



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : B29C 35/02, B32B 31/00, B30B 7/02	A1	(11) International Publication Number: WO 94/29093 (43) International Publication Date: 22 December 1994 (22.12.94)
--	----	--

(21) International Application Number: PCT/IT93/00104

(22) International Filing Date: 9 October 1993 (09.10.93)

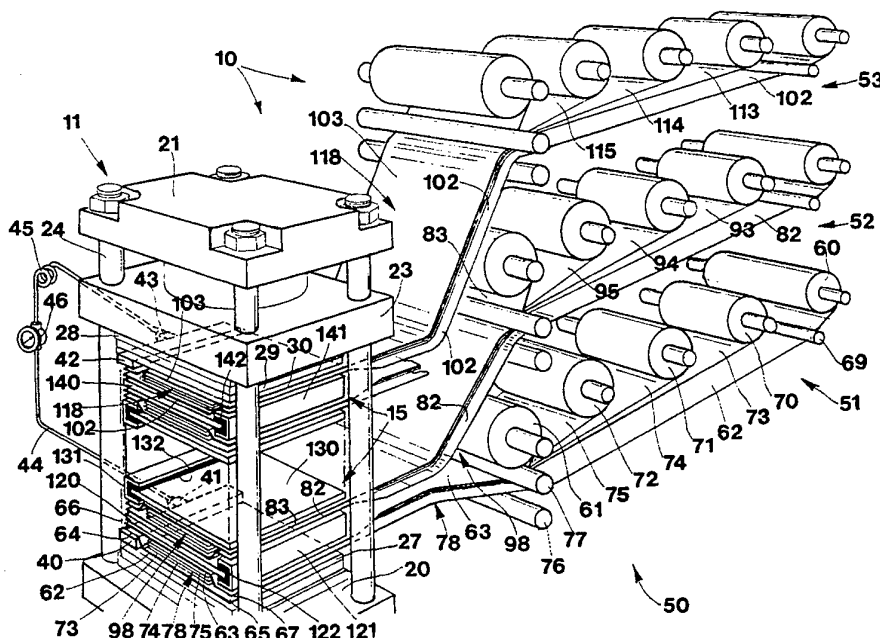
(30) Priority Data:
MI93A001275 15 June 1993 (15.06.93) IT(71) Applicant (for all designated States except US): CEDAL SRL
[IT/IT]; Via Cascina Mojetta, 38, I-20148 Milano (IT).

(72) Inventor; and

(75) Inventor/Applicant (for US only): CERASO, Bruno [IT/IT];
Via Cascina Mojetta, 38, I-20148 Milano (IT).(74) Agent: DI GIOVANNI, Italo; Brevetti Dott. Ing. Digiovanni
Schmiedt, Via Aldrovandi, 7, I-20129 Milano (IT).(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CZ,
DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG,
MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK,
UA, US, VN, European patent (AT, BE, CH, DE, DK, ES,
FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent
(BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD,
TG).

Published

With international search report.

(54) Title: PROCESS FOR MANUFACTURE BY ENDOTHERMIC HEATING OF PLASTIC LAMINATES IN A CONTINUOUS
BAND PRESSED IN CYCLES

(57) Abstract

Continuous process for manufacturing, in a cold press (11), plastic laminates with copper laminae and intermediate layers of prepreg, by multicomposition bands (78, 98, 118) with copper laminae (62, 63, 82, 83, 102, 103) and bands (73-75, 93-95, 113-115) of prepreg continuously fed in from reels (60, 61, 70-72) which, placed one upon another, pass through the press (11), endothermic heating being provided by circulating electric current in the fractions of copper laminae (62, 63, 82, 83, 102, 103) which remain pressed in the press (11) during cyclic closing stages.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

Process for manufacture by endothermic heating of plastic laminates in a continuous band pressed in cycles

The invention concerns processes for manufacturing plastic laminates with metal laminae, especially for printed circuits.

The term plastic laminates usually means sheets made by stable association, generally by pressing, of several layers of plastic materials on a base of paper, fibreglass fabrics or other types of prepreg, in any case insulating.

10 In manufacturing printed circuits a metal lamina, normally of copper, is made to adhere to one or both sides when pressing takes place.

In this way a pile of packages, all practically the same, is formed each package comprising a number of impregnated sheets of plastic materials and copper laminae placed on

15 the two sides of the package respectively,

A metal sheet, of stainless steel or some other type, is placed between each package and the pile put in a multi-plate press which supplies heat and pressure at the same time.

- 2 -

Presses of this kind are generally complex and of no great efficiency because of the high temperatures and pressure levels needed, of the number of plates they contain, of having to produce heat and pressure in well-defined and accurate sequences, of the need to create - by conduction - uniform temperatures throughout the packages in the pile of which only those packages at top and bottom can be in direct contact with the heating plates.

Propagation of heat by the press plates to the piled-up packages and of refrigeration units is severely hindered by their having to pass through prepreg components, which are well-known to be very poor conductors, in the packages at the top and bottom of each pile.

The number of plates in the press not only complicates its structure but also delays loading and unloading of packages as well as creating problems for short runs on account of having to amortize their higher costs.

The machines and equipment for the manufacture of continuous plastic laminates are well known.

A multi-composition band is prepared including bands of copper and others of prepreg. Machinery comprising a hot press maintain adequate pressure on the multi-composition band and move it forward at the same time at a suitable speed for applying to the material a heat-pressure cycle for a sufficiently long time to transform it into a rigid plastic laminate.

Even with this process machine output is adversely affected by the presence of heating plates and by the difficulty of applying pressure simultaneously to several of such bands.

The process does not therefore usually give the results

- 3 -

expected from a continuous system particularly as it is a complex matter to apply heat and pressure to moving parts.

Subject of the invention is a process for manufacturing plastic laminates with metal laminae, especially copper, and intermediate layers of prepreg, in a cold press with endothermic heating applied by electric current.

The metal laminae and prepreg elements are made from a multi-composition band formed of two metal strips, especially copper, and of intermediate bands of prepreg.

One or more of said multi-composition bands pass, superimposed, through the press cyclicly and continuously unwinding from reels on a feeding device and are pressed down in cycles during closure of the press.

Having completed the pressing cycle, while the press is opening the multicomposition bands, now transformed by the press into plastic laminates, move forward for a length substantially that of the press itself, emerging from it and being replaced by more multicomposition bands, and so on.

In this way continuous lengths of rigid plastic laminates are obtained and can be cut to any particular one desired. The bands of prepreg are narrower than the laminae and they occupy an axial position in relation so said laminae. This means that the laminae project from the two sides of the bands of prepreg.

Among the multicomposition bands lying above in the press, intermediate sheets of insulating material are inserted and to each of these, one after another, on a lateral edge parallel to the multicomposition bands and on alternate sides, there is a piece of highly conductive metal shaped in the form of a squared "C".

- 4 -

This piece of metal projects on either side of the insulating sheets at the edges of the laminae.

Therefore, at closure of the press, the C-shaped metal applied to one edge of the first intermediate insulating sheet simultaneously causes, by its projection onto said sheet, a bend to be made at one edge of the second lamina of a first multicomposition band, laid under said sheet, against the first edge of the first lamina of said multicomposition band, and a bend to be made at the first edge of the first of the laminae of a second multicomposition band, placed above said sheet, against the first edge of the second lamina of said second multicomposition band. At the same time the C-shaped metal, applied to the edge of the second intermediate sheet situated on the opposite side in relation to the multicomposition bands, at the edge of the first sheet to which this metal is applied, causes a bend to be made at the second edge of the second lamina of said second multicomposition band against the second edge of the first lamina of said multicomposition band.

Similar phenomena take place on all the multicomposition bands that pass through the press.

It follows from the foregoing that closure of the press determines continuous electrical connection among all the laminae squeezed inside the press.

This electrical connection is 'in parallel' among the pairs of laminae of each multicomposition band, and 'in series' serpentine-wise between said pairs.

It is preferable for contact strips to be applied to the top and bottom plates of the press that exercise pressure in cycles on the multicomposition bands passing through,

- 5 -

said contact strips being placed at the lateral edges of said multicomposition bands and projecting, in relation to the surface of said plates, to substantially the same extent as the C-shaped pieces of metal project
5 from the edges of the intermediate sheets.

Said contact strips are connected respectively to the two poles of the source of electricity.

Therefore, by placing the intermediate sheets adjacent to the press plates so that the lateral edge, to which
10 the C-shaped metal is applied, lies on the side opposite to that on which said contact strips are placed, when the press closes contact is made between the lateral edge of the first lamina of a multicomposition band facing towards the plates and the bend of said edge against
15 the edge of the second lamina.

It follows that when the press closes there is also automatic closure of the electric circuit between the source of electricity and the pair of laminae which, together with the intermediate bands of prepreg, form the plastic
20 laminates while, at the same time, an automatic start is made with endothermic heating and the pressing cycle.

Preferably the C-shaped metal pieces are applied to the edges of the intermediate insulating sheets with intermission between them of pieces of suitably shaped rubber or
25 equivalent means.

Height of the C-shaped metal is greater than that of the spaces between contiguous intermediate sheets after deduction of the thickness of the edges of the laminae forming part of a multicomposition band between said sheets.

30 Therefore when the press closes the elasticity of said rubber pieces ensures optimum matching between the edges

- 6 -

of each pair of laminae of each multicomposition band, and electrical continuity among all the pairs of superimposed multicomposition bands.

The advantages of this invention are evident.

- 5 Output is extremely high as this is related to the heating cycle which is very short compared with systems at present in use.

This is because the type of heating used makes it possible to heat the multicomposition bands only, to become
10 plastic laminates, and not the whole press.

In the cold press used it is obvious that numerous multicomposition bands can be put in, one above another, each of which will form a continuous strip of plastic laminate. Absorption of initial plant costs are low; consumption
15 of energy extremely low.

The manufacturing cycle is completely automatic with all the favourable effects that this implies.

Characteristics and purposes of the invention will be made still clearer by the following example of its execution
20 illustrated by diagrammatically drawn figures.

Fig. 1 Press and accessory equipment for manufacturing plastic laminates by the invented process, with the press when closed, perspective view.

Fig. 2 The press in Fig. 1 when open, front view.

- 25 Fig. 3 The press in Fig. 2, when closed, front view.

The manufacturing system 10 comprises a cold press 11 and unit 50 for feeding in copper laminae and bands of prepreg. The press 11 comprises the fixed plates at the base 20 and at the top 21 connected by columns 24 and the upper
30 mobile plate 23 moving up and down said columns.

Metal slabs 25 and 26, and the sheet of insulating material 27, are placed on the bottom plate 20.

- 7 -

Metal slabs 28 and 29 and the sheet of insulating material 30 are applied to the mobile plate 23.

An electric contact strip 40 with terminal 41 is fixed to one side of the lower insulating sheet 27.

5 An electric contact strip 42 with terminal 43 is fixed to one side of the upper insulating sheet 30.

Said terminals 41 and 43 are connected, by cables 44 and 45, to a source 46 of electric current.

The feed unit 50 comprises a series of feeders like 51,
10 52, 53.

The feeder 51 has two reels 60, 61 respectively for the copper lamina 62 guided by the roller 69 and for the copper lamina 63, and reels 70, 71, 72 of bands 73, 74, 75 of prepreg interposed between the previous two reels.

15 Said copper laminae and bands of prepreg form a multicomposition band 78 guided by a pair of rollers 76, 77 towards the press 11.

The feeders 52, 53 are composed substantially like feeder 51 and form the multicomposition bands 98 and 118.

20 The first one comprises the copper laminae 82, 83 and bands of prepreg 93, 94, 95 while the second comprises the copper laminae 102, 103 and prepreg bands 113, 114, 115.

The bands of prepreg are narrower than the copper laminae. At the beginning of a pressing cycle the end of the multi-
25 composition band 78 is laid on sheet 27 of the press 11.

Over said band the intermediate sheet 120 of insulating material is laid.

A C-shaped piece of copper is applied to the right-hand side of said sheet and in between them a shaped piece of
30 rubber 122.

On said sheet 120 the end of the second multicomposition band 98 is laid and over that the second insulating sheet 130.

- 8 -

Similarly to the above, on the left-hand side of said sheet a C-shaped piece of copper is applied with a piece of shaped rubber 132 in between them.

On the sheet 130 the end of a third multicomposition
5 band is laid and so on till the multicomposition band 118 has been laid to complete the pile 15 of packages of laminates formed by said multicomposition bands.

As the copper laminae are wider than the prepreg bands, the end 64 of the copper lamina 62 and the end 67 of
10 the copper lamina 63 bend as shown in Figs. 1 and 3 due to the effect of reliefs created by the contact strip 40 and by the C-shaped laterally applied piece of copper 121, coming in contact with the other opposing ends 66 and 65 of said bands.

15 Similarly the end 85 of the copper lamina 83 and the end 86 of the copper lamina 82 bend due to the effect of reliefs created by the C-shaped piece of copper 121 already indicated and of the similar piece of copper 131 on the sheet 130.

20 The same applies to the other components of the pile 15. In view of the above the closure of the press 11 creates reciprocal contact between the contact strip 40 and the ends 64,66 of the copper laminae 62,63, between the other ends 65, 67 of said copper laminae and one side of the
25 lateral C-shaped metal 121, between the other side of said piece of C-shaped metal and the ends 86, 87 of the copper laminae 82, 83, between the second ends 84,85 of said laminae and the C-shaped piece of copper 131 on a second intermediate sheet 130, and so on to completion of the pile
30 15 by the intermediate sheet 140 with its lateral C-shaped piece of copper 141 and shaped piece of rubber 142.

- 9 -

As explained, each package has two laminae, one above and one below, formed by the ends of the two copper laminae in contact with each other at the sides, and is connected to another, alternately, serpentine-wise, in series, from one side of the pile to the opposite one by means of the lateral C-shaped pieces of copper associated to the intermediate sheets.

When the press closes at the same time the electric circuit is closed between the generator of electricity and all the packages of laminates formed by the multicomposition bands.

When electric current passes through them the laminae act as electric resistances and heat the packages as indicated by the arrows.

Pressing is therefore done accompanied by endothermic heating.

In the figures the various parts which, when the press closes, come in contact and partially bend, are drawn for clarity better separated than in reality so that they may be more easily distinguished.

- 10 -

Claims

1. Process for the manufacture of plastic laminates with metal laminae, especially of copper, and intermediate bands of prepreg in a cold press (11) with endo-
5 thermic heating by electricity,
characterized in that the metal laminae, especially of copper, and the bands of prepreg come from a multicomposition band (78,98,118) formed by two metal laminae (62,63) (82,83) (102,103), especially of copper, and
10 intermediate bands of prepreg (73-75) (93-95) (113-115) and in that one or more of said multicomposition bands (78,98,118) pass, one upon another, through the press (11) unwinding in cycles from the reels (60,61,70-72) of a feeder (51-53) and are pressed when the press (11) clo-
15 ses, endothermic heating being supplied by circulation of electric current in the fractions of metal laminae (62,63) (82,83) (102,103) that remain closed when the press (11) is closed and in that, the pressing cycle having been completed, while the press (11) is opening, the multicom-
20 position bands (78,98,118), transformed inside the press (11) into plastic laminates, are made to move forward for a length substantially that of the press (11), moving outside it and being replaced by other fractions of multicomposition bands (62,63) (82,83) (102,103) and so on
25 thus forming a continuous rigid strip of plastic laminates;
2. Process as in claim 1,
characterized in that width of the prepreg bands (73-75) (93-95) (113-115) is less than that of the metal laminae (62,63) (82,83) (102,103) and are so placed axially as to
30 project on each side of the prepreg bands, and in that the multicomposition bands (78,98,118) superimposed inside the

- 11 -

press (11) have between them intermediate sheets (120, 130, 140) of insulating material and to which, one after another at a lateral edge parallel to the multicomposition bands (78, 98, 118), and alternately, on the opposite edge, is applied a highly conductive C-shaped piece of metal (121, 131, 141) projecting from both surfaces of the intermediate sheet (120, 130, 140) at a position corresponding to that of the edges of the laminae (62, 63) (82, 83) (102, 103) so that due to the effect of closure of the press (11) the piece of C-shaped metal (121) applied to the edge of the first intermediate sheet (120) causes by its projection onto said sheet (120) a first edge (67) of the second (63) of the metal laminae (62, 63) of a first multicomposition band (78) laid under said sheet (120) to bend against the first edge (65) of the first metal lamina (62) of said multicomposition band (78) and causes a first edge (86) of the first (82) of the metal laminae (82, 83) of a second multicomposition band (98) laid above said sheet (120) to bend against the first edge (87) of the second metal lamina (83) of said second multicomposition band (98), while the C-shaped metal piece (131) applied to the edge of the second intermediate sheet (130) causes bending of the second edge (85) of the second metal lamina (83) of said second multicomposition band (98) against the second edge (84) of the first metal lamina (82) of said second multicomposition band (98) and so on for all the multicomposition bands (78, 98, 118) that pass through the press (11), all this, consequently upon closure of the press (11), causing continuous electrical connection among all the fractions of metal laminae (62, 63) (82, 83) (102, 103) that are pressed together, said connection being 'in parallel'

- 12 -

among the pairs of metal laminae (62,63) (82,83)(102,103) in each multicomposition band (78,98,118) and 'in series', serpentine-wise, between said pairs (62,63) (82,83) (102, 103).

5 3. Process as in claim 1,

characterized in that at the two upper (30) and lower (27) plates of the press (11) that exert pressure in cycles on the superimposed layers of multicomposition bands (78,98, 118), there are two contact bodies of copper or another me-

10 tal, electrically highly conductive, separated from the other parts of the press (11) by sheets or other insulating means, connected by electric conductors to the two poles of the source (46) of electricity, so that when the press (11) closes, the electric circuit also closes between said
15 source (46) of electricity and the pairs of metal laminae (62,63) (82,83) (102,103) that together with the intermediate bands (73-75) (93-95) (113-115) of prepreg form the plastic laminates, and therefore simultaneous automatic start of endothermic heating and the pressing cycle.

20 4. Process as in claim 1,

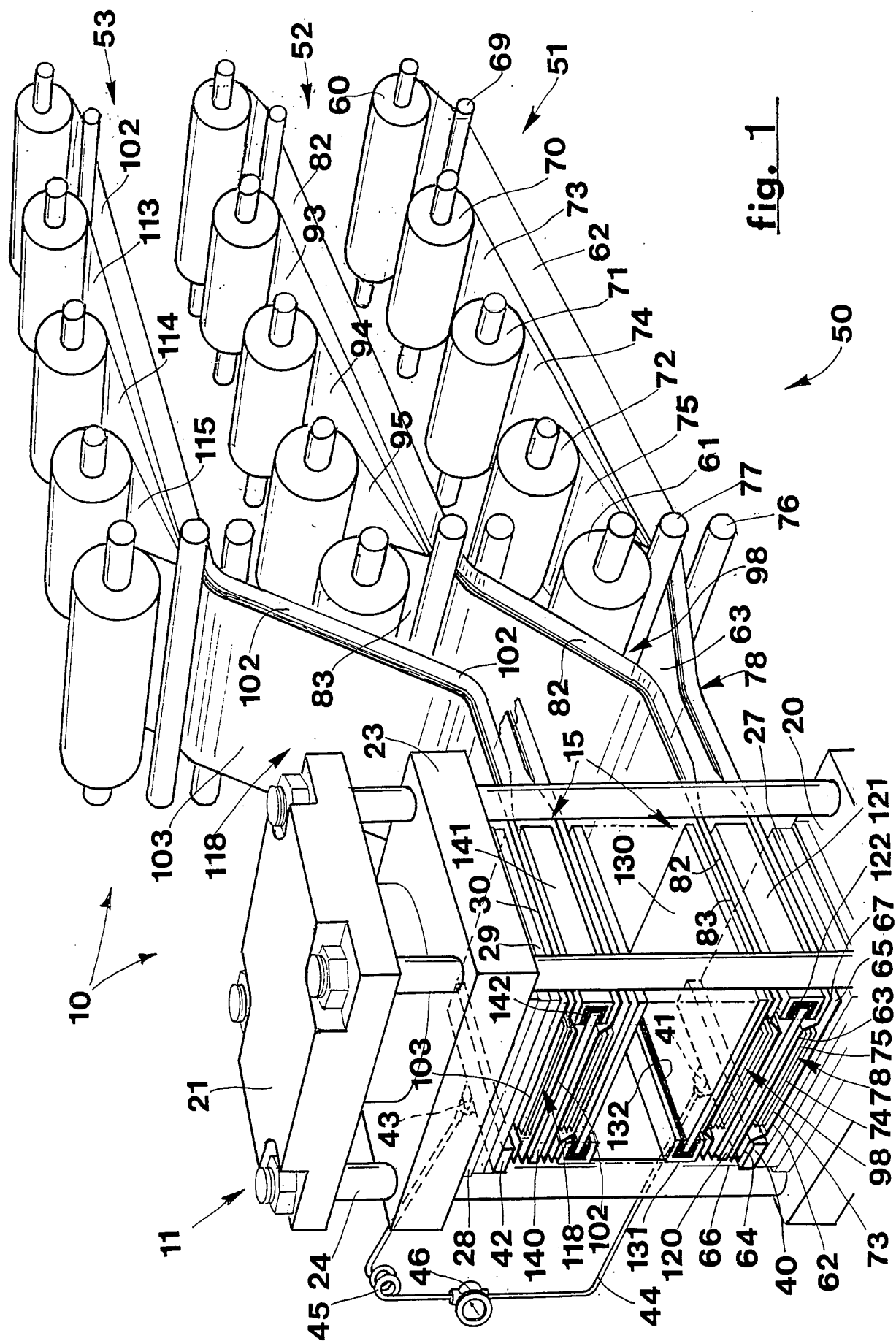
characterized in that on the upper (30) and lower (27) plates of the press (11) that exert cyclic pressure on the multicomposition bands (78,98,118) that pass through it, at one of the lateral edges of said multicomposition bands
25 (78,98,118), there are metal contact strips (40,42) raised in relation to the surface of said plates (27,30) to an extent substantially equal to that of the C-shaped metal (121,131,141) on the intermediate sheets (120,130,140), placed at the edges of said sheets, said contact strips
30 (40,42) being connected by electric conductors (41,43-35) to the source (46) of electricity so that by so placing

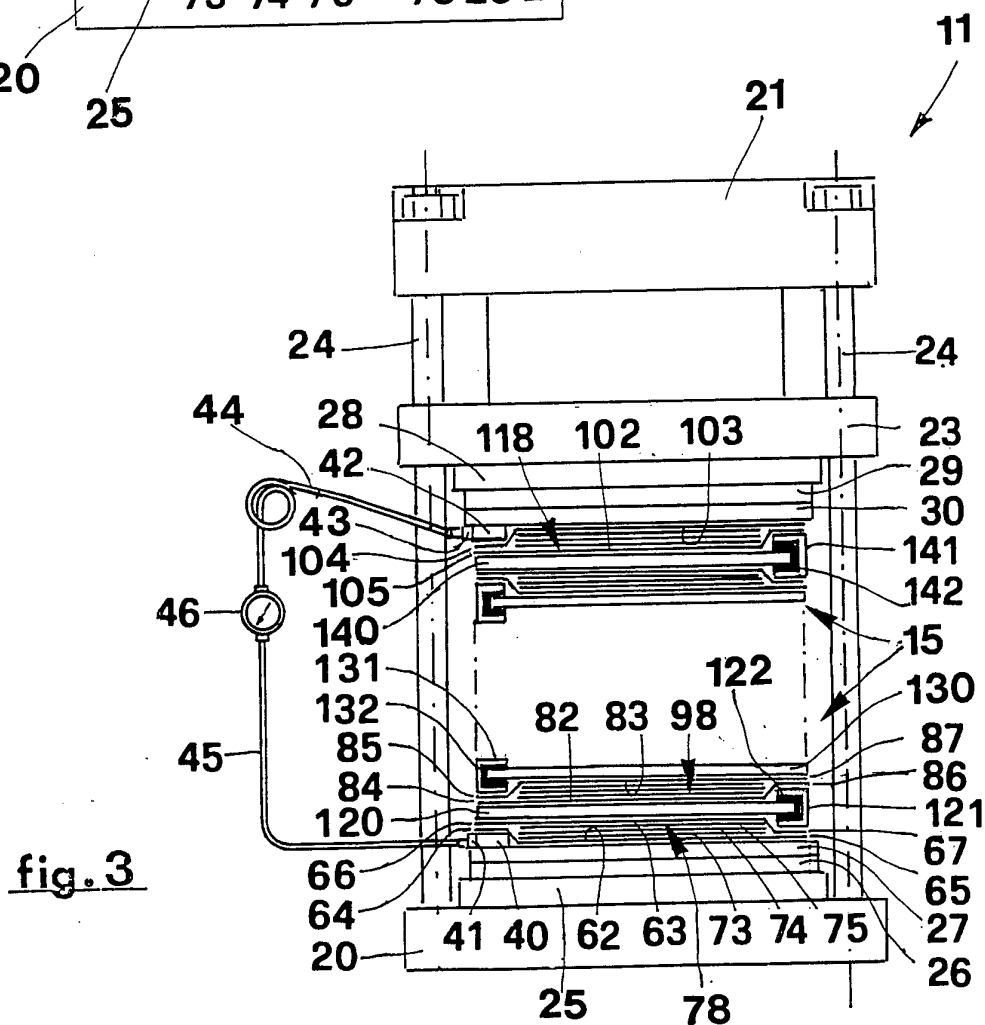
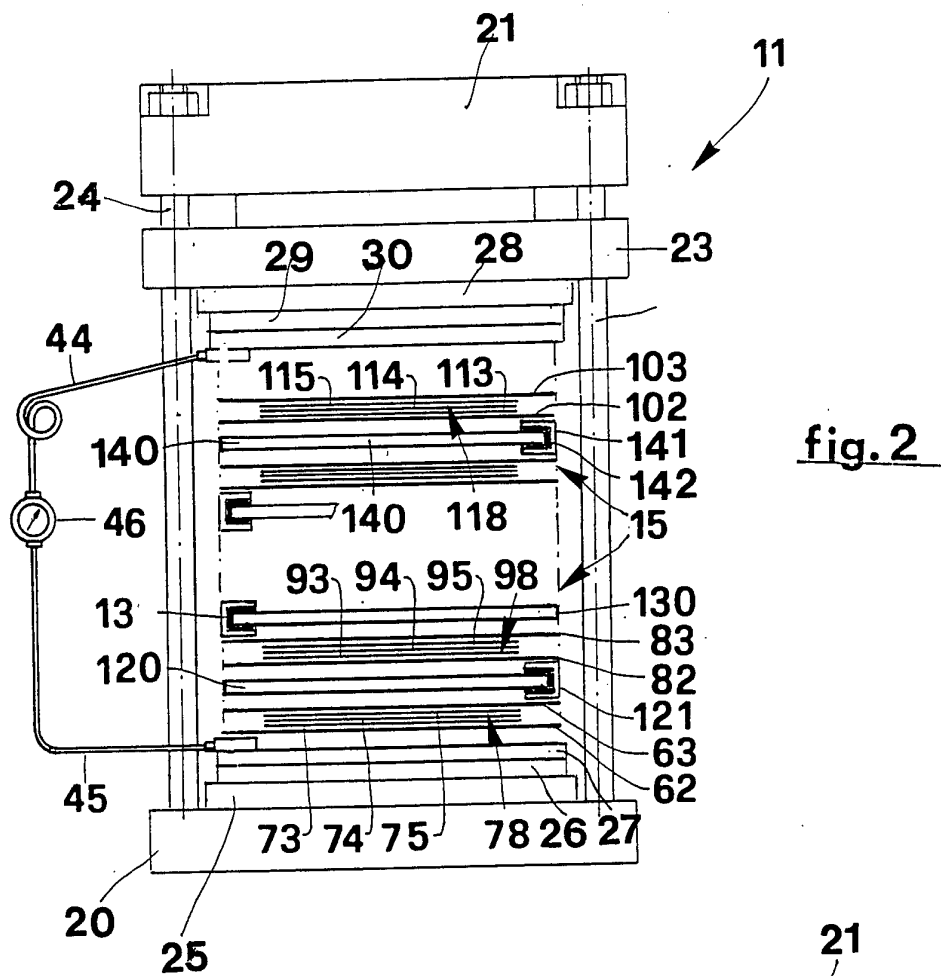
- 13 -

said intermediate sheets (120,130,140) that the lateral edge to which the C-shaped metal piece (121,131,141) is applied on the side opposite to that where said contact strips (40,42) are situated, when the press (11) closes contact is made between the lateral edges (64,104) of the metal laminae (62,103) of the multicomposition bands (78,118) placed next to the plates (27,30) and said contact strips (40,42) and said edges (64,104) are bent against the edges (66,105) of the other metal laminae (63,102) of said multicomposition band (78,118), with automatic closure, when the press (11) closes, of the electric circuit between the source (46) of electricity and the pairs of metal laminae (62,63) (82,83) (102,103) which together with the intermediate bands of prepreg (73-75) (93-95) (113-115) form the plastic laminates, and simultaneous automatic starting of endothermic heating and of the pressing cycle.

5. Process as in claim 4, characterized in that the C-shaped metal pieces (121,131, 141) are applied to the edges of the intermediate sheets (120,130,140) with interposition between of C-shaped pieces of rubber (122,132,142) of other equivalent means, to ensure that when the press (11) closes, matching will be perfect between the edges (64-67), (84-87) of each pair of laminae (62,63)(82,83) of each multicomposition band (78, 98,118) and electrical continuity will be established among all the pairs of metal laminae (62,63)(82,83) of the multicomposition bands (78,98,118) that pass through the press (11).

1/2





INTERNATIONAL SEARCH REPORT

International application No.
PCT/IT 93/00104

A. CLASSIFICATION OF SUBJECT MATTER

IPC 5 B29C35/02 B32B31/00 B30B7/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 B29C B32B B30B H05K B27D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IBM TECHNICAL DISCLOSURE BULLETIN Vol. 10, No. 1, June 1967 "Lamination Process" Disclosed by T. L. Ellis	1
A	---	2
A	GB,A,1 321 305 (CUPRO SAPPHIRE) 27 June 1973 see the whole document	2,5
A	---	
A	FR,A,2 254 423 (SIEMPELKAMP) 11 July 1975 see page 4, line 3 - page 5, line 24; figures 1-4	2-4
A	---	
A	GB,A,485 717 (A FRIZ) 24 May 1938 see page 2, line 18 - line 32; figures 1,2	2-4

	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

11 February 1994

Date of mailing of the international search report

28.02.94

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Philpott, G

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IT 93/00104

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR,A,2 623 982 (MASUHIRO MITSUYAMA) 9 June 1989 see the whole document ----	3
A	GB,A,2 119 710 (H R SMITH) 23 November 1983 see abstract see page 2, line 38 - line 79; figure 3 ----	1,3
A	DE,C,397 501 (OTTO PIERON) 24 June 1924 see page 3, line 57 - line 65; figures 1-3 ----	1-3
A	WORLD PATENTS INDEX Derwent Publications Ltd, London, GB AN 84-002127, DW 8401 & JP-A-58197017 -----	1,3,4

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/IT 93/00104

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-1321305	27-06-73	NONE	
FR-A-2254423	11-07-75	DE-A- 2334957	30-01-75
		DE-A- 2425102	27-11-75
		FR-A, B 2236649	16-01-75
		JP-A- 50034371	02-04-75
		JP-A- 52059686	17-05-77
		SE-B- 393559	16-05-77
		SE-A- 7409035	13-01-75
		SE-A- 7507892	09-07-75
		GB-A- 1472345	04-05-77
GB-A-485717		NONE	
FR-A-2623982	09-06-89	JP-A- 1301297	05-12-89
		JP-C- 1761170	20-05-93
		JP-B- 4048359	06-08-92
		CA-A- 1281928	26-03-91
		DE-A- 3834067	15-06-89
		GB-A, B 2213100	09-08-89
		US-A- 4935088	19-06-90
GB-A-2119710	23-11-83	NONE	
DE-C-397501		NONE	