

"CONTINUOUS PRODUCTION OF COPPER-CLAD LAMINATE"

1 This invention relates to a process for
continuously producing a copper-clad laminate for printed
wiring boards.

 As copper-clad laminates for printed wiring
5 boards, there have been used those obtained by combining
various fibrous substrates such as woven fabrics, non-
woven fabrics, paper-like materials made from glass
fibers, organic fibers, wood pulp, and the like with
various thermosetting resins such as phenolic reins,
10 epoxy resins, polyester resins, and the like, for example,
paper-phenolic resin, glass mat-polyester, glass cloth-
epoxy resin, etc. These laminates have generally been
produced by impregnating or coating a substrate with a
varnish which is liquid at room temperature and has been
15 diluted with a solvent, removing the solvent in a drier
and the like and simulaneously proceeding the reaction
to a state suitable for press molding in later stage to
produce a prepreg wherein the reaction is proceeded to
so-called B stage, cutting the prepreg in desired
20 dimensions, piling copper foils on the surfaces of the
resulting prepreg, and pressure molding with heating
in multi-stage parallel heating plates while holding
the prepreg between flat panels. According to such a
conventional process, there can be obtained a voidless
25 substrate having good impregnating properties by treating

1 the substrate with a varnish having a low viscosity
for impregnation prior to the press molding and there
can also be obtained a laminate having smooth surfaces
without warpage satisfying important properties as wiring
5 boards by holding the prepreg between the flat panels
during the molding in parallel heating plates. But such
a process has disadvantages in that a large amount of
solvent is necessary for impregnating the substrate,
much energy is necessary for drying, recovering of the
10 solvent is difficult and most of the solvent is lost.
Flying out of the solvent also causes a problem of air
pollution. Further, since individual steps such as
impregnation, piling of prepreg, press molding, cutting,
etc., are conducted separately without employing a
15 continuous process, much man-power and man-hour are
required, which results in increasing production cost.

In order to solve such problems, there have
been proposed various processes such as a process for
producing a laminate by using a solventless resin, a
20 process for continuously producing a laminate for printed
wiring boards using a solventless resin, etc. For
example, there are proposed a so-called SMC process
wherein glass chopped strands are impregnated with an
unsaturated polyester resin, the resulting resin impreg-
25 nated glass chopped strands (a sheet-like molding
material (SMC)) previously increasing viscosity
chemically and having a copper foil on the surface
thereof are supplied in a mold, followed by pressing

1 with heating; a pultrusion process for producing a
lamine comprising passing a substrate in an unsaturated
polyester resin bath for impregnation with the resin,
supplying the substrate together with a copper foil into
5 a heating die and conducting continuous molding (Insu-
lation Circuit, November, page 28, 1977); a process for
producing a laminate comprising leading a plurality of
substrates into a solventless resin bath for impregnation
with a desired amount of the resin and molding by
10 calendering or heating roller press (British Patent
No. 1525872); a process for producing a laminate com-
prising forming a mixture of solventless resin and a
filler into a sheet-like material by an extruder,
conducting the reaction to the B stage, laminating a
15 prepreg obtained by a conventional process on the sheet-
like core material and a copper foil on the prepreg, and
molding with, e.g., a belting press (Japanese Patent
Appln Kokai (Laid-Open) No. 135859/79); etc. But,
according to the SMC process, local orientation of the
20 glass fiber readily takes place with the flow of
materials during the press molding, which results in
making the warpage greater. According to the pultrusion
process and the roller press process, since a sufficient
pressure hardly be applied during the molding, removal
25 of voids is difficult, and it is also difficult to
produce a flat laminate having no warpage since the
substrate material is strongly pulled during the holding
of flowability of the resin so as to disturb the

1 arrangement of fiber material. According to the extrusion
process, good properties can hardly be obtained without
providing the prepreg prepared separately. In these
processes, solventless resins are used, but since these
5 resins are previously impregnated into substrates
uniformly, followed by molding by using molds, rollers,
heating plates, etc., the above-mentioned problems are
still retained.

On the other hand, according to a conventional
10 FRP molding process (FRP = fiber reinforced plastics),
a product is produced by placing a fibrous substrate
without impregnation with a resin in a mold, supplying
a liquid solventless resin to the mold and pressing
with heating so as to conduct the impregnation and mold-
15 ing at the same time in the mold. Such a process is
employed in, for example, matched die molding, cold
pressing, etc. According to this process, the impreg-
nation of substrate with a resin previously is omitted
to give a simplified process. But even if applying such
20 a FRP molding process to the production of copper-clad
laminates for printed wiring boards required to have
high properties, there can hardly be obtained laminates
having no voids and little warpage. Further, according
to the matched die molding process, there are other
25 problems in that the continuous production is impossible
since individual products are molded batch wise one
after one by cutting and removing superfluous portions
of the substrate by share edge portion of the mold at

the end thereof, in the case of covering the surface with a copper foil molten resin liberated from the share edge portion flows into the portion between the copper foil and the mold to lose properties suitable as copper-clad laminate for printed wiring boards, and the like.

It is an object of this invention to provide a process for continuously producing a copper-clad laminate for printed wiring boards having almost no warpage using a solventless thermosetting resin with good impregnation of the resin and an apparatus for conducting the process.

This invention provides a process for continuously producing a copper-clad laminate for printed wiring boards which comprises

running a continuous, fibrous substrate,
supplying partially and intermittently a solventless thermosetting resin mixture to the running substrate,

laminating a copper foil at least one surface of the running substrate,

pressure molding with heating the copper foil laminated substrate in a mold comprising a pair of opposed plates at least one of the plates having a tapered lip surrounding a flat central portion, the lip projecting from the plate and tapering in the direction of the opposed plate, such that the plates pinch the copper foil and the substrate without cutting the copper foil,

taking off the molded laminate from the mold while opening the mold, and

cutting the molded laminate.

The invention also provides an apparatus for continuous production of copper-clad laminates for printed wiring boards comprising

5 one or more means for supplying a continuous, running fibrous substrate,

a belt conveyor for carrying at least one running continuous substrate,

10 a resin supplying means connected to at least one resin supplying tank for supplying the resin partially (as hereinafter defined) and intermittently on the running substrate,

one or more copper foil supplying means for laminating continuous copper foil on the running substrate,

15 a press provided with a mold for molding a copper-clad laminate without cutting the copper foil and substrate, said mold comprising a pair of opposed plates at least one of the plates having a tapered lip surrounding a flat central portion, the lip projecting from the plates and tapering in the direction of the opposed plates,

20 a take-off device for taking off the molded laminate from the mold,

and a cutter for giving separated laminates by cutting superfluous copper foil and substrate.

cutting the molded laminate.

In the attached drawings, Fig. 1 is a partly cross-sectional perspective view of a mold used in this invention, and Fig. 2 is a schematic flow sheet explaining the process of this invention.

5 One of the important features of this invention is to use the mold having a special structure as shown in Fig. 1.

 According to the above-mentioned FRP process such as matched die process, cold pressing process, etc.,
10 there are used molds comprising a positive mold and a negative mold which are matched at the periphery portions thereof with a little clearance. Superfluous substrate pressed out of the mold is cut at the share edge portion and by the flow resistance of the resin at the
15 clearance portion the inner pressure is applied to the product in the mold. When such a mold having a matched structure is used for producing copper-clad laminates for printed wiring boards, copper foils and substrates are cut at the share edge portion, so that the molten
20 resin flowed from the cut portion is led to the surface of the copper foil to form a thin cured film of resin on the copper foil, which results in losing functions as printed wiring boards and making a continuous molding impossible because of impossibility of transporting a
25 molded laminate to the next procedure. In order to maintain a sufficient inner pressure, the clearance at the share edge portion should be as small as about

1 0.1 to 0.2 mm, but in order to improve the impregnation
of the resin and to remove voids so as to satisfy the
enhanced requirements for printed wiring boards, the
clearance should become smaller; this is practically
5 very difficult.

In order to solve such a problem, the present
inventors have devised a special mold which can hold a
sufficient inner pressure to remove voids without
causing cutting of copper foil and substrate and accomp-
10 lished a continuous process for producing laminates of
this invention. That is, the mold comprising a positive
and negative one having a matched structure is not used,
but there is used the mold comprising a pair of flat
plates at least one of which has projecting portions
15 tapered to the center of the flat plate at the periphery
thereof so as not to cut copper foil and substrate at the
projecting portion and so as to pinch the copper foil and
the substrate strongly for subjecting to pressure molding
with heating. This is one of the features of this inven-
20 tion. By the use of the pair of flat plates at least one
of which has tapered projecting portions, the copper foil
and the substrate are clamped strongly by the projecting
portion during pressure molding with heating, but by
the clamped portion oozing out of molten resin is
25 prevented and the inner pressure can be maintained.
The inner pressure to be maintained depends on the
degree of clamping of the substrate and in order to
hold a substrate, enough to maintain a sufficient inner

1 pressure so as to remove voids without cutting the copper foil and the substrate, the use of a mold having projecting portions tapered to the center thereof is essential.

The form of projecting portion is explained referring to Fig. 1. The form of projecting portion can be determined by the height (h), width (b) and tapered angle (θ). The degree of clamping of the substrate depends on the press pressure applied to the projecting portion and is determined by a ratio of projecting portion area to the plate area, and the width (b) can be optionally selected depending on the size of the plate. The height (h) of the projecting portion can be determined by reducing the thickness of the substrate at the clamped portion by the projecting portion from the desired thickness of the substrate. The tapered angle (θ) is preferably 55° or more irrespective of the height and the width. If the tapered angle (θ) is zero, i.e., the edge being in right angle, the copper foil and successively the substrate may be cut before sufficient clamping is attained. When the tapered angle is 55° or more, sufficient clamping so as to obtain a sufficient inner pressure becomes possible without cutting. But too large tapered angle makes the yield of laminates lower since substrate on the tapered portions is removed from the final products. The tapering is not limited to a linear slope as shown in Fig. 1 and a slope with a slight curvature or a step-like slope may be used. In such a case, an average angle corresponding to

1 the θ is preferably 55° or more. In Fig. 1, a lower
mold having the projecting portion is shown, but the
projecting portion may be formed on the upper mold or
both of the lower and upper molds so as to face each
5 other. When the projecting portions are formed on both
of the lower and upper molds so as to face each other,
the cost for making such molds may be increased but the
yield of final products can be increased by shortening
the portion corresponding to the tapered portion of the
10 molds, said portion being taken off from the final
products. The portion of the width (b) may be flat or
slightly curved plane.

Another important feature of this invention
is that the solventless thermosetting resin is supplied
15 to the running fibrous substrate partially and intermit-
tently. The term "partially" means that the resin is
supplied to the running fibrous substrate not on the
whole substrate thereof but only "partially" on the
portion corresponding to the central portion when that
20 portion is placed in the special mold in an amount
sufficient for impregnating the substrate in the mold
with the resin. The partially supplied resin on the
central portion is molten in the mold during the
pressure molding with heating with a low viscosity and
25 flows towards the periphery of the mold by pressing so
as to permeate into the whole body, while at the same
time by the preventing effect at the projecting portion
from oozing out of the resin the inner pressure is

1 finally increased so as to attain the sufficient impreg-
nation of the substrate with the resin. When the resin
is supplied to the substrate wholly, not partially, the
flow of the resin is reduced and removal of bubbles from
5 the substrate becomes insufficient. Further, in the
continuous process, the resin placed in the position
near the mold and to be molded in the next time is cured
by the heat from the mold during the pressure molding
with heating and since said cured portion cannot be used
10 for molding, the yield is thus undesirably lowered.

Further, the resin should be supplied to the
running fibrous substrate "intermittently". The term
"intermittently" means that the resin should be supplied
to the running substrate with a time interval so as to
15 make the continuous operation of pressure molding using
the special mold possible.

By supplying the resin to the running substrate
partially and intermittently, the continuous process
according to this invention becomes possible. More
20 concretely, it is preferable to supply the resin to a
central portion of the running substrate so that said
portion takes a place at a central portion in the mold
when placed in the mold, more preferably about 30 mm
inside of the projecting portion of the mold.

25 As the fibrous substrate, there can be used
fiber-reinforced substrates, e.g., woven fabrics such
as cloth, nonwoven fabrics such as swirl mats, paper-
like materials, these materials mentioned above being

1 made from glass fibers, woven fabrics, nonwoven fabrics
and paper-like materials made from organic fibers, wood
pulp, etc.

As the solventless thermosetting resin, there
5 can be used thermosetting resins containing substantially
no solvent such as epoxy resins, unsaturated polyester
resins, phenolic resins, and the like.

Among the solventless thermosetting resins,
those except for resins such as unsaturated polyesters
10 containing crosslinkable monomer (these being liquid) are
sometimes solid or semi-solid with high viscosities at
normal temperatures. In such a case, the resin can be
supplied in molten state with low viscosity with heating
previously to the running substrate together with one
15 or more curing agents, fillers and other additives in
admixture with the resin.

It is preferable in this invention to use a
thermosetting resin mixture containing one or more
curing agents, fillers and the like additives which
20 mixture can give a melt viscosity of 0.1 to 50 poises at
the mold molding temperature. If the viscosity is lower
than 0.1 poise, the inner pressure does not raise suf-
ficiently, which results in insufficient impregnation
causing many voids in the substrate. This is because
25 even if the special mold having the tapered projecting
portion is used and clamped with the projecting portion,
it is impossible to make the clearance between the sub-
strate zero by the projecting portion. Thus, the resin

1 may be oozed out from such clearances to give undesirable effects. Bulky substrates such as nonwoven fabrics and paper-like materials can easily raise the inner pressure compared with woven fabrics such as cloth, so that the
5 resin with a lower viscosity can suitably be used for such bulky fibrous substrates. On the other hand, if the viscosity is higher than 50 poises, the inner pressure may easily be raised but impregnation into the substrate may be lowered due to higher viscosity. Further,
10 during the pressure molding with heating, fibrous materials flow together with the flow of the molten resin, which results in bringing about inclination and local orientation of the fibrous materials and greater warpage of the produced laminates. Considering the flow of the fibrous
15 materials, the use of woven fabrics is preferable and the use of nonwoven fabrics and paper-like materials with long fibers is advantageous due to stronger resistance to the flow than those with short fibers.

These substrates are used in continuous form
20 alone or as a mixture of two or more of them. It is also possible and preferable to use a woven fabric such as glass cloth as a surface material and a nonwoven fabric such as a swirl mat or paper-like material as an inner core layer. By the reasons mentioned above,
25 the use of the nonwoven fabric or paper-like material as the core layer is preferable, since such a material is good in impregnation properties due to giving a higher inner pressure under the same clamping pressure but such

1 a material is disadvantageous due to readily flowable.
On the other hand, the use of the woven fabric as the
surface layer is preferable, since the woven fabric
is more resistant to the flow of the molten resin and
5 disturbance of the substrate at the surface portion may
be prevented. Thus the combined use of the woven fabric
and the nonwoven fabric or paper-like material with the
above-mentioned structure makes it possible to produce
a copper-clad laminate with good impregnation without
10 warpage, the woven fabric surface layer giving a
larger strength such as flexural strength to the result-
ing laminate.

Further, the solventless thermosetting resin
mixture may be supplied to the substrate from the surface
15 thereof, but it is preferable to supply the resin mixture
to the substrate at the central portion to the direction
of the thickness of the substrate.

The process for continuously producing a copper-
clad laminate for printed wiring boards is explained in
20 detail referring to Fig. 2. The solventless thermosetting
resin 11 is supplied from a resin supplying means 12
after mixing with one or more curing agents and, if
required fillers and the like additives in a resin
supplying tank 2 between running fibrous substrates 1 and
25 1' comprising a core layer 13 and a surface layer 14
partially and intermittently. Numeral 10 denotes a
conveyer for carrying the continuous substrate. The
substrate supplied with the resin on the central portion

1 is piled with copper foils 3 on both sides and led to a
press 4 by which the copper-clad substrate is pressure
molded with heating using a mold 5 having projecting
portions. In such a case, it is preferable to preheat
5 the copper foil prior to piling at a temperature of
 $\pm 60^{\circ}\text{C}$ of the molding temperature, more preferably
 $\pm 30^{\circ}\text{C}$ of the molding temperature in order to prevent
the wrinkle of the product. After completion of
the molding, the mold is open and the molded product
10 is taken off by a take-off device 6 before closing
of the mold 5. By this take-off operation the
portion of the substrate to be molded in the next
place is led into the mold. If necessary, the molded
substrate may be cooled by a cooling press 7 for prevent-
15 ing warpage before the handling with the take-off device.
Then the resulting substrate is cut by a cutter 8 to give
the desired copper-clad laminate for printed circuit
boards. In Fig. 2, the substrates are fed from the two
places and the resin is supplied to the center of the
20 substrates, but a plurality of substrates may be supplied
from one place and the resin may be supplied to the
plurality of substrates on the surface thereof.

In order to prevent the reaction and increasing
of the viscosity of the molten resin before leading the
25 substrate to the press 4, when the resin is solid at
room temperature and necessary to be mixed with the
catalyst and the like with heating, the substrate may be
cooled by a cooling device 9. The cooling after the

1. molding is effective for preventing the warpage but
said cooling may be omitted if required. As mentioned
above, it is important to supply the resin partially
to the substrate so as to make the resin supplied portion
5 center of the mold when placed in the mold. By such
an operation, the resin on the substrate portion to be
molded in the next place can be maintained on the sub-
strate without contacting with the heated mold for
pressure molding.

10 This invention is illustrated by way of the
following Examples, in which all parts are by weight
unless otherwise specified.

Example 1

 Using a continuous apparatus as shown in Fig. 2,
15 copper-clad laminates were produced continuously. A
solventless epoxy resin which is solid at room tempera-
ture (Araldite 8011, a trade name, mfd. by Ciba Ltd.)
was melted at 110°C in a heating vessel 1. In another
vessel 2, a mixture of an acid anhydride curing agent
20 (methylnetetrahydrophthalic anhydride, HN-2200, a trade
name, mfd. by Hitachi Chemical Co., Ltd.) and a curing
accelerator (benzyltrimethylamine) were placed in liquid
state at room temperature. From the two vessels, the
contents were passed under pressure to a static mixer
25 12 so as to mix 100 parts of the resin, 33 parts of
the curing agent and 1.0 part of the accelerator. While
sufficiently mixing, the resin mixture was supplied from

1 the static mixer to a running substrate on a belt
conveyer, said substrate comprising glass cloth with
520 mm wide (210 g/m^2) as a surface layer 14 and a swirl
mat of 520 mm wide (450 g/m^2) as a core layer 13
5 partially and intermittently. That is, the resin
mixture was placed with a distance of about 200 mm
along the running direction in a total amount of 400 g
per area of about 400 mm square. Then the same sub-
strate as mentioned above, i.e., that comprising a swirl
10 mat as a core layer and glass cloth as a surface layer
was laminated on the resin placed substrate as shown
in Fig. 2, followed by cooling with a water-cooled
press 9 with a slight pressure of contact pressure. On
the other hand, copper foils with 35 μm thick preheated
15 at 170°C were piled on the both surfaces of the substrate
and the resulting substrate was transported by a take-
off device 6 so that the resin supplied portion was
placed in the center of the mold 5 heated at 170°C .
Subsequently the mold was closed in 30 seconds and
20 pressure molded for 3 minutes under a final pressure of
 50 kg/cm^2 . The upper mold was a flat plate of 510 mm
square and the lower mold was a flat plate of 510 mm
square having at the periphery thereof a projecting
portion with a height (h) of 1.1 mm, a width (b) of
25 3 mm and a tapered angle (θ) of 70° . The melt viscosity
of the resin mixture at 170°C was 3 poises. After
completion of the molding, the mold was open and the
molded portion of the substrate was moved 510 mm by

- 1 the take-off device 6, followed by cutting by a cutter 8 to give a copper-clad laminate of 500 mm square. By repeating this operation, copper-clad laminates with little warpage and no voids were produced continuously.

- 5 Properties of the produced copper-clad laminates are shown in Table 1.

Table 1

Items	Performance
Thickness	1.6 ± 0.05 mm
Warpage	1.5 mm/500 mm or less
Voids	None
Peeling strength of copper foil	2.0 kg/cm
Soldering heat resistance (260°C)	180 sec or more
Flexural strength	35 kg/mm ²
Insulation resistance (normal state)	4 x 10 ¹⁵ ohms
Dielectric constant	4.6
Dielectric loss tangent	0.016
Surface roughness	3 μm

Note) Voids: After removing the copper foil from the product by etching, the resulting surface was observed with a microscope.

Surface roughness: Average height measured by a surface roughness meter.

Other items: Measured according to JIS C-6481.

1 Example 2

Copper-clad laminates were produced in the manner as shown in Fig. 2.

5 A liquid resin mixture was prepared by mixing at 50°C 100 parts of an epoxy modified unsaturated polyester resin (UPE-10, a trade name, mfd. by Hitachi Chemical Co., Ltd.), 50 parts of hydrated alumina (H-40, a trade name, mfd. by Showa Keikinzoku K.K.) as a filler, and 0.5 part of dicumyl peroxide as a curing agent.

10 The resin mixture was supplied to a running substrate with a distance of 100 mm along the running direction of the substrate in an amount of 470 g as a total per area of 450 mm square, said substrate comprising glass cloth as a surface layer with 520 mm
15 wide (210 g/m^2) and glass paper as a core layer with 520 mm wide (300 g/m^2). Then, the same substrate as mentioned above comprising glass cloth and glass paper was piled on the resin placed substrate as shown in Fig. 2, followed by pilling with copper foils with 35 μm
20 thick preheated at 170°C on both surfaces (by omitting the cooling procedure). Then, the substrate was pressure molded in the mold in the same manner as described in Example 1, taken off and cut to give a copper-clad laminate of 500 mm square. The melt viscosity
25 of the resin mixture at 170°C was 10 poises.

Properties of the produced copper-clad laminates are shown in Table 2.

Table 2

Items	Performance
Thickness	1.6 ± 0.05 mm
Warpage	1.5 mm/500 mm or less
Voids	None
Peeling strength of copper foil	1.7 kg/cm
Soldering heat resistance (260°C)	180 sec
Flexural strength	33 kg/mm ²
Insulation resistance (normal state)	5 x 10 ¹⁴ ohms
Dielectric constant	4.8
Dielectric loss tangent	0.017
Surface roughness	2 - 3 μm

1 Example 3

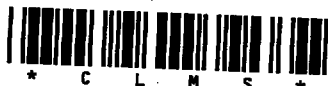
The process of Example 1 was repeated except for using as substrate only a swirl mat having a basis weight of 600 g/m² without using a surface layer of glass cloth and changing the tapered angle (θ) to 60° in place of 70°. The resulting copper-clad laminates were slightly inferior to those obtained in Example 1 in warpage, surface roughness and flexural strength, but the impregnation properties were good.

10 Properties of the produced copper-clad laminates are shown in Table 3.

Table 3

Items	Performance
Thickness	1.6 ± 0.1 mm
Warpage	3 mm/500 mm or less
Voids	None
Peeling strength of copper foil	2.0 kg/cm
Soldering heat resistance (260°C)	180 sec or more
Flexural strength	25 kg/mm ²
Insulation resistance (normal state)	3 × 10 ¹⁵ ohms
Surface roughness	4 - 5 μm

1 As explained above, since it is not necessary
to impregnate the fibrous substrate with a resin varnish
previously according to the process of this invention,
it is not necessary to use a large amount of solvent
5 without recovering, and it is not necessary to use the
energy for drying to remove the solvent, which results
in giving great effects on saving the materials and
the energy. Further, since not only an unexpensive
substrate such as a nonwoven fabric or the like but also
10 many combinations of materials can be used as substrate,
various demands for substrates can easily be satisfied.
In addition, since the procedures can be carried out
continuously, man-power can be reduced greatly to lower
the working cost remarkably.



CLAIMS

1. A process for continuously producing a copper-clad laminate for printed wiring boards which comprises
running a continuous, fibrous substrate,
supplying partially (as hereinbefore defined) and
intermittently a solventless thermosetting resin mixture to the
running substrate,
laminating a copper foil to at least one surface of the
running substrate,
pressure molding with heating the copper foil laminated
substrate in a mold comprising a pair of opposed plates at least
one of the plates having a tapered lip surrounding a flat central
portion, the lip projecting from the plate and tapering in the
direction of the opposed plate, such that the plates pinch the
copper foil and the substrate without cutting the copper foil,
taking off the molded laminate from the mold while
opening the mold, and
cutting the molded laminate.
2. A process according to claim 1, wherein the fibrous
substrate comprises a glass fibre woven fabric as a surface layer
and glass fibre non-woven fabric or paper-like material as a core
layer.
3. A process according to claim 1 or 2, wherein the
solventless thermosetting resin mixture is supplied to the
substrate at the centre portion along the thickness direction of
the fibrous substrate.



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4. A process according to any one of the preceding claims, wherein the solventless thermosetting resin mixture is supplied to the fibrous substrate partially so as to place the resin mixture 30 mm or more inside from the projecting portions of the mould when placed in the mould.
5. A process according to any one of the preceding claims, wherein the melt viscosity of the solventless thermosetting resin mixture at the mould temperature is 0.1 to 50 poises.
6. A process according to any one of the preceding claims, wherein the copper foil is preheated prior to the lamination on the surface of the substrate.
7. A process according to any one of the preceding claims, wherein a cooling step is provided prior to the pressure moulding step.
8. A process according to any one of the preceding claims, wherein the mould has a tapered projecting lip with a tapered angle of 55° or more.
9. A process according to any one of the preceding claims wherein the plates of the mould are shaped substantially as shown in Figure 1 of the accompanying drawings.



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10. A process according to claim 1 substantially as
hereinbefore described with reference to any one of the Examples.

11. A processs according to claim 1 substantially as
hereinbefore described with reference to Figure 2 of the
5 accompanying drawings.

12. An apparatus for continuous production of copper-clad
laminates for printed wiring boards comprising
one or more means for supplying a continuous, running
fibrous substrate,

10 a belt conveyor for carrying at least one running
continuous substrate,

a resin supplying means connected to at least one resin
supplying tank for supplying the resin partially (as hereinbefore
defined) and intermittently on the running substrate,

15 one or more copper foil supplying means for laminating
continuous copper foil on the running substrate,

a press provided with a mold for molding a copper-clad
laminate without cutting the copper foil and substrate, said mold
comprising a pair of opposed plates at least one of the plates
20 having a tapered lip surrounding a flat central portion, the lip
projecting from the plate and tapering in the direction of the
opposed plate,

a take-off device for taking off the molded laminate
from the mold,



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and a cutter for giving separated laminates by cutting superfluous copper foil and substrate.

13. An apparatus according to claim 12, which further comprises a cooling means between the resin supplying means and the copper foil supplying means and/or between the moulding press and the take-off device.

14. Apparatus according to claim 12 or 13 wherein the plates of the mould are shaped substantially as shown in Figure 1 of the accompanying drawings.

15. Apparatus according to claim 12 substantially as hereinbefore described with reference to any one of the Examples.

16. Apparatus according to claim 12 substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.
