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**Lynam**

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(54) **MIRROR REFLECTIVE ELEMENT AND METHOD OF FORMING SAME**

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(21) Appl. No.: **12/197,666**

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**Related U.S. Application Data**

(62) Division of application No. 10/709,434, filed on May 5, 2004, now Pat. No. 7,420,756.

(60) Provisional application No. 60/471,872, filed on May 20, 2003.

(51) **Int. Cl.**
***B29C 47/02*** (2006.01)

(52) **U.S. Cl.** ..... **156/242**; 156/99; 156/102; 156/244.11; 264/1.6; 264/1.7; 264/1.9; 264/173.11

(58) **Field of Classification Search** ..... 156/99, 156/102, 242, 244.11, 244.27; 264/1.6, 1.7, 264/1.9, 173.11
See application file for complete search history.

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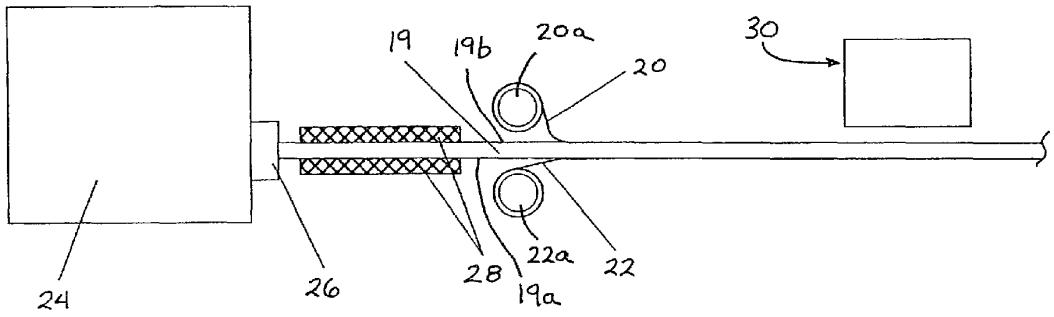
(57) **ABSTRACT**

A method for forming a reflective element substrate for a mirror assembly of a vehicle includes generally continuously forming an elongated sheet of substrate material and applying a substantially transparent functional film to a surface of the elongated sheet. The substantially transparent functional film is unrolled from a reel or roll of the film and the unrolled film is applied to the surface of the elongated sheet generally continuously as the sheet is formed or extruded or cast. Two or more mirror substrates are formed from the elongated sheet after the film is applied to the surface of the sheet.

**20 Claims, 3 Drawing Sheets**



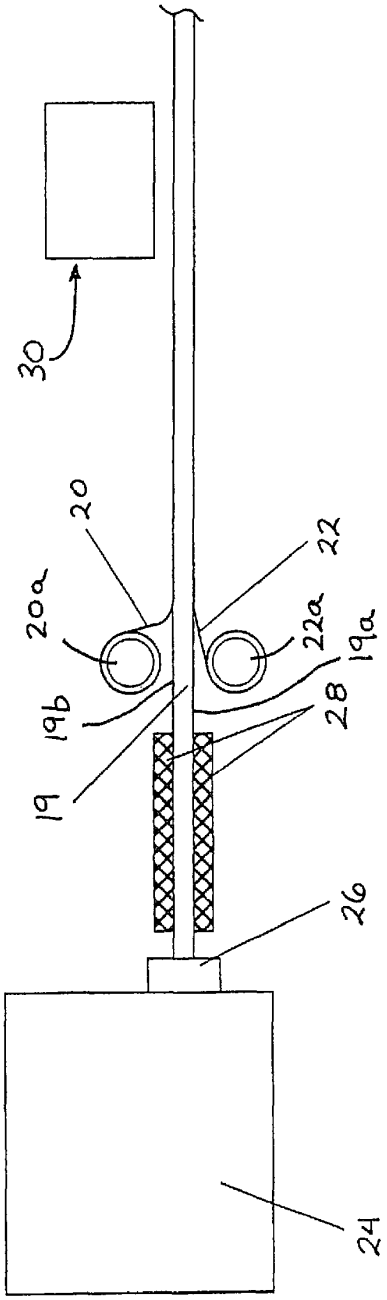



FIG. 5

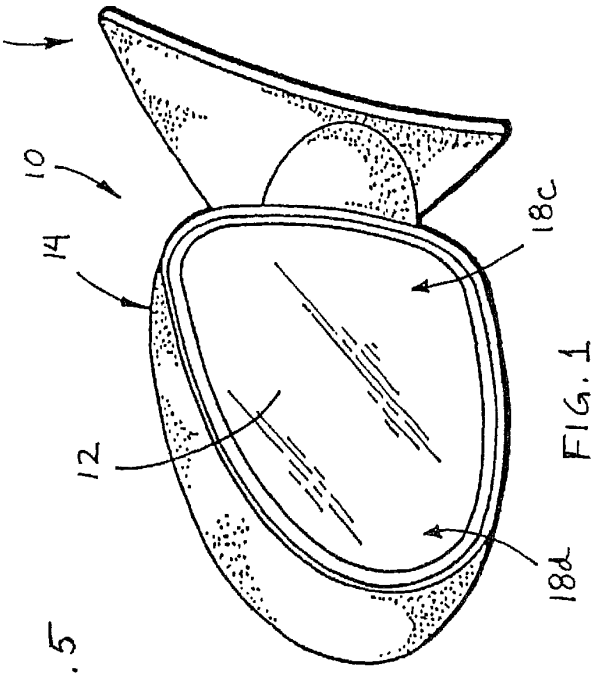



FIG. 1

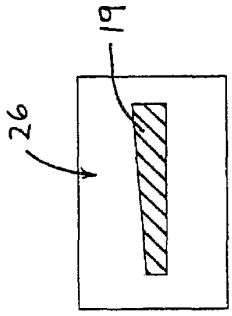
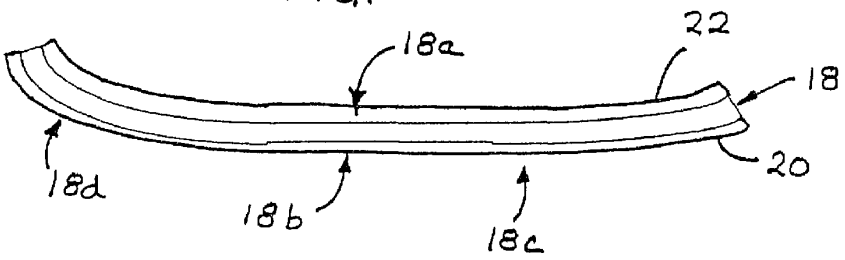



FIG. 5A

FIG. 3



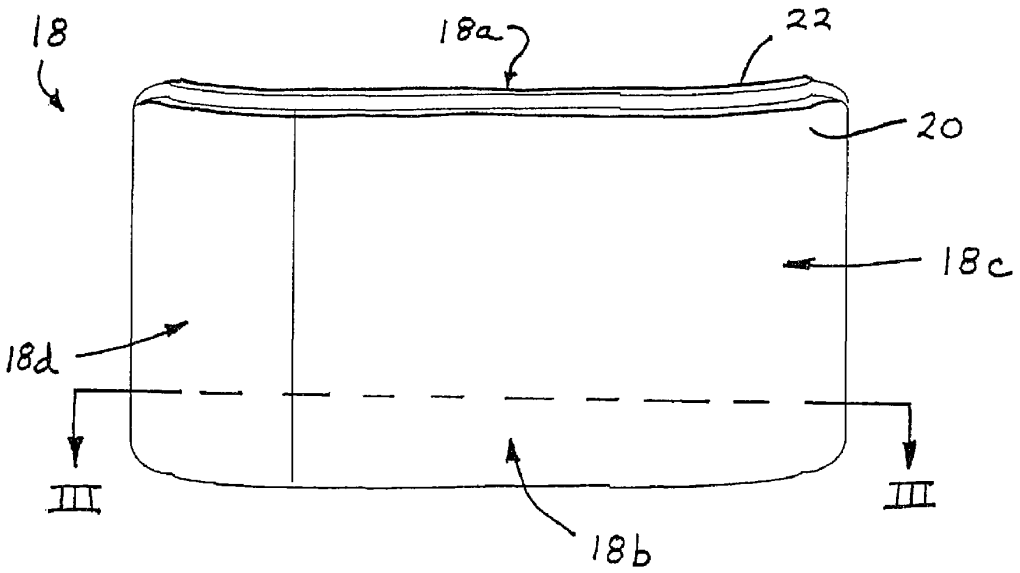
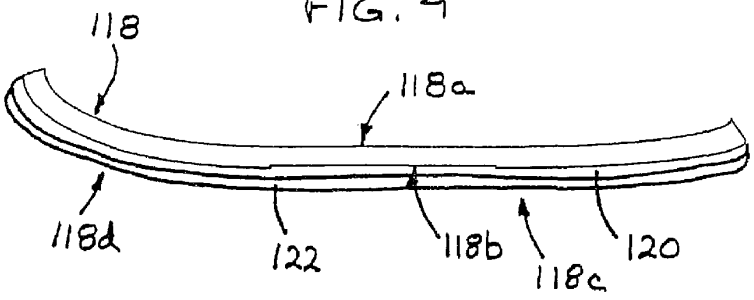




FIG. 2

FIG. 4



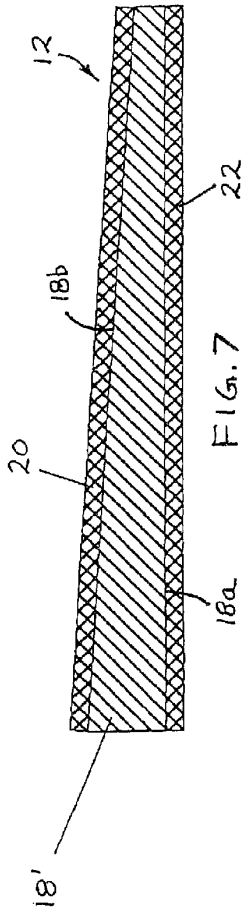



FIG. 7

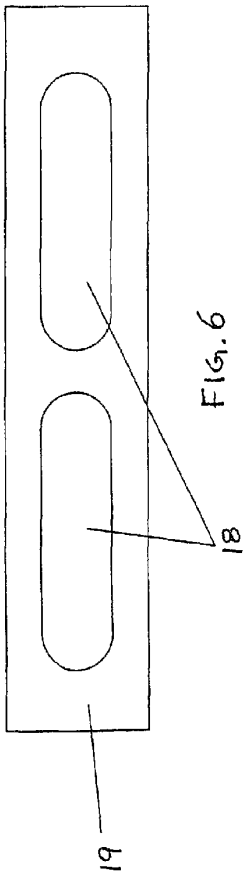



FIG. 6

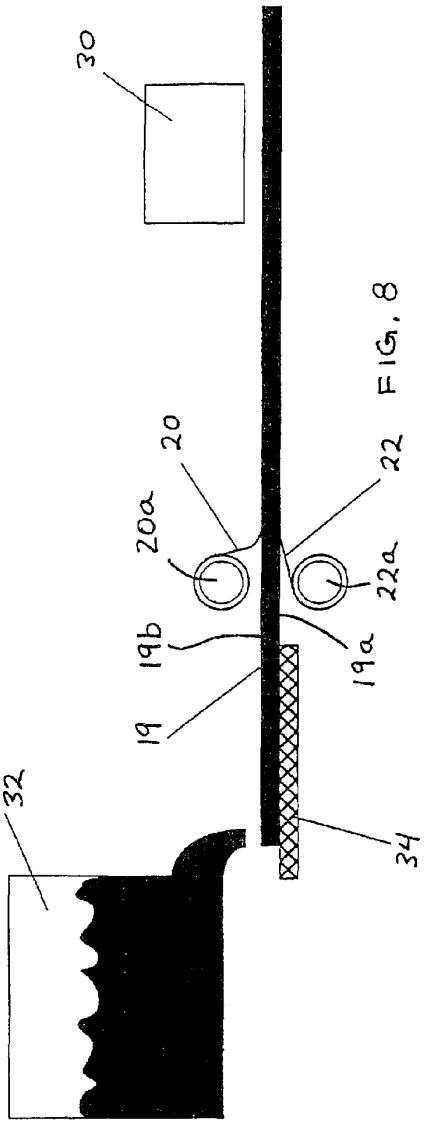



FIG. 8

# MIRROR REFLECTIVE ELEMENT AND METHOD OF FORMING SAME

## CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a division of U.S. patent application Ser. No. 10/709,434, filed May 5, 2004, now U.S. Pat. No. 7,420,756, which claims the benefit of U.S. provisional application Ser. No. 60/471,872, filed May 20, 2003, which is hereby incorporated herein by reference in its entirety.

## FIELD OF THE INVENTION

The present invention relates generally to rearview mirror elements for a rearview mirror assembly of a vehicle and, more particularly, to exterior rearview mirror elements comprising multi-radius reflective elements.

## BACKGROUND OF THE INVENTION

Typically, mirror reflective elements are formed of glass and have a reflective coating deposited thereon, such as via vacuum deposition or wet chemical silvering or the like, such as on a silver line, such as described in U.S. Pat. No. 4,737,188, which is hereby incorporated herein by reference. Polymeric reflective elements are also known, such as are described in U.S. Pat. Nos. 6,601,960; 6,409,354; 4,944,581; 4,385,804; 4,193,668; 4,666,264; and 5,483,386, which are hereby incorporated herein by reference. For such polymeric mirror reflective elements, the need exists for a hard coat or surface on the first or outer or exterior surface of the element which is contacted by the exterior elements, such as rain, road debris, or the like, or contacted, for example, by a person scraping ice or wiping snow or condensation off the mirror element outer surface, such as during winter. A variety of hard coats have been proposed in the art, typically applied by dip coating or vacuum deposition techniques. However, a need exists for an automotive mirror reflective element which has the properties of plastic (i.e., a specific gravity roughly half that of glass), and which has a glass-like exterior surface.

Also, exterior rearview mirror reflective elements may be aspheric or multi-radius, and may typically have a less curved or substantially flat (around 2000 mm radius or thereabouts) inboard portion or surface at the inboard side of the reflective element (i.e., closer to the side body of the vehicle when the mirror assembly is mounted to the vehicle), and a more curved multi-radius portion or surface at the outboard side of the reflective element (i.e., further from the side body of the vehicle when the mirror assembly is mounted to the vehicle), in order to provide an extended field of view. It is typically desirable to have the reflective elements or substrates of such exterior mirror elements to be formed of a glass material because glass material typically provides an enhanced scratch resistance over conventional optical resins and the like.

Therefore, there is a need in the art for a mirror reflective element that overcomes the shortcomings of the prior art elements and substrates.

## SUMMARY OF THE INVENTION

The present invention provides a molded wide angle or multi-radius substrate for a reflective element. The molded substrate comprises a polymeric optical resin transparent material and has a curved exterior surface, which may have a less curved/flatter or substantially flat inboard portion or surface and a more curved outboard portion or surface. The molded substrate may have an anti-abrasion film or layer, such as an ultrathin glass film, applied over the exterior surface or first surface to provide substantial protection against scratches occurring to the molded substrate. The inner surface or second surface of the reflective element substrate may have a reflective coating or layer, such as a polymeric reflective film, laminated or adhered or otherwise applied thereto.



According to an aspect of the present invention, a wide angle reflective element for a mirror assembly for a vehicle includes a wide angle substrate having an exterior surface and a glass film disposed at the exterior surface. The exterior surface of the substrate has a less curved inboard portion or surface and a more curved outboard portion or surface. The substrate comprises a polymeric resin material. The glass film is adapted to substantially conform to the exterior surface of the wide angle substrate. The glass film comprises a glass material and has a thickness of less than approximately 0.8 mm.

According to another aspect of the present invention, a reflective element for a mirror assembly for a vehicle comprises a substrate having an exterior surface, and an anti-abrasion film applied to the exterior surface. The substrate comprises a polymeric resin material, such as a transparent optical polymeric resin material. The anti-abrasion film preferably comprises a glass material (such as a soda lime glass or a borosilicate or the like) and has a thickness of less than approximately 0.8 mm, and is flexible to conform to the exterior surface.

The substrate may be cut from a strip or sheet of molded or extruded or cast substrate material (or less preferably, may be cut from an injected molded strip or sheet). The flexible glass film may be unrolled from a reel or roll and applied to the exterior surface of the elongated strip or sheet of substrate material. The substrate, including the glass film or layer, may then be cut or otherwise formed from the elongated strip or sheet.

The substrate may comprise a wide angle substrate and/or may comprise a multi-radius exterior surface having a less curved inboard portion or surface and a more curved outboard portion or surface.

A reflective film or layer may be applied to the inner surface or side of the substrate or strip opposite the exterior surface. The reflective film may comprise a polymeric reflective film laminated or otherwise adhered or applied to the inner side of the substrate or strip. The reflective film may comprise an all polymer-thin-film multilayer, high reflective mirror film comprising multiple coextrusion of many plastic layers to form a highly reflective mirror film.

Optionally, a reflective film or layer may be applied to the exterior surface of the substrate or sheet or strip, and the glass film or layer or sheet may be applied over the reflective film layer. In such an application, the substrate acts as a support or backing plate for the reflective film or layer and the glass film or layer, whereby optical clarity/transparency of the substrate material is not necessary.

According to another aspect of the present invention, a method for forming a reflective element substrate for a mirror assembly of a vehicle comprises generally continuously forming an elongated strip or sheet of substrate material and applying a substantially transparent functional film, such as an anti-abrasion film or a hydrophilic film or a hydrophobic film or the like, to a surface of the elongated strip sheet. The substrate material may comprise a transparent optical polymeric resin. The functional film is preferably unrolled from a reel or roll of film and applied to the surface of the elongated strip or sheet generally continuously as the strip or sheet is formed or extruded or cast or molded. Preferably, multiple

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