

[54] **METHOD OF APPLYING DECALS TO SURFACES OF COMPLEX CURVATURE**
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[22] Filed: **Aug. 17, 1972**
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2,880,539	4/1959	Frenkel et al.....	156/361
2,922,192	1/1960	Morin	156/518
3,130,107	4/1964	Shank, Jr.	156/559
3,297,508	1/1967	Jahp.....	156/249
3,520,751	7/1970	Cranfill	156/261
3,549,446	12/1970	Bennett et al.	161/406
3,709,763	1/1973	O'Neil.....	156/249

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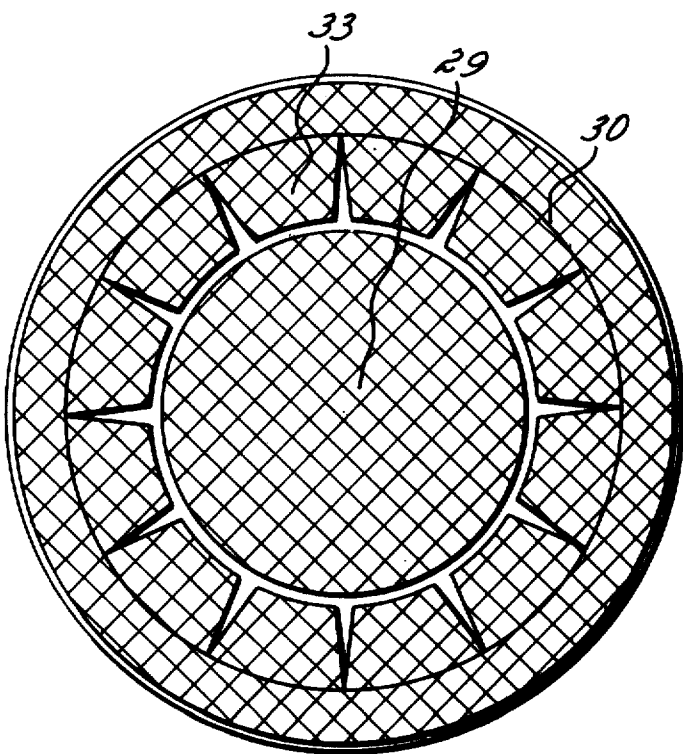
[52] U.S. Cl. **156/211; 156/212; 156/230; 156/238; 156/240; 156/249; 156/251; 156/252; 156/257; 161/406; 161/413**
[51] Int. Cl. **B29c 27/14; B44c 1/00**
[58] Field of Search 156/234, 238, 239, 240, 156/249, 251, 261, 297, 518, 541, 211, 212, 235, 247; 161/406, 413

[56] **References Cited**

UNITED STATES PATENTS			
1,986,611	1/1935	Thomsen	156/518
2,441,164	5/1948	Miller	156/212
2,608,503	8/1952	Meyer.....	156/249
2,754,994	7/1956	Cole.....	156/541
2,811,744	11/1957	Baldanza.....	156/238

[57] **ABSTRACT**
A method for applying a decal to a complex curved surface of an article. The decal is formed on a backing, and the decal and backing are perforated to form a separable portion which can conform to the curvature of the article. The backing is held while the separable portion is pushed toward the surface, so that the separable portion is separated from the surrounding portion as by tearing along a perforated line. The decal, including the separated portion and its backing, are pressed by a platen into contact with the article surface a sufficient period of time for the decal to transfer to it. The backing is then removed.

10 Claims, 11 Drawing Figures



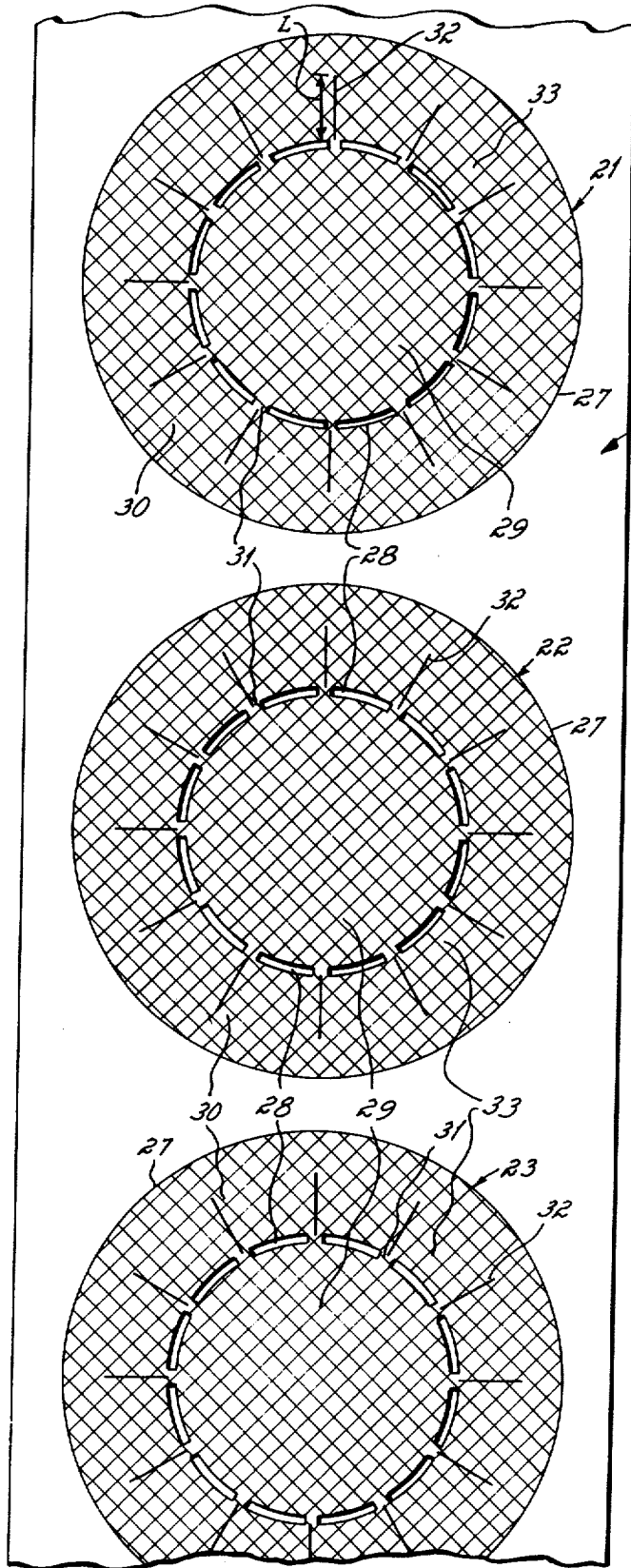


Fig. 2

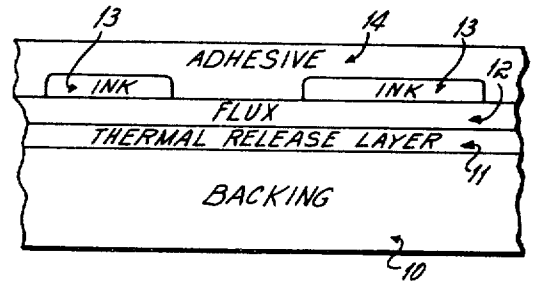


Fig. 1

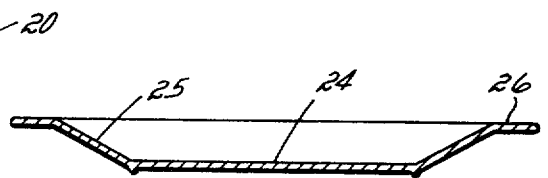


Fig. 3

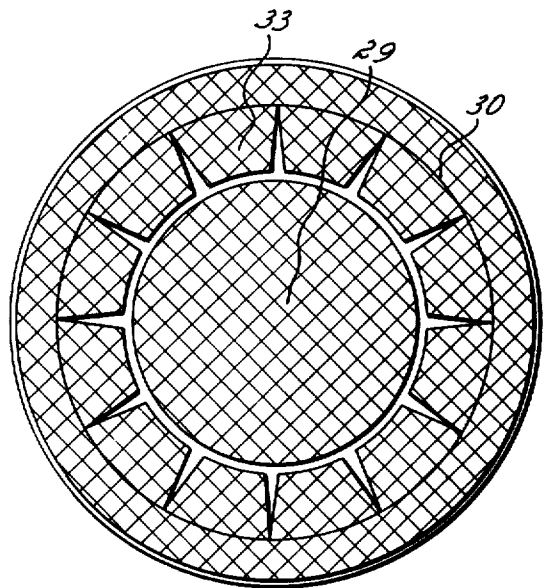


Fig. 4

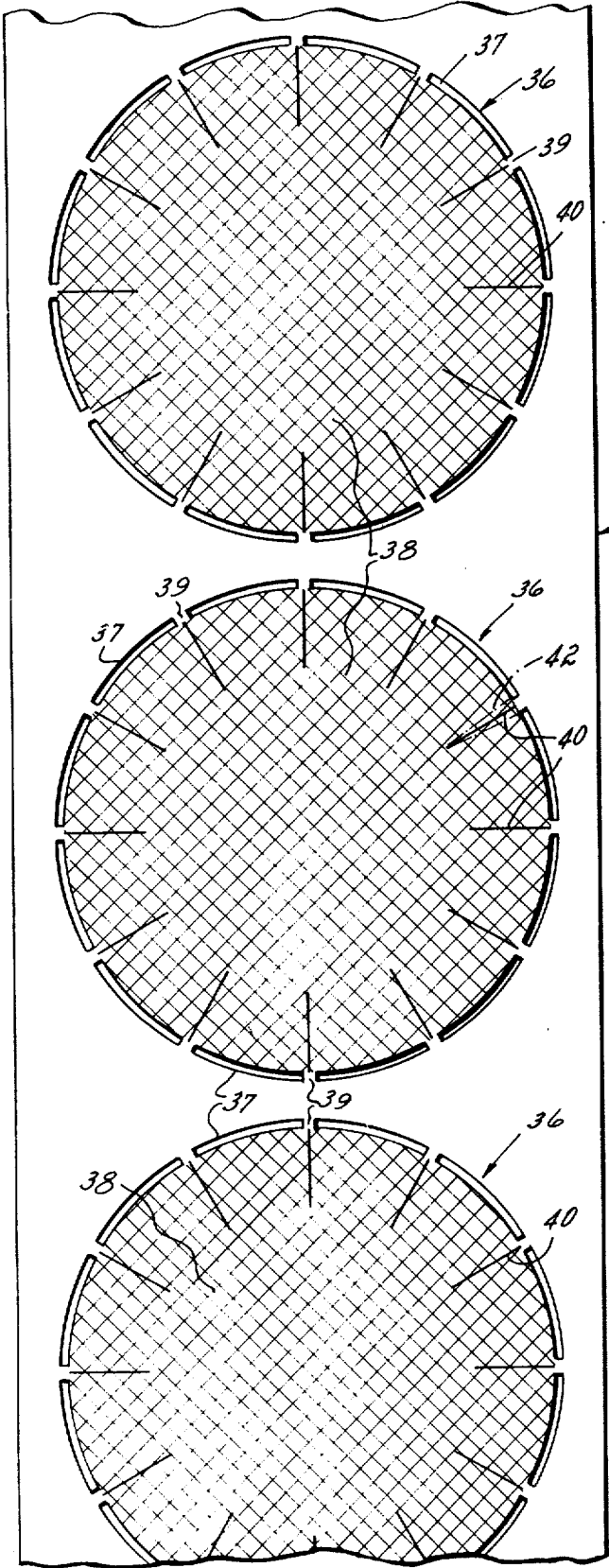


Fig. 3

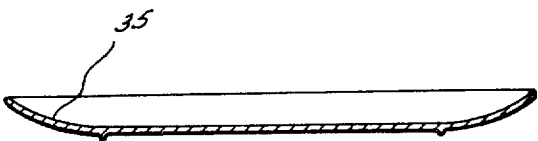


Fig. 6

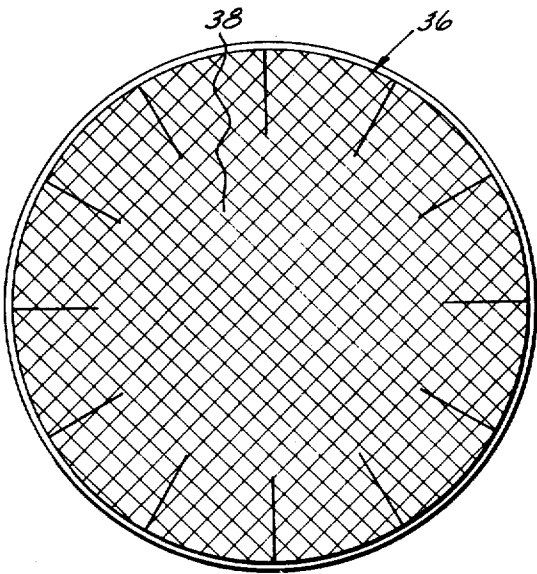


Fig. 7

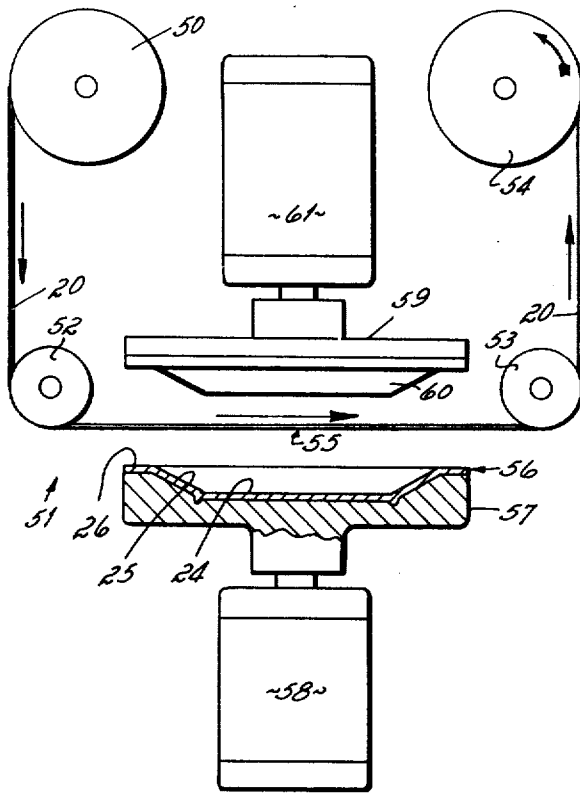


Fig. 8

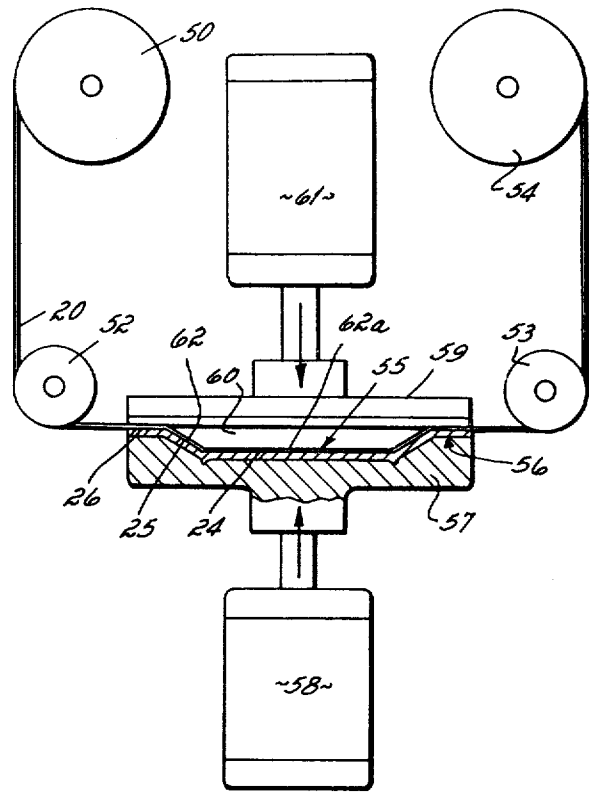


Fig. 9

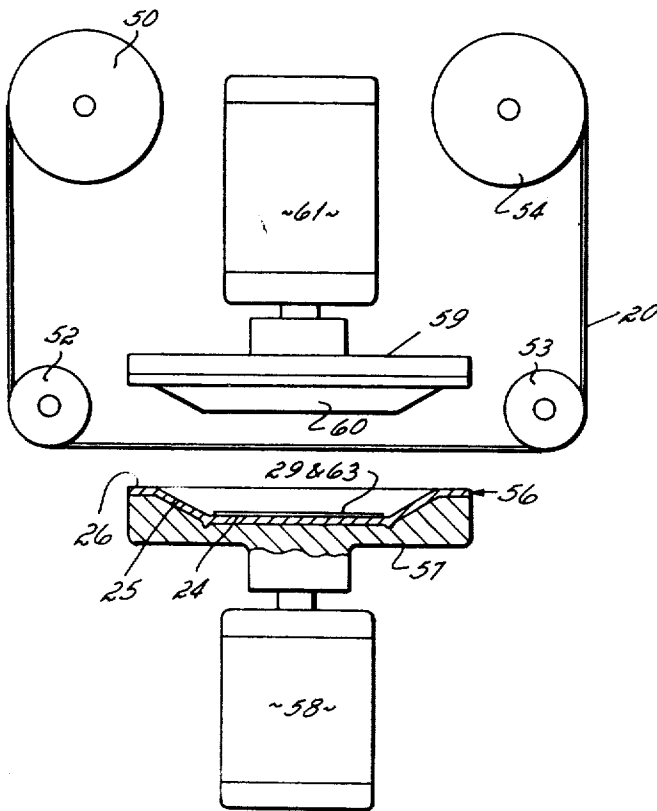


Fig. 10

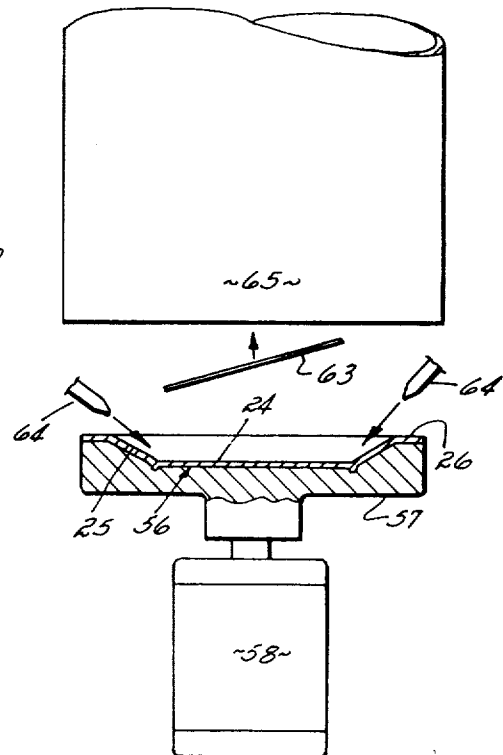


Fig. 11

METHOD OF APPLYING DECALS TO SURFACES OF COMPLEX CURVATURE

This invention relates to a method for applying a decal decoration to a complex curved surface (such as a highly concave or a convex surface) of an article such as glass tableware, ceramic and plastic articles, and the like.

Application of decals to articles having single axes of curvature, such as tumblers, or having concave or convex surfaces of slight curvature, such as the sidewall of a cup, is well known in the art, see for example Shank U.S. Pat. No. 3,031,370 and 3,130,107, to which reference may be had as background. So-called thermally activated or thermal release decals are widely used for such decoration of hot, newly formed glass and ceramic articles. The decals have a slight "stretchability" which enables them to be formed as flat sheets but still to conform to a slight complex curvature. According to conventional practice, a decal decoration comprising powdered glass frit is formed on a backing which may be paper, to which it is adhered by a meltable or, more broadly, a thermally releasable adhesive. The decal, on the backing, is pressed into contact with the surface to which it is to be applied while the latter is heated. The decals are typically applied to newly formed glass articles which retain some of their heat of formation, and are at a temperature in the range of about 150°-300° F, depending on the type decal used. The heat melts the adhesive and thereby releases the decal from its backing and at the same time activates an adhesive on the face side of the decal, causing it to adhere and thereby transfer to the article surface with which it is in contact. After the now released backing is removed, the decal on the glass surface is subjected to an annealing or fusing step, as in a lehr or oven, which bonds the decorative frit integrally to the surface.

The technique described is satisfactory for the application of decal decoration to flat surfaces, and to surfaces which have a single axis of curvature such as a cylindrical or conical surface of a tumbler, and to surfaces which are only slightly concave or convex, such as rim areas of plates, and cup sidewalls. The slight stretchability of the decals is sufficient to permit them to conform to such curvatures. However, while it is possible to apply decals manually to complex curved glass surfaces, there has not previously been any mechanical or automated technique for doing so at a commercially useful rate. This has effectively prevented the efficient large scale application of decals to more than limited or narrow surface areas on plates and bowls. As a result, such areas have usually not been decorated at all, since decal decoration has been too laborious.

The chief difficulty in the decoration of such surfaces resides in the fact that a thermal release decal must be brought to the surface and held against it, while supported on its backing, in intimate pressed contact for a period of time sufficient for the heat of the article to release the backing and to enable the decal to adhere to the surface. The decal and backing do not stretch sufficiently to permit good contact, by this technique, with a complex curved surface. Such areas could in theory be decorated by applying a plurality of small decal portions, each small enough to conform to the curvature of the small area to which it is applied, however the problem of carrying and accurately positioning separate small pieces is technically difficult.

This invention is directed to a method whereby thermal release decals can be applied, at a commercially useful rate, to such highly curved surfaces. The invention provides for forming and carrying the entire decal on a single backing or web, which may be a continuous rolled strip with a large plurality of similar decals along it. A part or all of the decal area, still carried on its backing, is separated (as by tearing) from the surrounding portion as it is brought into intimate contact with the article surface. The decal and backing area are also perforated along lines to permit them to conform to the article surface. Thus, the fragmentation of the decal into the discrete sections required for conformity with a highly curved surface does not take place until the decal is actually pressed into contact with the surface.

More specifically, the backing, with the thermal release decal formed on it and in flat condition, is perforated to define at least one separable portion including a part or all of the decal. The separable portion is separable from the surrounding portion but remains connected to it, for example, by thin bridge or neck portions that will tear in pressing so as to free the separable portion from the surrounding portion. The decal and backing, including the separable portion, are also perforated to permit them to conform to the curved surface of the article to which the decal is to be applied. The backing is positioned in opposition to the article surface and is held externally of the decal-containing portion while a platen rapidly pushes the decal-containing portion toward the article. This ruptures the bridges and releases the separable portion from the remainder, as the decal is being moved by the platen into contact with the surface. The separated portion is held under pressure in contact with the article surface for a period of time sufficient for the heat of the article to cause the decal to adhere to the curved surface and to release from the backing. When the decal has adhered to the surface, the backing is removed and the decal can be given any subsequent firing or lehring operation necessary to complete the fusion.

The invention will be further described and explained by reference to the accompanying drawings, in which,

FIG. 1 is a transverse sectional view of a portion of a typical thermally activated decal;

FIG. 2 shows in plan a portion of a strip backing carrying a plurality of decals, each in accordance with a preferred embodiment of the invention, perforated for application to a flat rim dinner plate;

FIG. 3 is a sectional view of a typical flat rim dinner plate, to which a decoration of the type shown in FIG. 2 is to be applied;

FIG. 4 is a plan view of the flat rim plate of FIG. 3, to which a decal of the type shown in FIG. 2 has been applied;

FIG. 5 shows in plan a portion of a strip backing carrying a plurality of decals having somewhat different perforations than shown in FIG. 2, for application to a coupe shape dinner plate;

FIG. 6 is a sectional view of the coupe shape dinner plate, for which a decoration of the type shown in FIG. 5 is suited;

FIG. 7 is a plan view of the plate of FIG. 6, to which a decoration of the type shown in FIG. 5 has been applied;

FIG. 8 shows diagrammatically a vertical elevation, partially in section, of a decal applying apparatus for

carrying out the method of the invention, at the start of the decal applying operation;

FIG. 9 shows the apparatus of FIG. 8 but with a decal on the web pressed in contact with the article surface;

FIG. 10 shows the apparatus of FIG. 8 after the separable portion has been torn or pressed out and the decal adhered to the article, with the separated portion of the backing still on the separated decal but the remainder of the backing removed; and

FIG. 11 is a vertical diagrammatic view, partly in section, of apparatus for removing the separated portion of the backing from the decal.

Referring now to FIG. 1, a typical thermal release decal includes a backing 10 which may be formed of paper or other suitable material having the necessary flexibility and strength. Disposed on one surface of the backing 10 is a thermal release layer 11 which permits the material above layer 11 to separate from the backing when sufficient heat is applied to the decal. In many applications, the thermal release layer 11 comprises a wax or similar material which will melt at a certain temperature and thereby permit the separation of the decorative layers from the backing 10.

The decorative layers, located above the thermal release layer 11, may include a flux layer 12 which comprises a suitable transparent glass frit material for protecting the coloration layer or zones 13 from abrasion caused by surface contact, as well as for providing a barrier to prevent any lead which might be used in the coloring from contacting food placed upon the decorated glassware.

The coloring zones 13 are located between the flux layer 12 and the thermally activated adhesive layer 14 and are arranged to form a decorative design. The thermally activated adhesive layer 14 is comprised of a suitable adhesive material which will adhere to the glass or ceramic surface to be decorated and which is activated by temperature. As known in the art, when the decal of the type shown in FIG. 1 is placed in contact with a heated glass surface, the adhesive 14 will adhere to the article surface, leaving the coloring portions 13 in the desired positions to place a decoration on the article. When fused, the flux layer 12 will seal the coloration to form a protective layer. The thermal release layer 11 will be melted at the temperature employed, allowing the backing 10 to be removed. Upon cooling, the glassware will have the desired decoration adhered thereto. The decal structure shown in FIG. 1 is well known in the art, and does not comprise the invention, and is set forth herein in connection with the explanation of the decal applying method of the invention.

FIG. 2 shows a part of a continuous or strip backing 20, with individual decal-containing areas 21, 22 and 23 spaced along it. The decals are of the construction shown in FIG. 1 and described above. Each of the decals at 21, 22 and 23 has a decoration within the shaded area. For use in the invention, the backing strip 20 is perforated as will be explained.

The ware shown in FIG. 3 is what is known in the art as a flat rim dinner plate, and has a flat central bottom surface 24, a flat rim area 26, and a conical or tapered area 25 joining the rim 26 to the bottom surface 24. For plates of the type shown in FIG. 3 having a complex curvature such as that comprised by the tapered area 25, the flat rim 26 and the flat bottom surface 24, decals perforated in the manner shown in FIG. 2 are particularly suitable. The circle 27 defines the decal-

containing area of the backing, and is the outer periphery of the decal which is to be applied to the ware. A plurality of arcuate open slots 28 which almost form a complete circle are located interiorly and concentrically within circle 27, and define a separable portion 29 that is within the overall decal-containing area. Bridge portions or webs 31, however, remain between adjacent arcuate slots 28, and they form a supporting connection between the central portion 29 and the rim portion 30, permitting the central portion to remain attached to the rim portion prior to application, but to be easily separable therefrom by tearing each of the bridges in application. Thus, in this embodiment, part of the decal is within the perforated line, and part is outside of it.

In addition to the perforations in the form of the slots 28 which define the separable portion, the decal of FIG. 2 is additionally provided with slits 32 which extend radially outwardly from each of the bridge portions a distance L that corresponds to the surface dimension of the tapered area 25 of the glassware to be decorated. The slits 32, after the central portion 29 has been torn away from the remainder of the decal during application, as will be described later, permit the decal to be shaped so as to conform to the surface of the tapered area 25. The slits 32 thus permit the decal to conform to the shape of the flat rim ware shown in FIG. 3, without stretching or tearing.

When a decal shaped and perforated in accordance with FIG. 2 is applied to a flat rim plate of the type shown in FIG. 3, it will cover the areas which are shaded in FIG. 4. As will be described, the separable portion 29 will be severed from the surrounding portion of the decal area. The tapered sidewall 25 of the plate will be covered by the tabs or areas 33, separated by the slits 32. It can be seen that the decal, though formed as a flat sheet, enables almost the entire area of the plate to be decorated. Where more limited sidewall decoration is desired, the tabs 33 can be configured or slit accordingly.

For other ware configurations, such as the coupe shape dinner plate shown in FIG. 6, somewhat different decal perforations are advantageous. In comparison to the flat rim plate shown in FIG. 3, the coupe shape ware does not have a flat rim, having instead a concave sidewall 35. The decal configuration represented in FIG. 5 is especially advantageous for applying decorations to a saucer shaped plate of this type. In contrast to the decoration of FIG. 2, the entire decal-containing area 36 of FIG. 5 is defined within perforations in the form of arcuate tear slots 37, and those slots substantially form the outer periphery of the decal itself.

As in the other decal previously described, the separable portion 38 of the decoration 36 is releasably or frangibly attached to the remainder of the backing 20 by bridges 39 which are located between the ends of adjacent slots 37. Upon application, the decal 36 in FIG. 5 is completely separated from the carrier 20 by tearing the bridges 39. The decal will conform to the shape of the glassware during its application, as will be explained. This conforming of shape is permitted by the radially extending slits 40 which extend inwardly from the decal periphery a distance which approximately corresponds to the radial length of the curved portion 35 of the saucer. If the curvature is great, a radially extending triangular shaped slot 42 (shown in phantom

lines) may be used in place of radial slits to permit the decal better to conform to the surface.

With the foregoing in mind, it will be clear to those skilled in the art that the appropriate configuration of perforations, i.e., slits and slots, will depend upon the shape of the article to which the decoration is to be applied. For shapes other than those generally described, other combinations of perforations can be utilized to permit the decal to conform to the surface being decorated.

The decal application process can be performed by an apparatus shown generally in FIG. 8. A web supply reel 50 holds a wound strip of the type generally shown in FIG. 3, that carries a large number of decals. As shown at 51, the backing strip 20 leads from the supply reel 50 around tensioned guide rollers 52 and 53 to a take-up reel 54 which holds the remaining portion of the web after the decals have been separated from it in the application process.

The reel 50 is oriented so that the decals face downwardly, or toward the surfaces 24, 25 and 26 of the articles such as plate 56 to which they are to be applied. At the beginning of the decal applying process, the strip is positioned so that a decal 55 is aligned directly above the ware 56 which is seated in a conventional holding chuck 57, as by vacuum. The chuck 57 is reciprocable by a chuck piston 58.

Disposed above the decal-containing area 55 and aligned with the chuck 57 is an applying head 59. The applying head includes a platen 60 having a shape which conforms to the upper surfaces of the ware 56. The applying head is carried by a reciprocating head drive means 61 which can move the applying head 59 in up and down motion. Like the chuck drive means 58, the head drive means 61 may comprise a pneumatic cylinder and its operation may be automatically timed with respect to the positioning of a decal area 55, and the lifting of chuck 57.

The decal is shown being applied in FIG. 9. Applying head 59 has been lowered and chuck 57 has been raised, from the respective positions shown in FIG. 8. An area outwardly of separable central portion 29 is held by and between plate 56 and the platen 60, so that the decal tabs 33 and center 29 conform to the shape of the plate surface itself. The centrally located separable portion 62a is displaced by the platen 60 from the overall plane of the web 20, to a different plane which comprises the central planar surface 24 of the plate 56. As the platen presses it into this position, the bridges 31 which secured the central decal portion 29 to the surrounding portion 30 of the decal, are torn or otherwise separated in the process. The bridges support the central decal portion until the platen causes them to separate, and the relative motion of the platen then carries the separated decal portion directly into engagement with the portion of the ware to which it is to be adhered.

It is also seen at 62 that the tapered sidewall region of the plate also has a portion of the decal pressed into conforming shape against it.

The separated decal areas, on their backings, are held under platen pressure against plate 56 for a sufficient period of time for their release from the backings. The operating conditions for application of thermal release decals are well known in the art, see for example the Shank patents previously identified.

After the decal areas have been adhered, and the release layer 11 has melted, platen 60 is raised by applying head moving means 61, and chuck 57 is lowered by the chuck moving means 58 away from the held strip 20, as shown in FIG. 10. At this point the released backing 63 of the central portion centralportion 29 remains on the center 24 of the plate 56, as the strip 20 is removed after the decal area 30 has been transferred from it. The raising of the platen 60 and the lowering of the plate 56 thus separates the strip backing from the decal.

Referring now to FIG. 11, the plate 56, the chuck 57 and the chuck moving means 58 are moved (as by a conventional index head not shown) from alignment with platen 60, to a position at which backing 63 on separated decal area 29 is removed. Air jet means 64 are provided to direct a stream of air toward the central portion 24 of the plate 56, to lift the backing 63 from the central portion of the decal. The free backing 63 is then drawn upwardly by a vacuum hood 65 and is carried off to disposal.

After removal of the backing, shown in FIG. 11, the plate 56 may be given a conventional final heat treatment in a lehr or oven, to set the glaze and harden the bond.

Upon completion of the decal application process, a new decal is positioned between applying head 59 and chuck 57. As viewed in FIG. 8, the take-up reel 54 is rotated in the direction indicated and the web 51 will advance a new decal from the supply reel 50 into the proper position between applying head 59 and chuck 57. At this point, another decal can be applied to another plate held by the chuck 57.

While the foregoing description of the decal applying method has been made in connection with a preferred embodiment thereof, certain modifications in form may be readily made without departing from the spirit and scope of this invention. For example, while the invention has been described with particular emphasis upon decals formed on a continuous web, individual decals can be positioned by appropriate positioning means between an applying head and plate. Such individual decals would include the separable portions in order to permit the decal to conform to a curved surface.

Although the present method will be of most immediate utility for application of decals to a complex curved surface, it is more broadly applicable to coverage of slightly curved surfaces or even flat surfaces, if desired, (one example of decal application to a flat surface at the bottom of a plate appearing in FIGS. 8-11). The term decal, as used herein, is meant broadly to include transfers carried on a backing and which must be held in contact with the article surface while on the backing, for the transfer to be completed.

These and other modifications will be apparent to those skilled in the art, and are within the spirit and scope of this invention as defined by the following claims.

I claim:

1. A method for applying a decal to an article having a curved surface, such as tableware, comprising the steps of:

forming a decal on a backing, the decal-containing area of the backing being surrounded by a non-decal containing area of said backing;

perforating the decal area with lines which extend outwardly toward the periphery of the said decal containing area and which are configured to permit the decal-containing area to conform to the curvature of the surface of the article to which the decal is to be applied;

forming other perforations defining a separable portion which is separable by tearing from the surrounding portion, the separable portion including at least a part of the decal-containing area;

thereafter positioning the decal-containing area, while still attached to the non-decal containing area, in alignment with the article surface to which the decal is to be applied,

holding the non-decal containing area taut while imparting to the decal-containing area a different curvature than said non-decal containing area by pressing said decal-containing area toward said curved surface by a plunger having a pressing surface conforming generally to the curvature of the article surface, thereby separating said separable portion from the surrounding portion at said other perforations as an incident to said pressing;

holding the decal-containing area, which includes the area containing both said outwardly extending lines and said separated portions, under pressure and in contact with said article surface to transfer the entirety of said decal-containing area thereto;

releasing said pressure and removing the held area of the backing from said article surface;

and removing the separated portion of said backing from said article surface.

2. The method of claim 1 wherein the perforations

include a series of closely spaced slots defining a margin of the decal-containing area.

3. The method of claim 1 wherein said perforations include radial slits which permit said decal-containing area to conform to the article surface.

4. The method of claim 1 wherein the decal-containing area is perforated by slots inwardly of the periphery of the decal, and by slits extending generally perpendicularly to said periphery, to conform to said article surface.

5. The method of claim 1 wherein said perforations include slots having narrow bridge portions between them, which portions are torn free by the said pressing.

6. The method of claim 1 wherein said forming includes forming a plurality of similar decals on a backing which comprises a long strip.

7. The method of claim 6 wherein said strip is coiled on a reel at each end and a single decal-containing area thereof is positioned adjacent said article.

8. The method of claim 7 additionally including the steps of:

replacing the decorated article with an undecorated article;

advancing the strip to position another decal-containing area thereof for pressing into contact with the surface of the undecorated article;

and repeating the last four steps of claim 1.

9. The method of claim 1 wherein the decal-containing area is pressed into contact with said surface by a platen on the remote side of said backing.

10. The method of claim 1 wherein said decal is a thermal release decal.

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