DAMPING ARRANGEMENT
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ABSTRACT OF THE DISCLOSURE
A damping device includes two coaxial ring members of rigid material and one of which consists of a plurality of arcuate sections, and an annular damping member of elastomeric material sandwiched between and bonded to the ring members.

The present invention relates to a damping arrangement. More specifically, the invention relates to an arrangement for damping the vibratory movements of rotary members. Still more specifically, the invention relates to a damping arrangement for damping vibratory movements of centrifuge drums, and particularly to an arrangement well suited for use in conjunction with the drums of sugar centrifuges.

In centrifuges of the drum type the drum should ideally remain perfectly balanced at all times to assure proper rotation with minimum resistance. However, in view of the fact that different quantities of material must be accommodated in a given drum at different times, and further because such material may be distributed differently throughout the drum at any given time during rotation thereof, the drum cannot be simply secured in a permanently balanced position in which it can then rotate without disturbance. Rather, such drums are suspended in pendulum fashion so that they can automatically compensate for shifts occurring in the distribution of material being treated and imbalances resulting therefrom shifts, and the resulting imbalances are highly undesirable since they result in the transmission of vibratory stresses to the centrifuge framework. Furthermore, excessive pendulum type motions of the drum, that is motions other than rotary, can constitute a danger to the operator as well as to the centrifuge itself.

Attempts have therefore been made to reduce the transmission of vibratory stresses to the centrifuge framework, and at the same time to reduce non-rotary motions of the centrifuge drum, by journaling the same in annular supports of elastomeric material which are secured to the centrifuge framework and which are interposed between the same and the drum bearings. Screw-threaded discs are then placed in position to pre-stress these annular supports in order to enable them to dampen the undesired movements of the drum. However, in such constructions of this type as are known to us at the present time, the pre-stressing obtained is inadequate. The result is that when the drum performs a non-rotary motion, that is when it for instance wobbles or tilts about its axis, the pre-stressing force on one side of the annular elastomeric damping support is effective while on the diametrically opposite side of the pre-stressing forces are significantly reduced or even removed. In other words, as the drum or, more precisely, the shaft carrying the drum, tilts to one side and thus increases the stress applied to one localized area of the annular damping support, the diametrically opposite area of the damping support is so relieved that temporarily the pre-stressing obtained by the aforementioned discs is reduced or removed. Since the drum-supporting shaft, in addition to rotation about its own axis, also performs with its journal ends a substantially axial motion during such wobbling, the region or area of the damping support in which the pre-stressing is temporarily removed naturally "travels" around the annular damping support. Thus, the damping support will always be stressed to a maximum degree on that side against which the shaft exerts stress, whereas on the diametrically opposite side there will be little or no pre-stressing at all, or the damping support may even tend to draw away from its support. In other words, the wobbling or tilting of the drum and its supporting shaft, which has hereinafter been referred to as a "pendulum-type" motion, is not significantly suppressed in these prior-art arrangements.

It is therefore a general object of the present invention to overcome the above-outlined disadvantages of the prior art. A more specific object of the present invention is to provide a damping arrangement which is capable of effectively damping non-rotary motions of a rotating member, such as a drum in a centrifuge.

Still a further object of the invention is to provide such an arrangement which is simple to construct, inexpensive to manufacture and reliable in its operation.

A concomitant object of the present invention is to provide an arrangement of the type outlined above in which a damping member is pre-stressed and remains pre-stressed regardless of stresses transmitted to it subsequently by the rotary member which it supports.

In accordance with one feature of our invention we provide, in such a damping arrangement, a damping device which comprises a first and a second component. The first component is disposed within the first component and is normally coaxial therewith. Each of these components consists of rigid material. We further provide an annular damping member consisting of elastomeric material, and this annular damping member is sandwiched between the above-mentioned annular components in coaxial relationship therewith. In fact, the annular damping member is bonded to both of the annular components.

In accordance with our invention one of the components consists of a plurality of arcuate sections which are separated from one another by axially extending slots, and the damping member has an annular surface which is adjacent to one of the components and which is provided with a plurality of recesses. Thus, in response to localized compression of the damping member, the volume of recesses in such portions of the damping member which are subjected to localized compression, is reduced since some of the material of the damping member will escape into these recesses.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a sectional elevation of a damping arrangement in accordance with the present invention;
FIG. 2 is a transverse section through a damping device in accordance with the present invention and utilized in the damping arrangement shown in FIG. 1;
FIG. 3 is a view similar to that in FIG. 2, but showing another embodiment of the novel damping device;
FIG. 4 is a section taken on the line IV—IV of FIG. 3;
FIG. 5 is a view similar to FIG. 3 and showing yet another embodiment of the novel damping device; and
FIG. 6 is a section taken on the line VI—VI of FIG. 5.

Discussing now the drawings in detail, and firstly FIG.
3,385,543 thereof, it will be seen that there is shown in this figure an outer support 1 and a bearing member 2 of a centrifuge. Inserted between these members 1 and 2 is a damping device in the form of an annular member 3 which is shown in detail in FIG. 2.

In the embodiment shown in FIG. 2, the damping device comprises an annular damping member 4 consisting of elastomeric material such as rubber or a suitable plastic, and composed of a plurality of arcuate sections 5. The embodiment of FIG. 2 further comprises their circumferential ends at the positions indicated with reference numeral 5. Arranged within the annular damping member constituted by these arcuate sections 5 is an annular component, such as a steel ring, to which the arcuate sections 4 are bonded, for instance by vulcanization. As is evident from the drawing, this ring consists of a plurality of sections 6 which abut as at 7 so that the ring is circumferentially complete. The outside of the damping member is in turn surrounded by another annular component, such as a steel ring, which consists of arcuate sections 8 bonded to the sections 4 of elastomeric material, for instance by being vulcanized thereto. The arcuate sections 8 of the outer annular component are angularly spaced from one another so that slots 9 exists between them which extend in axial direction of the device.

In the embodiment shown in FIG. 2 the circumferential end faces of the arcuate sections 4 of elastomeric material are provided with suitable recesses which are aligned with the slots 9 separating the arcuate sections 8 of the outer annular component. Thus, there are created radially extending recesses 10 which penetrate both the outer annular component and partly into the annular damping member. It will be clear that pre-stressing of the annular damping member of elastomeric material will cause some of the material of the damping member to flow into these recesses 10. If, thereafter, additional stresses act on the damping device shown in FIG. 2, for instance stresses which act transversely on the axis, the pre-stressing factor applied to the damping device will remain substantially intact all around the device since, as such stresses are exerted against one localized area, only the material in the area diametrically opposite this localized area will tend to recede from the respective recesses 10, while the material intermediate these recesses will substantially maintain its pre-stressed character. Also, bonding of the material of the damping member to the respective sections 6 and 8 of the inner and outer annular components makes it impossible for the damping device to withdraw from its pre-stressing support.

Pre-stressing of the damping device is accomplished, as indicated in FIG. 1, by means of a sleeve 11 into which the damping device is pressed, whereby the arcuate sections 4 of elastomeric material are radially compressed. In the arrangement shown in FIG. 1 this sleeve 11 is provided with a flange 20 provided with a bore or bores so that it can be secured to the outer member 1 by means of suitable securing devices, such as the screws 12. It will be understood, of course, that in a modified embodiment of the damping device shown in FIG. 2 the sleeve 11 could also be inserted within the damping device so as to cause radially outward compression.

Such an arrangement is, in fact, shown in FIGS. 3 and 4 where it will be seen that the outer annular component is a unitary ring, preferably of steel but in any case of a suitable rigid material, while the elastomeric damping member, indicated with reference numeral 16, is also of unitary construction. The inner annular component annularly consists of arcuate sections 14 which are angularly spaced from one another so as to define slots 15. The annular damping member is formed with radial recesses on its inner face and these recesses are aligned with the respective gaps 13 and form together with them the spaces 10. In other words, the embodiment in FIGS. 3 and 4 is substantially the reverse of the embodiment shown in FIG. 2, with the further modification that the outer annular component 13 as well as the annular damping member 16 are of unitary construction. In this embodiment, it will be clear, a compression or holding member such as the sleeve 11 can be inserted for radial outward compressive action. Coming, finally, to the embodiment shown in FIGS. 5 and 6, it will be seen that here the inner annular member 17 is of unitary construction, as is the case with the annular damping member of elastomeric material. As in the embodiment of FIG. 2 the outer annular component again consists of arcuate sections 19 which are angularly spaced so as to define slots 9. The annular damping member 18 is again formed with the recesses on its outer face and these recesses are aligned with the slots 9 to form the spaces 10. In this embodiment pre-stressing by radial compression will of course again take place from the outside.

It will be seen from what has been said that the present invention provides a damping arrangement in which all vibratory motions of the rotating drum and its supporting shaft, regardless of whether they result from the rotation of the drum or from a wobbling action of the shaft, are efficiently and permanently damped since the annular damping member must and will remain pre-compressed in all of its parts under all circumstances arising during operation of the centrifuge or other equipment in which the novel arrangement is utilized. It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of damping arrangements differing from the types described above.

While the invention has been illustrated and described as embodied in a damping arrangement, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing from the spirit and scope of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed is new and desired to be secured by Letters Patent is:

1. In a damping arrangement, a damping device comprising a first and a second annular component, said second component being disposed within the first component and being normally coaxial therewith and each of said components consisting of rigid material; and an annular damping member consisting of elastomeric material, said annular damping member being sandwiched between and bonded to said annular components in coaxial relationship therewith, one of said components consisting of a plurality of arcuate sections separated by slots and said damping member having an annular surface adjacent to said one component and provided with a plurality of recesses each of which registers with one of said slots so that, in response to localized compression of said damping member, the volume of recesses in such portions of the damping member which are subjected to localized compression is reduced by such compression.

2. A structure of the character described in claim 1; and further comprising holding means adjacent to and coaxial with one of said components and holding the same against movement radially of said damping device.

3. A structure of the character described in claim 1, wherein said damping member is composed of a plurality of arcuate sections.

4. A structure of the character described in claim 3, wherein said one component is said first component.
5. A structure of the character described in claim 1, wherein said damping member is of one-piece construction.

6. A structure of the character described in claim 1, wherein said rigid material of said first and second components is steel.

7. A structure of the character described in claim 1, wherein said annular damping member is vulcanized to said annular components.

8. A structure of the character described in claim 2, wherein said one component is said first component and said holding means is a sleeve surrounding said first component and exerting radial compressive forces on said damping member through the intermediary of said first component.

9. A structure of the character described in claim 2, wherein said one component is said second component and said holding means is a sleeve received within said second component and exerting radial compressive forces on said damping member through the intermediary of said second component.

10. A structure of the character described in claim 2; and further comprising support means for supporting said holding means.

11. A structure of the character described in claim 10, wherein said holding means comprises flange means; and further including securing means rigidly securing said flange means to said support means so as to preclude movement of said holding means with reference to said support means.

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