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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G03C 1/74	A1	(11) International Publication Number: WO 94/08272
		(43) International Publication Date: 14 April 1994 (14.04.94)

(21) International Application Number: PCT/US92/08487

(22) International Filing Date: 5 October 1992 (05.10.92)

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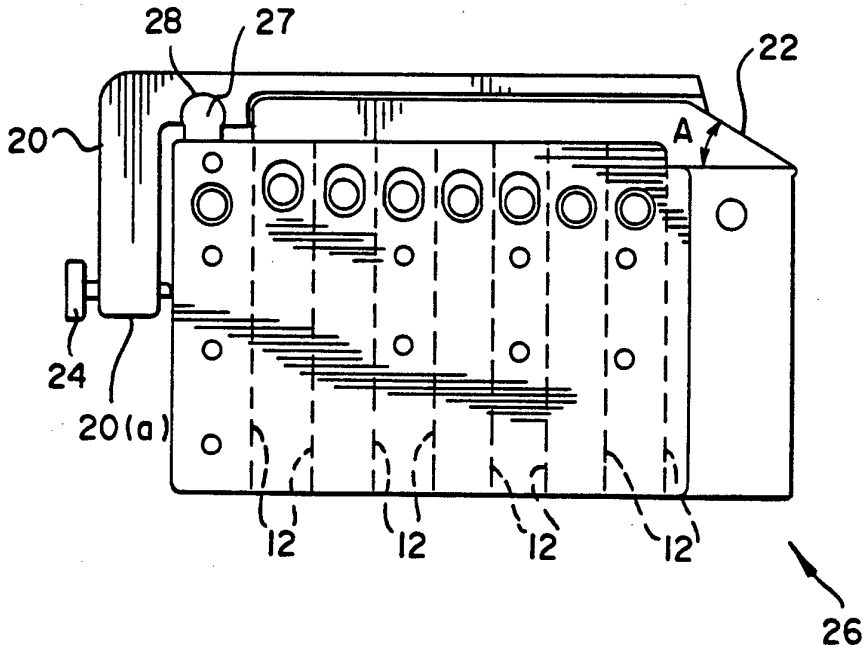
(81) Designated States: AU, JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE).

Published
With international search report.

(54) Title: HOPPER EDGE GUIDE SYSTEM



(57) Abstract

A method and apparatus for guiding multiple layers of a liquid down a hopper slide (23) surface are disclosed. The continuous edge guide includes an edger arm (20) extending across the length of the slide surface (23) and having a side facing the slide surface (23). A continuous edge pad (22) is abutted to the contact side which sealingly mates with the slide surface (23). The continuous edge guide is capable of being positioned anywhere across the width of the slide surface. In one embodiment biasing means (31) are positioned along the edger arm to force the edge pad into contact with the slide surface. In an alternate embodiment, the edge pad has a slot at a point above the first or second hopper element to provide good contact between the edge pad and slide surface.

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HOPPER EDGE GUIDE SYSTEM

Field of the Invention

The present invention concerns coating multiple layers of material onto a moving substrate. More specifically, the present invention teaches a method and apparatus for coating multiple layers of photographic materials onto a photographic support.

Background of the Invention

In the coating of photographic layers onto a support such as film base or paper, a number of individual layers are coated onto the support by means of a coating hopper. One type of coating hopper is known as the multiple slide hopper, which is composed of individual slide elements separated by slots and cavities. By introducing the individual coating liquids into separate cavities, the liquids are distributed to the desired width in a uniform fashion by flowing through the separate narrow slots. Upon exiting the slots, the layers flow down the slide surface by gravity. Layers of different coating liquids become superimposed on one another as layers from upstream slots flow over layers from the downstream slots. It is often advantageous to have steps between adjacent slide elements. These steps or slide offsets generally range from 0.005-0.100 inches. At the end of the slide surface at a lip, the superimposed layers of liquid coating flow off of the slide surface and are coated onto the moving web.

In general, the width of the coating layers can be less than the width of the hopper slide or web to be coated. It is generally necessary to provide some means of lateral confinement of the coating liquids on the hopper slide in order to achieve the desired width of coating layers on the web. Confining the liquid layers on the hopper slide is achieved by

devices known in the art as edge guides. Preferably, edge guides should be designed such that surface tension or inertial effects do not create non-uniformities in the thickness of the layers of the coating composition in the longitudinal (parallel to direction of web travel) edge portions. Such non-uniformities in the coated layers can be a cause of coated waste or problems in drying the longitudinal edge portions of the coating as well as problems in conveying or winding the coated support.

The prior art of edge guides is exemplified by U.S. Patent 3,289,632 (Barstow) and German Patent 3,037,612 A1 (Koepke et al). There are several problems associated with the technology that is described in these patents. In particular, the edge guides described by these patents do not comprise a method for achieving widthwise adjustability of the edge guides on the hopper surface, which is important in minimizing coated waste in an operation where a variety of products are coated that have different finished dimensions. The current technology also lacks a method for insuring that the edge guides are held down on the hopper face in such a way as to prevent excessive leakage under the edge guides, which can cause manufacturing or product quality problems. Furthermore, the edge guides described in the aforementioned prior art are not capable of accommodating differences in height between the different slide elements, known as slide offsets, in a continuous, integral manner.

Summary of the Invention

A hopper edge guide system is described for use in a slide hopper having a plurality of hopper elements forming a slide surface terminating at a lip. The hopper edge guide system includes an edger arm extending along the length of the slide surface and

having a contact side facing the slide surface. An edge pad is abutted to the contact side of the edger arm and mates with the slide surface to form an effective seal against leakage under the edge pad. The edger arm is adjustably positionable across the width of the slide surface. In one embodiment of the edge guide the edger arms are relieved at a point over the second hopper element from the lip. A plurality of biasing means are positioned along the edger arm which exert compressive force on the edge pad to provide a leak proof seal between the slide surface and the edge pad.

In an alternate embodiment the edge pad comprises a slot above the first or second hopper element from the lip which provides proper mating with the slide surface by accommodating various steps in the slide surface.

The edge pad of the present invention forms a vertical wall perpendicular to the slide surface. This wall is the restraining surface for the lateral edge of the composition flowing on the slide. Above the vertical wall is a surface inclined at an angle of about 10° to about 20° above the horizontal. The edge pad forms an angle of between about 15° to about 30° from the slide surface at the lip of the hopper.

Brief Description of the Drawings

FIG. 1 shows a cross-sectional view of a multiple layer hopper system used for bead coating a support.

FIG. 2 shows a top view of the adjustable edge guide of the present invention.

FIG. 3 shows a side view of the adjustable edge guide of the present invention.

FIG. 4 shows a side view of the continuous edge pad used in the present invention.

FIG. 5 shows a top view of the continuous edge pad used in the present invention.

FIG. 6 shows a side view of the edger arm used in the present invention.

FIG. 7 shows a top view of the edger arm used in the present invention.

FIG. 8 shows a side view of an alternative embodiment of the continuous edge pad of the present invention.

FIG. 9 shows a cross-sectional view of the continuous edge guide and coating composition on a hopper slide.

FIG. 10 shows the optical density versus widthwise distance for a coating composition whose thickness is 1.17 times the height of the vertical wall of the edge pad on the hopper slide.

FIG. 11 shows the optical density versus widthwise distance for a coating composition whose thickness is 0.43 times the height of the vertical wall of the edge pad on the hopper slide.

FIG. 12 shows the optical density versus widthwise distance for a coating composition whose thickness is 1.75 times the height of the vertical wall of the edge pad on the hopper slide.

For a better understanding of the present invention together with other objects, advantages and capabilities thereof, reference is made to the following description and appended claims in connection with the above-identified drawing.

Description of the Preferred Embodiment

This section provides a detailed description of the continuous edge guide system. Widthwise coating thickness measurements that demonstrate the need to judiciously design the edge pad are also provided.

FIG. 1 shows a multilayer coating hopper 10 having three hopper slide elements 11 separated by

hopper slots 12 which provide coating liquid from cavities 13. The coating liquids flow through slots 12 and down the slide surfaces 23 superimposed on each other. In FIG. 1 a bead coater is shown although the present invention works equally well for curtain coating hoppers.

FIGS. 2 and 3 show an assembly of the continuous edge guide system for a coating hopper that has eight slots 12. As shown in FIGS. 2 and 3, the system comprises a pair of stainless steel edger arms 20 and each having a continuous edge pad 22. The stainless steel edger arm 20 mates with the continuous edge pad 22 and holds the continuous edge pad 22 securely to the slide surfaces 23. Edger arms 20 each comprise a downwardly extended crank portion 20(a) through which a thrust screw 24 contacts the back of the hopper 26 to apply a biasing force to edge pad 22.

The cylindrical bar or gib 27 acts as a pivot point so that as screw 24 is tightened, the edger arm 20 pivots toward the surface of the hopper forcing the edge pad 22 into contact with the slide surface. Thus, it is not necessary to attach the edge pads 22 to the hopper surface through the use of screws or some other method that would involve drilling holes on the hopper slide surface. The edger arm 20 and edge pad 22 are positioned on the hopper by mounting the edger arm 22 on the gib as shown in FIG. 3. A mounting opening 28 in the edger arm 20 is slightly more than half round such that the edger arm is captured by the gib 27. The edge pad 22 is not attached or fastened to the slide surface directly. It is held in position through the force of edger arm 20. The edge pad 22 is positioned under the edger arm 20 by adjoining the top rib of the edge pad to the outboard face of the edger arm which is perpendicular to the slide surface. This is shown in FIG 9. The arm 20 is free to move across the width of the hopper when the screw 24 is loosened which enables

the continuous edge pad to define virtually any coating width that is desired. This widthwise adjustability is important in minimizing coated waste in an operation where a variety of products are coated that have different finished dimensions.

A detailed drawing of the continuous edge pad is shown in FIGS. 4 and 5. The continuous edge pad 22 mates precisely with the hopper slide surface. The edge pad can be fabricated by a machining process. The edge pad material can be a mica-filled fluoropolymer (trade name FLUOROSINT®, available from Polymer Corporation) selected for its machining, stability, and wetting properties. However, other polymeric materials or metals such as stainless steel could be used, and it is envisioned that other fabrication techniques, such as moulding or casting could also be employed.

As the name suggests, the continuous edge pad provides a continuous, integral, lateral confinement of the coating liquids on the hopper slide. This is an improvement over systems in which individual edge pads or guides are used for each hopper element because it avoids discontinuities in the confining surface that could introduce flow disturbances that may cause layer thickness variations in the coated film.

Discontinuities in the confining surface can also be a source of leakage of coating liquids outboard of the coating width. Such leakage can cause manufacturing problems especially if the leakage contacts the coated support or coating roll or congeals on the hopper slide and edge pad surfaces and causes flow disturbances. The continuous edge pad is capable of providing continuous confinement of the coating liquid even when the various slide elements are at different heights. These slide element offsets, as they are known in the art, are often employed to achieve the proper flow field in the vicinity of the hopper slot exit in order to avoid layer thickness non-

uniformities. These offsets are shown more clearly in FIG. 8.

Two preferred embodiments will now be discussed that improve the mating of the continuous edge pad to the hopper slide surface as well as improve the manufacturing process for the continuous edge pad. The fabrication of the edge pad requires great precision. The edge pad must be machined to precisely mate with the hopper slide surface and edger arm. If the edge pad is not machined properly, it is possible for coating liquids to leak underneath the edge pad. Such leakage represents a serious manufacturing problem since the leakage can readily contaminate the coating roll and cause coating imperfections or even contaminate the coated web itself. Without the preferred embodiments, it is generally necessary to custom fit a particular edge pad to a particular hopper. It is, therefore, generally not possible to fabricate an edge pad directly from a blueprint. Rather, the hopper must be sent to the machine shop so the edge pad can be custom fitted to the hopper. This results in the hopper not being available for production, significant costs involved in transporting the hopper to the machine shop, and the risk of possible damage to the hopper in transport or during fitting of the edge pads.

In the first preferred embodiment the edger arm is relieved or undercut beginning at the point where the edger arm would meet the edge pad over the second hopper element from the lip and extending toward gib 27 along the length of the arm where it would contact the edge pad. This is shown in FIGS. 6 and 7, which is a detailed drawing of the edger arm. The edger arm is relieved at 40 by 0.010" to 0.100". Where the edger arm has been relieved, holes 50 for the ball spring plungers (not shown) are installed in the arm at locations roughly corresponding to the center of each

hopper element when the arm is in place. This is shown in FIG. 2. The ball spring plungers 51 insure contact between the edger arm and pad and provide maximum force to hold the edge pad down on the hopper surface. The relief 40 allows the ball spring plungers to compress or relax to compensate for any deviation in the thickness of the edge pad. Thus, the fabrication tolerances on the edge pad are increased significantly, allowing for the pad to be fabricated without custom fitting it to the hopper.

In the second preferred embodiment the top rib 22(a) of the edge pad 22 is slotted at the point at which the pad is over the first two slide elements 12 when the pad is placed on the hopper. This is shown in FIG. 8. This thin slot 80 allows the edge pad 22 to flex under the pressure of the edger arm 20 to allow good contact between the edge pad 22 and hopper slide surface even when there is variability in the position of the first hopper slide element from the lip with respect to the rest of the hopper elements, which sometimes occurs as the hopper is disassembled and reassembled. This embodiment insures a good contact between the edge pad and the most downstream hopper slide element. Good contact between the edge pad and most downstream hopper slide element is essential because excessive leakage of coating liquid underneath the edge pad in this area can easily cause problems in manufacturing if the leakage contacts the coating roll or web. This embodiment makes it possible to accommodate variability in the vertical offset between the first two hopper elements of as much as 0.004".

FIG. 9 shows a cross-sectional view of the continuous edge pad 22 and the coating liquids 60 as they flow down the hopper slide 61 taken along line 9-9 of FIG. 8. There are several design features that are incorporated in the continuous edge pad that insure that surface tension or inertial effects do not create

excessive layer non-uniformities in the longitudinal edge portions of the coated layers. As shown in FIG. 9, the coating liquids 60 are actually confined by the continuous edge pad 22 at a vertical wall 63 that is perpendicular to the slide surface 61. Above the vertical wall is a land surface 64 that is inclined at an angle, B, from a horizontal in a plane parallel to the slide surface. The angle B is preferably in the range of 10 to 20 degrees in order to discourage significant capillary wicking and provide a controlled wetting line of the coating liquids at the top of the vertical wall should the thickness of the coating liquids on the slide exceed the vertical wall height. As shown in FIG 8 the front of the edge pad near the hopper lip is fabricated to an angle, A, of preferably 15 to 30 degrees from the hopper slide surface. This range of angles prevents significant capillary wicking on the angled front of the pad that may cause an excess of coating thickness in the extreme longitudinal edge portions. The edge pad 22 is held in place by the edger arm 20 as shown in FIG. 8.

The height of the vertical wall 63 relative to the thickness of the coating liquids on the hopper slide is an important parameter in determining the uniformity of the thickness of the coated layers in the two longitudinal edge portions. While it is recognized that exactly matching the vertical wall height to the thickness of the coating solution is ideal, this is not generally possible in practical situations. It has been found, surprisingly, that good uniformity in the thickness of the coated layers is obtained when the vertical wall height is in the range of being about 30% higher to about 20% lower than the thickness of the coating liquids on each hopper slide element. Thus, one pad can be used for a range of different coating conditions or products. However, if the vertical wall is too high, the coating liquids will flow by surface

tension forces up along the vertical wall. This creates a situation in which there is a sharp increase in the thickness of the coated layers in the immediate vicinity of the wall followed by a decrease in thickness in the adjacent portion of the coated film. In this situation, there can be significant layer thickness non-uniformity in the longitudinal edge portions of the coating. In addition, the area of increased coating thickness next to the vertical wall is difficult to subsequently dry. This can result in contamination problems or other problems in conveying or winding the coated web. If the vertical wall is too low, the coating liquids can overflow the vertical wall and flow down the land surface of the edge pad. This situation is not desirable since it can lead to layer thickness non-uniformities in the longitudinal edge portions of the coating. In addition, overflowing the vertical wall represents a less controlled situation and is prone to problems with the coating liquids congealing on the land surface over time, which can lead to layer thickness non-uniformities or other manufacturing problems.

The importance of judiciously selecting the vertical wall height relative to the thickness of the coating liquid on the hopper slide is illustrated in the following Examples.

Example 1

A three layer bead coating was made at a speed of 300 feet per minute. The coating liquids consisted of aqueous gelatin solutions at the following flow rates and viscosities:

COATING LIQUID	VISCOSITY(cP)	FLOW RATE ($cm^3/cm/s$)
Bottom	5.4	0.72
Middle	17.3	0.195
Top	36.4	0.195

The bottom layer contained a carbon slurry to add optical density, which allowed coated layer thickness measurements to be made by a microdensitometer. An appropriate surfactant was added to the top layer.

In this example, an edge pad was employed in which the vertical wall height on the bottom slide element of the hopper was about 15% less than the thickness of the three layers on that element. FIG. 10 shows a densitometric trace of the coated film taken in the widthwise direction. Since the upper two layers contained only clear gelatin, the density trace closely approximates the widthwise film thickness profile of the bottom layer. The general shape of the densitometric profile shows the so-called "edge bead" on the longitudinal edge portion of this 9 inch wide coating. It can be seen from this trace that the bottom layer thickness is quite uniform in the longitudinal edge portion of the coating. The bottom layer thickness non-uniformity extends only about 0.28 inches from the absolute longitudinal edge of the coating.

Example 2

In this example, all conditions were the same as Example 1 except the vertical edge pad height on the bottom slide element was changed to a height that was about 130% greater than the thickness of the coating liquids on that slide element. The corresponding

densitometric trace is shown in FIG. 11. The thickness of the bottom layer in the extreme longitudinal experimental edge portion is nearly twice that of the center portion of the coating. Significant layer non-uniformity exists up to 1.0 inches from the absolute longitudinal edge of the coating.

Example 3

In this example, all conditions were the same as Example 1 except the vertical edge pad height on the bottom slide element was changed to a height that was about 60% of the thickness of the liquid layers on that slide element. The corresponding densitometric trace is shown in FIG. 12. The bottom layer non-uniformity extends 0.5 inches from the absolute longitudinal edge of the coating. It was observed that the coating liquids overflowed the vertical wall on the bottom slide element.

The edger arm and continuous edge pad of the present invention can be used in a curtain coating operation. U.S. Patent 3,632,403 describes the curtain coating apparatus and process. Since the hoppers used in a curtain coating operation are similar to those used in a bead coating operation, the edger arm and continuous edge pad of the present invention work just as well in either situation.

While there has been shown and described what are at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various alterations and modifications may be made therein without departing from the scope of the invention.

What is Claimed is:

1. A hopper edge guide system for use in a slide hopper having a plurality of hopper elements forming a slide surface terminating at a lip comprising:

at least one edger arm extending along the length of the slide surface; the edger arm having a contact side facing the slide surface, the contact side being relieved at a point over the second hopper element from the lip;

a continuous edge pad abutted to the contact side of the edger arm and sealingly mating along the length of the slide surface; and

adjustable mounting means for positioning the edger arm across the width of the slide surface.

2. The hopper edge guide system according to claim 1 further comprising:

a plurality of biasing means positioned along the edger arm so that the biasing means exert force on the edge pad.

3. The hopper edge guide system according to claim 2 wherein each one of the plurality of biasing means is positioned approximately over the center of one of the plurality of hopper elements.

4. The hopper edge guide system according to claim 2 wherein the plurality of biasing means are ball spring plungers.

5. The hopper edge guide system according to claim 1 wherein the edger arm is relieved to a depth of between about 0.01 inch to about 0.10 inch at a point over the second hopper element from the lip.

6. The hopper edge guide system according to claim 1 wherein the adjustable mounting means comprises:

a bar positioned near the rear on the slide hopper extending thereacross in a widthwise direction; and

a thrust screw extending through a rear portion of the edger arm wherein the edger arm couples with the bar such that when the thrust screw is tightened the thrust screw contacts the rear of the hopper thereby forcing the edge pad into contact with the slide surface.

7. The hopper edge guide system according to claim 1 wherein the edger arm is made of stainless steel.

8. The hopper edge guide system according to claim 1 wherein the edge pad is made of a mica-filled fluoropolymer.

9. The hopper edge guide system according to claim 1 wherein the edger arm and edge pad terminate at an angle of between about 15° to about 30° from the slide surface at the lip.

10. The hopper edge guide system according to claim 1 wherein the edge pad forms a vertical wall that is perpendicular to and extends along the length of the slide surface.

11. The hopper edge guide system according to claim 1 wherein the edge pad forms a vertical wall of a predetermined height that is perpendicular to and extends along the length of the slide surface and above the vertical wall the edge pad forms a surface inclined

at an angle from the plane of the slide surface of between about 10° to about 20°.

12. The hopper edge guide system according to claim 11 wherein the height of the vertical wall is in the range of between about 80% to about 130% of a thickness of a coating liquid on each hopper element.

13. A hopper edge guide system for use in a slide hopper having a plurality of hopper elements forming a slide surface terminating at a lip comprising:

an edger arm extending along the length of the slide surface, the edger arm having a contact side facing the slide surface;

a continuous edge pad abutted to the contact side of the edger arm and sealingly mating with and over the length of the slide surface, the edge pad having a slot at the first or second hopper element from the lip and approximately perpendicular to the slide surface; and

adjustable mounting means for positioning the edger arm across the width of the slide surface.

14. The hopper edge guide system according to claim 13 wherein the adjustable mounting means comprises:

a bar positioned near the rear on the slide hopper extending thereacross in a widthwise direction; and

a thrust screw extending through a rear portion of the edger arm wherein the edger arm couples with the bar such that when the thrust screw is tightened the thrust screw contacts the rear of the hopper thereby forcing the edge pad into contact with the slide surface.

15. The hopper edge guide system according to claim 13 wherein the edger arm is made of stainless steel.

16. The hopper edge guide system according to claim 13 wherein the edge pad is made of a mica-filled fluoropolymer.

17. The hopper edge guide system according to claim 13 wherein the edger arm and edge pad terminate at an angle of between about 15° to about 30° from the slide surface at the lip.

18. The hopper edge guide system according to claim 13 wherein the edge pad forms a vertical wall that is perpendicular to and extends along the length of the slide surface.

19. The hopper edge guide system according to claim 13 wherein the edge pad forms a vertical wall of a predetermined height that is perpendicular to and extends along the length of the slide surface and above the vertical wall the edge pad forms a surface inclined at an angle from the plane of the slide surface of between about 10° to about 20°.

20. The hopper edge guide system according to claim 19 wherein the height of the vertical wall is in the range of between about 80% to about 130% of a thickness of coating liquid on each hopper element.

21. A method for guiding an edge of one or more layers of a coating liquid moving down a slide hopper having a plurality of hopper elements forming a slide surface terminating at a lip comprising:

providing an edger arm which extends along the length of the slide surface and has a contact side

facing the slide surface wherein the contact side is relieved at a point over the first or second hopper element from the lip of the slide surface;

providing an edge pad abutted to the contact side of the edger arm and sealingly mating along the length of the slide surface; and

mounting the edger arm at a predetermined point across the width of the slide surface.

22. A method for guiding an edge of one of more layers of a coating liquid moving down a slide hopper having a plurality of hopper elements forming a slide surface terminating at a lip comprising:

providing an edger arm which extends along the length of the slide surface and terminates at the lip, the edger arm having a contact side facing the slide surface, the edge pad having a slot at a point over the first or second hopper element from the lip and approximately perpendicular to the slide surface;

providing an edge pad abutted to the contact side of the edger arm and sealingly mating along the length of the slide surface; and

mounting the edger arm at a predetermined point across the width of the slide surface.

23. A hopper edge guide system for use in a slide hopper having a plurality of hopper elements forming a slide surface terminating at a lip comprising

at least one edger arm extending along the length of the slide surface, the edger arm having a contact side facing the slide surface

a continuous edge pad abutted to the contact side of the edger arm and sealingly mating along the length of the slide surface; and

adjustable mounting means for positioning the edger arm across the width of the slide surface.

24. The hopper edge guide system according to claim 23 further comprising

a plurality of biasing means positioned along the edger arm so that the biasing means exert force on the edge pad.

25. The hopper edge guide system according to claim 24 wherein each of the plurality of biasing means is positioned approximately over the center of one of the plurality of hopper elements.

26. The hopper edge guide system according to claim 24 wherein the plurality of biasing means are ball spring plungers.

27. The hopper edge guide system according to claim 23 wherein the mounting means comprises:

a bar positioned near the rear on the slide hopper extending thereacross in a widthwise direction; and

a thrust screw extending through a rear portion of the edger arm wherein the edger arm couples with the bar such that when the thrust screw is tightened the thrust screw contacts the rear of the hopper thereby forcing the edge pad into contact with the slide surface.

28. The hopper edge guide system according to claim 23 wherein the edger arm is made of stainless steel.

29. The hopper edge guide system according to claim 23 wherein the edge pad is made of a mica-filled fluoropolymer.

30. The hopper edge guide system according to claim 23 wherein the edger arm and edge pad

terminate at an angle of between about 15° to about 30° from the slide surface at the lip.

31. The hopper edge guide according to claim 23 wherein the edge pad forms a vertical wall that is perpendicular to and extends along the length of the slide surface.

32. The hopper edge guide system according to claim 23 wherein the edge pad forms a vertical wall of a predetermined height that is perpendicular to and extends along the length of the slide surface and above the vertical wall the edge pad forms a surface inclined at an angle the horizontal plane of the slide surface of between about 10° to about 20°.

33. The hopper edge guide system according to claim 32 wherein the height of the vertical wall is in the range of between about 80% to about 130% of a thickness of a coating pack on each hopper element.

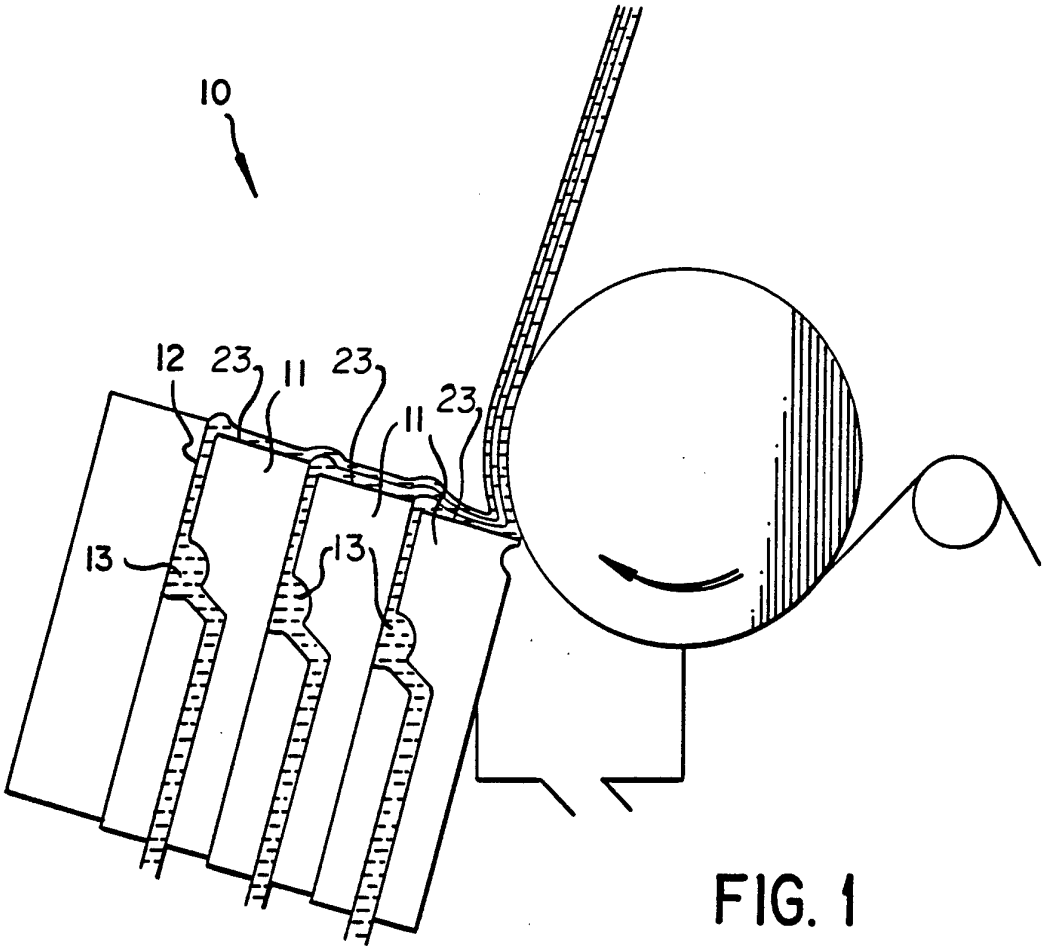
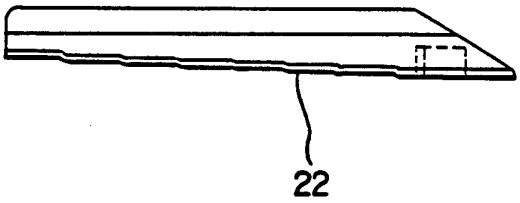


FIG. 1

FIG. 4



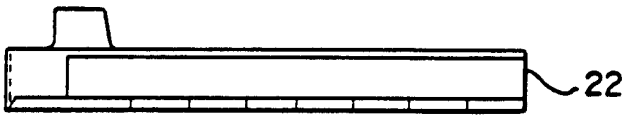


FIG. 5

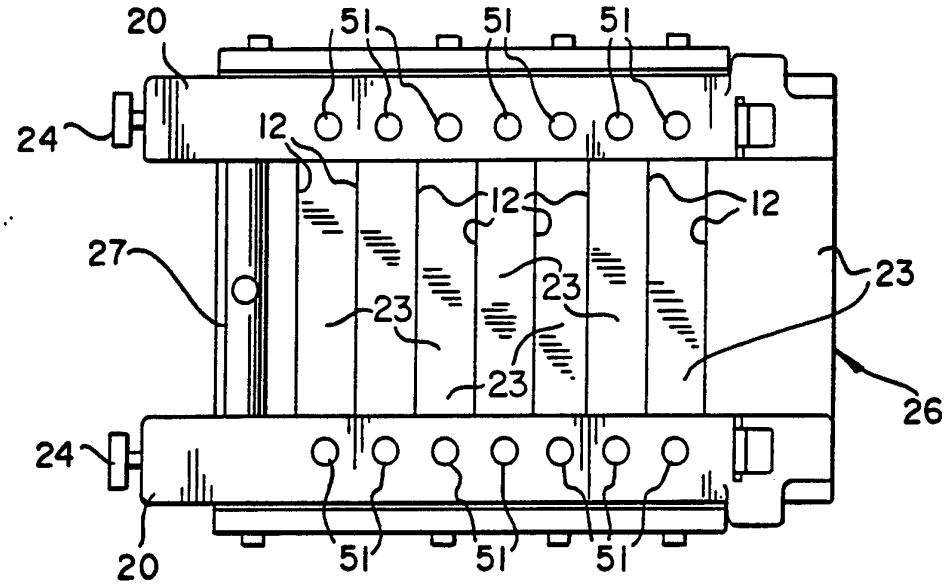

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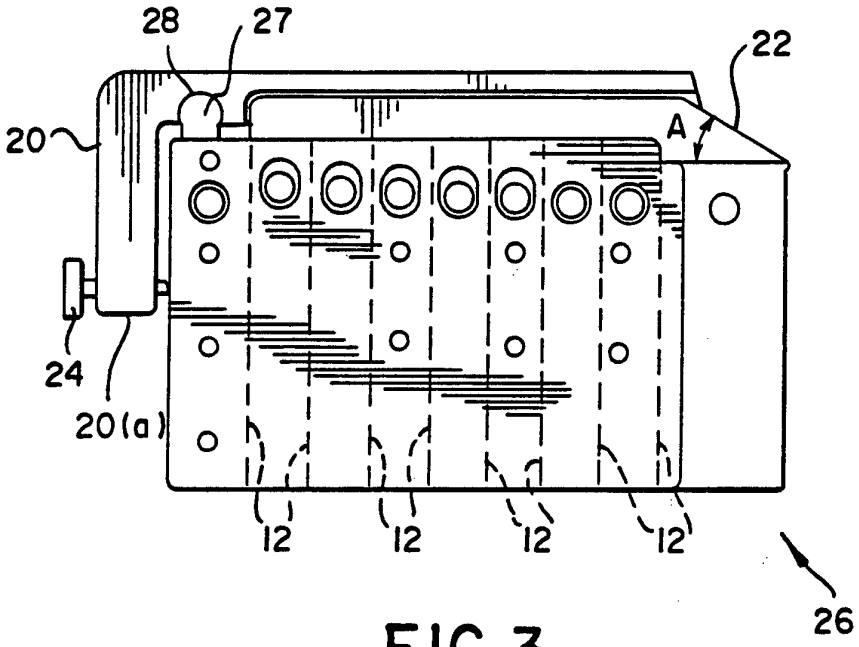
FIG. 2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20(a)
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12
26

FIG. 3

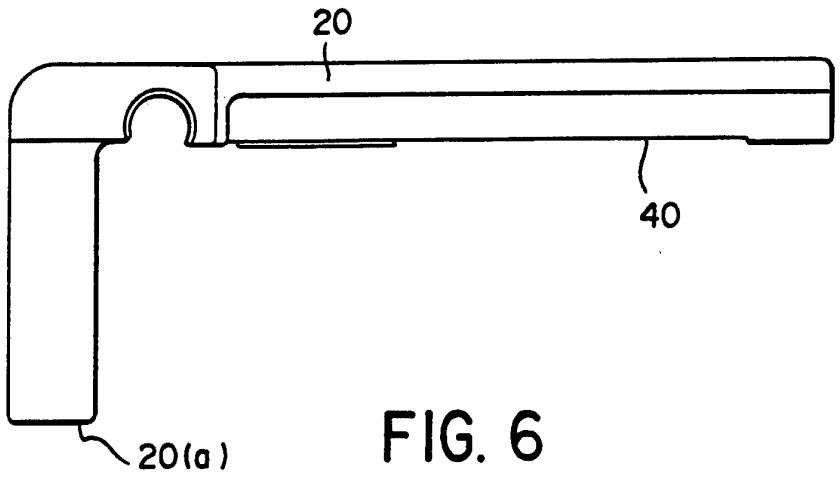

FIG. 6

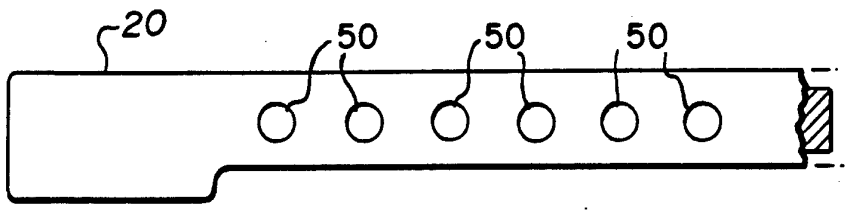

FIG. 7

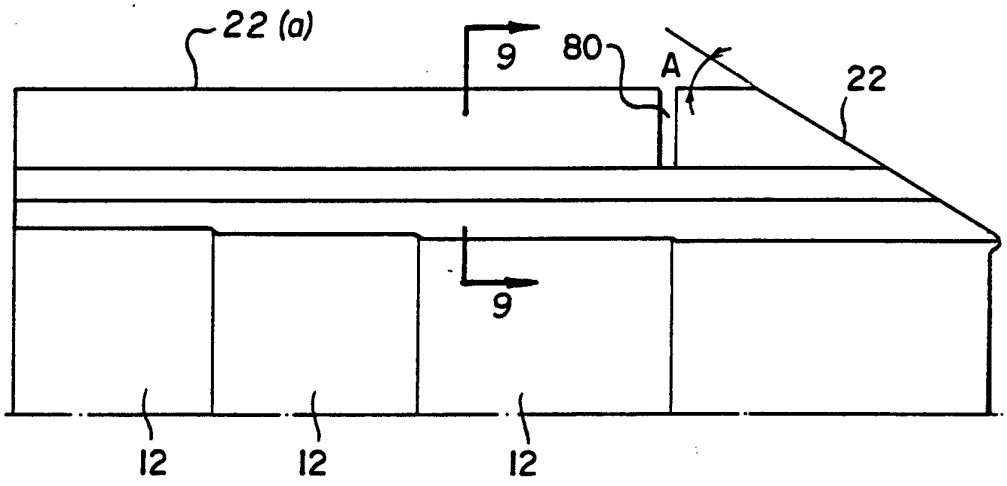

FIG. 8

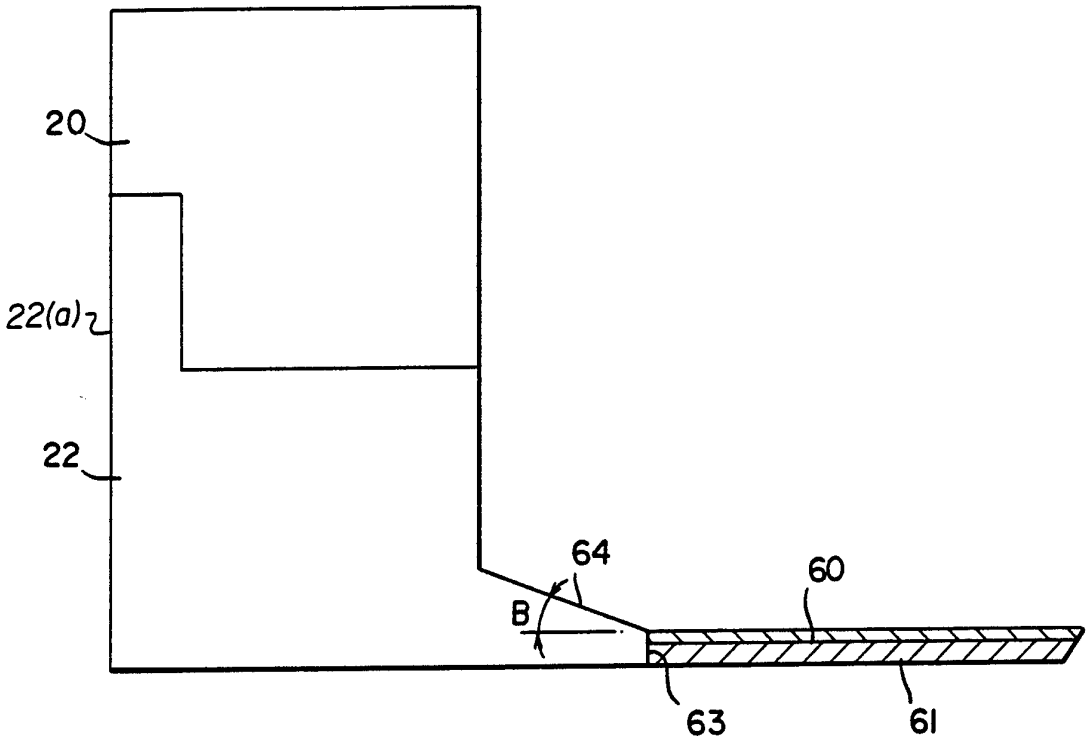
20
22(a)
22
64
B
60
63
61

FIG. 9

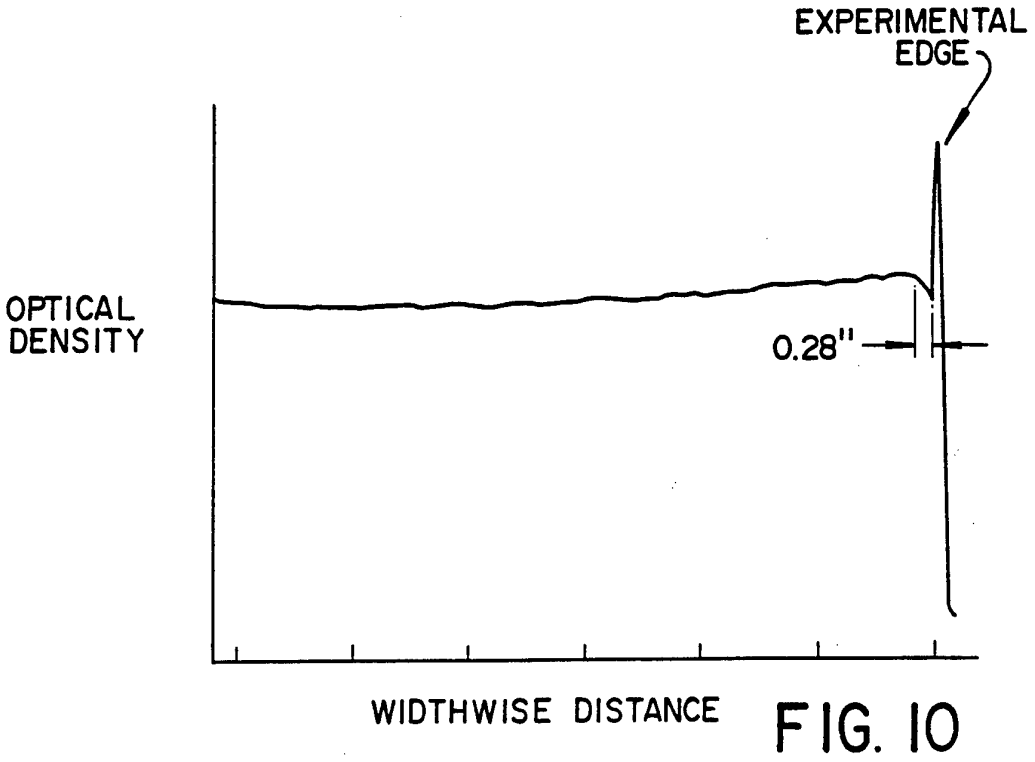
EXPERIMENTAL EDGE
OPTICAL DENSITY
0.28"
WIDTHWISE DISTANCE

FIG. 10

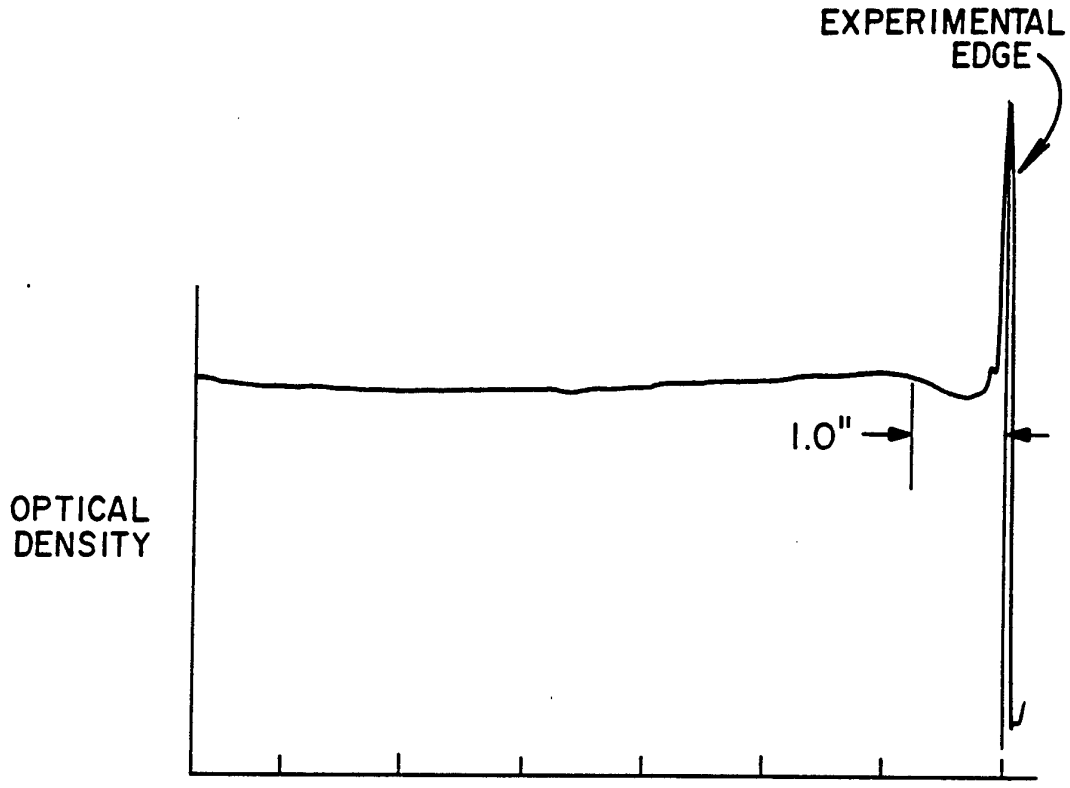
EXPERIMENTAL
EDGE
1.0"
OPTICAL
DENSITY
WIDTHWISE DISTANCE

FIG. 11

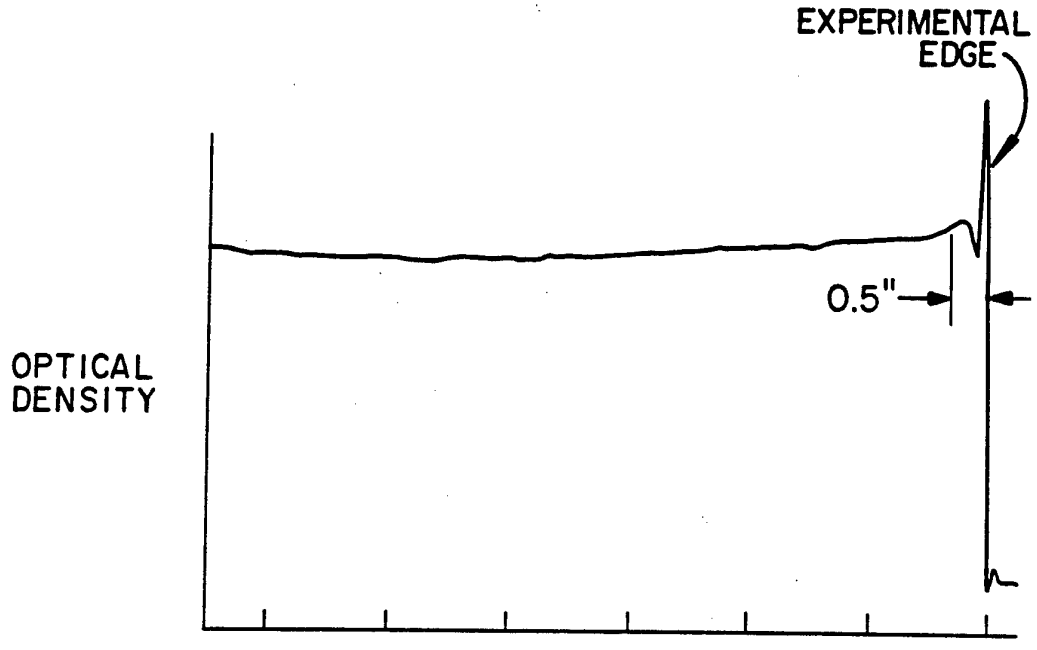
EXPERIMENTAL
EDGE
0.5"
OPTICAL
DENSITY
WIDTHWISE DISTANCE

FIG. 12

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 92/08487

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G03C1/74

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G03C ; B05C

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 °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	DE,A,3 037 612 (AGFA-GEVAERT AG) 13 May 1982 cited in the application see figures 1-3	1-33
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 111 (C-577)16 March 1989 & JP,A,63 287 575 (FUJI PHOTO FILM CO LTD) 24 November 1988 see abstract	1-33
A	EP,A,0 313 043 (FUJI PHOTO FILM CO., LTD.) 26 April 1989 see figure 6	1-33
A	GB,A,2 037 189 (FUJI PHOTO FILM CO,. LTD.) 9 July 1980 see figure 2	1-33

-/--

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"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

"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

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
26 MAY 1993	06. [illegible]
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	BARATHE R.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 92/08487

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	EP,A,0 018 029 (AGFA-GEVAERT NAAMLOZE VENNOOTSCHAP) 29 October 1980 see page 6, line 16 - line 28 see figure 3 see page 8, line 33 - page 9, line 7	1-33
A	EP,A,0 003 860 (AGFA-GEVAERT NAAMLOZE VENNOOTSCHAP) 5 September 1979 see figure 8	1-33
A	DE,C,3 621 417 (FLACHGLAS AG) 6 August 1987 see figure	1-33

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

US 9208487
SA 65558

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 26/05/93

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-A-3037612	13-05-82	JP-C-	1714916	27-11-92
		JP-B-	3071185	12-11-91
		JP-A-	57110364	09-07-82
EP-A-0313043	26-04-89	JP-A-	1231962	18-09-89
		US-A-	4977852	18-12-90
		US-A-	4976999	11-12-90
GB-A-2037189	09-07-80	JP-C-	1187707	30-01-84
		JP-A-	55084577	25-06-80
		JP-B-	58022266	07-05-83
		DE-A,C	2950947	10-07-80
		US-A-	4297396	27-10-81
EP-A-0018029	29-10-80	CA-A-	1140001	25-01-83
		JP-C-	1567743	10-07-90
		JP-A-	55139865	01-11-80
		JP-B-	63032511	30-06-88
		US-A-	4313980	02-02-82
EP-A-0003860	05-09-79	US-A-	4233346	11-11-80
DE-C-3621417	06-08-87	AT-B-	395685	25-02-93
		NL-A-	8701454	18-01-88