and form annular or spiral cooling fins 49. With this construction, a second ring 70 serves only to provide a seal.

In a further asymmetrical construction according to Figure 6, the flange body 11 is constructed as a simple drawn sheet part and is reinforced by a ring 12 in the vicinity of its inner diameter. It carries two vulcanised-on locating and sealing rings 62 and 63 which are in this case disposed radially and axially. The flywheel body 21, which is likewise connected to the sealing rings, in this example accommodates the curved plates 40 in the slots 45.

In Figures 7 and 8, examples of the anisotropic construction of the locating and sealing rings are shown. In Figure 7, the end view 64 of such a ring shows narrow layers 65 of harder material, which in the cross-section 60 of the ring extend over its entire width. Under the effect of shearing forces in a peripheral direction, these layers or inserts lie somewhat obliquely, as at 66, without thereby noticeably influencing the elasticity desired in a tangential direction. When subjected to a compression loading in a radial direction - indicated by arrows - they do however provide a desired stiffening effect. A stiffening effect also occurs under shearing stresses in an axial direction.

Finally, Figure 8 shows another embodiment in which, for reasons of production, the inlays are connected to form a meanderingly bent strip 67. In order to avoid any hindrance to elasticity when the radially extending stiffened portions are disposed obliquely under the effect of shearing forces in a peripheral direction, the beds 69 of the meandering strip 67, as indicated in the perspective view, are made somewhat weaker in thickness, or may be constructed as prepared breakage places.

WHAT I CLAIM IS:-

1. A torsional damper with clearances provided between a flange body and a flywheel body and filled with highly viscous fluid, characterised in that the clearances are defined by interdigitating plates on the flange body and flywheel body, the plates being curved about an axis of relative rotation of the flange body and flywheel body.

2. A torsional damper according to claim 1, characterised in that the plates are of cylindrical construction.

3. A torsional damper according to claim 1, characterised in that the plates are of spiral construction.

4. A torsional damper according to claim 1, characterised in that the plates are formed from sheet metal.

5. A torsional damper according to claim 1, characterised in that the plates are cast.

6. A torsional damper according to claim 1, characterised in that the ends of the plates are inserted into and fixed in grooves in the flange and flywheel body respectively.

7. A torsional damper according to claim 1, characterised in that a plurality of plates are assembled together with intermediate members acting as spacers.

8. A torsional damper according to claim 1, characterised in that the flywheel body is disposed inside a flange body constructed in the manner of a housing and having plates on its inner radial surface.

9. A torsional damper according to claim 1, characterised in that the flywheel body is disposed outside the flange body, provision being made to seal the clearances between flywheel body and flange body.

10. A torsional damper according to claim 9, characterised in that for locating and sealing purposes, at least two elastic rings of approximately rectangular cross-section are used.

11. A torsional damper according to claim 10, characterised in that the rings extend over the entire width which the design makes available.

12. A torsional damper according to claim 10, characterised in that the rings are disposed between axial faces.

13. A torsional damper according to claim 10, characterised in that the rings are disposed between fadial faces.

14. A torsional damper according to claim 10, characterised in that the rings are disposed between conical faces.

15. A torsional damper according to claim 10, characterised in that the ring arrangement is symmetrical with relation to a central plane perpendicular to the axis of the damper, both rings serving a locating and sealing function.

16. A torsional damper according to claim 10, characterised in that substantially only one ring absorbs varying forces while the other has only sealing functions and consists of a more elastic material.

17. A torsional damper according to claim 10, characterised in that the rings are anisotropically constructed in that they react softly to shearing forces in a peripheral direction but rigidly in a radial direction to accommodate the locating forces.

18. A torsional damper according to claim 17, characterised in that the rings are made up of layers of different hardnesses, the separating faces lying in radial planes containing the central axis.

19. A torsional damper according to claim 17, characterised in that the rings are made up from grades of rubber of different elasticity.

20. A torsional damper according to claim 17, characterised in that a meandering strip of sheet metal having weakened bends is vulcanised into the rings.

21. A torsional damper according to claim 8, characterised in that on an end face of the housing is a sheet metal membrane.

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Fig.1.

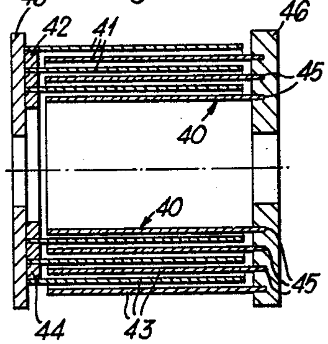


Fig.2.

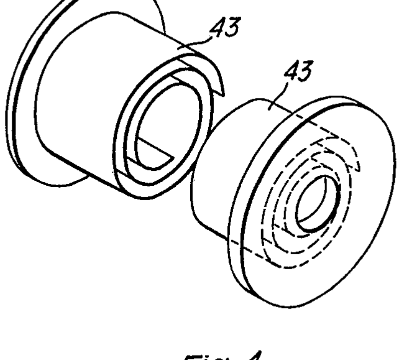


Fig.3.

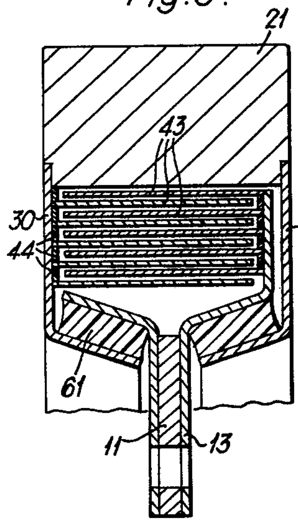
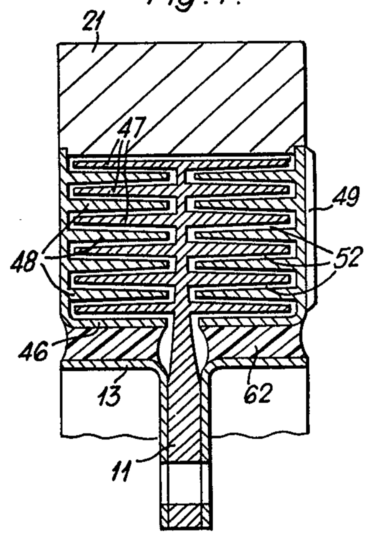


Fig.4.



1566357 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

Fig. 5.

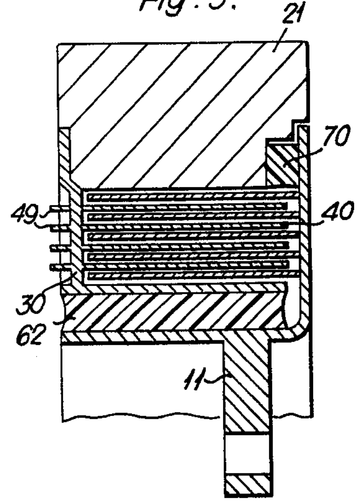


Fig. 6.

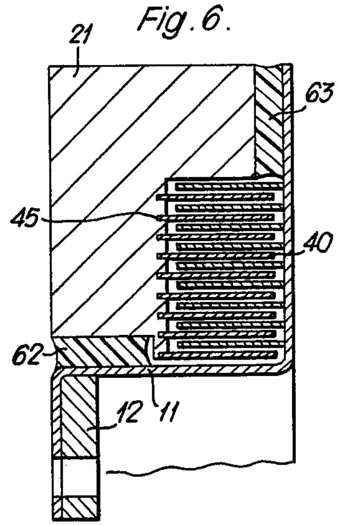


Fig. 7.

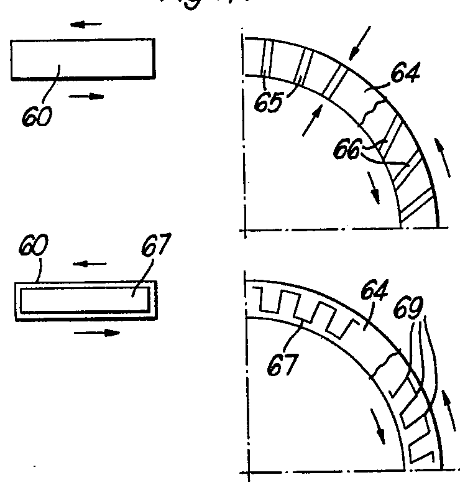


Fig. 8.