

COMPOSITE PRODUCT AND METHOD AND APPARATUS FOR ITS FORMATION

TECHNICAL FIELD

5

This invention relates to plastic composites and more particularly to plastic composites having one or more colors or multiple congruent layers formed by injection molding.

10

BACKGROUND OF THE INVENTION

Various proposals have been suggested and practiced for the manufacture of plastic composites for use as automotive interior trim and exterior trim products.

15

One approach is to form metal or plastic substrates and applying multiple coatings thereon to produce a high gloss class A surfaced part. The substrates can be formed from steel, or anyone of a wide range of known plastic materials such as ABS, L ABS , ABS/PC blends, PU, TPO, PET, PBT or other equivalent high strength plastic material suitable for injection molding of a product shape. The coatings for such substrates may be selected from known coatings such a primer coat, an adhesion promoter, a base coat and a clearcoat, and in the case of metals, an electrodeposition coat. Examples of such coatings are set forth in United States Patent Nos. 4,681,811 and 5,320,869. The solvents used in such systems can cause undesirable emission problems.

25

Another approach is to form a paint film and inject polymeric material behind the paint film to produce a part with a desired color match on its exposed class A surface. Examples of known paint film and injection molded plastic parts are shown in United States Patent Nos. 5,432,666 and 5,009,821. Such systems require the separate manufacture and handling of the film. Furthermore, the film is at times difficult to shape depending upon the contour of the part being produced.

30

Still another approach to providing a colored plastic part is to provide an enamel coating that will reduce emissions while producing a crater resistant surface on the part being coated. One such system is set forth in United States Patent No. 4,396,680. Such systems require use of conventional coating systems and baking ovens to form a finish on the substrate that has the desired appearance.

Yet another approach is to provide laminating equipment in which a color layer is formed by extrusion and then connected to a substrate. United States Patent No. 4,349,592 discloses the use of such technique in the manufacture of a decorative molding exterior trim part.

Still another approach is to form amber-red-clear tail lamp housings by progressive molding a large clear housing and depositing smaller non-congruent red and amber layers thereon.

While the various methods are suitable for their intended purpose, they all involve processing considerations that either produce emissions or require unnecessary handling of one or more layers of material in the manufacture of a composite exterior or interior trim product having a desired class A type surface appearance color matched to adjacent vehicle components.

Thus, there is a continuing need in this field or art for an article and its method of manufacture that will obviate the above problems.

25

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a colored plastic composite multi-layered injection molding system.

30

Another object is to provide such a colored plastic composite having first and second layers of injection molded material in a common cavity and arranged in overlying relationship to form a base layer and a top layer that covers the base layer without removal from a tool and wherein the top layer constitutes a finished surface covering of the composite in which the base layer comprises injection molded polymeric material having colors blended therein and the top layer comprises injection molded polymeric material with or without light reflective particles embedded therein for changing the color effect of said colors when the composite is viewed from different angles.

10

Still another object of the invention is to provide such a colored plastic composite having first and second layers of injection molded material in overlying relationship to form a base layer and a top layer that covers the base layer without removal from a tool and wherein the top layer constitutes a finished surface covering of the composite in which the base layer comprises injection molded polymeric material having colors blended therein from the group consisting of pigments and/or dyes and/or light reflective particles and wherein the top layer is injection molded clear polymeric material.

15

Yet another object of the invention is to provide a colored plastic composite having first and second layers of injection molded material in directly molded relationship to form a base layer and a top layer without removal from the tool that covers the base layer and wherein the top layer constitutes a finished surface covering of the composite and the base layer comprises injection molded polymeric material having particles blended therein comprising either or both pigments or dyes and with or without light reflective particles embedded therein and the top layer of injection molded material is a polymeric material for protecting the base layer.

20

25

Another object of the invention is to provide a colored plastic composite having a base layer, an intermediate layer and a top layer that covers the base layer and the intermediate layer and wherein the top layer constitutes a finished surface covering of the composite wherein the base layer comprises injection molded
5 polymeric material having colors blended therein; the intermediate layer comprises injection molded polymeric material having light reflective particles embedded therein for changing the color effect when the composite is viewed from different angles and the top layer injection molded polymeric material.

10 A further object is to provide the colored plastic composite of the preceding object wherein the protective top layer is a clear polymeric material; or a polymeric injection molded material having an exterior glossy surface with a D.O.I. (distinctness of image) reading in the range of 75-100.

15 According to the invention another object is to provide a process for manufacturing a multi-layer composite product of injection molded plastic comprising providing a moveable mold part and a plurality of stationary mold parts of congruent shape; sequentially moving the moveable mold part with respect to the stationary mold parts to form one or more mold cavities of progressively
20 greater capacity between the mold parts and injecting at least one layer of polymeric material into one of the mold cavities to produce an enhanced colored appearance on the viewing surface of the composite product.

Another object is to provide such a process wherein a cover layer is
25 injected into one or more of the mold cavities by providing polymeric material having colors blended therein to provide a colored appearance in the injection molded composite product.

Still another object is to provide such a process further comprising providing polymeric material with or without light reflective particles embedded therein and injecting it into one of the mold cavities.

- 5 Yet another object is to provide such a process of further comprising injecting into one of the mold cavities polymeric material having either or both colored pigments or dyes and light reflective particles blended therein.

- 10 Still another object is to provide such a process further comprising injecting polymeric material with colored pigments or dyes into one of the cavities and injecting polymeric material with light reflective particles therein for changing the color effect of said colored pigments or dyes when the composite is viewed from different angles.

- 15 Yet another object of the invention is to provide such a process further comprising injecting polymeric material into the mold cavities for covering the polymeric material injected in progressively increasing volume mold cavities of congruent shape.

- 20 Another object is to provide such a process further comprising injecting a covering of polymeric material into one of the mold cavities and injecting polymeric material having colors or dyes into one of the mold cavities to form a congruent layer of material against the covering.

- 25 Another object of the invention is to provide such a process including providing more than one rotational mold halves and providing more than one stationary mold sections of congruent shape and providing progressively greater capacity mold cavities by varying dimensions of the stationary mold sections.

Still another object is to provide the process of the preceding object by wherein the rotational mold halves and stationary mold sections are respectively provided as mold covers and mold cores.

5 Yet another object is to provide the process of the preceding object wherein the material is injected into a first mold cavity on one of the covers and rotating the cover and moving it to a second core to form a second mold cavity of a shape congruent to the first mold cavity for injecting additional material against the material previously deposited on the cover.

10

Yet another object of the present invention is to provide a multi-stage sequentially operated injection molding apparatus having at least one rotational mold half and providing more than one stationary mold sections of congruent shape and providing progressively greater capacity mold cavities by varying
15 dimensions of the stationary mold sections.

15

Still another object of the present invention is to provide the apparatus of the preceding object wherein rotational mold halves and stationary mold sections are respectively provided as mold covers and mold cores.

20

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objects, features and advantages of the present invention will become more apparent from the following description and accompanying drawings

25 wherein:

Figure 1 is a perspective view of the apparatus of the present invention;
Figure 2 is a perspective view looking at the face of a stationary platen in
Figure 1;

Figures 3-5 are perspective views of mold cores shown in Figure 2;

Figure 6 is a perspective view of a composite product formed by the present invention;

Figure 7 is a cross-sectional view taken along the line 2-2 of Figure 6 looking in the direction of the arrows;

5 Figure 8 is a cross-sectional view of another embodiment of the invention;
and

Figures 9-11 are sectional views of three different capacity mold cavities produced by the apparatus of Figures 1-4.

10 BEST MODE FOR CARRYING OUT THE INVENTION

A composite product 10 is shown in Figures 6 and 7 that is representative of interior trim and exterior trim products that must be color matched to adjacent components within a vehicle structure. In this arrangement the composite product 10 includes an outer layer of injection molded polymeric material 12; an intermediate layer 14 of injection molded polymeric material with or without particles of light reflecting material and a substrate layer 16 of injection molded polymeric material having color pigments or dyes. The outer layer 12 has a smooth glossy outer surface 18 defining a class A surface meeting automotive appearance requirements. The layers 12, 14 and 16 have substantially congruent outer perimeters.

Another composite product 20 is shown in Figure 8 having a substrate section 22 of injection molded material that includes color and an outer layer 24 of injection molded material of polymeric material with or without light reflecting material. The outer layer 24 has a smooth outer surface 26 that defines a class A surface having smooth glossy appearance that meets both smoothness and distinctness of image (D.O.I.) requirements in automotive applications. In a preferred embodiment the D.O.I. reading is in a range of 75-100.

Each of the aforesaid products can be formed in a process to be described by use of apparatus 30 diagrammatically shown in Figures 1-5. Apparatus 30 includes a mold press 32 including an expandable throat section 34. A rotary mold support or rotary platen 36 is carried on a moveable platen 38. The rotary mold support 36 is driven about a horizontal axis by a belt and motor drive system 40. In the illustrated embodiment, the mold support 36 is shown carrying a plurality of mold covers 42, 44, 46 each forming a mold cavity with a polished surface for meeting class A surface finish requirements.

As best shown in Figure 2, a stationary platen 48 is provided for supporting a plurality of mold cores 49, 50, 52 to be selectively aligned with each of the mold covers 42, 44, 46 in a process to be described.

In Figure 2, the mold cores 49, 50, 52 are broken away to show a plurality of underlying sprue gates 54, 56, 58 with injectors to direct molten material through passages in the mold cores 49, 50, 52. The molten material is supplied to the injector feed systems 60, 62, 64 of a known type including feed hoppers, extrusion barrels, heaters, and heated manifolds in communication with the sprue gates 54, 56, 58. The mold cores 49, 50, 52 are shown in Figures 3-5 respectively as having profiles or displacement mass that varies but with substantially congruent perimeter shapes. In the illustrated embodiment of the invention mold core 49 (shown in Figure 3) has a three dimensional profile 49a that, when closed against cover 42, will produce a mold cavity 63 to receive an outer layer 12 of injected material forming the class A surface 18.

In Figure 4, the mold core 50 is shown as having three dimensional profile 50a less than the profile 49a that, when closed against a cover 44 with an outer layer of material injected therein, will define a mold cavity 65 between the mold cover 44 and the mold core 49 that is of progressively greater capacity to

accommodate both the outer layer of material retained on the cover 44 and to define a space to receive an intermediate layer 14 of injected material.

In Figure 5, the mold core 52 is shown as having a three dimensional profile of less mass (volume) than mold core 50 that, when closed against a cover carrying layers 12, 14 will define a cavity 67 between the mold cover and the mold core 52 of still greater capacity to accommodate the previously injected layers 12, 14 that are retained on the cover while defining a space in the closed mold to receive the layer 16 of a composite product.

10

The press 30 is closed and opened by a drive system not shown that is operative to move the moveable platen 38 on tie bars 66, 68, 70 and 72. The drive system for the press can be of known types including hydraulic cylinders, electric motor driven screw drives with toggle connections and the like as are well known to those skilled in the art and forming no part of the present invention.

15

More specifically, the mold covers 40, 42, 44 when placed within the mold press 30 are rotated by the rotary mold support 36 with respect to the moveable platen 38. The moveable platen 38 is driven such that the mold covers 40, 42, 44 and the mold cores 49, 50, 52 are closed when the molten material is directed into a mold cavity defined between the cover and the respective mold core sections. The mold covers 40, 42, 44 are separated along a parting line and standard ejectors are employed to either retain molded material on the cover or to remove it during the process to be described.

25

The mold press 30 includes a hot runner system for supplying the melt into the mold cavities. An injecting system 74, 76, 78 (shown diagrammatically in Figure 2) includes known hot runners and an injector for each of the gates 54, 56, 58, respectively, and is diagrammatically shown as communicating through passages in each of the mold cores 49, 50, 52, respectively and as communicating

30



with each of the feed systems 60, 62, 64 each having a known screw mechanism 80 that receives a predetermined desired plastic composition from a supply hopper 82. This arrangement enables the process to be tuned for a particular polymer/additive combination that is best suited for application in the process of the present invention to obtain the best resultant color composite of the present invention.

The mold covers 42, 44, 46 and mold cores 49, 50, 52 while shown as three in number can be decreased in number or increased in number and still practice the process of the present invention that generally includes a process for manufacturing a multi-layer composite product of injection molded plastic comprising providing a at least one moveable mold part such as the mold cover 42 and a plurality of stationary mold parts such as the mold cores 49, 50, 52 and sequentially moving the moveable mold part with respect to the stationary mold parts to form one or more mold cavities (shown at 63, 65 and 67 in Figures 9, 10 and 11) of progressively increased capacity and injecting at least one layer of polymeric material into one of the mold cavities to produce a smooth glossy appearance on the viewing surface of the composite product as produced by the surface finish on the mold cover defining the cavity portion of the injection mold cavity.

20

If more than one moveable mold part is provided as shown in Figure 2 at 42, 44, 46, the process can involve a series of operations including first, second and third shot positions shown at SP₁, SP₂, SP₃ in Figure 2. As illustrated at SP₁ mold cover 42 is first closed against the mold core 49 to define the mold cavity 63 (smallest cavity) that is to be injected with an outer layer of polymeric material; at the same time at SP₂ the mold cover 44 that carries a previously injected outer layer of material is closed against the mold core 50 to define the next sized mold cavity 65 in which the intermediate layer of polymeric material is directed; at the same time at SP₃ mold cover 46 is closed against the mold core 52 so that the base layer can be injected into the next sized mold cavity 67 against two layers of

30

previously deposited material retained on the mold cover 46. Following injection of the material(s) into the closed molds, the moveable platen 38 separates from the stationary platen 48 and a finished part (comprising three layers of injected material) is ejected from the mold cover 46.

5

The rotary tool carrier or platen 36 is then rotated to move the mold cover 46 to the first shot mold cavity position SP_1 , the mold cover 42 is moved to the second shot mold cavity position SP_2 and the mold cover 44 is moved to the third shot mold cavity position SP_3 ; the platens are moved to close the mold covers against the mold cores and the first, second and third shots of mold injected material are injected as described above.

10

The process than continually repeats.

15

While the process is shown with the mold cavity part carried by the rotary tool carrier or platen 36 the process also contemplates the mold cores being carried on the rotary tool carrier and the mold covers (cavities) carried on the stationary platen 48. In such reversal of locations, the gate will be located such that the first surface formed will be the base; it will be carried on the core to a second station where the intermediate layer will be formed and then to a third station where the finished first surface will be formed on the mold cavity part at the third station.

20

The process can include an injection shot to form the cover layer that is injected into one or more of the mold cavities by providing polymeric material having colors blended therein to provide an enhanced colored appearance in the injection molded composite product.

25

Such process, if desired, can further comprise providing polymeric material with or without light reflective particles embedded therein and injecting it into one of the mold cavities.

30

The process can further comprise injecting into one of the mold cavities polymeric material having either or both colored pigments or dyes and light reflective particles blended therein.

5

The process can still further comprise injecting polymeric material with colored pigments or dyes into one of the cavities and injecting polymeric material with light reflective particles therein for changing the color effect of said colored pigments or dyes when the composite is viewed from different angles.

10

The process can still further comprise injecting polymeric material into the mold cavities for covering the polymeric material injected in progressively increasing volume mold cavities having substantially congruent outer perimeter shapes.

15

The process can further comprise injecting a covering of polymeric material into the mold cavities for covering the first layer of polymeric material in the one of the mold cavities and injecting polymeric material having colors or dyes into one of the mold cavities to form the first layer of material;

20

The process can also include providing three or more rotational mold halves and providing three or more stationary mold sections and providing progressively greater capacity mold cavities by varying dimensions of the stationary mold sections while retaining congruent outer perimeter shapes.

25

For a better understanding of the multi-stage sequentially operated injection molding apparatus of the present invention having more than one rotational mold half and providing more than one stationary mold section and providing progressively greater capacity mold cavities by varying dimensions of the stationary mold sections a diagrammatic showing thereof is set forth in Figures 9-

30

11 wherein the movement of one of the moveable mold covers or cavity parts is illustrated.

In the sequence of sections shown in Figures 9-11, the mold cover 42 is followed as it is positioned at the SP₁, SP₂, and SP₃ locations within the mold press 32 by the process of sequentially advancing the mold cover 42 with respect to the three stationary mold cores 49,50,52 located within the mold press 32 as previously discussed to form one or more mold cavities of similar outer perimeter shape and of progressively greater capacity and injecting at least one layer of polymeric material into one of the mold cavities to produce a colored appearance on the viewing surface of the composite product.

Thus as shown in Figure 9, the mold cover 42 is positioned on the core 49 when the mold press 32 is closed to form the mold cavity 63. As shown in Figure 10, the mold cover 42 is positioned on the core 50 when the mold press 32 is closed to form the mold cavity 67 between a layer of material previously deposited at Figure 9. The core 50 has a section 50a of less mass than the core section 49a so that a mold cavity of progressively greater capacity is defined thereby so as to accommodate the layer of material deposited in the mold cavity and to provide a mold cavity 67 for injection of a second layer of material. As shown in Figure 11, the mold cover 42 (with two layers of in tool deposited material) is positioned on the mold core 52 when the mold press 32 is closed. The core 52 has a section 52a of less mass than the core section 50a so as to form a mold cavity 62 of progressively greater capacity (with similar outer perimeter shape) that will accommodate the previously deposited layers of in tool injected material and to form the mold cavity 67 for deposition of a third layer of injection molded material in the same tool, e.g., the mold cover or cavity part 42.

In accordance with the illustrated equipment, the rotary platen 36 first positions the mold cover 42 in the mold press 32 and it is closed against the mold

core 49. At this point in the process a shot of molten polymeric material is injected into the mold cavity 63 by known feed systems shown schematically at 54, 74 and 60. The injected molten material forms, for example, a material layer of clear polymer 84 corresponding to the outer class A surface as shown in the embodiment of Figure 6. Once injected the clear polymer layer 84 stays with the cover 42. The mold press is opened and the cover 42 is repositioned in the press following reversing of known gating system and ejection plungers.

The mold cover 42 is then closed against the smaller volume core member 50 with the injection molded material 84 remaining thereon as shown in Figure 10. The mold cavity is partially filled by the material layer 84 and the remaining cavity space 65 is then filled with injection molded polymeric material such as a material layer 86 of clear polymeric material having particles of light reflecting material therein. Again the mold press is opened and the mold cover 42 is repositioned by rotation and then closed against the still smaller volume core member 52 while the previously in-tool injection molded layers 84, 86 remain on the mold cover 42 following reversing of the gating and the ejection pins.

The mold cover 42 is then positioned within the mold press 32 with the injection molded material layers 84, 86 remaining thereon as shown in Figure 11. The mold cavity 67 is partially filled by the material layers 84, 86 and the remaining space is then filled with injection molded polymeric material such as a material layer 88 of clear polymeric material having pigment particles of color therein. The mold press is opened and the material layers 84, 86, 88 are then removed from the mold cover 42 by hydraulically actuated ejector pins as a unitary, in-tool formed part.

The arrangement enables a wide range of products to be produced by a duplication of tool sets with it being understood that the schematically shown tooling is that required for a part with three layers of injection mold polymeric

material of substantially congruent perimeter shape. For parts with two or one layer of such injection mold polymeric material the number of cores and presses can be reduced in like number.

5 In practicing the invention in order to obtain a class A surface on the product the cover cavity is polished. Three polymer pours are directed into the cavity as it is progressively advanced with respect to the core sections of progressively less mass (to define a progressively greater volume mold cavity while retaining congruent perimeters). Suitable epoxy ejectors are provided in
10 in conjunction with the cover and suitable gating is provided along with mold runs to direct the polymeric material into the mold cavity during the sequential shots of material into the mold cavity.

 All injection moldable polymeric materials are suitable for the various
15 layers including both thermoplastic and thermoset materials.

 Suitable materials for imparting color to the products for matching adjacent parts of a vehicle include any organic or inorganic pigment or dye of any class or variety as well known to those skilled in the art.

20

 Suitable light reflective material types for imparting brightness to a layer include mica flakes or any other suitable light reflective material.

INDUSTRIAL APPLICABILITY

25

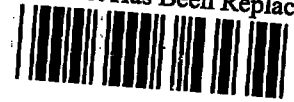
 The article, apparatus and method of the present invention is especially suitable for manufacture of in-tool multiple layer injection molded parts for use any automotive and other applications and including products such as door panels, consoles, kick panels, luggage racks and the like and for manufacture in the field
30 of automotive exterior trim components such as wheel covers, bumper fascia,

exterior door panels, skirts and the like. The process is also applicable to the manufacture of other color composite plastic articles including but not limited to luggage housing and electronic equipment housings.

- 5 Variations and modifications are possible without departing from the scope and spirit of the present invention as defined by the appended claims.



This Sheet Has Been Replaced



What is claimed is:

1. A colored plastic composite molded in an injection mold including an enhanced finished surface covering on the composite comprising injection molded polymeric material and a layer of injection molded material formed directly against the covering material of injection molded material.
2. A colored plastic composite molded in an injection mold including an enhanced finished surface covering on the composite comprising a single layer having an injected finished surface covering of the composite and said single layer comprising injection molded polymeric material having colored pigments or dyes and light reflective particles embedded therein for changing the color effect of said pigments or dyes when the composite is viewed from different angles and the single layer having the appearance of the colored material enhanced by the finished surface covering.
3. The colored plastic composite of claim 2 wherein said finished surface covering is opaque.
4. The colored plastic composite of claim 2 wherein said finished surface covering is colored.
5. The colored plastic composite of claim 2 wherein said finished surface covering is a clear polymeric material.
6. A colored plastic composite having first and second layers injection molded in overlying relationship to form a base layer and a top layer that covers the base layer and wherein the top layer constitutes an enhanced finished surface covering of the composite characterized by:



This Sheet Has Been Replaced



said base layer comprising injection molded polymeric material having colored pigments or dyes blended therein;

said top layer comprising injection molded polymeric material with or without light reflective particles embedded therein for changing the color effect of
5 said colored pigments or dyes when the composite is viewed from different angles.

7. A colored plastic composite having first and second layers injection molded in overlying relationship to form a base layer and a top layer that covers the base layer in direct contact therewith and wherein the top layer constitutes an
10 enhanced finished surface covering of the composite characterized by:

said base layer comprising injection molded polymeric material having particles blended therein from the group consisting of: colored pigments or dyes; and light reflective particles embedded therein;

and a top layer of injection molded polymeric material for protecting said
15 base layer.

8. A colored plastic composite having first and second layers injection molded in overlying relationship to form a base layer and a top layer that covers the base layer in direct contact therewith and wherein the top layer constitutes an
20 enhanced finished surface covering of the composite characterized by:

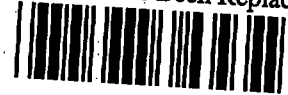
said base layer comprising injection molded polymeric material having particles blended therein comprising colored pigments or dyes and light reflective particles embedded therein;

and a top layer of injection molded clear polymeric material for protecting
25 said base layer.

9. A colored plastic composite having a base layer, an intermediate layer and a top layer that covers the base layer and the intermediate layer and wherein the top layer constitutes an enhanced finished surface covering of the
30 composite characterized by:



This Sheet Has Been Replaced



said base layer comprising injection molded polymeric material having colored pigments or dyes blended therein;

said intermediate layer comprising injection molded polymeric material in direct contact with said base layer and having light reflective particles embedded therein for changing the color effect of said colored pigments or dyes when the composite is viewed from different angles;

said top layer comprising injection molded polymeric material in direct contact with said intermediate layer.

10 10. The colored plastic composite of claim 9 wherein said protective top layer is opaque.

11. The colored plastic composite of claim 9 wherein said protective top layer is colored.

15 12. The colored plastic composite of claim 9 wherein said protective top layer is a clear polymeric material.

13. The colored plastic composite of claim 9 wherein said protective top layer has an exterior glossy surface.

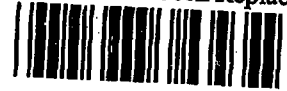
14. The colored plastic composite of claim 2 wherein said finished surface covering is a clear polymeric material having an exterior glossy surface.

25 15. A process for manufacturing a multi-layer composite product of injection molded plastic comprising providing a moveable mold part and a plurality of stationary mold parts of congruent perimeter shape; sequentially moving the moveable mold part with respect to the stationary mold parts to form one or more mold cavities of progressively greater capacity and injecting at least one layer of polymeric material into one of the mold cavities to produce a colored

30



This Sheet Has Been Replaced



appearance on the viewing surface of the composite product and to produce a covering surface congruent to said at least one layer for enhancing the appearance of said at least one layer of polymeric material.

- 5 16. A process for manufacturing a multi-layer composite product of injection molded plastic comprising providing a moveable mold part and plural stationary mold parts of congruent perimeter shape;
 sequentially moving said moveable mold part with respect to said stationary mold parts to form plural mold cavities of progressively greater capacity
10 and congruent perimeters;
 injecting a first layer of colored polymeric material into one of the mold cavities:
 injecting a second layer of polymeric material into another of the mold cavities for covering the first layer of polymeric material and for enhancing the
15 colored appearance thereof.
17. The process of claim 16 further comprising providing polymeric material having colored pigments or dyes blended therein and injecting it as the first layer of polymeric material;
20
18. The process of claim 16 further comprising providing polymeric material having light reflective particles embedded therein and injecting it as one of the layers of material into one of the mold cavities.
- 25 19. The process of claim 16 further comprising injecting polymeric material having either or both colored pigments or dyes and light reflective particles blended therein into one of the mold cavities.
20. The process of claim 16 further comprising injecting polymeric
30 material with colored pigments or dyes into one of the cavities and thereafter



This Sheet Has Been Replaced



injecting polymeric material with light reflective particles therein for changing the color effect of said colored pigments or dyes when the composite is viewed from different angles.

5 21. The process of claim 16 further comprising injecting clear polymeric material into another of the mold cavities for covering the polymeric material in the one of the mold cavities.

 22. The process of claim 16 further comprising injecting a covering of
10 polymeric material into another of the mold cavities for covering the first layer of polymeric material in the one of the mold cavities; and

 injecting polymeric material having colored pigments or dyes into one of the mold cavities to form a first layer of material;

15 23. The process of claim 16 including providing one or more rotational mold halves and providing more than one stationary mold sections and providing progressively greater capacity mold cavities by varying the size of the stationary mold sections.

20 24. The process of claim 23 including providing the rotational mold halves and stationary mold sections respectively as mold covers and mold cores.

 25. The process of claim 23 including the steps of maintaining the material injected into the one mold cavity on one of the covers and rotating the one
25 of the covers and moving it to a second core to form a second mold cavity for injecting additional material against the material previously deposited on the cover.

 26. Multi-stage sequentially operated injection molding apparatus comprising a moveable mold section and more than one stationary mold sections
30 of congruent perimeter shape; said moveable mold section selectively closed with



This Sheet Has Been Replaced



respect to said more than one stationary mold sections and either said more than one moveable mold sections or said more than one stationary mold section being of progressively less mass for providing progressively greater capacity mold cavities when said moveable mold section is selectively closed with respect to said more
5 than one stationary mold sections.

27. The multi-stage sequentially operated injection molding apparatus of claim 26 wherein said moveable mold section is carried on a rotary platen.

10 28. The multi-stage sequentially operated injection molding apparatus of claim 26 wherein said moveable mold section is a mold cover defining a mold cavity and said stationary mold section is a mold core.

15 29. The multi-stage sequentially operated injection molding apparatus of claim 26 wherein said moveable mold section is a mold core and said stationary mold section is a mold cover.

20 30. The multi-stage sequentially operated injection molding apparatus of claim 26 wherein said rotational mold section is a mold cover having a polished inner surface and said stationary mold sections are mold cores.