April 27, 1965 H. JEFFREE 3,180,220

MIRRORS WITH REFLECTIVE SHEETS STRETCHED OVER SUPPORT FRAMES

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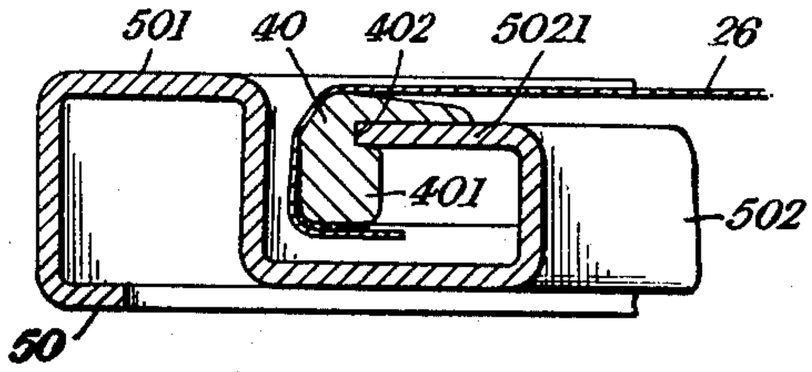

Fig. 1.

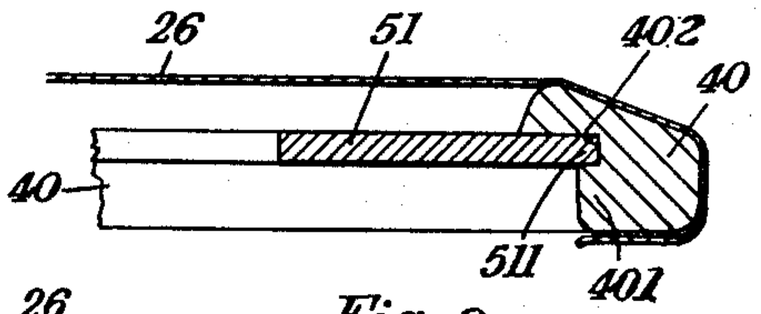

Fig. 2.

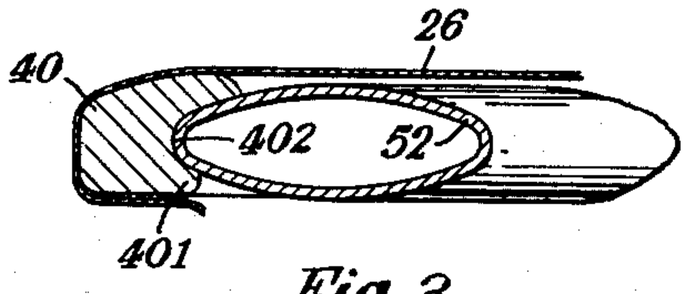

Fig. 3.

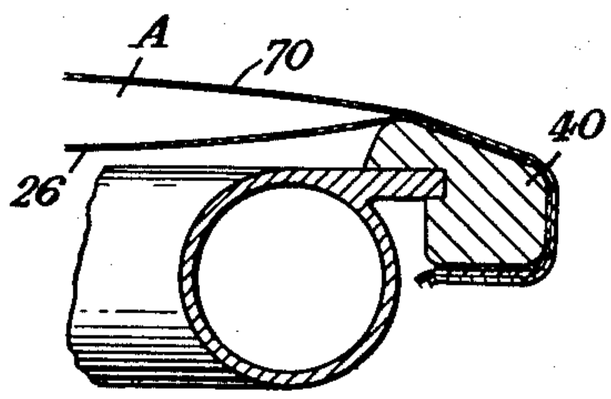

Fig. 6.

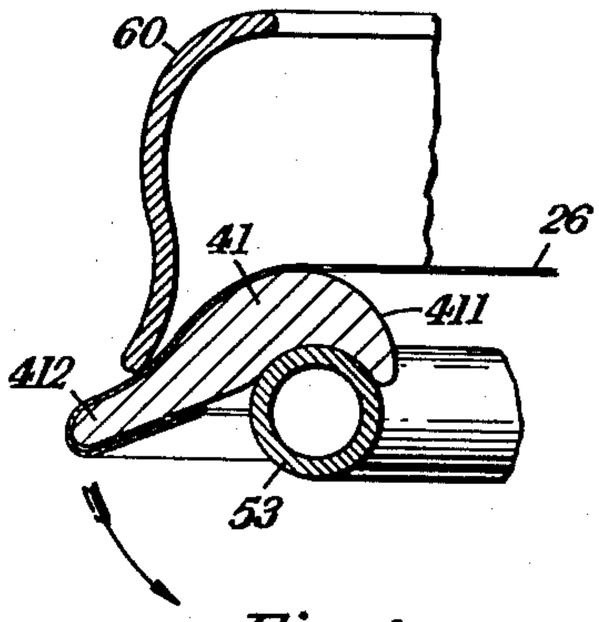

Fig. 4.

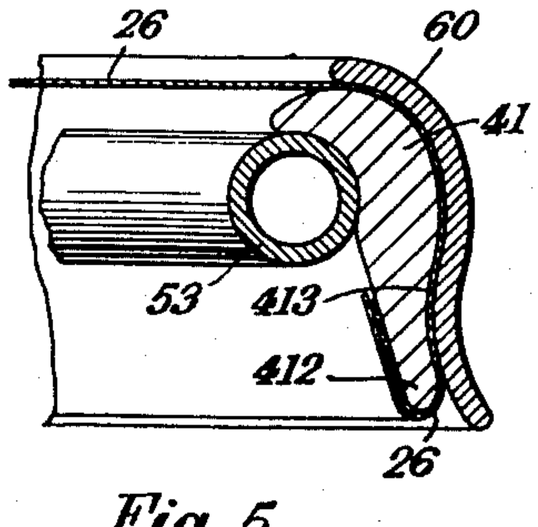

Fig. 5.

INVENTOR
Herbert Jeffree
By Holte & Holte
attorneys

United States Patent Office

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MIRRORS WITH REFLECTIVE SHEETS STRETCHED OVER SUPPORT FRAMES

Herbert Jeffree, Byfleet, England, assignor to Vickers Armstrongs (Aircraft) Limited, London, England, a British company

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The invention has reference to the manufacture of mirrors in which a thin reflecting sheet material is stretched over a supporting frame of substantially planar form to provide the necessary optical flatness of the mirror surface.

The object of the invention is the provision of an improved manner of stretching the reflector and for this purpose it is here proposed that the supporting frame shall have two components, to one of which the reflector material is attached, and which is capable of being extended by stretching, whilst the other is of a size, shape and rigidity such that when the first component is extended, the second component is capable of engaging the first component and holding it permanently in the extended condition, whereby the requisite tensile stress is applied to the reflector.

The component to the periphery of which the reflector material is attached may consist of a circular or other annular frame which is sufficiently ductile to render it capable of an extension of appreciable magnitude without damage. The attachment thereto of the reflector, which is conveniently a metallized sheet of plastic material, may be by wrapping the margins of the sheet about and fixing it thereto by a suitable adhesive; this may be performed when both reflector material and frame are likewise in a free or only lightly stretched condition. The reflector frame is provided with a rim or flange which is offset from the plane of the reflector surface and which is grooved or otherwise rebated on its inwardly facing side.

The second, or tensioning, frame is an annulus of substantially stiffer construction than the reflector frame. It may, for example, be made of a heavy-section metal sheet, so as to be capable of resisting a centripetal load without substantial deformation. This frame is provided with a continuous edge or rim-like part which lies in one plane, and an offset flange which on its outer face is shaped so as to be complementary to the inwardly facing groove or rebate of the reflector frame flange.

The reflector flange is made smaller than the tensioning flange by that amount which, when the reflector frame is stretched so that the outward face of the tensioning frame is received in the groove or rebate thereof, will produce the desired degree of tension in the reflector material. The rigidity of the tensioning frame is sufficient to hold the reflector frame permanently in the stretched condition, and the cross-sectional shapes of the tensioning frame flange and the rebated surface of the reflector frame are preferably such that the two frames are effectively locked in their assembled relationship against accidental separation.

The manner in which the invention may be carried into effect is hereinafter described with reference to the accompanying drawings illustrating a number of alternative embodiments of the invention.

In said drawings, FIGURES 1 to 6 are respective cross-sectional representations of several mirror-frame embodiments.

In each case the supporting frame has two components, to one of which (viz. the one which constitutes the boundary member) said sheet is attached and which is capable of being extended by stretching, whilst the other component is of a size, shape and rigidity such that when the first component is extended, it will be engaged by the

second component and held thereby permanently in the extended condition in which the requisite tensile stress is applied to the reflective sheet.

Referring now to FIG. 1, numeral 40 designates a component of the supporting frame to which a reflective sheet 26 is attached by wrapping its margins about the outer sides of the component 40 and fixing it thereto by means of a suitable adhesive; this attachment may be made when both the sheet 26 and the component 40 are likewise in a free or only lightly stretched condition. The component 40 may consist of a circular or other annular support which is sufficiently ductile to be capable of being stretched or extended by an apprecaible amount without damage. Said annular support or annulus is provided with a rim or flange 401 which is offset from the plane of the sheet 26 and which has a groove 402 on its inwardly facing side.

The second component of the frame is an annulus 50 which is of suostantially stiffer construction than the component 40. It may, for example, be made of a heavy-section metal sheet, so as to possess sufficient rigidity to be capable of resisting the centripetal load imposed in the component 40 by the stretching operation without appreciable deformation. This component 50 is provided with a continuous planar edge or rim-like part 501 and an offset flange 502 having an inturned portion 5021 which is complementary to the groove 402 of the component 40.

The flange 401 of the component 40 is made smaller than the flange portion 5021 of the component 50 by that amount which, when the component 40 is stretched so that the portion 5021 of the component 50 is received in the groove 402 of the component 40, will subject the sheet 26 of reflective material to the desired degree of tension. The rigidity of the component 50 is sufficient to hold the component 40 and therefore the sheet 26 permanently in the stretched condition, and the cross-sectional shapes of the two components are preferably such that they are effectively locked in their assembled relationship against accidental separation.

In the embodiment shown in FIG. 2, the component by which tension is applied to the component or annulus 40 carrying the reflective sheet 26 consists of a flat annular plate 51 of which the outer edge 511 is received in the groove 402 of the component 40.

The alternative tensioning component 52 of the embodiment shown in FIG. 3 is a continuous tube of elliptical cross-section, the major axis of the ellipse lying parallel to the plane of the sheet 26 and the periphery thereof being received in the groove 402 of the component 40.

The further modified embodiment shown in FIGS. 4 and 5 incorporates a tensioning component 53 of circular cross-section upon which is mounted an annular component 41 for supporting the reflective material 26. Said component is partially introvertible, being capable of being rolled in the direction of the arrow (FIG. 4) upon the component 53 about the peripheral axis of the latter, between the positions shown in these figures.

A cross-section through the member 41 intersects the surface 411 thereof in an arc which is eccentric to the tube 53, so that the effect of rolling the member 41 into the position shown in FIG. 5 is to impose a uniform, centrifugal tension in the sheet 26. This may be performed by means of a ring 60 which may be pressed downwardly upon the skirt portion 412 of the member 41 and which is shaped internally to mate with the outer face of the portion 412. The re-entrant curved shape of the mating surfaces, indicated at 413, is effective to prevent dislodgement of the ring 60, so that the latter serves to hold the component 41 permanently in its stressed condition by which tension is maintained in the reflective sheet 26.

Where the sheet **26** is of transparent material provided only on the face with a metallic reflective coating, either side of the sheet may be presented as the front face of the mirror. If the metallized face is so presented, it may with advantage be protected against damage by the application of one or more coatings of transparent lacquer. If the reverse side is used as the mirror, the transparent material itself serves to protect the metallized surface from damage.

Resonance in the tensioned reflective mirror sheet in response to vibrations of particular frequencies may be damped by mounting a backing of polystyrene or other appropriate material in close proximity to, but out of contact with, the rear surface of the sheet. Such damping material may also serve to protect the mirror against damage.

The aforesaid methods of manufacturing a plane mirror may be modified in the manner shown in FIG. 6 for the purpose of making a concave or convex mirror. The sheet **26**, having a metallized reflective coating, is supplemented by a transparent sheet **70**, and the two sheets **26**, **70** are assembled with a bubble of air or other gas between them at A. Both sheets are attached to the rim of the frame **40**, and tensioned by any of the means hereinbefore described, the resultant reflecting surface of the sheet **26** being concave.

A convex mirror may be made by reversing the relative positions of the sheets **26** and **70**, so that the former presents an outwardly facing convex surface. If the frame **40** is circular, the mirror will approximate to a part of a sphere.

What I claim as my invention and desire to secure by Letters Patent is:

1. An improved mirror having a thin reflective sheet material stretched over a supporting frame, wherein said frame has a first and a second component, to the first of which said reflective sheet is attached, and which is capable of being extended by stretching, whilst said second component is of a size, shape and rigidity such that when said first component is extended, said second component is capable of engaging said first component and holding it permanently in the extended condition, whereby the requisite tensile stress is applied to said reflective sheet.

2. A mirror as claimed in claim 1, wherein said first component is grooved on an inwardly directed face, which groove receives an outwardly directed face of said second component when said first component is extended, to enclose said outwardly directed face.

3. A mirror as claimed in claim 1, wherein said first component has a surface of substantially circular section upon which is mounted an annulus which is capable of being rolled about an axis containing the center of cross-section at all points, said annulus being spanned by said reflective sheet, and wherein the latter is attached to a surface of said annulus which is of arcuate cross-section eccentric to said axis, and comprising means for rolling said annulus about said axis in such manner that its resultant extension is effective to apply said tensile stress to said reflective sheet.

4. A mirror as claimed in claim 3, wherein said rolling means and said annulus have mating surfaces of reentrant curved shape, whereby when said annulus is rolled into the tensioned condition it is locked against displacement therefrom.

5. A mirror as claimed in claim 1, wherein said reflective sheet is supplemented by a transparent sheet, the two sheets being assembled with a gas bubble between them so that when tensioned a convex conformation is produced in their exterior surfaces.

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JEWELL H. PEDERSEN, *Primary Examiner.*

JOHN K. CORBIN, FREDERICK M. STRADER, *Examiners.*