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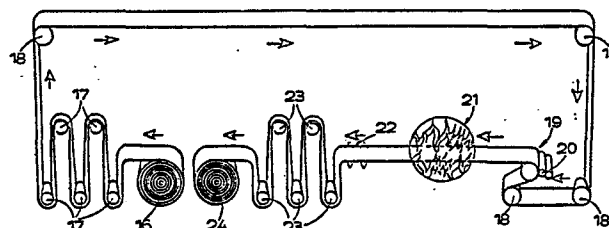
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⑤④ **Process for producing pre-coated metal sheet.**

⑤⑦ Pre-coated metal sheet for use in the manufacture of bakeware and other products intended to be used at high temperatures is first given a coating, on one or both sides, of a material, e.g. a lacquer, polyethylene sulphonate or a non-stick material, capable of withstanding temperatures of at least 250°C, baked at 350-450°C to dry the coating, and then has a printing medium compatible with the coating material applied to, and cured on, the coating as decoration. The sheet may be coiled between the coating and decoration steps, and may be coiled again after the decoration has been cured. Preferably the coating is applied by the reverse roll method and the decoration is printed on the coating by the forward roll method.



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IMPROVEMENTS RELATING TO PRE-COATED METAL SHEET
SUITABLE FOR USE IN THE MANUFACTURE OF BAKEWARE
AND OTHER PRODUCT INTENDED FOR USE
AT HIGH TEMPERATURES

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This invention relates to pre-coated metal sheet
suitable for use in the manufacture of bakeware and
other products intended for use at high temperatures,
being metal sheet which is provided with a coated
10 finish before the sheet is used in the manufacture of
such products.

Such pre-coated metal sheet is used in the
production of bakeware and other products by various
15 manufacturing methods including: pressing; stamping;
roll-forming and deep drawing. It avoids the necessity
of applying a coated finish to the product after the
manufacturing process which for some products can
present difficulties both in the application of a
20 coated finish and in the obtaining of an acceptable
finish.

Hitherto the pre-coated metal sheet which has been
produced for use in the manufacture of bakeware and
25 other products intended for use at high temperatures
has had a plain finish; it has not had patterns,
printing or other surface decoration on it. The
present invention provides pre-coated metal sheet which
has a surface decoration.

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According to the present invention there is
provided a process of producing pre-coated metal sheet
having a surface decoration and suitable for use in the
manufacture of bakeware and other products intended for
35 use at high temperatures, which process comprises the
steps of cleaning a raw metal sheet, applying to at

least one surface of the sheet by roller means a coating of a material capable of withstanding temperatures of 250°C or higher, baking the coated sheet at a temperature of 350°C to 450°C to dry the coating, and applying as a decoration on the dried coating a printing medium compatible with the coating, followed by curing to dry the printing medium and subsequent cooling.

The coated sheet may be produced in flat form but preferably it is coiled. By applying the coating by the reverse roll method, that is by having the roller means and sheet moving in opposite directions where they make contact for the application of the coating to the sheet, the deposition of the coating on the sheet can be closely controlled, which assists in obtaining a good quality coated finish on the sheet. Applying the coating without opposition of movement between the roller means and sheet is possible but the deposition of the coating on the sheet may be more difficult to control.

The printing medium may be applied by roller means or possibly by silk screen printing means.

The coating may be applied to both sides of the sheet. When the coating is applied to both sides the printing medium may also be applied to both sides or just to one of them, depending upon the manufacture in which the coated sheet is intended to be used.

Some examples of suitable materials for the coating are heat resistant lacquers, a polyethylene sulphonate (PES) for flame and very high temperature resistance, and non-stick materials such as Fluon, Nuon, Teflon and Xylan (registered trade marks).

Different coating materials may be used on the two sides of the sheet. For example, for use in the manufacture of some bakeware products the side of the sheet which will be at the exterior of a product may be coated with PES and the opposite side may be coated with a non-stick material.

The coating may be opaque, translucent or metallic.

In general the examples of coatings mentioned will withstand usual pressing and forming operations to which the coated sheet may be subjected in the manufacture of a product. PES and the non-stick materials will withstand more difficult forming and deep drawing operations. For extreme conditions of manufacture involving rough handling and severe forming, or where the surface finish of a product made from the coated sheet is particularly critical a protective strippable film, for example of polyethylene, may be applied to the coated sheet after the printing medium has been applied. That film will be removed after the product has been formed.

The printing medium which is applied to the coating must be compatible with the coating material. Generally it will contain the same base constituent as the coating material although concentrations of that constituent and of solvent and pigment will vary to suit the application of the printing medium by the roller means.

Typically the coating will be applied to the sheet to a thickness of 0.25 to 1.00 mm when the sheet is of steel or up to 1.5 mm if the sheet is of aluminium, and

the printing medium will be applied to a thickness which is about a quarter of that of the coating.

5 The sheet may be of mild or stainless steel, aluminium or its alloys, or possibly other metals, including clad metals such as Hi-Top or aluminized steel.

10 An embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which,

15 Figures 1 and 2 are schematic layouts respectively of a coil-coating line for carrying out on strip metal sheet the coating stage of the process according to the present invention, and a line for carrying out the stage of applying the printing medium to the coated strip metal sheet, and

20 Figure 3 is a plan view of a portion of the strip metal sheet after the printing medium has been applied to it.

25 For convenience the process will be described as applied to the production of pre-coated steel or aluminium sheet in strip form which is intended to be used for the manufacture of bakeware products capable of withstanding high temperatures of 250°C and higher.

30 Referring to Figure 1, raw steel or aluminium strip 1, which initially is in a coil 2, is wound off the coil and taken through a series of tensioning rollers 3 to a degreasing station 4 at which a hot alkali degreasing agent is sprayed on to the two sides
35 of the strip to remove soluble foreign matter. From

the degreasing station 4 the strip passes between abrasive brushing rollers 5 which remove insoluble contaminants from the strip. It then passes on to a washing station 6 at which it is rinsed with hot water to wash away the alkali and contaminants loosened by the brushing rollers 5. Next the cleansed strip has a chemical bonding agent (for example a chromate) applied to it by rollers 8 before entering an oven 7 where any moisture remaining on the strip is driven off. From the oven the strip is directed over various rollers 9 to a coating station 10 at which coatings are applied to both surfaces of the strip by respective sets of applicating rollers 11 and 12 which operate on the reverse roll method. To one surface is applied a coating of PES (such as that supplied by Crown Decorative Products Limited under the name Crown Nuon 500 which is solvent based and available in a variety of colours), and to the other a coating of a non-stick material such as one of those previously mentioned herein is applied. After the coating station 10 the strip is taken through a baking oven 13 at a peak oven temperature of 400-430°C for 60 seconds to dry off solvents of the coatings and bake the coatings. From the baking oven the coated strip passes through a cooling station 14 where it is cooled by water jets before being taken through a series of rollers 15 and being wound back into a coil 16.

Each of the coatings on the strips is plain and extends over the full surface of the side of the strip to which it is applied.

For the next stage of the method reference is to be had to Figure 2 of the accompanying drawings. The coated strip is subsequently wound off the coil 16, taken through tensioning rollers 17 and on by way of

other guide rollers 18 to a printing station 19. At the printing station 19 a printing medium is applied, for example as a decorative pattern, to the PES coating of the strip by means of a suitably embossed roller 20 which operates on the forward roll method, that is it is rotating in the direction of movement of the strip, the speed of travel of the strip and the rotational speed of the roller being synchronised to ensure good definition in the pattern printed on the strip. A suitable printing medium is that supplied by Crown Decorative Products Limited under the name Crown Coilprint 500. From the printing station 19 the coated and printed strip is taken through a curing oven 21 where the printing medium is cured. Typically when Crown Coilprint 500 is applied as the printing medium the strip is heated in the curing oven at a peak metal temperature of 400-430°C for 60 seconds. Upon leaving the curing oven 21 the coated and printed strip is cooled at a cooling station 22 by water jets and passed round a series of rollers 23 before finally being wound into a coil 24 again.

A portion of the coated strip with the pattern printed on it is shown in Figure 3. Other patterns, or other decoration, may be printed on the coated strip, as desired.

The resultant coated and printed strip is ready for use in the manufacture of bakeware products by known pressing or other forming operations.

Instead of being coiled between the coating and printing stages, the coated strip, after having been passed through the baking oven and cooled, could pass directly on to the printing station for the application of the printing medium, and from there through the

curing oven and further cooling station before being wound into a coil.

5 If a protective strippable film is required to be added to the coated and printed strip before the strip is subjected to the product manufacturing operations, the film may be applied to the strip by rollers after the curing oven and the final cooling station.

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CLAIMS

1. A process of producing pre-coated metal sheet having a surface decoration and suitable for use in the manufacture of bakeware and other products intended for use at high temperatures, characterised in that it comprises the steps of cleaning a raw metal sheet (1), applying to at least one surface of the sheet by roller means (11, 12) a coating of a material capable of withstanding temperatures of 250°C or higher, baking the coated sheet at a temperature of 350°-450°C to dry the coating, and applying as a decoration on the dried coating a printing medium compatible with the coating, followed by curing to dry the printing medium and subsequent cooling.

2. A process according to claim 1 characterised in that the coating material is a polyethylene sulphonate.

3. A process according to claim 1 or claim 2 characterised in that the raw metal sheet (1) is wound from a coil (2) prior to the cleaning step, and the coated sheet with the printing medium applied to it is wound into a coil (24) after the curing and subsequent cooling steps.

4. A process according to any preceding claim characterised in that the coated sheet is cooled and wound into a coil (16) after the baking step, and is subsequently wound off that coil for the application of the printing medium.

5. A process according to any preceding claim characterised in that in the step of applying the coating to the sheet (1) the sheet is moved in a

direction opposite to that in which the roller means (11, 12) is turning as it applies the coating to the sheet.

5 6. A process according to any preceding claim characterised in that the printing medium is applied to the coating by roller means (20), the sheet being moved during the step of applying the printing medium in the direction of rotation of the roller means.

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7 A process according to any preceding claim characterised in that it includes the further step of applying a protective strippable film to the coated sheet after the printing medium has been applied to the coating and cured.

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8. A process according to any preceding claim characterised in that the metal sheet (1) is steel, the coating is applied to a thickness of 0.25 to 1.00 mm, and the printing medium is applied to a thickness approximately 25% that of the coating.

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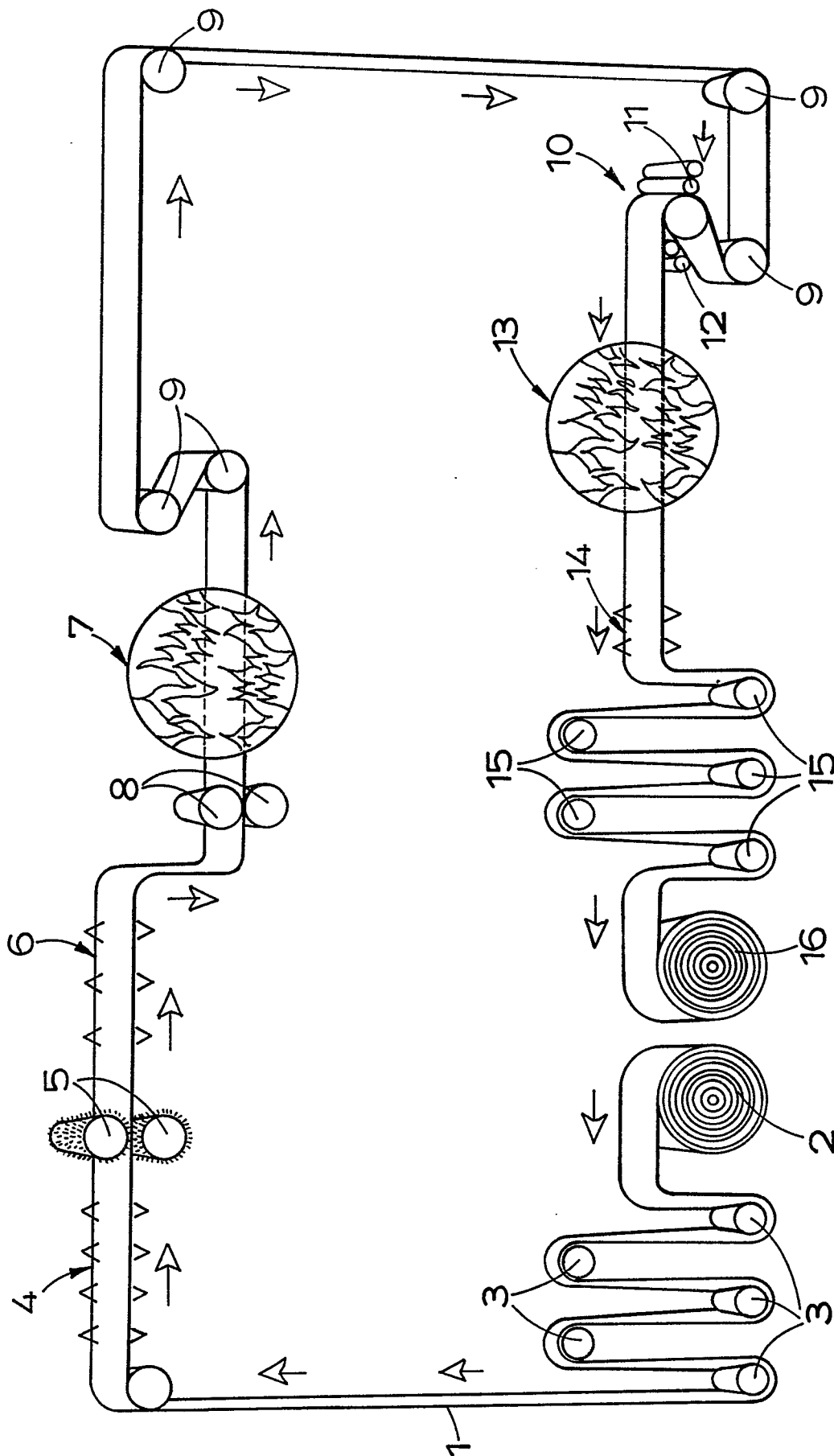
9. A process according to any of claims 1 to 7 characterised in that the metal sheet (1) is aluminium, the coating is applied to a thickness of 0.25 to 1.5 mm, and the printing medium is applied to a thickness approximately 25% that of the coating.

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10. A process according to claim 2 or any of claims 3 to 9 as dependent from claim 2 characterised in that the material sheet (1) has the coating of a polyethylene sulphonate applied to one surface, has a coating of a non-stick material applied to the other surface, and has the printing medium applied to the coating of polyethylene sulphonate.

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**FIG. 1.**

