United States Patent

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[73] Assignee **Gesellschaft Fur Kernforschung G.m.b.H.**

[54] **SPRING**
5 Claims, 4 Drawing Figs.

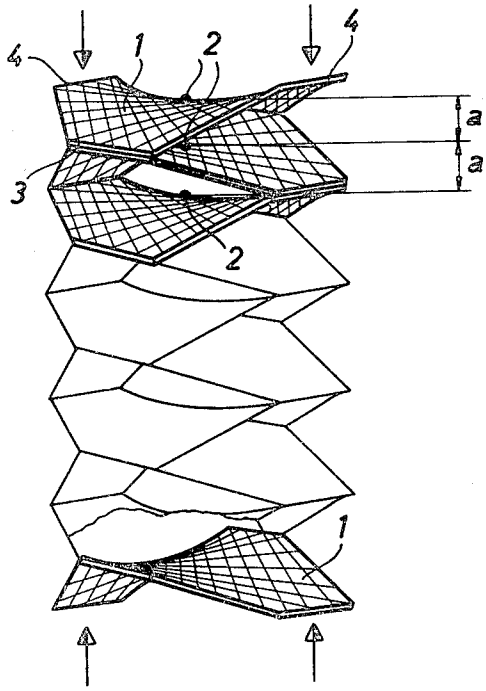
[52] **U.S. Cl.** **267/165**
[51] **Int. Cl.** **F16f 1/34**
[50] **Field of Search** 267/1 (65), 1 (62), 1 (59), 1 (60), 1 (61), 1 (64)

[56] **References Cited**
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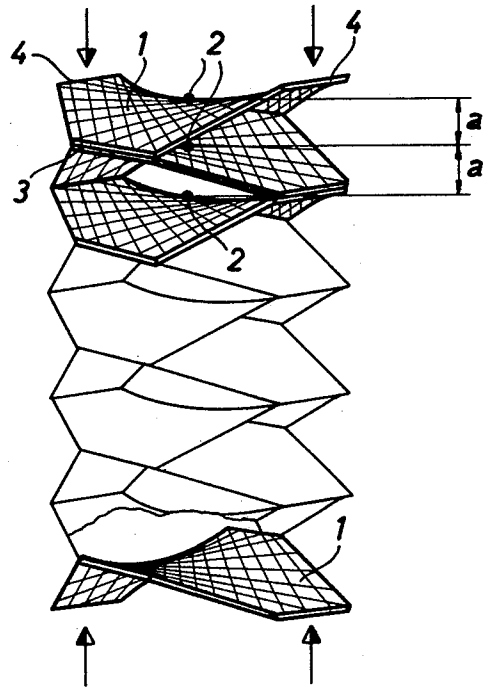
ABSTRACT: A novel spring composed of a multiplicity of doubly arcuate plates (preferably hyperbolic parabaloids) which are attached together into a stack. The particular attachment means is for next adjacent plates to be attached to each other along a pair of opposite edges with each plate being attached to the plate before it and the plate after it by alternating opposite edge pairs (preferably 90° apart).



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2 Sheets-Sheet 1

Fig.1



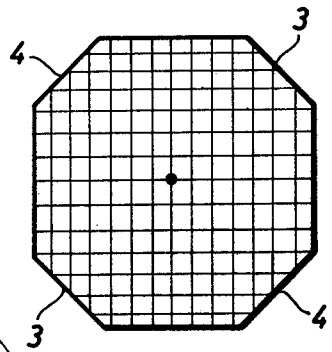
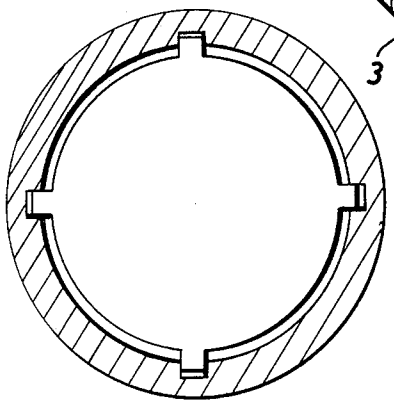


Fig. 4



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Fig.2

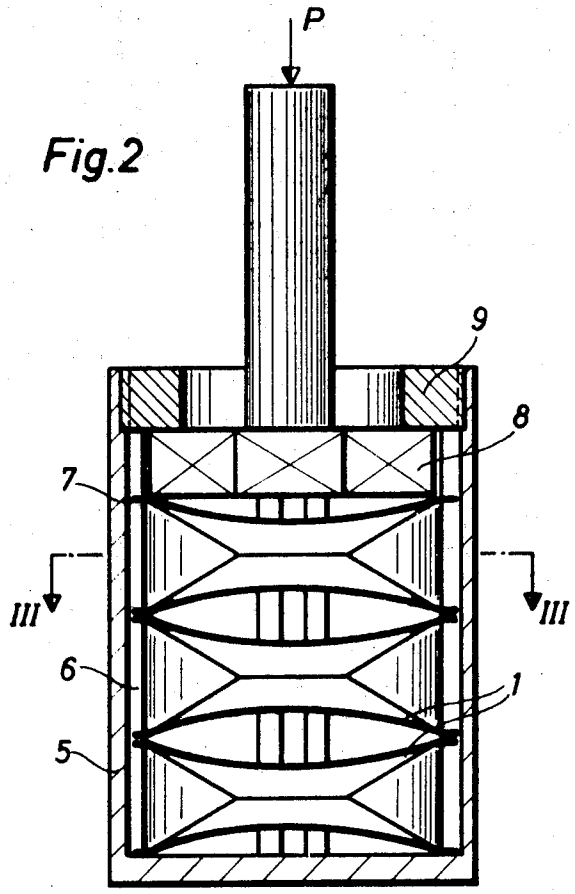
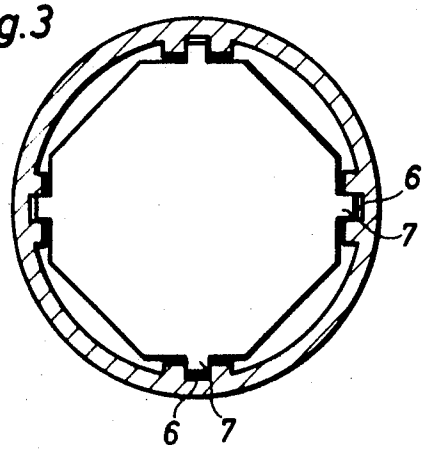


Fig.3



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SPRING

The invention relates to a spring consisting of individual dished plates arranged in layers above each other and supporting each other on their rims where they are equipped with guide members which correspond with each other or with a holder.

In one of the best known executions of this type of spring the plates consist on cone-shaped cups equipped with a central bore (DBP 937,859). These springs are capable of taking up very large forces, but the load on the material is very uneven so that only a relatively small utilization of the material is achieved.

Moreover, a spring is known in which the individual plates have a square or rhomboid shape and are bent on both sides around a diagonal line so that a load will produce an essentially uniaxial and uniform ending stress condition which permits a better utilization of the material relative to the cup spring (DAS 1,108,521).

On the basis of this state of the art as mentioned last above the invention is based on the problem of creating a stackable spring in which the degree of utilization of the material can be increased still further.

The solution of this problem according to the invention consists in subdividing the plates into even-numbered sectors which are dished increasingly from the center to the rims with the dishings of adjacent sectors being opposed to each other in direction. If such plate is shaped, e.g., like a regular hyperbolic paraboloid (saddle area), the plate is loaded through the two main diagonals when a load is put on. This results in a biaxial stress. This, in turn, has the consequence that the storable work and hence also the degree of utilization of the material can be increased considerably as against a uniaxially loaded bending spring referred to the same disc volume and the same maximum stresses. Despite this high work storing capacity the novel spring unit is below a plate spring but above a bending spring with respect to its rigidity.

The stacked spring bank can be made very compact on account of the high utilization of material. In addition there are particularly favorable damping characteristics if the spring bank is put into a damping medium, e.g. a vessel filled with oil.

The fabrication of the spring according to the invention is relatively easy. The saddle area, e.g., may be made as a ruled surface by moving a straight line (generating line) in space along tow skew ruled straight lines positioned in parallel planes. Such surface has two rims each dished on alternate sides, corresponding to four sectors. The individual plates are stacked one after the other, each twisted against the other by one sector so that in each case the rim of one sector dished upward is always supported by the rim of the adjacent plate dished downward.

The plates may be either circular or polygonal. It is advantageous to flatten the rims at the periphery of the dishings slightly to reduce surface pressure and for better mutual contact.

The spring according to the invention is explained in more

detail below on the basis of the drawings:

FIG. 1 shows a perspective view of the principal design of a spring bank consisting of 10 octagonal spring plates shaped after the area of a hyperbolic paraboloid (saddle area) with the corresponding plan view.

FIG. 2 shown a longitudinal section through a spring bank installed in a vessel.

FIG. 3 shows a cross section along the line III–III of FIG. 2.

FIG. 4 shows a top view of the housing.

In FIG. 1 the spring plates 1 are designed after the area of a regular hyperbolic paraboloid (saddle area) and have a rim of an octagonal shape. For reasons of better perspective representation the surfaces of the spring plates are provided with a square screen.

The distance *a* of the spring plates between saddle point 2 and saddle point has been grossly exaggerated in the drawing, also for reasons of representation. In relation to the diameter of the plates it is very small, e.g. of the order of a few percent of the diameter.

In the plan view the edges marked 3 and 4 are the edges of contact of two spring plates each. Referred to the uppermost spring plate shown edges 3 are bend downward, edges 4 upward. The unmarked edges extend pairwise and skew. The other arrows included in the drawing show the starting point and direction of the forces introduced.

In FIG. 2 the spring bank is assembled out of six spring discs 1. The bank is contained in a vessel 5 acting as the guide sleeve and filled with a damping medium, e.g. oil or water. The vessel is provided with longitudinal slots 6 in which radial shoulders 7 of the spring plates 1 slide. The shoulders 7 are dimensioned so that as to be guided only on the two sides of the grooves. The depth of the groove is bigger than the length of the shoulders so that there is a space between the spring plate and the root of the groove. The spring bank is loaded by a die 8 with the force P in the direction of the arrows. To prevent the die or individual springs from jumping out of the housing e.g. a ring 9 is attached to the upper rim of the guide sleeve protruding into the interior.

I claim:

1. A spring consisting of a multiplicity of curved plates each of which is attached to and supported by two opposite edges of the next adjacent plate, wherein each plate except the first and the last is attached to both the plates next adjacent thereto at alternating opposite edge pairs thereof.

2. Spring as claimed in claim 1, where the plates have the shape of regular hyperbolic paraboloids (saddle areas).

3. Spring as claimed in claim 1, where the rims of the plates are flattened at the periphery of their dishings.

4. Spring as claimed in claim 1, where the spring bank is inserted in a vessel filled at least partly with a damping medium, especially a liquid and where the plates have radial shoulders engaging in the longitudinal guide grooves of the vessel shell.

5. A spring as claimed in claim 1, provided with guide members wherein the plates of the spring are each subdivided into four sectors with the curvature of each adjacent sector being in opposite directions.