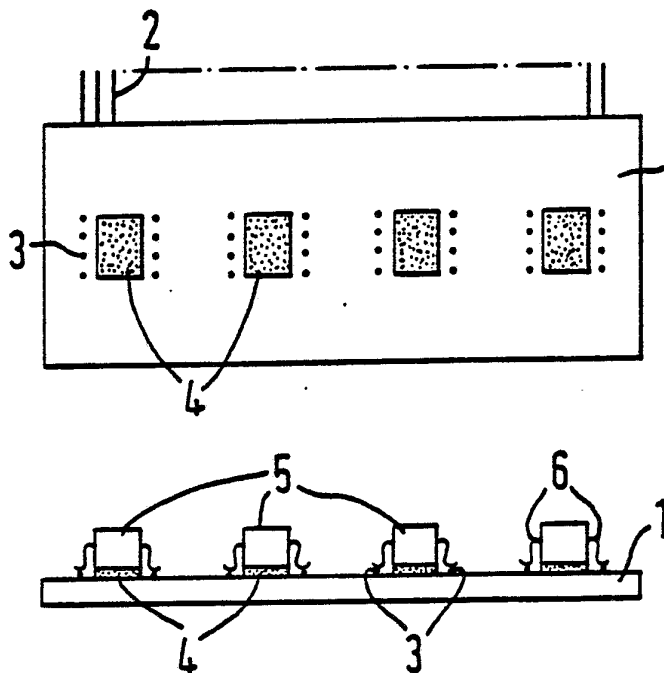




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁴ : H05K 13/04, H01L 21/58	A1	(11) International Publication Number: WO 85/ 01634 (43) International Publication Date: 11 April 1985 (11.04.85)
(21) International Application Number: PCT/GB84/00330 (22) International Filing Date: 27 September 1984 (27.09.84) (31) Priority Application Number: 8325803 (32) Priority Date: 27 September 1983 (27.09.83) (33) Priority Country: GB (71) Applicant (for all designated States except US): DORTRELL LIMITED [GB/GB]; High Street, Bordon, Hampshire (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : BURKE, John, Patrick [GB/GB]; 62 Laggan Road, Maidenhead, Berkshire (GB). (74) Agent: BROOKS, Nigel, Samuel; Hebbardens, Lower Bordon, Petersfield, Hampshire GU32 1ES (GB).		(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK, FR (European patent), GB (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i> <i>With amended claims and statement.</i> Date of publication of the amended claims and statement: 25 April 1985 (25.04.85)

(54) Title: ELECTRONIC CIRCUIT ASSEMBLY**(57) Abstract**

A ceramic substrate carrier (1) has side contact pins (2) and surface component contacts (3). At the positions where components (5) are to be mounted and connected to the contacts (3), rectangles (4) of flat format adhesive are applied by a silk-screen process. The components (5) are then positioned upon their respective rectangles of adhesive to adhere the components in place. The electrical connection of component leads (6) to their respective surface contacts (3) is then effected by soldering.

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ELECTRONIC CIRCUIT ASSEMBLY

The present invention relates to electronic circuit assembly.

5 Integrated circuits are to be found in more and more electronic equipment to the extent that circuit boards incorporating integrated circuits alone are now in common use. The traditional manner of pre-assembling electronic components, including integrated circuits, to circuit boards, for
10 instance etched-copper printed-circuit boards has been to pre-assemble a component to a board by passing its contacts through board apertures and bending over at least some of the contacts to mechanically retain the component on the board. Subsequently, the contacts are soldered to the
15 copper circuit strips.

More recently, "hybrid" circuits have started to be used. Such a circuit comprises a number of simple integrated circuits which are cheaper to use than a single more complex integrated circuit. The integrated circuits in a
20 "hybrid" are usually connected to a "ceramic substrate" board which typically may have five layers of silk-screen deposited contact strips built-up on the substrate. For making contact with the contacts of such a board, the contacts of integrated circuits do not pass through board
25 apertures but abut the board contacts at the ends of the components' contacts which are bent over as feet. The sets of contacts are soldered together, typically either in a solder wave wherein the board is inverted and passed over a solder wave, or in a vapour phase soldering installation
30 wherein previously applied, e.g. by silk screening, solder cream is caused to fuse in an oven. Both such methods of soldering rely upon the integrated circuit components being mechanically fixed to the board. Such fixing is presently effected by adhering of the components in position with
35 epoxy resin adhesive.



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Such adhesive has disadvantages. If too fast curing adhesive is used problems can be experienced with the application gun becoming clogged with already cured adhesive.

The alternative is to use a slower curing adhesive. This
5 has disadvantages in that if speeding up of production is required, the adhesive can be caused to cure by heating but this requires passage of the pre-assembled components and board through an adhesive-curing oven.

The object of the present invention is to improve the
10 assembly of electronic circuits in respect of the adhering of electronic components to carriers.

As used herein the term "electronic components" is intended to include not only integrated circuits but also associated components such as transistors, diodes, capacitors,
15 tors, resistors and inductors. The term integrated circuit includes not only integrated circuit chips incorporated in bodies moulded with sizes and contact numbers to suit the specific chips, as is U.K. practice, but also integrated circuit chips wired into standardized chip carriers, as is
20 U.S. practice. The term chip carrier should not be confused with the term circuit carrier or "carrier" as defined below.

As used herein the term "carrier" is intended to include conventional printed circuit boards, ceramic substrate boards and any other form of board or like planar member
25 provided with contacts to which two or more electronic components' contacts are to be connected as by soldering.

According to one aspect of the invention there is provided a method of preparing an electronic component carrier, as hereinbefore defined, comprising providing a
30 carrier with surface contacts for connection to a plurality of electronic components, and pre-applying adhesive to substantially all the areas of the carrier surface, to which electronic components are to be mounted to be connected to the contacts.

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Whilst it is envisaged that all the areas to receive components will have adhesive pre-applied in this aspect of the invention, one or two of the areas for typically six components per carrier may not have adhesive pre-applied for special reasons peculiar to the carrier and/or component(s) concerned. However it will be appreciated that the pre-application of the adhesive is an essentially separate operation from the positioning of the components. It is not interlaced as the application of adhesive and positioning of the components is presently in a combined operation.

The adhesive may be pre-applied in an integrated production line as the step immediately prior or a few steps prior to the positioning of the or the first of the components upon their respective areas of free surface of adhesive to adhere the components in place on the carrier. Alternatively where the production line produces merely carriers, the positioning of the components may be carried out in another production line, possibly in a separate premises.

It is envisaged that the components may be applied singly either manually or automatically or together usually automatically.

Soldering, or analogous connection, for final assembly of the components to the carrier will normally be carried out immediately after positioning of the components.

The invention also includes the products of the method of the first aspect of the invention, namely a carrier having a pre-applied adhesive both with and without components positioned thereon.

Where the positioning of the components takes place in a separate production line, usually in a separate premises, a release backing material will normally be applied to the pre-applied adhesive. The backing may be in strip form with an array of carriers adhered thereto.

When a release backing is used, the adhesive will be



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such as not to cure and/or lose its tackiness until the release backing is removed therefrom. Accordingly it is envisaged that in this technical application for the invention the adhesive will be a resin modified acrylic pressure sensitive adhesive. Nevertheless it is anticipated that other adhesives may be suitable. It should be noted that the adhesive should be such as not to lose effectiveness at soldering temperatures. However since the whole component being soldered does not reach the soldering temperature, adhesives which would normally lose effectiveness when heated evenly to soldering temperatures may be used.

It is preferred that once "pre-applied" the adhesive should have a "flat format" preferably with clearly defined limits so as not to encroach on the carrier's contacts. By "flat format adhesive" is to be understood an adhesive so applied to present a free surface at least substantially parallel to the surface to which it has been applied. Spray applied liquid adhesive may take up a flat format if the spray droplets are sufficiently small.

It is envisaged that any one of the following adhesive forms may be suitable as flat format adhesives:

- (i) Two sided adhesive tape cut to shape;
- (ii) Transferable adhesive film applied from a backing tape, the film either being cut to shape possibly with its backing tape or being pre-shaped on the backing tape. Where the pre-shaping and pre-positioning of adhesive film is sufficiently accurate, the carrier may be offered directly to the adhesive. The backing tape may then become the release backing mentioned above;
- (iii) Screen printed adhesive;
- (iv) Adhesive sprayed through a mask;
- (v) Adhesive applied by a roller either through a mask or selectively applied as in offset printing;
- (vi) Adhesive applied by brush preferably through a



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mask.

The preferred method of pre-applying adhesive is by screen printing. This necessitates the adhesive being in liquid form during the pre-application step. Thereafter
5 the adhesive's solvent may be allowed to evaporate off at room temperature where the adhesive is solvent based, turning the adhesive into a solid or a gel. This is a slow process, typically taking one hour where the solvent is water. Evaporation can be speeded by passing the carriers through a
10 thermal oven after pre-application of the adhesive. Such heat accelerated evaporation is still slow, typically taking 5 minutes, in comparison with the screen printing speeds obtainable.

Pressure sensitive adhesives are under development
15 which cure by undergoing a molecular change involving cross-linking between polymer chains. This change from liquid to a solid or a gel occurs on exposure to ultra violet light. Such an adhesive is preferred. After pre-application of the adhesive to the carriers by screen printing, the latter
20 are passed through an "ultra violet tunnel" in which they are subjected to ultra violet light so as to cause the adhesive to solidify or gel. Typically this curing takes less than $\frac{1}{2}$ minute. This speed is important, since it enables the carriers to pass from a station at which the
25 adhesive is pre-applied to a station at which they are exposed to ultra violet light, the application of this adhesive and the exposure to ultra violet light occurring synchronously to components at the respective stations.

An alternative, within the concept of the present
30 invention, is that the electronic components as opposed to the carrier may have the adhesive pre-applied to them, by analogous, preferably "flat format" means.

According to the second aspect of the invention there is provided a method of preparing a plurality of electronic
35 components for mounting upon a carrier as hereinbefore defined, comprising applying adhesive to a flat surface of



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the component, which surface of the component is to abut the carrier surface, with the interposition of the adhesive.

Preferably the pre-applied-adhesive electronic components are temporarily adhered to a release backing. The
5 release backing may be incorporated in a sealed strip-like container, either totally within the container or forming part of the container.

As required the components are positioned on the carrier thereby adhering them in place.

10 The invention also includes the products of the second aspect of the invention, namely components having adhesive pre-applied to them, both before and after positioning on a carrier.

To help understanding of the invention, various specific
15 embodiments thereof will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a carrier with adhesive pre-applied in accordance with the invention;

20 Figure 2 is a side view of the carrier of Figure 1 with electronic components pre-assembled thereto;

Figure 3 is a diagrammatic side view of carriers being offered up to a tape carrying discreet adhesive film portions;

25 Figure 4 is a diagrammatic side view of adhesive being pre-applied to carriers by a roller;

Figure 5 is a diagrammatic side view of adhesive being applied to electronic components and the components being temporarily adhered to a release tape;

30 Figure 6 is a diagrammatic side view of the components and release tape of Figure 5 being encapsulated in strip form;

Figure 7 is a side view of the components of Figure 5 being pre-assembled to a carrier; and

35 Figure 8 is a diagrammatic side view of carriers passing



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a screen printing station and an ultra violet tunnel.

The carrier 1 of Figure 1 is a ceramic substrate carrier and has the usual contact pins 2 and component contacts 3. At the position where each component is to be placed
5 rectangles 4 of flat format adhesive have been pre-applied by a silk-screen process. The outline of the rectangles exactly corresponds to the outline of the components 5, see Figure 2, to be applied. Figure 2 shows the components 5, integrated circuits in this "hybrid" circuit, positioned in
10 place on the flat format adhesive rectangles 4 and thus adhered to the carrier with their contacts 6 aligned with the carrier's contacts 3 for subsequent soldering.

Figure 3 shows carriers 31 being offered up by an indexing wheel 7 to a waxed release tape 8 having portions 34
15 of adhesive to be pre-applied to the carriers 31. The carriers may be fed manually or automatically to the indexing wheel where they are retained by any suitable means such as by suction until they are opposite a pressure roller 9 which adheres the carriers to the adhesive. As the
20 indexing wheel rotates further the vacuum for the carrier passing the roller 9 is released leaving the carrier temporarily adhered to the release tape 8. Both lateral positioning of the tape and the adhesive portions 34 and longitudinal positioning with respect to the carriers in the
25 indexing wheel 7 is controlled by gearing of the wheel 7 to sprockets 10 engaging in sprocket holes running along each side of the tape. Hence the portions 34 are correctly positioned on the carriers.

Figure 4 shows an alternative arrangement for pre-
30 applying adhesive portions 44 to carriers 41 via a roller 11. The carriers 41 pass under the roller 11 on a conveyor system 12 in synchronism with the roller 11. Adhesive is applied to the roller 11 by feed rollers 12 and apportioned on the roller 11 by an apertured portioning roller 13 having
35 recesses 14 corresponding to the dimensions of adhesive



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portions 44 to be applied to the carriers 41. As the roller 11 rotates, it transfers the apportioned adhesive to the carriers 41 passing under it.

Figure 5 shows a similar arrangement for pre-applying adhesive 54 to electronic components 55. Since the components are to have their entire surface 15 to be adhered to a carrier pre-applied with adhesive, the applying roller 16 does not require a portioning roller but merely adhesive feed rollers 12. The components 55 are passed under the adhesive applying roller 16 for transfer of adhesive thereto. To avoid any possibility of adhesive reaching the components' contacts 56 the roller 16 is wide enough to apply adhesive to the bodies only of the components. Downstream of the roller 16 a release backing 17 is fed from a roll 18 onto the pre-applied adhesive 54.

Figure 6 shows the release backing 17 together with its temporarily adhered components 55 is fed between two strips of plastics material film 19,20 which are formed into an encapsulating strip 21 by a pair of forming and sealing rollers 22.

Figure 7 shows a carrier 71 with no pre-applied adhesive onto which one pre-applied adhesive 54 carrying component 51' has already been pre-assembled and adhered in place; and another such component 51" is in the process of being positioned.

Figure 8 shows the pre-application of ultra violet light curing adhesive 82 to carriers 81. A conveyor 83, having carrier receptacles 85, moves through (i) a carrier placing station 86 at which a carrier 81 is placed on the conveyor, (ii) a pre-application station 87 and (iii) a UV station 88. At the station 87 the adhesive 82 is screen printed through a screen 88 with a wiper 89 onto the carrier 81 at the station to form an adhesive portion 84. At the UV station 88, the adhesive portion 84 on the respective carrier 81 is irradiated with ultra violet light from a UV



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lamp 90, to cause it to solidify or gel. A release backing is applied at the next station (not shown) in the manner of release backing 17 shown in Figure 5. The carrier 83 moves on a lock/stop basis typically every $\frac{1}{2}$ minute whereby the operations at each station occur synchronously. The use of UV curing adhesive is particularly advantageous in that it cures at the UV station 88 in the cycle-time taken for the operations at the other stations.

It is emphasised that the above embodiments are given by way of example only and the invention is not intended to be limited thereto. In particular the adhesive may be pre-applied by a silk-screen process. The release backing may be apertured to permit screen printing of solder cream after the adhesive has been pre-applied.

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CLAIMS

1. A method of preparing an electronic component carrier, as hereinbefore defined, comprising providing a carrier (1; 31; 41; 81) with surface contacts (3) for connection to a plurality of electronic components (5), and pre-applying adhesive (4; 34; 44; 84) to substantially all the areas of the carrier surface, to which electronic components (5) are to be mounted to be connected to the contacts (3).
2. A method as claimed in claim 1 wherein the adhesive is applied by screen printing.
3. A method as claimed in claim 1 or claim 2 wherein the adhesive (82,84) is such as to gel or solidify in ultra violet light, and the carriers (81) pass from a station (87) at which the adhesive is pre-applied to a station (88) at which they are exposed to ultra violet light, the application of the adhesive and the exposure to ultra violet light occurring synchronously to components at the respective stations.
4. A method of preparing a plurality of electronic components (51', 51"; 54) for mounting upon a carrier (71), as hereinbefore defined, comprising pre-applying adhesive (54) to a flat surface (15) of the component, which surface of the component is to abut the carrier surface, with the interposition of the adhesive (54).
5. A method as claimed in any preceding claim, in which the adhesive (4; 34; 44; 54; 82,84) is so applied to the carrier (1; 31; 41; 81) or the components (51',51"; 54) as to present a free surface substantially parallel to the surface to which it has been applied.
6. A method as claimed in any preceding claim, in which



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the adhesive is a pressure sensitive adhesive.

7. A method as claimed in any preceding claim, in which the adhesive is curable and is left at least not fully cured
5 after application and before mounting of the components to the carrier.

8. A method as claimed in any preceding claim, in which the adhesive is surface tacky and its free surface is
10 covered by a release backing (8,17).

9. A method of pre-assembling a plurality of electronic components to a carrier therefor including a preparation step as claimed in any preceding claim, followed by the step
15 of positioning of the plurality of electronic components upon their respective areas of free surface of adhesive to adhere the components in place on the carrier.

10. A method as claimed in claim 8, followed by the electrical connection of the components to their respective
20 contacts (3), as by soldering.

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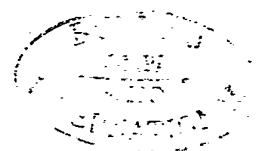
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AMENDED CLAIMS

[received by the International Bureau on 4 April 1985 (04.04.85);
original claims 1-10 replaced by amended claims 1-12 (2 pages)]

1. A method of preparing an electronic component carrier, as hereinbefore defined and having surface contacts
5 for connection to a plurality of electronic components, characterized in that the method includes the step of pre-applying adhesive to substantially all the areas of the surface of the carrier, to which electronic components are to be mounted for subsequent soldering connection to the
10 contacts, the adhesive being surface tacky or pressure sensitive for mounting electronic components thereon.
2. A method of preparing an electronic component carrier as claimed in claim 1 wherein the method further includes the step of causing the adhesive to gel or solidify,
15 for becoming surface tacky or pressure sensitive, prior to mounting electronic components thereon.
3. A method of preparing an electronic component carrier as claimed in claim 1 or claim 2 wherein the step of pre-applying the adhesive comprises screen printing the
20 adhesive onto the carrier.
4. A method of preparing an electronic component carrier as claimed in claim 2 or claim 3 wherein the step of setting the adhesive to cause it to gel or solidify comprises
25 passing the carrier through a thermal oven for evaporation of solvent from the adhesive, the adhesive being such as to set by evaporation of a solvent.
5. A method of preparing an electronic component carrier as claimed in claim 2 or claim 3 wherein the step of setting the adhesive to cause it to gel or solidify comprises
30 passing the carrier through an ultra violet tunnel for molecular change of the adhesive under ultra violet light, to which it is exposed in the ultra violet tunnel, the adhesive being such as to set by molecular change.
6. A method of preparing an electronic component
35 carrier as claimed in claim 5, in which a succession of



component carriers are moved through stations of a production line, at one of which the uncured adhesive is pre-applied and at a later one of which ultra violet light irradiates the pre-applied adhesive, the application of adhesive and
5 the exposure to ultra violet light taking place synchronously to different component carriers at the respective stations.

7. A method of preparing an electronic component carrier as claimed in any preceding claim, in which a release backing is applied to the exposed adhesive areas
10 subsequently from the pre-application of the adhesive.

8. A method of assembling a plurality of electronic components on a carrier therefor prepared according to any one of the preceding claims, including the step of positioning the plurality of electronic components upon their respective
15 areas of pre-applied adhesive to adhere the components in place.

9. A method of assembling a plurality of electronic components on a carrier as claimed in claim 8, including the step of electrically connecting the leads of the adhered
20 components to their respective contacts as by soldering.

10. An electronic component carrier prepared in accordance with the method of any one of claims 1 to 9 having surface tacky or pressure sensitive adhesive pre-applied to substantially all the areas of the carrier surface
25 to receive electronic components.

11. A plurality of electronic component carriers as claimed in claim 10 prepared in accordance with claim 7, the plurality of electronic component carriers having been applied to a single release backing in strip form.

30 12. An electronic component carrier as claimed in claim 10, having electronic components adhered to the set pre-applied adhesive.



STATEMENT UNDER ARTICLE 19

Amended claim 1 now includes the feature of
original claim 6.

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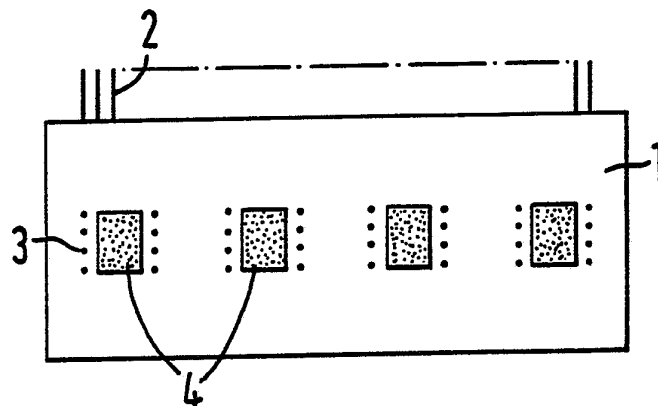


FIG. 1

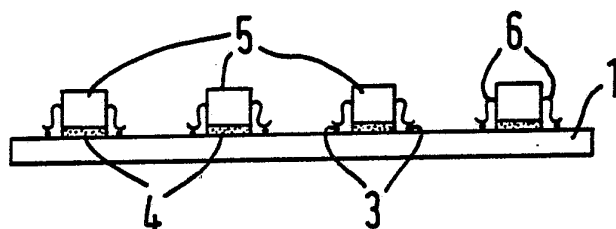


FIG. 2

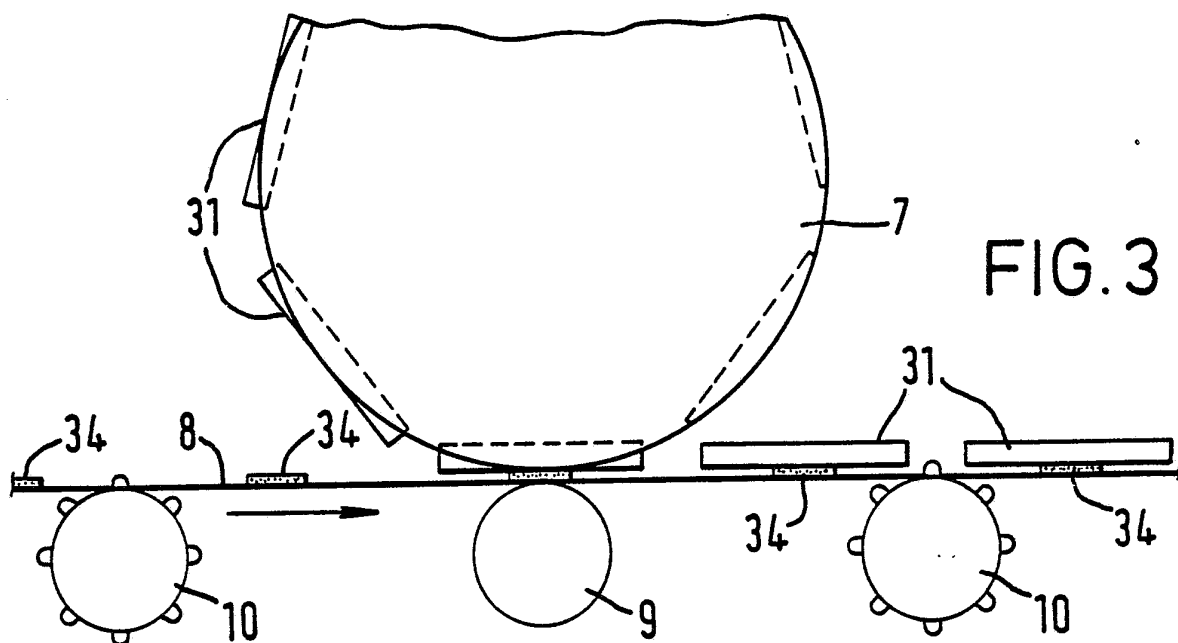


FIG. 3

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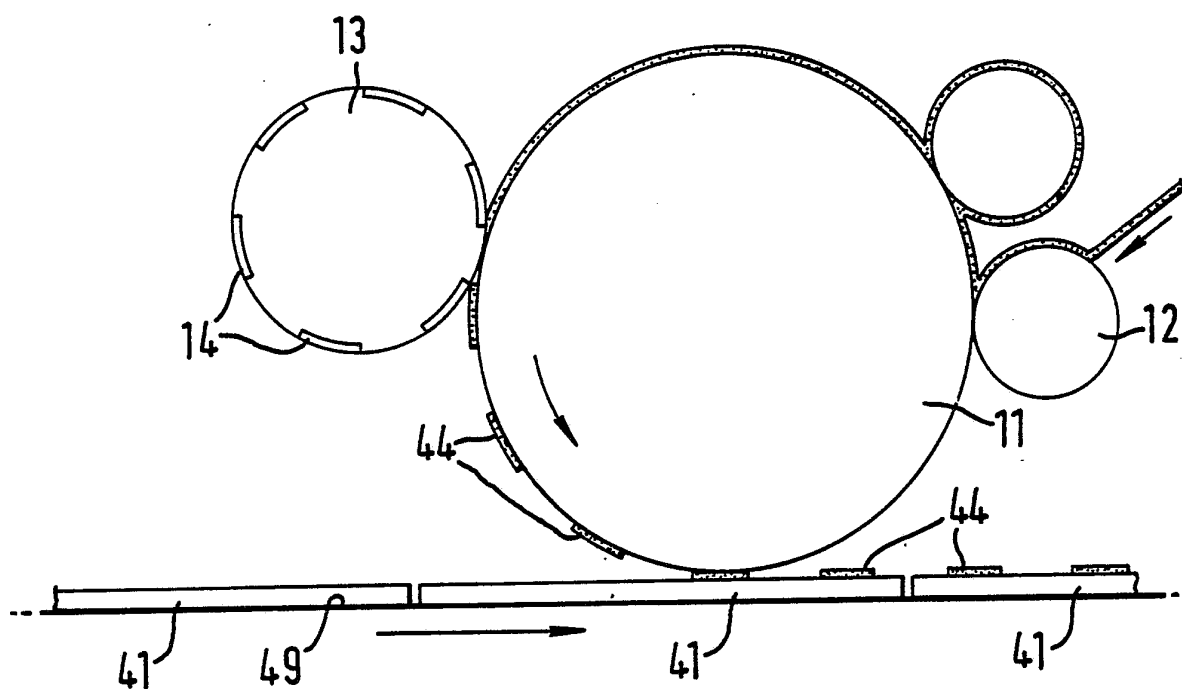


FIG. 4

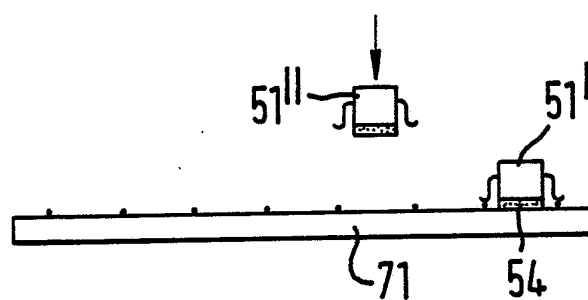


FIG. 7

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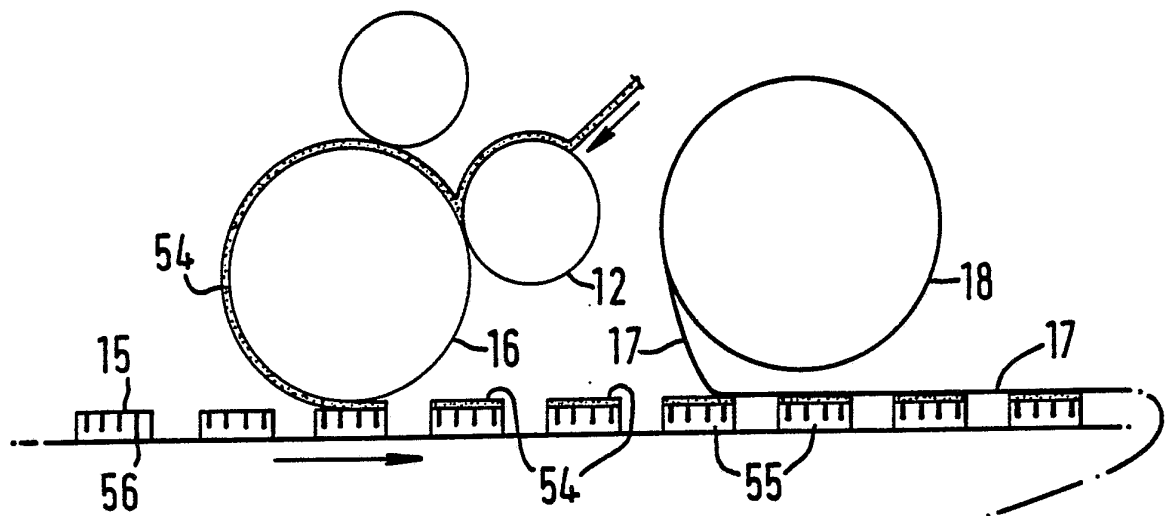


FIG. 5

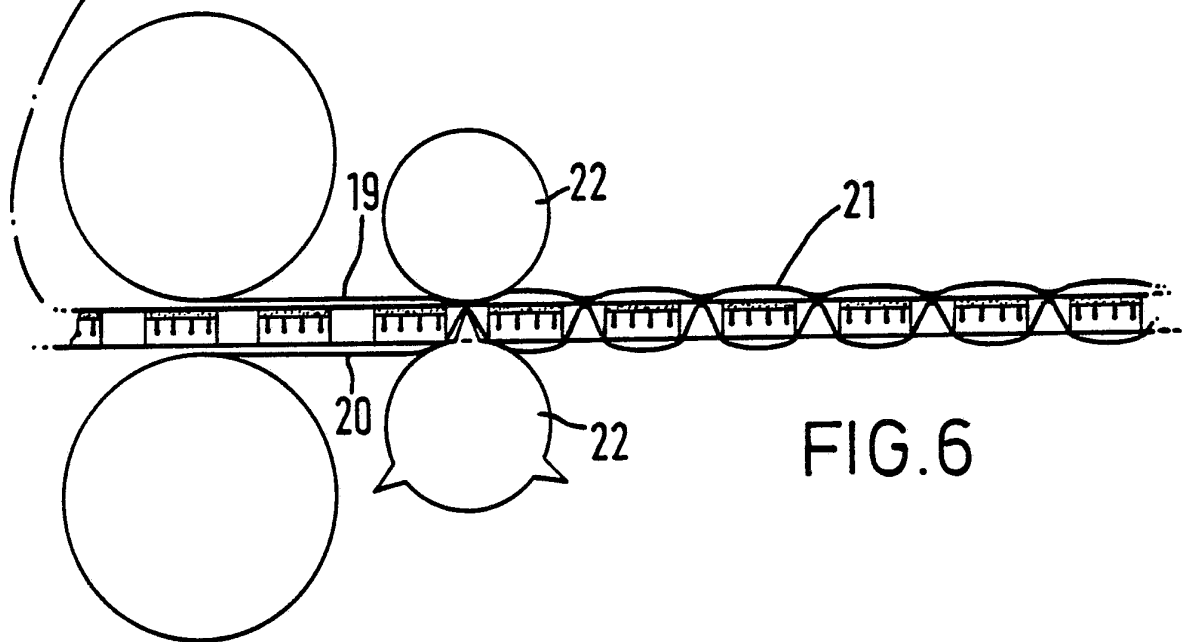


FIG. 6

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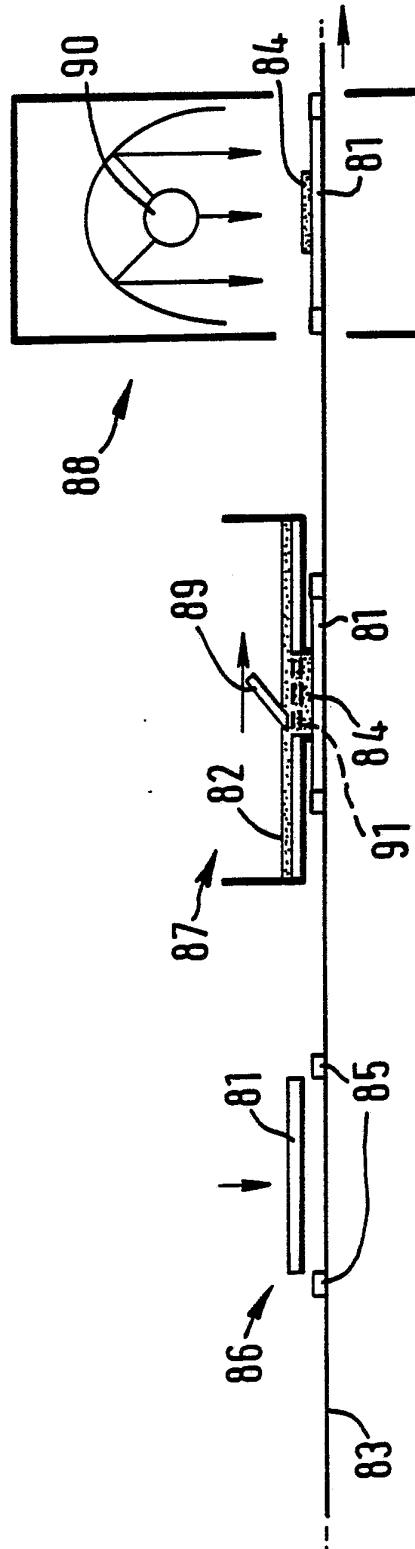
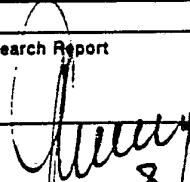


FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 84/00330

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁴ : H 05 K 13/04; H 01 L 21/58		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁴	H 01 L; H 05 K	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ⁹	Citation of Document, ¹¹ with Indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
E	Patents Abstracts of Japan, vol. 8, no. 81, 13 April 1984; page 1518E238 & JP, A, 57110128 (Mitsubishi Denki K.K.) 6 January 1984 --	1,3,4,7
Y	DE, A, 2736090 (SHARP) 23 February 1978 see claims 1,2,7; page 5, lines 16-32 --	1,6
Y	Patents Abstracts of Japan, vol. 6, no. 144, 3 August 1982; page 1022E122 & JP, A, 55144828 (Suwa Seikosha K.K.) 26 April 1982 --	1,8
A	CB, A, 2025804 (MATSUSHITA ELECTRIC INDUS- TRIAL) 30 January 1980 see page 2, lines 13-69 -----	1
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search <div style="text-align: center;">16th January 1985</div>	Date of Mailing of this International Search Report <div style="text-align: center;">14 FEB. 1985</div>	
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