ABSTRACT

"HIGH ELASTICITY PLASTIC SPRING"

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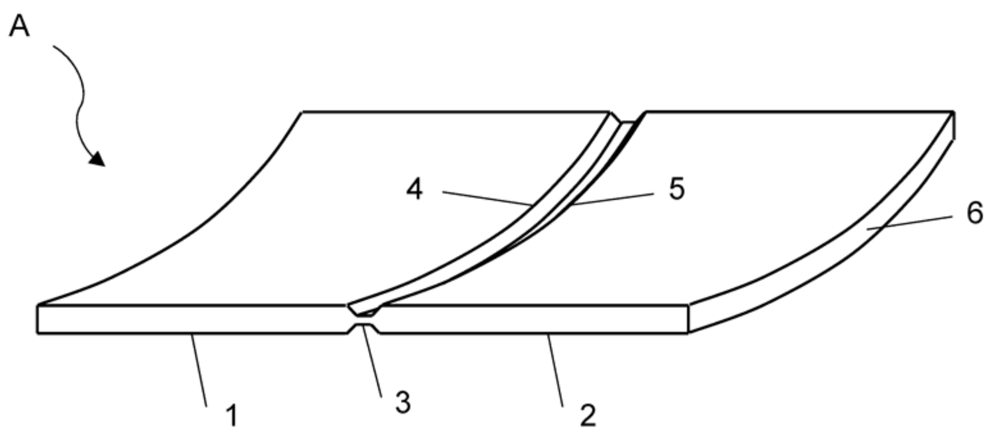
High elasticity spring (A), made of plastics, composed of two plate-shaped elements (1, 2), having, at rest, a curved profile (6), and linked to each other by a film hinge (3).

Said elements (1, 2), under the effect of an applied torque, can rotate with respect to each other, around a film hinge (3) and, in their rotation, undergo a deformation, since their linked edges (4, 5) are compelled, by the film hinge (3) linking them, to keep their profiles aligned to each other; the elastic deformation of the profiles (4,5) of said elements (1, 2) gives rise to an accumulation or a release of energy, which determines the elastic response of the spring at the variation of the relative angle between said two elements (1, 2).

Said spring may eventually be integrated with another plastic element and may be manufactured in the same injection moulding operation.



"HIGH ELASTICITY PLASTIC SPRING"

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DESCRIPTION

FIELD OF THE INVENTION

The present invention is related to high elasticity springs made of plastics.

BACKGROUND OF THE INVENTION

The poor elasticity of plastics is widely known. The name "plastic" itself almost expresses a contrast with the concept of elasticity, typical of many metallic materials.

Anyway, even plastics exhibit a certain degree of elasticity, but the performances of plastic springs, in terms of width of elastic flexure and reaction force, are always much lower than those of metallic springs having the same shape and dimensions.

Notwithstanding this, applications exploiting the elasticity of plastics are numerous, for example in snap-fastenings and in flexible elements performing mild spring action.

However, the range of feasible applications of plastic springs is limited, in spite of strong economical motivations resulting from the possibility to integrate plastic springs with other plastic components, and significantly reduce the cost of many products.

Indeed, a plastic spring, for example a flexible plate spring, in order to meet stated requirements for its width of elastic flexure and its reaction force, will result in much larger dimensions (length, width, thickness) than an equivalent metallic spring, and this determines, in many cases, its unfeasibility.

Hence, the demand for a high elasticity plastic spring, suited to replace metallic springs in many applications, is very strong.

SUMMARY OF THE INVENTION

The present invention, as will be better understood from the following descriptions, allows to realize plastic springs, whose performances are an order of magnitude better than plastic springs shaped as simple flexible rods or plates. Particularly, such springs achieve, in limited dimensions and keeping themselves within the limits of elastic deformation of a plastic material, a +/- 90° elastic flexure and a reaction force an order of magnitude larger than those achievable by traditional springs made of the same plastic material and having the same dimensions.

An embodiment of the present invention is composed of two curved plates, linked to each other, along their curved edges, by a film hinge having the same curved profile of said edges.

Said two plates can move with respect to each other, only by rotating around said film hinge. However, they could not rotate, unless undergoing a deformation. The curved edges of said plates, being compelled to keep themselves aligned to each other, by the film hinge linking them, are forced to change their shape, as the relative angle between said two plates varies.

At rest, when no force is applied to said plates, they are aligned to each other, along their curved edges.

When external forces apply a torque between the plates, they are forced to rotate with respect to each other, around the film hinge linking them.

The torque applied to said plates, meets a reaction from the force needed to deform said plates, in order to let them assume a relative angle other than the rest angle.

As the applied torque increases, the angle between said plates increases too, until it reaches a limit of about 90°. When this limit is reached, the two linked edges of said plates, and the film hinge linking them, assume a nearly straight profile.

When the applied torque decreases, the linked edges of said plates tend to return to their original curved profile, and the two plates assume a relative angle, corresponding to the angle wherein the applied torque is balanced by the forces needed to keep a curvature of said plates, such as their linked edges fit to each other. The relative angle between the two plates decrease, until annulling itself when the torque is null.

A spring made according to the present invention is made of a single plastic component, which may be integrated with another plastic component and may be manufactured in the same injection moulding operation, resulting in zero components and zero manufacture and assembly costs.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of the invention is hereinafter described, with specific reference being made to the drawings, in which:

FIG. 1 is an isometric view of an embodiment of a plastic spring, according to the present invention, in rest position.

FIG. 2 is an isometric view of the spring of FIG. 1, wherein the relative angle between the two plates is 90°.

FIG. 3 is an isometric view of the spring of FIG. 1, wherein the relative angle between the two plates is -90°.

FIG. 4 is a cross section of the spring of FIG. 1.

FIG. 5 is a cross section of the spring of FIG. 6.

FIG. 6 is an isometric view of an alternative embodiment of a plastic spring, according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The foregoing detailed description is given by way of illustration and example only of some significant embodiments of the present invention and is not intended to limit the scope of the claims in any manner, the spirit and scope of the present invention being limited solely by the appended claims.

FIG. 1, 2, 3 and 4 illustrate an embodiment A of the present invention, composed of two curved plates 1 and 2, linked to each other by a film hinge 3.

Said two plates 1 and 2 have, at rest a curved profile 6, illustrated in FIG. 1 and 4.

Said film hinge 3 links said two plates 1 and 2, along the curved profile of said edges 4 and 5.

Said two plates 1 and 2 can move with respect to each other, only by rotating around said film hinge 3. Their rotation, however, is possible only by a contemporary deformation of said plates 1 and 2, determined by the relative angle between said two plates, and by being their edges 4 and 5 compelled to keep aligned to each other, by the film hinge 3 linking them.

At the rest position, illustrated in FIG. 1, wherein no external force is applied, said plates 1 and 2 assume a relative rest angle of about 0°, that is, they are aligned to each other.

When external forces apply a torque between said plates 1 and 2, said plates are forced to rotate with respect to each other, around the film hinge 3 linking them.

The torque applied to said two plates 1 and 2 meets a reaction from the forces needed to cause the deformation which said plates must undergo, in order to be allowed to assume a relative angle other than the rest angle.

As the torque applied to said plates 1 and 2 increases, the angle between said plates increases too, and equals the angle wherein the applied torque is balanced by the forces needed to force said plates to assume such a curvature as the profiles of their edges 4 and 5 fit to each other. When the relative angle between said two plates 1 and 2 reaches 90°, as illustrated in FIG. 2, the edges 4 and 5 of said plates, and the film hinge 3 linking them, tend to assume a straight profile.

When the applied torque between said plates 1 and 2 decreases, the edges 4 and 5 of said plates tend to return to their original curved profile, forcing said plates to assume a relative angle, corresponding to the angle wherein the applied torque is balanced by the forces needed to keep a curvature of said plates, such as said edges fit to each other. The relative angle between the two plates decrease, until annulling itself when the torque is null.

FIG. 3 illustrates a situation opposed to that of FIG. 2, wherein said plates 1 and 2 have been applied a torque of opposite sign, such as said plates assume a relative angle of -90°, and such as the edges 4 and 5 of said plates 1 and 2, and the film hinge 3 linking them, assume a nearly straight profile.

The cross-section 6 of said plates 1 and 2, of the embodiment of the present invention illustrated in

FIG. 1, 2, 3 and 4, is not recommended in applications where the spring is required to flex in both directions, as illustrated in FIG. 2 and 3. In fact, a negative flexure, as illustrated in FIG. 3, may cause excessive stress at the extremities 7 and 8 of the film hinge 3, which may cause said film hinge to tear.
In applications requiring the spring to flex in both directions, an alternative embodiment B of the present invention is preferable, as illustrated in FIG. 5 and 6, wherein the curved profile of the cross-section 16 of the plates 11 and 12, is provided with two tapered terminations 19 and 20, in order to avoid excessive stress and tearing at the extremities 17, 18 of the film hinge 13.
Notwithstanding the limited elasticity of plastics, a spring realized according to the present invention, can undergo wide elastic flexures (+/- 90°), and keeps its elasticity even after repeated flexing. The performances of such a spring are an order of magnitude better than the those achievable by a rod-shaped or plate-shaped spring of similar dimensions, and result from the conformation of the spring, which transforms a large relative rotation of the two plates 1 and 2, or 11 and 12, in a small deformation of said plates, which keeps itself within the limits of elastic deformation.
A plastic spring according to the present invention may be manufactured as a loose part, or may be integrated with another plastic component and manufactured in the same injection moulding operation, resulting in zero components and zero manufacture and assembly costs.
While only some preferred embodiments of the present invention have been shown and described, it will be understood that various modifications and changes could be made thereunto, in order to adapt the invention to the requirements of specific applications. The present description should not be intended to give a comprehensive list of all the possible variations of the present invention. It should be noted, however, that variations of dimensions or profiles of the embodiments shown and described may cause even significant variations of the device, without departing the spirit and scope of the invention disclosed.

CLAIMS

1. Plastic spring, composed of two plate-shaped elements, having, at rest, a curved profile, linked to each other, along their curved edges, by a film hinge; said plate-shaped elements, under the effect of an applied torque, can rotate with respect to each other around said film hinge, undergoing a deformation along said linked edges, which are compelled to keep aligned to each other; the elastic deformation of said plate-shaped elements gives rise to an accumulation or a release of energy, which determines the elastic response of said spring at the variation of the relative angle between said plate-shaped elements.

2. The plastic spring of claim 1, wherein the curved edges, along which said two plate-shaped elements are linked to each other, have, at rest, a bowed profile.

3. The plastic spring of claims 1 or 2, wherein the profile of the curved edges, along which said two plate-shaped elements are linked to each other, are provided with two straight segments, whose orientation, with respect to the regression line of said profile, forms an angle, named terminal angle, of 0°.

4. The plastic spring of claim 3, wherein said terminal angle is different from 0°.

5. The plastic spring of claim 1 or 2 or 3 or 4, wherein the spring itself is integrated with another plastic component, whereto one of said plate-shaped elements is adjoined.

6. The plastic spring of claims 1 or 2 or 3 or 4 or 5, wherein the spring itself is the return spring of a pushbutton driving one or more electrical contacts.

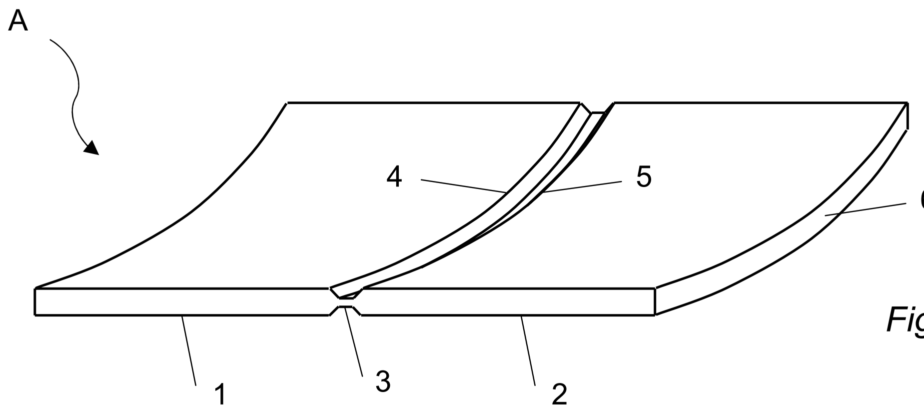

Fig. 1

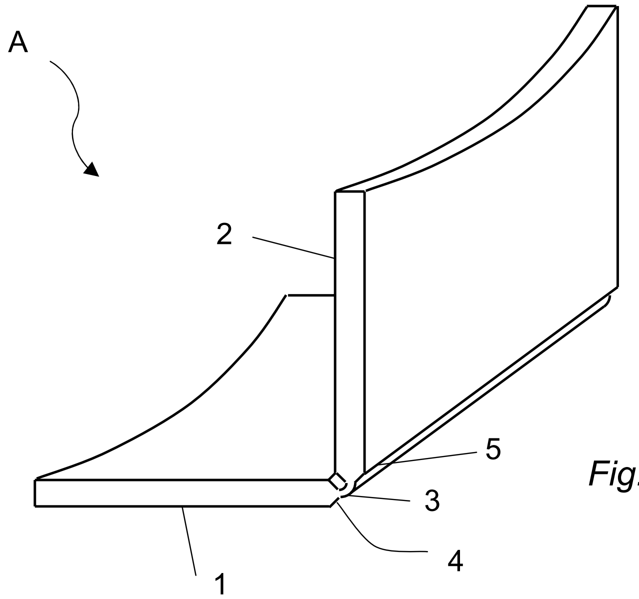

Fig. 2

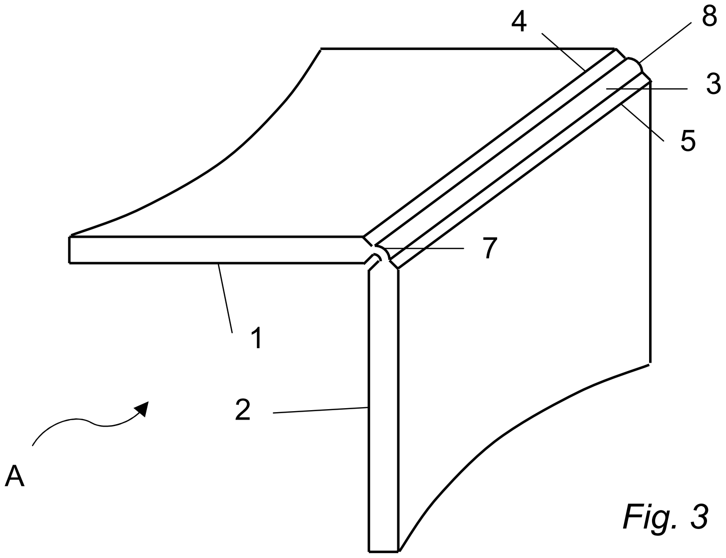

Fig. 3

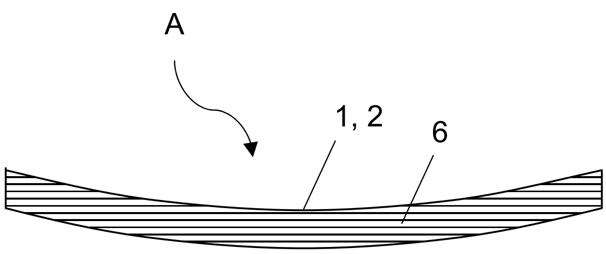

Fig. 4

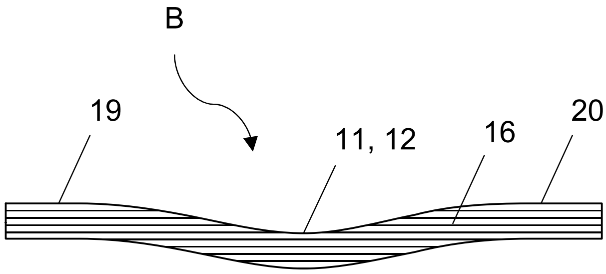

Fig. 5

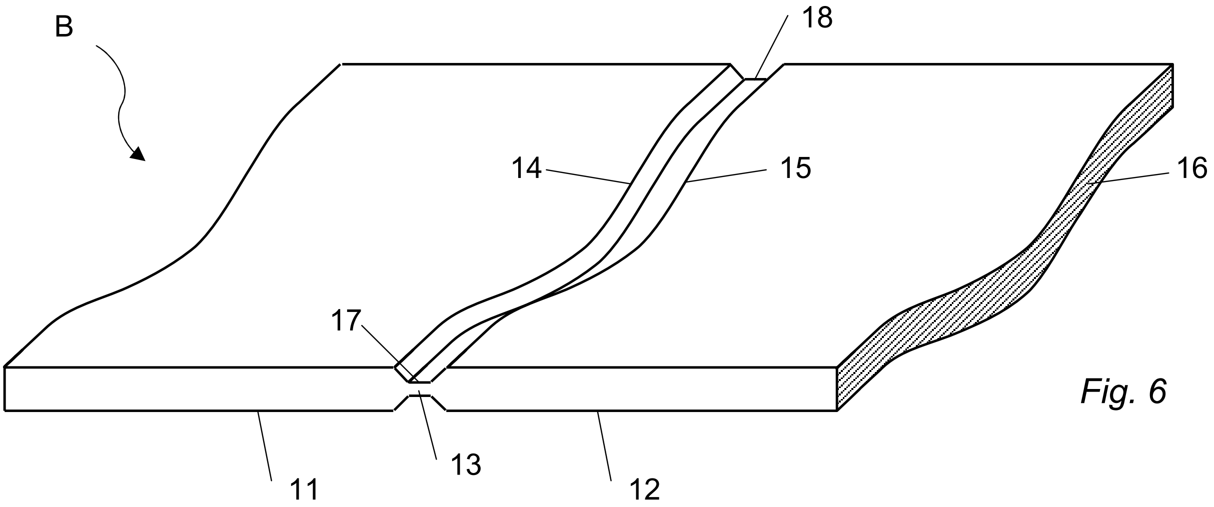

Fig. 6