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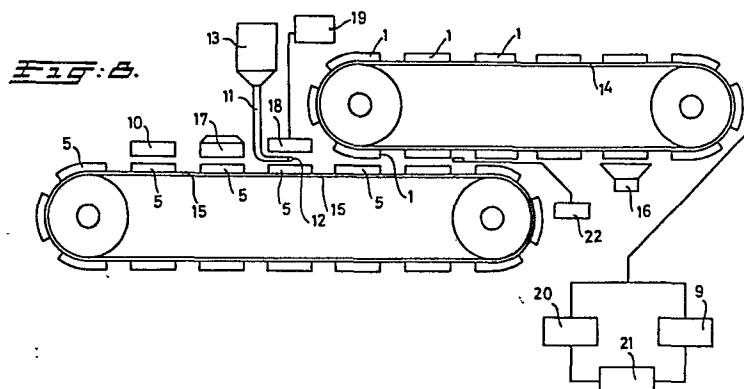
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(54) Process and installation for forming a metal product by applying a photo semi-conducting material.

(57) A process of forming metal products by providing a coating (2) of semi-conductive material upon a conducting substrate (5) which is provided with a primary pattern of charged regions (2a - 2d) of a latent electrostatic image; a pattern of regions (4a - 4d) of plastics particles being deposited upon said charged regions (2a-2d) of the semi-conductive material, transferring said pattern (4a-4d) of plastics material to a metal carrier (1), fusing said plastics material to the carrier (1), removing metal by etching from or depositing metal upon

uncoated parts (6a - 6c) of the carrier and removing the regions of plastics (4a-4d) from the carrier (1). An installation for forming these metal articles comprises a support (15) for a substrate (5), a corona discharge member (17), a plastics applying member (13), a second support (14) for a carrier (1), said support (14) being able to position a carrier (1) opposite the substrate (5), a potential source (22) for charging a carrier (1), an etching member (9) or a galvanically metal depositing member (20), and a plastics removing bath (21).



-1-

Process and installation for forming a metal product by
applying a photo semi-conducting material.

The invention relates to a process of forming a metal product by applying a plastics pattern upon a metal carrier, whether or not directly followed by a metal removal or metal deposition or chemical treatment, known per se.

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It is known in the art to manufacture eventually perforated foil-like metal products by providing a metal foil or sheet with a photo lacquer coating, exposing said photo lacquer coating, after drying, through a dia-positive or a dia-negative and subsequently developing same while the plastics, if desired, are fused by heating them, whereupon either undesired portions of the carrier are removed by etching or certain metals are deposited upon the carrier by means of a galvanic procedure, and thereafter the photo lacquer coating is removed.

15

This process presents the disadvantage that for each metal article a carrier has to be coated with the photo lacquer, whereupon said photo lacquer coating has to be dried and subsequently has to be exposed through a dia-positive or a dia-negative, dependent upon the kind of photo lacquer as used, which steps are rather time-consuming.

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-2-

If metal articles of a similar type have to be produced in large series, a process in which a plurality of the aforementioned steps could be omitted, is preferred.

- 5 Said object is attained according to the present invention in that a coating of photo semi-conductive material upon a conducting substrate is provided with a primary pattern of a latent electrostatic image whereupon plastics particles possessing an opposite charge are deposited upon said photo
- 10 semi-conducting material, said plastics particles being transferred to an electrically conducting carrier by means of a potential difference whereupon the transferred plastics particles are fixed upon said carrier and the carrier is subjected to a treatment, wherein either metal ions are removed
- 15 from non-coated portions of the carrier or metal is deposited upon non-coated portions of the carrier, followed by a removal of the fixed plastics particles. Said removal can be conveniently effected by means of a solvent.
- 20 When the above described process is used carriers can be obtained possessing the desired plastics pattern, without the necessity of first coating each carrier with a photo lacquer coating, drying said photo lacquer coating and exposing each carrier separately.
- 25 The deposited removable plastics coating upon the photo semi-conductive material will, as a matter of fact, directly form the desired pattern upon the carrier, which pattern, after fixation, may serve either to protect portions not to be
- 30 etched away from said carrier, or for protecting those portions

-3-

upon which no metal should be deposited during a galvanic metal deposition.

By etching away non-coated portions of the carrier, metal articles are obtained which may, for instance, be used for integrated circuits, whilst depositing metals upon non-coated portions of the carrier at pre-determined locations, may result in an optimum deposit of small quantities of e.g. very expensive metals, such as gold or silver, without any disadvantageous result upon the clarity of the pattern, either obtained by a galvanic deposition or by etching.

A very appropriate manner of depositing plastics particles upon a photo semi-conductive material is charging a continuous layer of photo semi-conductive material upon a metal substrate, in a dark space with an electric charge of a certain polarity, preferably by means of a corona discharge and by exposing with an image the charged layer of the electrically charged photo semi-conductive material, so that a primary charge pattern will be formed upon the photo semi-conductive material, which pattern is brought into contact with oppositely charged plastics particles.

Preferably the plastics particles to be deposited upon the electrically charged predetermined primary pattern, are obtained from a dispersion of plastics particles in a non-electrically conducting liquid particularly an isoparaffin or, more generally, a liquid toner.

The present invention also relates to a metal product obtained by applying the process in accordance with the invention.

-4-

The invention furthermore relates to an installation for forming a metal product by coating the surface of a metal carrier, with a plastics coating and by a fixation of said coating, followed by a metal removal or metal deposition or chemical treatment known per se, at least comprising a support
5 for the carrier, a plastics applying member and a fixation member for the fixation of applied plastics, characterized in that the installation comprises a member for charging a photo semi-conductive material in the darkness, an image
10 exposing device for applying an image exposure, a plastics applying member for applying plastics particles and a member for providing a potential to the carrier.

The present invention will be illustrated with an example of
15 an embodiment as shown in the accompanying drawings, wherein:

Figure 1 is a substrate provided with a charged coating of photo semi-conductive material applied thereupon;
Figure 2 shows the same carrier with the coating of
20 electrostatically charged photo semi-conductive material, after having exposed said material to an image exposure;
Figure 3 shows the substrate comprising the coating of photo semi-conductive material and the plastics particles deposited thereupon in originally charged areas;
25 Figure 4 shows a substrate comprising a coating of photo semi-conductive material and opposite thereto, a carrier which comprises the plastics particles as shown in fig. 3;
Figure 5 shows the finished carrier comprising the plastics pattern deposited thereupon;
30 Figure 6 shows the carrier of fig. 5 after the etching

-5-

procedure;

Figure 6A shows the carrier of fig. 6 after removal of the plastics pattern;

5 Figure 7 shows the carrier of fig. 5 after having deposited metals upon non-coated portions of the carrier, by a galvanic procedure;

Figure 7A shows the carrier of fig. 7 after removal of the plastics pattern;

10 Figure 8 shows an installation for performing the process in accordance with the invention.

By means of an endless belt 15 a copper substrate sheet 5 is conveyed, being provided with a homogeneous coating of a photo-semi-conductive material 2 adhering to the substrate 5, which
15 material may for instance consist of selenium. Said coating 2 is in the darkness provided with an electrostatic charge by means of a corona discharge 10.

Subsequently the coating of the photo semi-conductive material
20 is exposed with an image in the exposing device 17, in such a manner, that portions 2a, 2b, 2c and 2d of the material will maintain their electrostatic charge, whereas portions 3a, 3b and 3c will no longer be charged.

25 Hereupon the substrate 5, comprising the image exposed continuous coating of photo semi-conductive material 2, is positioned below a developing electrode 18, which is at a fixed distance from the surface of the photo semi-conductive material 2. Said developing electrode 18 is provided by the installation 19,
30 with a potential of the same polarity as the polarity of the charged pattern upon the photo semi-conductive material, which

-6-

potential, however, is lower in absolute value, and corresponds to the potential of the photo semi-conductive material 2.

Through an inlet 11 and a mouth 12 a liquid toner is fed from a storage vessel 13, to the surface of the coating 2 of photo
5 semi-conductive material upon the substrate 5. The mouth 12 is accommodated in such a manner that the toner is fed between the developing electrode 18 and the upper surface of the layer 2 upon the substrate 5.

10 The toner possesses good di-electric and film-forming properties.

The developing electrode 18 is of great importance as the plastics particles are substantially deposited upon charged
15 portions of the photo-semi-conductive material and not beside those portions. Moreover, the developing electrode prevents that plastics particles will be deposited upon those portions, even when impurities are present in non-charged portions of the photo semi-conductive material.

20

Subsequently, the substrate 5 comprising the photo semi-conductive coating 2 and areas of deposited plastics particles 4a, 4b, 4c and 4d, is positioned below a carrier 1, which can be displaced by means of a second endless belt 14, com-
25 prising a plurality of carriers 1.

Said carriers 1 may, for instance, consist of a copper sheet 1, having only a slight thickness of, for instance, 0,1 mm.

30 By means of a potential source 20, the carrier 1 is brought at a potential being higher than, but of the same polarity as the

-7-

portions 2a, 2b, 2c and 2d upon which plastics particles have been deposited.

By means of this potential the plastics in the portions 2a,
5 2b, 2c and 2d are transferred to the carrier 1, which is subsequently conveyed towards an area above a heating member 16, where the plastics particles in the portions 4a, 4b, 4c and 4d are fused upon the carrier 1. Apertures 6a, 6b and 6c are now present between portions 4a, 4b, 4c and 4d.

10

Finally a carrier 1, consisting of a copper sheet is obtained, upon which the above outlined portions of plastics are situated, wherein between non-coated portions form the bottom of apertures 6a, 6b and 6c.

15

Due to the action of an etching means, for instance hydrochloric acid, being present in etching liquid applying member 9, the portions of sheet 1 situated below the apertures 6a, 6b and 6c can be removed by etching, so that continuous apertures 7a,
20 7b and 7c are formed. In a special plastics removing bath 21 the plastics regions 4a, 4b, 4c and 4d are removed by means of a suitable solvent, so that a metal article is obtained as shown in fig. 6A.

25 The obtained products may, for instance, be used for manufacturing integrated circuits.

In fig. 7 another embodiment is illustrated, wherein, by means of a galvanic metal deposit member 20, precious metals, e.g.
30 silver and gold, can be deposited in^{to} cavities 6a, 6b and 6c,

-8-

thereby forming metal deposit areas 8a, 8b and 8c. It is obvious that said galvanic deposit is not restricted to precious metals, although very good results are obtained hereby. The plastics in the portions 4a, 4b, 4c and 4d is
5 also removed in the plastics removing bath 21. The product obtained in that manner is schematically illustrated in fig. 7a.

The present invention will still be further illustrated by means of the following example.

EXAMPLE

10

A nickel substrate 5 having a thickness of 0,2 mm comprises an adhering selenium coating 2.

Said photo semi-conductive selenium material 2 is subjected
15 in the darkness to a corona discharge so that the semi-conductive material is electrostatically charged with a charge having a positive polarity, whereas the substrate has been given earth potential.

20 After an image exposure, portions 2a, 2b, 2c and 2d are obtained, still being electrostatically charged, whilst the portions 3a, 3b thereinbetween are no longer charged.

Subsequently the surface of the charged photo semi-conductive
25 material areas 2a to 2d included, is provided with plastics particles by using a liquid toner supplied in the area between the surface of the charged portions 2a to 2d included and a developing electrode 18, being situated at a constant distance thereabove. Said developing electrode 18 is, by means of in-
30 stallation 19, brought at a potential having the same polarity

-9-

as the potential of the charged areas of the photo semi-conductive material 2a, 2b, 2c and 2d, said areas having a potential of, for instance, $+400$ volt, the developing electrode having a potential of for instance $+25$ volt.

5

The toner consists e.g. of epoxy resin particles, being dispersed in an isoparaffin.

Hereupon the substrate 5 comprising the photo semi-conductive coating 2 and the plastics particles areas 4a, 4b, 4c and 4d applied thereupon, is positioned below a carrier 1 consisting of copper having a thickness of e.g. 0,10 mm. By means of the potential source 22 said carrier 1 is given a potential being 200 V higher than that of the areas 2a, 2b, 2c and 2d, being
15 coated with plastics particles. Due to the applied potential, said plastics particles areas 4a, 4b, 4c and 4d are transferred to the carrier.

Said plastics articles are fused during further transport of the carrier 1, by means of the heating device 16. It is
20 also possible to use a heated pressure roller and/or solvents, vapours, which will cause the plastics particles to be fixed to each other, as well as vapourized reactive gases which bind said plastics particles to each other.

25

By etching with 0,1 N hydrochloric acid, a carrier is obtained comprising continuous apertures 7a, 7b and 7c, which carrier can be used for integrated circuits. By a galvanic deposit a carrier is obtained comprising metal areas, consisting of
30 gold or silver in the regions 8a, 8b and 8c between the plastics

-10-

portions 4a, 4b, 4c and 4d upon the carrier 1.

By means of suitable solvents, for instance a ketone for an epoxy resin, the plastics coating in the regions 4a to 4d
5 inclusive, is removed from the formed products, whereupon metal products are obtained as shown in figures 6A and 7A, which products are suitable for use in electrical appliances.

-1-

CLAIMS

1. Method of forming a metal product by applying a plastics pattern upon a metal carrier, whether or not directly followed by a metal removal or metal deposition or chemical treatment known per se, characterized in that a coating of photo semi-
5 conductive material upon a conducting substrate is provided with a primary pattern of a latent electrostatic image, whereupon plastics particles having an opposite charge, are deposited upon said photo semi-conductive material, said plastics particles being transferred to an electrically conducting
10 carrier by means of a potential difference, whereupon the transferred plastics particles are fixed upon said carrier and the carrier is subjected to a treatment wherein either metal ions are removed from non-coated portions of the carrier or metal is deposited upon non-coated portions of the carrier,
15 followed by a removal of the fixed plastics particles.
2. Process according to claim 1, characterized in that, after fixation of the transferred plastics particles, uncoated conductive portions of the metal carrier are removed by etching.
20
3. Process according to claim 1, characterized in that, after fixation of the transferred plastic particles upon the conducting metal carrier, a metal is deposited upon the uncoated conductive portions of said metal carrier in a galvanic manner,
25 said metal deposited in a galvanic manner, being preferably a precious metal.
4. Process according to claims 1 to 3, characterized in that one or more of the following measures are applied:
30 a) the primary charged pattern of the photo semi-conductive

-2-

material is obtained by charging a continuous layer of photo semi-conductive material

- upon a metal substrate in the darkness by means of an electrostatic charge, having
- 5 a predetermined polarity and by an image exposure of the charged coating of electrostatically charged photo semi-conductive material so that a primary ^{charge} pattern will be obtained upon the photo semi-conductive material, which pattern is brought into contact with oppositely charged plastics particles;
- 10 b) the plastics particles to be adhered to a primary pattern are dispersed in a liquid toner, said liquid toner being an isoparaffin;
- c) the plastics particles to be adhered to the primary pattern are formed by a one or two components powder toner;
- 15 d) after the application of an electrostatic charge in the form of a primary charge pattern, an auxiliary surface is brought at a small and constant distance from the surface of the charged photo semi-conductive material regions, said surface having the same polarity but a lower potential, whilst
- 20 the plastics particles to be deposited are supplied between the surface of charged photo semi-conductive regions and said auxiliary surface;
- e) the deposited plastics particles upon the carrier are fixed by means of heat, pressure, solvents, vapours and/or
- 25 reactive gases;
- f) in order to transfer the plastics particles from the photo semi-conductive coating to the carrier, said carrier is given a higher potential than, but the same polarity as the regions of the photo semi-conductive coating, where plastics
- 30 particles have been deposited;
- g) each surface of the metal carrier is provided with a

-3-

fixed plastics pattern.

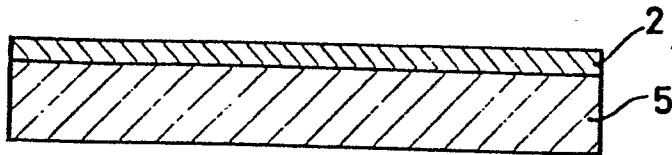
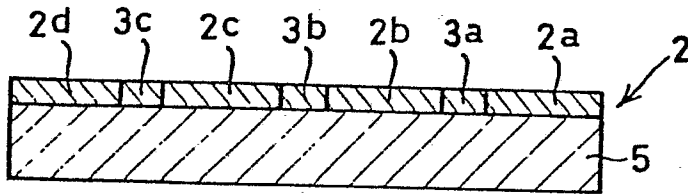
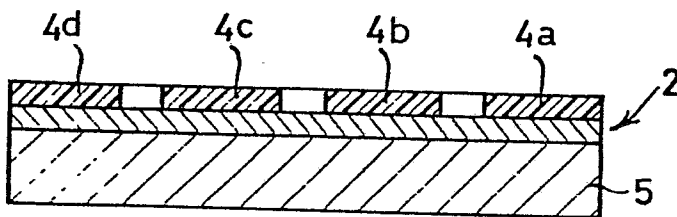
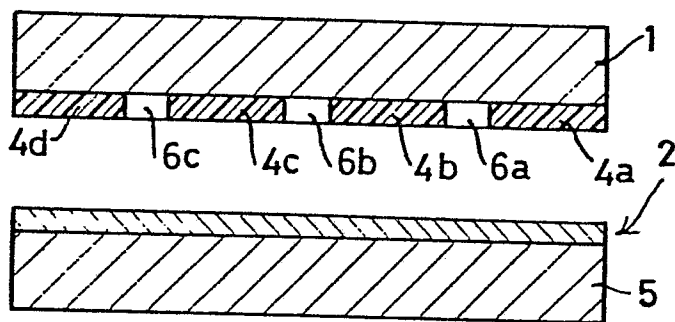
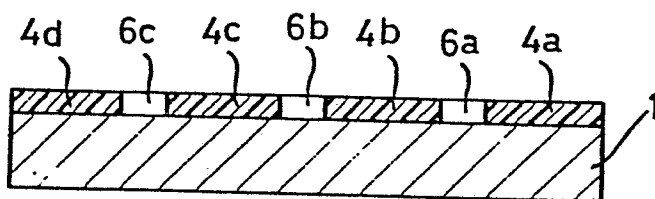
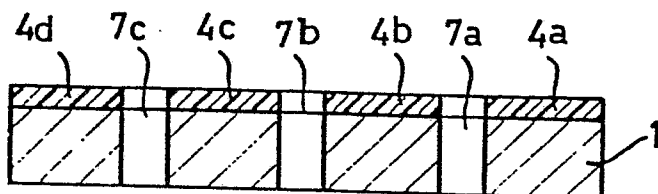
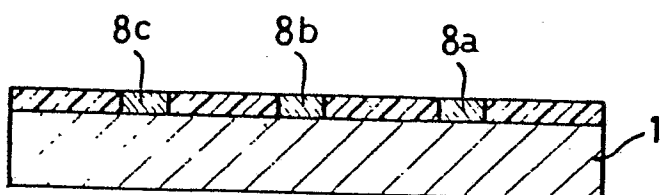
5. Installation for forming a metal product by coating the surface of a metal carrier, with a plastics coating and by a
5 fixation of said coating, followed by a metal removal or metal deposition or chemical treatment known per se, at least comprising a support for the carrier, a plastics applying member and a fixation member for the fixation of applied plastics characterized in that the installation comprises a member (10)
10 for charging a photo semi-conductive material in the darkness, an image exposing device (17) for applying an image exposure, a plastics applying member (13) for applying plastics particles and a member (20) for providing a potential to the carrier.
- 15 6. Installation according to claim 5, characterized in that the installation comprises one or more of the following parts:
- a) the charging member (10) is a member exerting a corona discharge;
 - b) said installation comprises a developing electrode (18)
20 which by means of an installation (19) can be given a lower potential^{than} but the same polarity as the areas upon the photo semi-conductive material, where plastics particles have been deposited;
 - c) the plastics applying member (13) for applying the elec-
25 trostatically charged plastics particles extends between the aforescribed developing electrode (18) and a support (15) for the substrate;
 - d) the developing electrode (18) is adjustable in height;
- 30 7. Installation according to claims 5 or 6, characterized in that the installation comprises a member (9) for applying

-4-

an etching liquid.

8. Installation according to claim 5 or 6, characterized in that said installation comprises a member (20) for galvanically depositing metals.

9. Installation according to any one or more of claims 7 or 8, characterized in that said installation comprises a plastics removing bath (21) so as to remove plastics from the carrier (1).

FIG: 1.FIG: 2.FIG: 3.FIG: 4.FIG: 5.FIG: 6.FIG: 7.

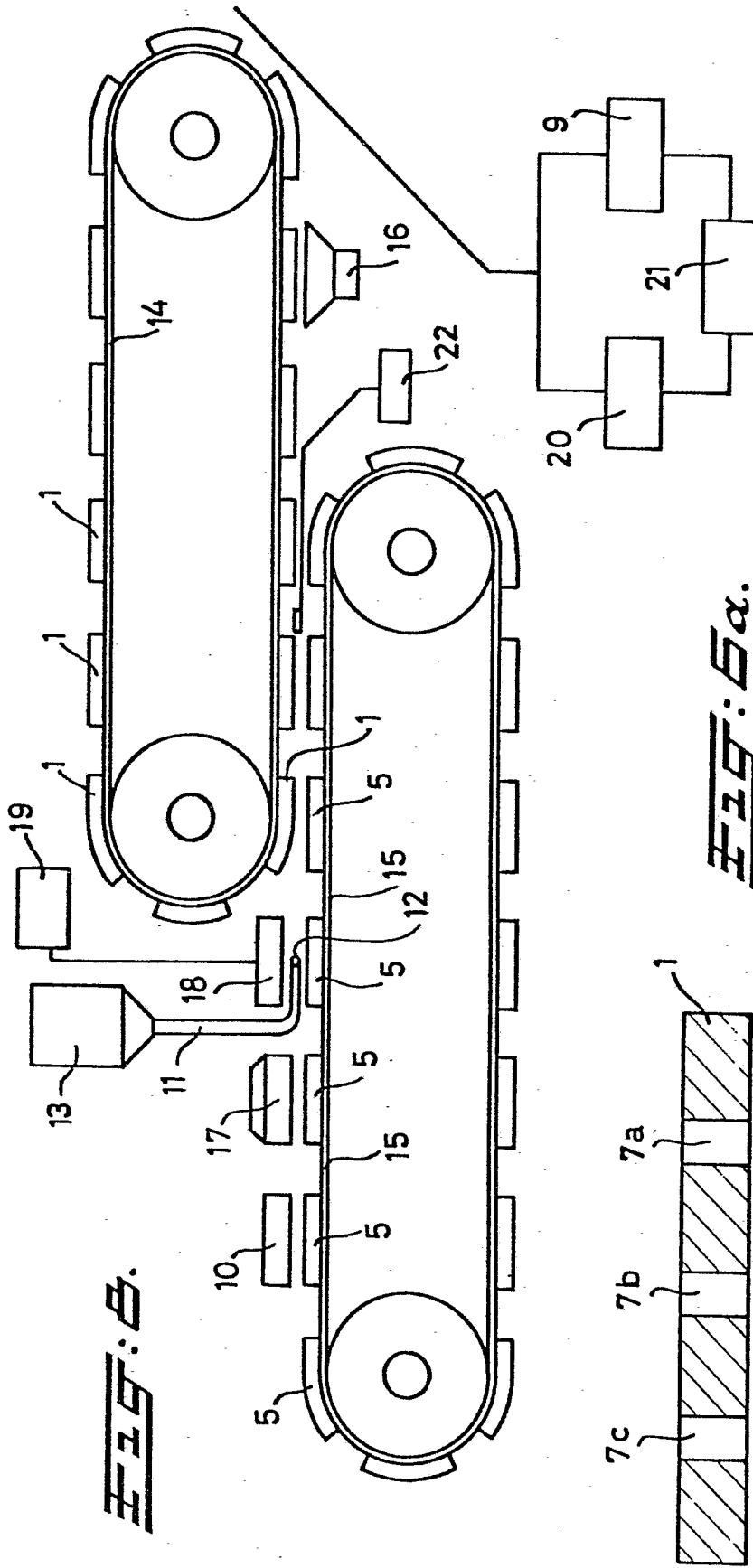


Fig. 6.

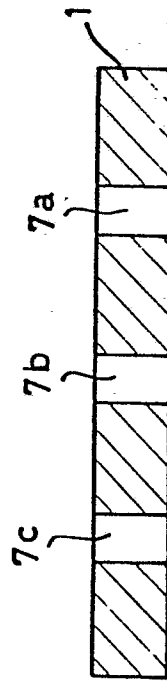


Fig. 6a.

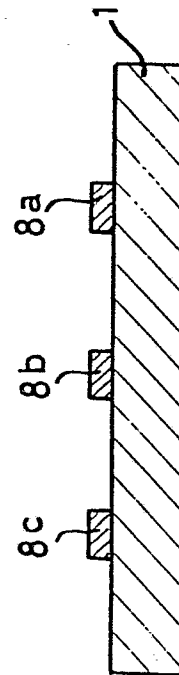


Fig. 7a.



European Patent
Office

EUROPEAN SEARCH REPORT

0041291

Application number
EP 81 20 0541

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	FR - A - 1 480 896 (RANK XEROX LTD.) * page 2, column 1, lines 10-40; figures 1,2 * --	1,5	G 03 G 13/26
A	US - A - 3 999 481 (J.G. SANKUS JR.) * column 2, line 38; column 3, line 37; figures 1-10 * --	1,5	TECHNICAL FIELDS SEARCHED (Int. Cl.)
A	DE - A - 2 539 025 (RESEARCH LABORATORIES OF AUSTRALIA) * claim 1 * --	1	G 03 G 13/22 13/26 13/28 13/32 B 41 C 1/10 1/14
A	US - A - 3 361 058 (M. MICHALCHIK) * figures 1-5 * -----	1,5	CATEGORY OF CITED DOCUMENTS
X The present search report has been drawn up for all claims.			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document
Place of search The Hague		Date of completion of the search 27-08-1981	Examiner BOEYKENS