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FILM FOR PROTECTING A VEHICLE BOTTOM PLATE

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ABSTRACT OF THE DISCLOSURE

The bottom plate and other parts of a vehicle are protected from corrosion and road materials by applying a film comprised of 10 to 40 percent of an ethylene copolymer, 90 to 60 percent of inorganic fillers, and optionally up to 20 percent of a plasticizer and up to 10 percent of a vinyl resin to impart special properties. The film is self-supporting and has a specific density of 1.5 to 3.0 g./cm.^{3}. The film is in the form of a sheet or shaped to the contour of the surface to which it is to be attached by adhesive or melt bonding.

BACKGROUND OF THE INVENTION

This invention relates to a film adapted for the protection of the bottom plate of a vehicle. This invention further relates to a method of applying a sheet or preshaped thermoplastic film to the bottom plate of a vehicle.

It is known to protect the bottom plate of a vehicle against corrosion and road-material by applying a liquid or powdery protective coating by a spray technique. This method, however, requires a substantial amount of equipment since the liquid or powdery material which is mostly supplied in barrels, must be conveyed, compressed and applied to the surface to be protected, often using very high pressure. Apart from spray losses which are often very high, and the contamination of the vehicle, tools, and premises, the diluents used in many products are solvent base and are a source of danger with regard to fire and also from a physiological point of view. Moreover, these solvents cannot be recovered and cause a loss of material of 30 to 50 percent. Present solvent-free systems based on synthetic resins must either be very thoroughly cured or require special curing agents to be added shortly before use since the products are usually two-component materials having a limited processing time after mixing.

The film formation in spray-applied coatings involves another serious problem, in that when solvent-containing coating materials are used it is impossible to pass the working piece through baking ovens before being sufficiently pre-dried without causing blistering and capillarity of the coating, resulting in an early susceptibility to corrosion. Moreover, regarding the application technique, sprayed materials have the drawbacks that for the formation of layers having a uniform thickness, i.e., a thickness of 2 to 4 mm., it is practically impossible to achieve a smooth spray pattern in one operation. Films of non-uniform thickness are normally obtained with differences between maximum and minimum areas of 1:2 to 1:4, and which have only the quality of the minimum layer thickness. This means that by the "hill and valley structure," the quality of the layer for protection against abrasion and corrosion is determined by the "valleys" and the material on the "hills" is wasted. From the thickness ratios given above, it is clear that often up to 50 percent of the material does not contribute to an increase in quality, and even when automatic spraying systems are used, these spray techniques give no full

guarantee of a uniform coating of the bottom plate of motor vehicles. Methods of forming a uniformly thick continuous sprayed coating of good adhesion over the entire surface of a bottom plate of a vehicle after the vehicle has been assembled are not presently known.

Plastic materials generally have quite good film-forming properties, but when cured by heating, often involve the problem of having to simultaneously achieve film formation and the reaction by which the film adheres to a surface. An as such, methods having the aim to form a uniformly thick, continuous, well-adhering plastic film over the entire surface of the bottom plate of motor vehicles are not known.

It is an object of the present invention to provide a completely new method for protecting the bottom plate of vehicles allowing for a safe and complete coating of the underside of vehicles in a simpler manner.

It is also an object of the present invention to set out a vehicle bottom plate protecting material having superior abrasion resistance and which eliminates any formation of blisters or formation of moisture conducting capillaries.

It is further an object of the present invention to set out a method whereby the protecting film in a sheet or preshaped form can be easily applied to a vehicle bottom plate during vehicle assembly.

BRIEF SUMMARY OF THE INVENTION

This invention comprises a film composition which is characterized in that it contains from about 10 to 40 percent by weight of an ethylene-vinyl acetate copolymer containing 10 to 40 percent by weight, preferably 15 to 30 percent by weight of vinyl acetate, 90 to 60 percent of inorganic fillers, and optionally 0 to 20 percent by weight of a plasticizer and 0 to 10 percent by weight of vinyl resin to impart special properties. The invention further comprises a method by which this film in a sheet of preshaped form is adhesively or melt bonded to a vehicle bottom plate as an integral part of the vehicle assembly process.

DETAILED DESCRIPTION OF THE INVENTION

Broadly, the present invention comprises a novel bottom plate protecting film which is also especially suitable for carrying out the method of the invention. This film is characterized in that it contains from about 7 to 40 percent by weight of an ethylene-vinyl acetate copolymer and preferably from about 10 to 40 percent by weight of the copolymer, 90 to 60 percent by weight of fillers, and optionally in addition up to 20 percent by weight of a plasticizer and up to 10 percent of a vinyl resin, has a softening or melting temperature in the range of 90 to 150° C., and a specific density of 1.5 to 3.0 g./cm.^{3}. Such films exhibit excellent abrasion properties and lead to coatings which are much superior to the sprayable surface protecting materials generally used so far.

The preferred method of applying the film of the present invention to the bottom plate is by turning a vehicle on the assembly line by 180° about its longitudinal or transverse axis, preferably its longitudinal axis, covering the bottom surface of the vehicle thus turned up area-wise with one or more bottom plate protecting films which soften at an elevated temperature, and melting the thermoplastic film or films by heating onto the bottom plate of the vehicle. The inverted vehicle covered on its underside with the film is passed through an oven, and according to a particularly preferred embodiment, the applied bottom plate protecting film or film sections are, in addition, pressed against the plate by means of heated compressed air or a sheet of a non-adhering material. Also,

infrared or light radiation heating may be used as the heating sources in place of a conventional oven. This method can easily be integrated into the assembly process in motor vehicle factories, since there the undersides are not contaminated by soil or oil, thus requiring no heavy duty cleaning operations. In practice, the bottom plate protecting films, pre-punched in the desired dimensions, are laid as a whole or as multiple sections area-wise onto the upwardly directed bottom surface and then firmly bound to the bottom surface by the subsequent heat treatment.

More particularly, the present invention is characterized in that it consists of a self-supporting thermoplastic film having a specific gravity of 2.0 to 2.5 g./cm.^{3}, and comprises 10 to 40 percent by weight of an ethylene/vinyl acetate copolymer containing 10 to 45 percent by weight, preferably 15 to 30 percent by weight of vinyl acetate, 60 to 90 percent by weight of an inorganic filler, and further 0 to 20 percent by weight of a plasticizer such as phthalates or adipates and 0 to 10 percent by weight of a vinyl resin, preferably an ethylene-vinyl acetate-acrylic acid ester terpolymer. The fillers contained in these bottom plate protecting films are relatively heavy fillers such as carbon black, baryte ($BaSO_4$), chalk, mica, ground slate, asbestos powder, lead ores such as lead oxides and lead sulfides and iron ores such as oxides. These fillers, when present in relatively high amounts, have a favorable influence on the adaption of the film to the underside of the vehicle by creating a tight fit and a low tendency to shrink. The particle size of these filler materials range from about 20 microns to about 500 microns, with a range of from about 60 microns to about 300 microns being preferred. The total film thickness may range from about 1 mm. to about 15 mm.

The surface of the film is preferably provided with a cold-embossed channel stripe relief, especially a honeycomb relief of 0.1 to 0.7 mm. depth, 1 to 5 mm. rib width, and 5 to 15 mm. edge length or, if circular, 5 to 20 mm. cell diameter. By such a honeycomb relief, it is possible to prevent the bottom plate protecting films from contracting, rolling up or shrinking like normal plastic films when they are passed through the oven. Further, the channels still present during melting of the film to the substrate allow trapped air to escape so that the film melts to the surface without forming wrinkles, blisters or capillaries. In an especially preferred embodiment, the adherence of the film can be improved by providing an adhesive layer, particularly with an adhesive material which is activated by heat, such as hot melt adhesives. Suitable hot melt adhesives are the ethylene-vinyl acetate copolymer, ethylene-vinyl acetate-acrylic acid terpolymer or polyamide adhesives. The disadvantage of air bubbles otherwise formed by non-uniform heating or inclusion of air between the film and plate is avoided by the embossed relief which facilitates the escape of air during melting. By the cold-embossing technique, the film is in a stress-free condition during heating, whereby the embossing channels are closed and the entire film, including the original embossed area fits snugly and completely to the plate, so that no water or condensation can penetrate through remaining channels and cause corrosion. Further, it is possible to provide the outer side of the self-supporting bottom plate protecting film with an optionally colored surface layer or coating so that the color may conform to the color of other parts of the completed vehicle.

The films of this invention are used in the form of a sheet, or a preshaped form to coincide with the contours of the bottom plate to which it is to be attached. Bottom plates or pans of vehicles have varying shapes, depending on whether it is front or rear engined, four-door, two-door or convertible style, and so on. These bottom plates have various inclined, curved and shaped surfaces. Therefore, in a preferred embodiment, these self-supporting films are used as a singular or multiple sectioned piece that is shaped to coincide with the shape of the bottom plate. In this way, when the plate and shaped film are heated, rapid melt bonding takes place. For essentially flat-bottom plates, a planar sheet material is effective.

A further advantage of using self-supporting films is the ease of storage and handling. As pre-shaped pieces, they can be nested one within the other, and efficiently handled for placement on the bottom plate.

The films can be produced by any of a number of known techniques such as extrusion, extrusion followed by stretching on a frame to the desired thickness, mold forming, and so on. Shaping of the films where the film is to be used as a bottom plate mating preshaped film, may be by a vacuum forming or a deep drawing technique. An especially favorable technique is the "towel method," wherein the heated film by its own weight engages a shaped surface, and conforms to the shape of that surface. The shaped surface is preferably an auto body sheet to which the premanufactured heavy plastic film is to be later applied.

The following examples are set out to further amplify the present invention:

EXAMPLE I

In the preparation of a bottom plate protecting film, an ethylene copolymer containing 30 to 45 percent by weight of vinyl acetate is used in an amount of 15 percent by weight, based on the total composition. In order to improve the compatibility with the filler, a total of 4 percent by weight of dioctyl phthalate plasticizer containing 20 percent of mineral oil is added, together with 81 percent by weight of fillers consisting of a mixture of ground slate, baryte and carbon black. This composition is pressed into a film having a specific density of 2.1 g./cm.^{3}, a thickness of about 1 mm. and laid onto a primed plate; the coated plate is passed for about 25 minutes through an oven heated to 140° C. A firmly adhering coating of about 1 mm. thickness is obtained. The test plate is tested for its abrasion resistance by spraying road chips with a spraying pressure of 5 kg./cm.^{2} gauge from a distance of 12 cm. against the coated plate and measuring the time until the film of 1 mm. thickness is puncture.

A bottom plate protection made according to the invention shows defects not earlier than after nearly two hours, while such defects are observed in a sprayed rubber material after 3 to 5 minutes, and in a sprayed polyvinylchloride plastisol after 10 to 20 minutes; the comparative coatings having also a minimum layer thickness of 1 mm.

EXAMPLE II

A mixture is prepared from 20 parts by weight of an ethylene/vinyl acetate copolymer having a vinyl acetate concentration of 22.5 percent, 2 parts by weight of an ethylene/vinyl acetate/acrylic acid ester terpolymer, 0.2 part by weight of carbon block and 77.8 parts by weight of barium sulfate. The mixture is rolled out to a film and embossed at room temperature with a honeycomb pattern of 18 mm. cell diameter, a miximum rib width of 2 mm. and a relief depth of 0.1 to 0.5 mm. This film is coated onto a sample plate and heated for 20 minutes in an oven at 150° C., and produces an excellent surface protection having similar abrasion data as the coating described in Example I.

EXAMPLE III

A passenger car in primed condition is turned on the assembly line by 180°, and its bottom surface is covered almost completely with a precut film being the same as that of Example II, and then passed for 15 minutes through an oven at a maximum temperature of 150° C. The adherence of the melted film is excellent. The openings for the further mounting of single parts such as axle supports, exhaust supports and fuel tanks can be cut into the film without difficulty. It is found to be especially advantageous that the holes obtained by cross-

wise cuts allow a snug fitting of the film of the parts passed there-through. For passages of large diameter, the necessary holes are prepunched into the film.

EXAMPLE IV

Another motor car is treated the same way as in Example III, using however, longitudinally on the right and on the left sides of the bottom plate two film sections being the same as that of Example II, and in the middle area preshaped self-supporting thermoplastic films having a specific gravity of 2.4 g./cm.^{3}. The latter consists of 20 percent by weight of a mixture of ethylene/vinyl acetate copolymers containing, respectively, 30 and 45 percent of vinyl acetate and further of 80 percent by weight of an inorganic filler (mica) which is premixed with 5 percent by weight of an ethylene/vinyl acetate/acrylic ester resin. The car is passed for 15 minutes through an oven at 140 to 160° C., whereby a uniform molten coating is obtained. By this application, the areas which are especially endangered by road material are protected.

EXAMPLE V

Example I is repeated, but with the fitting of the film to the plate assisted by sucking a hot silicone rubber film against the coating in a method similar to that of deep-drawing. An excellent continuous abrasion-resistant bottom plate protection is obtained. The film employed shows no holes, and is kept in a frame in a stretched condition. It is preheated to a temperature of 90 to 120° C., the frame is brought over the car turned by 180° where the film is trimmed in a hot condition at the edges with plastic blades (PTFE), so as not to damage the priming. In the subsequent oven treatment at 150° C., the film melts completely within 12 to 15 minutes and cannot be removed without being destroyed.

What is claimed is:

1. A bottom plate protecting film for vehicles having a specific density of 1.5 to 3.0 g./cm.^{3} comprising a film of from about 1 mm. to about 15 mm. thick, containing about 10 percent to 40 percent by weight of an ethylene-vinyl acetate copolymer of from about 10 percent to about 45 percent by weight of vinyl acetate and about 90 percent to about 60 percent by weight of inorganic fillers of a particle size of from 20 to 500 microns selected from the group consisting of carbon black, baryte, chalk, mica, ground slate, asbestos powder, lead sulfide ores and iron oxide ores, said film being provided with a cold embossed honeycomb relief of from about 0.1 mm. to about 0.7 mm. depth and about 5 mm. to about 15 mm. edge length.

2. A bottom plate protecting film for vehicles as in claim **1**, wherein said film further contains up to about 20 percent by weight of a plasticizer and up to about 10 percent by weight of a vinyl resin.

3. A bottom plate protecting film for vehicles, as in claim **1**, wherein one surface of said film is coated with an adhesive.

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