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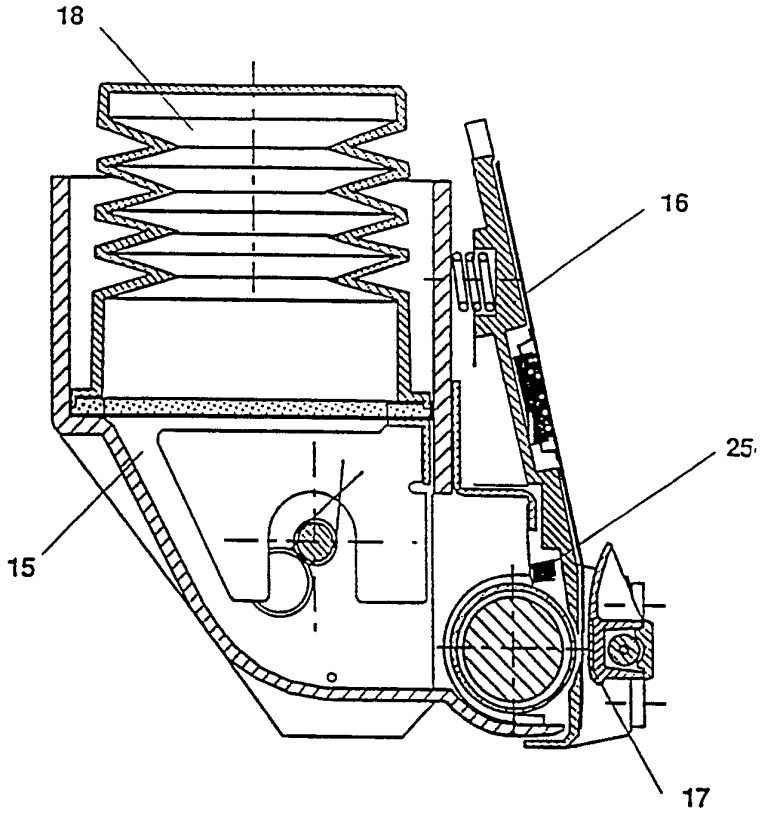
(57) Abstract

Method and device for improving the printing performance of electro-graphic printers, in which are produced a latent electrical charge pattern of electric signals by means of an electrode matrix or the like, which temporarily produces electrical fields for attraction of pigment particles (11) towards an information carrier (7). The electrodes (1, 2) of the electrode matrix during at least a part of the break time between the activation periods are exposed to a field of force which transports the pigment particles (11) in a direction from the electrodes.



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A METHOD FOR IMPROVING PRINTING PERFORMANCE FOR PRINTERS AND A DEVICE FOR ACCOMPLISHING THE METHOD.

The invention refers to a method of improving the printing performance of electro-graphic printers, in which are produced a latent electrical charge pattern of electric signals by means of an electrode matrix or the like, which temporarily produces electrical fields for attraction of pigment particles towards an information carrier.

BACKGROUND OF THE INVENTION

In the international patent application PCT/SE88/00653 is shown a method to develop pictures and text with pigment particles on an information carrier, directly from computer generated electric signals, without need for these signals to be intermediately stored at a temporary conversion to light energy, which is the case for photo conductive printers, eg. laser printers. These problems have been solved by bringing the information carrier into electrical cooperation with at least a screen or a lattice-shaped matrix, preferably an electrode matrix, which by control in accordance to the configuration of the desired pattern at least partly opens and closes passages through the matrix, which is galvanically connected to at least one voltage source. Through thus opened passages an electrical field is exposed for attraction of the pigment particles towards the information carrier.

This method (in the following called the EMS- Concept), as it is described in the above patent application, however can result in that the produced printing does not show high quality enough, especially at repeated and continous use.

A problem which can occur at repeated and continous use of devices according to the EMS- Concept, is that electrodes of the electrode matrix gradually become covered with toner.

This gradual covering in itself does not necessarily bring about any degrading av the quality of the print, but under certain circumstances it may degenerate in certain meshes are stopped up, whereby the print becomes uneven and bleached, or that too large toner quantities are deposited to the paper, whereby the definition disappears and the blackness of the print becomes to high.

Another problem, which has shown at the development of the EMS-concept, concerns the magnetic field which normally is required for transport of toner from its container to the immediate proximity of the electrode matrix. The most common method when using magnetic toners is to let the roller which shall transport toner (in the following called developing roller) surround a core with several magnetic poles, the magnetic flow of which is substantially directed ortogonal to the length axis of the roller. Since commercially available developers nearly exclusively are used in photoconductive printers and copiers the poles of the magnetic cores have been dimensioned and oriented such that the development of toner, shall be as favourable as possible during the short part of the periphery of the envelope surface of the developing roller, which is considered in this type of device. Several embodiments of the EMS-concept are based on multiple line electrode matrices where development must be possible along a longer path on the periphery of the developing roller than what is the case in photoconductive processes. The extension of the electrode matrix in certain cases may demand a ten times longer path. When using the design of magnetic poles which is common today, the printing in the mesh lines which are situated furthest from the center, on the magnetic pole in which proximity the development is intended to take place, will be weaker or not appear at all as a result of a non optimal magnetic field pattern in these areas. Further the curvature of the envelope surface of the developing roller often cooperates with these non

optimal magnetic forces in an unfavourable way, so that the conditions for good printing quality further are degraded at the outermost lines of the electrode matrix.

These described problems are not limited to ther EMS-concept but are found wholly or partially, in several electrographic printer concepts, where passages are created in an electric way.

Common to all problems described here and drawbacks of known technique is that the printing quality and thereby the readability is influenced in a negative direction, with reduced competitiveness and lower consumer value as a result.

THE OBJECT OF THE INVENTION AND MOST IMPORTANT FEATURES

The object of the invention is to create a method which gives the EMS and other electrographic printer concepts, high quality prints with good readability even during such circumstances when the device operates continously without maintenance and service. These problems have been solved by the electrodes of the electrode matrix at least during a part of the break time between activation periods being exposed for a force field which transports the pigment particles in direction from the electrodes.

DESCRIPTION OF THE DRAWINGS

The invention will be described in greater detail with reference to accompanying drawings on which embodiments are shown.

Fig. 1 shows in perspective view a developer provided with a print head and a bellow formed toner container for vacuum cleaning of the electrode matrix.

Fig. 2 shows a section through a developer with mounted print head according to fig. 1.

Fig. 3 shows a section through a modified developer with a mounted printhead and rotatable bellow formed container for toner.

Fig. 4 shows a section through a further embodiment of a developer with printhead according to fig. 2 the bellow shaped toner container of which is comprimated by a rotatable excenter device.
Fig. 5 shows the developer according to fig. 4 the bellow shaped toner container of which is decomprimated.

Fig. 6 shows a section through a plate electrode with retainer intended for blowing and /or vacuum cleaning of a printing slot.

Fig. 7 and 8 show sections through a rotatable magnet core, which magnetically can clean the electrode matrix from possible remaining toner.

Fig. 9 and 10 show how a transfer pole in a magnet core according to fig. 7 can be changed in order to increase the available zone where developing is allowed.

Fig. 11 shows how a transfer pole in a magnetic core can be changed in order to equalize the blackness in different meshes.

DESCRIPTION OF EMBODIMENTS

In the drawings the numeral 1 designates an electrode, in the continuation called print electrode, in a electrode matrix, the extension of which is substantially parallel to the movement direction of the paper, 2 a second electrode, in the continuation called a transversal electrode, in the

electrode matrix, the extensin of which is substantially transversal to the movement direction of the paper and 3 a passage, in the continuation called a mesh through the electrode matrix between the electrodes 1,2 for transport of toner at development. With the reference numeral 7 is designated an information carrier, eg. a sheet of paper, with 9 a developing roller for transport of pigment particles 11 (also called toner) from a container 14 to the vicinity of the electrode matrix, and with 10 a background electrode, which can be a so called plate electrode. 14 designates a container for the toner, 15 a developer and 16 a print head consisting of of the electrode matrix 1,2 drive electronics, the plate electrode 10 and a retainer for these means. With the reference numeral 17 is designated a print slot in the proximity of the electrode matrix, through which toner passes or sticks during development, while 18 is a bellow shaped container for the toner, which can be comprimated and decomprimated such, that an air stream alternatively a pressure can be produced inside the developer.

According to fig. 3 the toner container is constituted by a rotatable bellows 18, which is rotatable about a torsional spring 19, which operates to keep the rotatable bellows in an expanded position, that is with maximum contained air volume.

In the embodiment according to fig. 4 and 5 the movent of the bellows is achieved by an eccentrically formed turndisc 21, which is rotatable about a rotation axis 22, and which disc is intended to comprimate the bellows 18. A tension spring 23 acts to keep the bellows 18 in an expanded position with maximum contained air volume. The reference numeral 24 designates a thrust plate for transmission of pressure forces from the eccentric disc 21. By means of a magnetic scrape 25 correct amount of toner is dosed to the developing roller 9.

The background electrode 10 in fig. 6 is supplied with high voltage via a cable 26 and to an electrically conducting net 27 or other porous material, the structure of which does not reproduce itself as an inhomogenous pressure and which admits passage of air streams in both directions transversely versus the area of the means, which can be a permeable plate electrode. The reference numeral designates a retainer for the electrode matrix and other equipment belonging thereto, such as eg. drive electronics. A retainer for the permeable plate elctrode 27 is designated by 29 and control means for the paper 7. In the plate electrode retainer 29 is arranged a cavity 30a, 30b for transport of air to and/or from the print slot 17.

In the embodiments according to fig. 7 -11 the reference numeral 31 designates a magnetic core containing one or several magnetic poles and 32 a lever for rotating of the magnet core 31. The reference numeral 33 is a magnet pole in the magnetic core and 34 a rotation axis, which can be centrically or eccentrically located in the rotatable magnetic core. With 35 is designated magnetic field lines between two poles in the magnetic core or between the magnetic core and the magnetic scrape 25.

By letting an air stream pass through the pressure slot 17 during a very short time the electrode matrix can be effectively cleaned from possible remaining toner particles. An embodiment of tis type is shown in fig. 1 and 2. A conventional toner container has been replaced by a bellow formed container 14, which can be comprimated and decomprimated by applying forces on the top of the container. An operating device, eg. an electromagnet, or a rotating eccentric device automatically can comprimate or decomprimate the container preferably during forward feed of a new sheet of paper.

One embodiment with an eccentric disc is shown in fig.4 and 5. The device can be used both to generate an air stream

directed outwards (blowing) from the container, and an inwards directed (suction) airstream. It is however desirable to use the suction stream since toner can be returned to the container. During comprimating movements and blowing airstreams in the pressure slot 17, toner is spread in the machine and after a long time of operation it can form troublesome contamination of the means contained in the printer. To avoid this, the container 18 should be slowly comprimated with the movement R1 during a paper being developed. This is shown in fig. 4. The overpressure p1 generated hereby causes extremely limited air transports out of the developer, which do not disturb the developing process. When thereafter a paper has passed out from the pressure slot 17 and the electrode matrix is to be cleaned the operating device respectively the rotating device 22, 21 rapidly may release the container 18 pretensioned by the springs 23, so that a very rapid decomprimating R1 of the container 18 causes a relatively large negative pressure P2 in the developer. The air stream produced hereby through the pressure slot is powerful enough to clean not only the electrodes but also adjacent areas from remaining toner.

In fig. 3 another embodiment of the bellow formed container for toner 18 is shown, which is mainly comprimated by rotating movements. The foldings of the container 18 converge towards a rotation center in the shaft 20 and in its fit-up to this shaft sealing against the shaft. A torsion spring 19 pretensions the container 18 so that it in a nonactuated state contains the largest possible amount of air. The container then can be made to be comprimated and for the rest operate according to the description for the embodiment according to fig. 2 by a relatively slow movement being transferred to the shaft 20. The torque produced hereby which is demanded to keep the container maximally comprimated, can be released at a suitable time between two paper sheets. The pressure slot in this way will be cleaned and prepared for development of the following paper.

It is also possible to replace the earlier used stirring device for toner in the developer with the above described device, since the powerful and short negative pressure P2 whirls up toner in the developer.

Another method to clean the electrod matrix from remaining toner 11 is to blow and/or suck off the plate electrode 10. A such embodiment is shown in fig. 6. A cvavity 30a from an external pump or a fan unit can be supplied with over or negative pressure P. The permeable plate electrode 27 , which is connected to a high voltage source through the cable 26, allows air streams to freely pass through the slot shaped cavity 30b of the retainer 29. The hereby produced air stream will clean the electrode matrix and surrounding areas in th same way as been described earlier.
In addition to that the device in fig. 6 can be used as a cleaning means between separate paper developments, the device can also be used to suck the paper to good fit- up against the background electrode during the development process. The cavity is then provided with a weak negative pressure P, which does not lock or blocks the paper from sliding on the conducting plate electrode 27.

A further metod to clean the electrode matrix is shown in fig. 7 and 8. One of the magnet poles 33b in a magnet core 31 can be provided with an extra powerful magnet flow. During development this so called decontamination pole 33b should be placed downwards in the toner heap, so that the developing process is not affected. This is shown in fig. 7. When cleaning is to be carried out, a rotating apparatus may rotate the magnet core 31 so that the decontamination pole is turned up under the pressure slot 17. This is shown in fig. 8. The hereby produced magnetic force F on the magnetic toner particles should be dimensioned such that the particles are pulled from the electrodes 1, 2 down to the developing roller 9. After completed cleaning, which is

carried out in a very short time, the magnetic core 31 is rotated such that the decontamination pole 33b ends up downwards and the transfer pole ends up under the pressure slot 17.

In fig. 9 and 10 is shown how the toner particles form magnetic dipole chains 35 , which substantially follow the magnetic field lines betweeen the poles 33 of the system. Certain chains 35b form closed bridges between two poles, while other dipole chains are broken and form a "forest" of standing dipole chains, which consttute a developing zone, is enlarged in fig. 9. The width of this area in the figureis designated with Xb. When using multiline electrode matrices it is desirable to broaden this area compared to what is common in photoconductive printers, so that all lines in the electrode matrix end up over standing dipole chains 35a. This can advantageously be carried out by increasing the active pole width Z. Another way is to increase the distance between the pole 33a and the envelope surface of the developer roller 9.

Fig. 11 shows a further improvement of the magnetic field of the magnetic pole. The curvature of the envelope surface of the developer roller 9 causes an increased distance to toner particles for lines which are placed at the side of the highest point of the roller. This in turn leads to that the field strength from a plane plate electrode will vary on the toner partcles E1 and E2. This property of developing rollers with a relatively small diameter causes lower blackness in peripherically placed lines. The total force F on a particle is however a fusion of several acting forces on the particles, of which the electrostatic and the magnetic Fm forces are dominating. By compensating for the reduced electric field force E2 weith reduced counter directed magnetic forces Fm2 the conditions for development become nearly identical for all meshes irrespective of their position relatively the developing roller. This can be done by changing the profile fy(x) of the transfer pole 33. This can

be changed such that the distance between the end surface of the pole and the internal envelope surface of the developing roller increases with the distance from the center line.

The invention is not limited to the above described embodiment. It is thus possible to apply the invention on other developing and pigment particle systems than those shown herein, eg. mono component toner with carrier. Parts of the invention is also useful when the electrode is positioned behind the paper in a way that is described in eg. PCT/SE - 88/00653.

The air stream for cleaning the electrode matrix can be generated in several other ways than those described, but still lies within the scope of the invention.

The magnetic core can be modified what concerns the number of poles. Also electromagnetic poles are possible within the scope of the invention. It can be advantageous to temporarily and during a short time increase the magnetic field force by increasing the energy through the coil which generates the flow in the transfer pole. The core then has not to be rotated, as has been shown.

CLAIMS

1. Method of improving the printing performance of electrographic printers, in which are produced a latent electrical charge pattern of electric signals by means of an electrode matrix or the like, which temporarily produces electrical fields for attraction of pigment particles (11) towards an information carrier (7),
c h a r a c t e r i z e d t h e r e i n,
that the electrodes (1,2) of the electrode matrix during at least a part of the break time between the activation periods are exposed to a field of force which transports the pigment particles (11) in a direction from the electrodes.

2. Method according to claim 1,
c h a r a c t e r i z e d t h e r e i n,
that the field of force is constituted by an air stream and/or a magnetic force.

3. Method according to claim 2,
c h a r a c t e r i z e d t h e r e i n,
that a slot area (17) closest to the electrode matrix, through which pigment particles can be brought to pass, during a short time, preferably during feeding forward of a new information carrier (7), is exposed to a blowing or sucking air stream.

4. Method according to claim 3,
c h a r a c t e r i z e d t h e r e i n,
that the short duration air stream is provided by a short decomprimation of a container (18), producing a negative pressure in the slot area (17).

5. Device for performing the method according to claim 1 at electrographic printers, in which are produced a latent electric charge pattern of electric signals by means of an electrode matrix or the like, which is arranged to tempora-

rily produce electric fields for attraction of pigment particles (11) against an information carrier (7), c h a r a c t e r i z e d t h e r e i n , that a slot area (17) closest to the electrode matrix is conectable to a device for producing of a short duration magnetic force and/or a positive air pressure or negative air pressure.

6. Device according to patent claim 5, c h a r a c t e r i z e d t h e r e i n, that the container (14, 18) is constituted by a pigment particle container, which is bellow formed and arranged to be comprimated and decomprimated respectively by means of a setting or /or rotating apparatus.

7. Device according to patent claim 5, c h a r a c t e r i z e d t h e r e i n, that the device for producing ofa short duration magnetic force is constituted by a magnet (33 b) situated inside a developing roller (9) for transport of pigment particles (11) from a container (14,18) to said slot area (17), which magnet is arranged to swing from a passive position ina distance from the slot area to an active position just in front of the slot area.

8. Device for performing the method according to claim 1 and 2, at electrographic printers with an electrode matrix (1,2) or the like placed in close connection to a developing roller (9), for transport of pigment particles (11) from a container (14) to the electrode matrix, c h a r a c t e r i z e d t h e r e i n, that inside the developing roller (9) is arranged a magnetic core (31) with at least one magnetic decontamination pole (33), which is arranged to produce a magnetic field during a short time in a slot area closest to the electrode matrix, and which magnetic field to its extension corresponds to the extension of the electrode matrix.

9. Device according to claim 8,
characterized therein,
that the decontamination pole (33) is designed with a curved pole surface with smaller radius than the radius of the internal envelope surface of the developing roller, so that the distance between the end surface of the pole and the internal envelope surface of the developing roller increases with the distance from the center line of the pole.

10. Device according to patent claim 5, 8 or 9,
characterized therein,
that the device for producing of a magnetic force is an electromagnet, and that the field force of the magnet is variable.

AMENDED CLAIMS

[received by the International Bureau
on 7 November 1990 (07.11.90);
original claims 1 and 2 replaced by amended claim 1; other
claims unchanged but renumbered as claims 2-9 (3 pages)]

1. Method of improving the printing performance of electrographic printers, in which are produced a latent electrical charge pattern of electric signals by means of an electrode matrix or the like, which temporarily produces electrical fields for attraction of pigment particles (11) towards an information carrier (7),
c h a r a c t e r i z e d t h e r e i n,
that the electrodes (1,2) of the electrode matrix during at least a part of the break time between the activation periods are exposed to a field of force which transports the pigment particles (11) in a direction from the electrodes, and that the field of force is constituted by an air stream and/or a magnetic force.

2. Method according to claim 1,
c h a r a c t e r i z e d t h e r e i n,
that a slot area (17) closest to the electrode matrix, through which pigment particles can be brought to pass, during a short time, preferably during feeding forward of a new information carrier (7), is exposed to a blowing or sucking air stream.

3. Method according to claim 2,
c h a r a c t e r i z e d t h e r e i n,
that the short duration air stream is provided by a short decomprimation of a container (18), producing a negative pressure in the slot area (17).

4. Device for performing the method according to claim 1
at electrographic printers, in which are produced a latent electric charge pattern of electric signals by means of an electrode matrix or the like, which is arranged to temporarily produce electric fields for attraction of pigment particles (11) against an information carrier (7),
c h a r a c t e r i z e d t h e r e i n ,
that a slot area (17) closest to the electrode matrix is conectable to a device for producing of a short duration magnetic

force and/or a positive air pressure or negative air pressure.

5. Device according to patent claim 4,
c h a r a c t e r i z e d t h e r e i n,
that the container (14, 18) is constituted by a pigment particle container, which is bellow formed and arranged to be comprimated and decomprimated respectively by means of a setting or /or rotating apparatus.

6. Device according to patent claim 4,
c h a r a c t e r i z e d t h e r e i n,
that the device for producing ofa short duration magnetic force is constituted by a magnet (33 b) situated inside a developing roller (9) for transport of pigment particles (11) from a container (14,18) to said slot area (17), which magnet is arranged to swing from a passive position ina distance from the slot area to an active position just in front of the slot area.

7. Device for performing the method according to claim 1 and 2, at electrographic printers with an electrode matrix (1,2) or the like placed in close connection to a developing roller (9), for transport of pigment particles (11) from a container (14) to the electrode matrix,
c h a r a c t e r i z e d t h e r e i n,
that inside the developing roller (9) is arranged a magnetic core (31) with at least one magnetic decontamination pole (33), which is arranged to produce a magnetic field during a short time in a slot area closest to the electrode matrix, and which magnetic field to its extension corresponds to the extension of the electrode matrix.

8. Device according to claim 7,
c h a r a c t e r i z e d t h e r e i n ,
that the decontamination pole (33) is designed with a curved pole surface with smaller radius than the radius of the internal envelope surface of the developing roller, so that the distance between the end surface of the pole and the internal envelope surface of the developing roller increases with the distance from

the center line of the pole.

9. Device according to patent claim 4, 7 or 8,
c h a r a c t e r i z e d t h e r e i n,
that the device for producing of a magnetic force is an electromagnet, and that the field force of the magnet is variable.

FIG.1

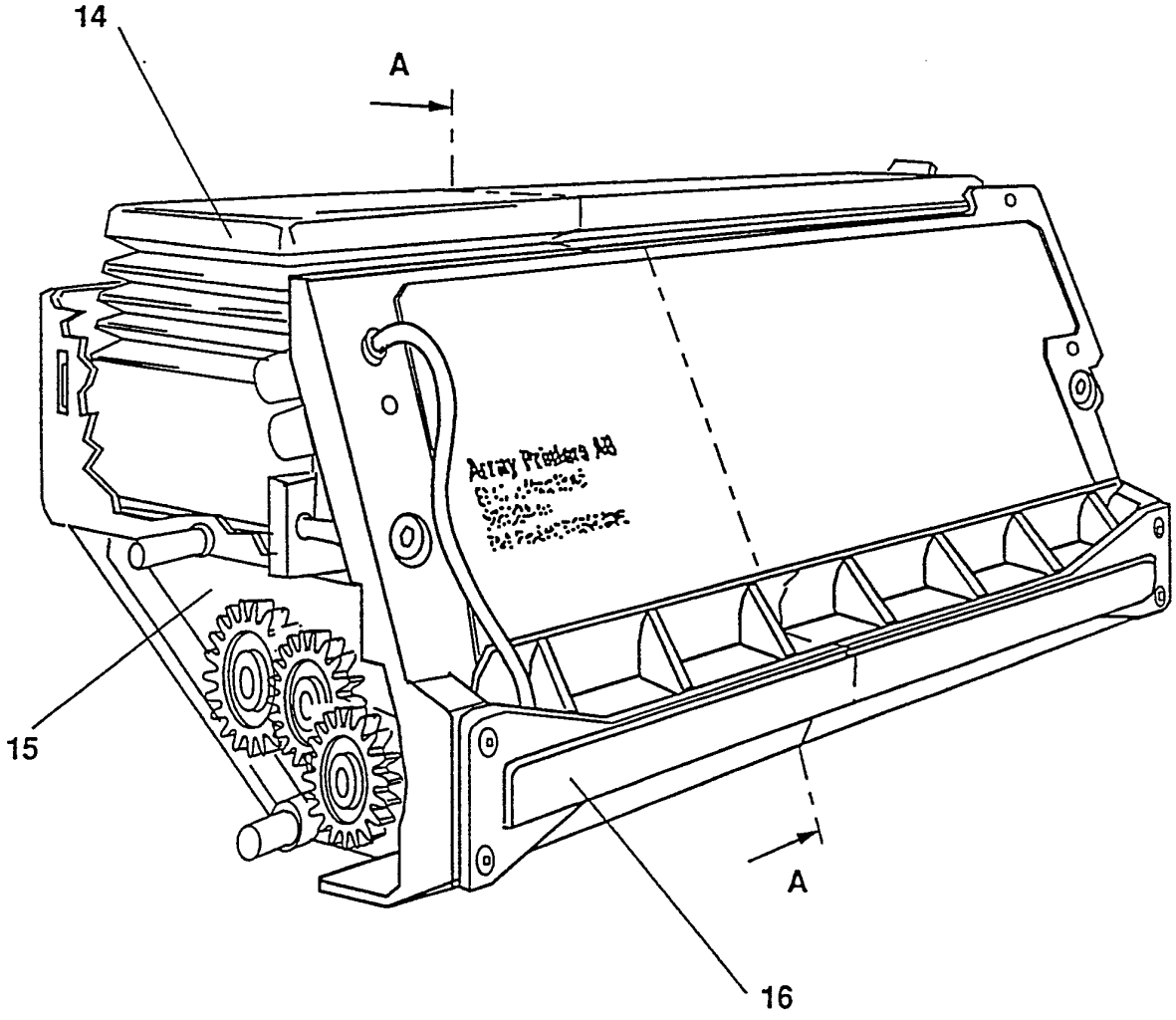


FIG. 2

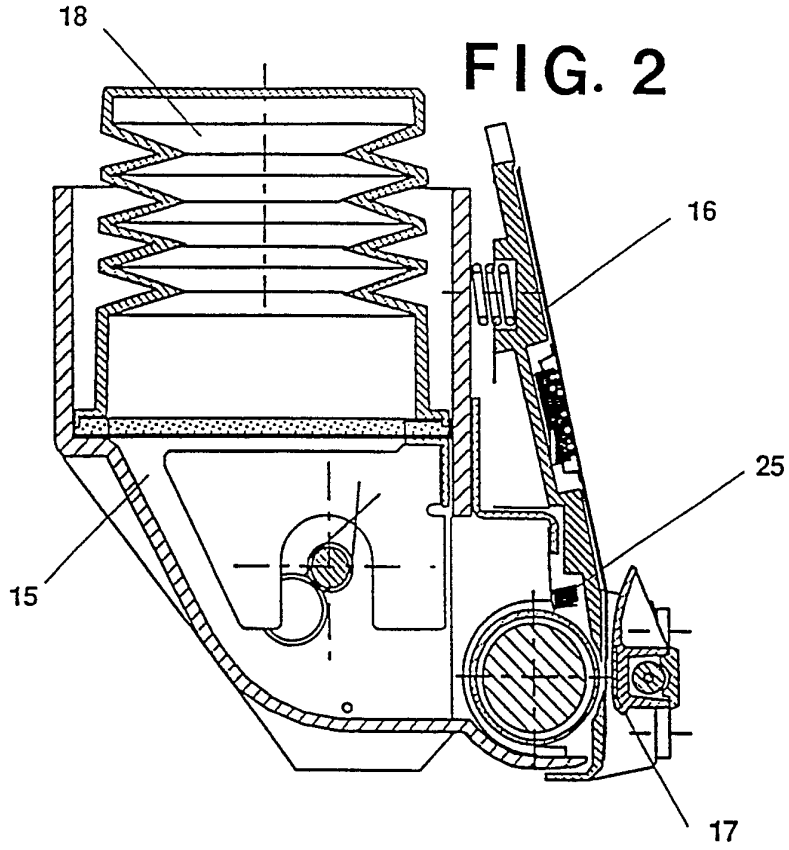
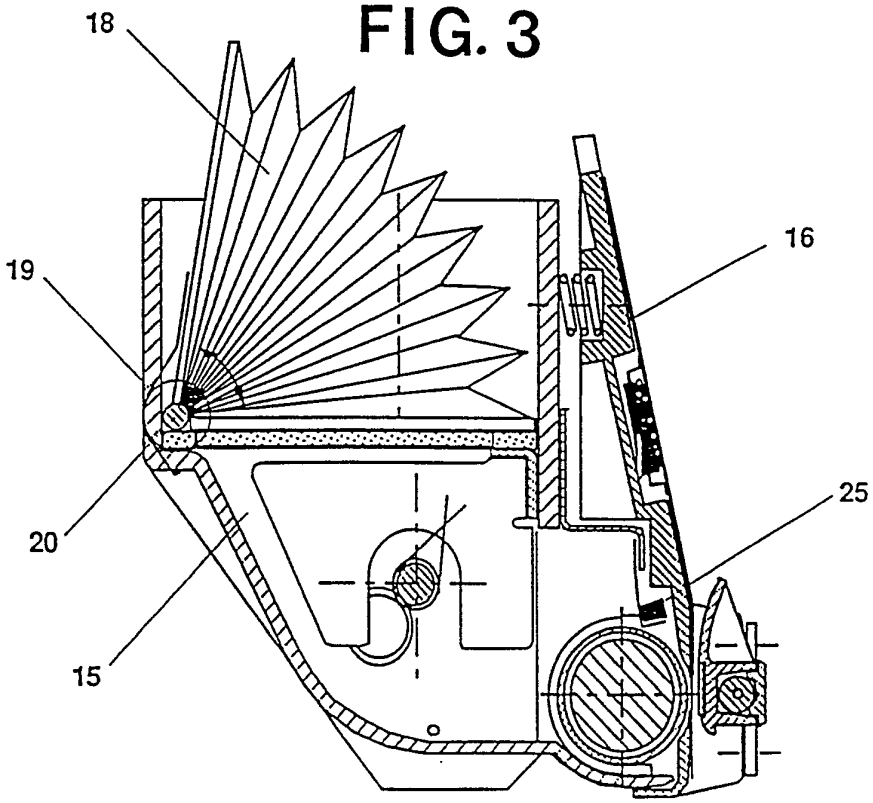


FIG. 3



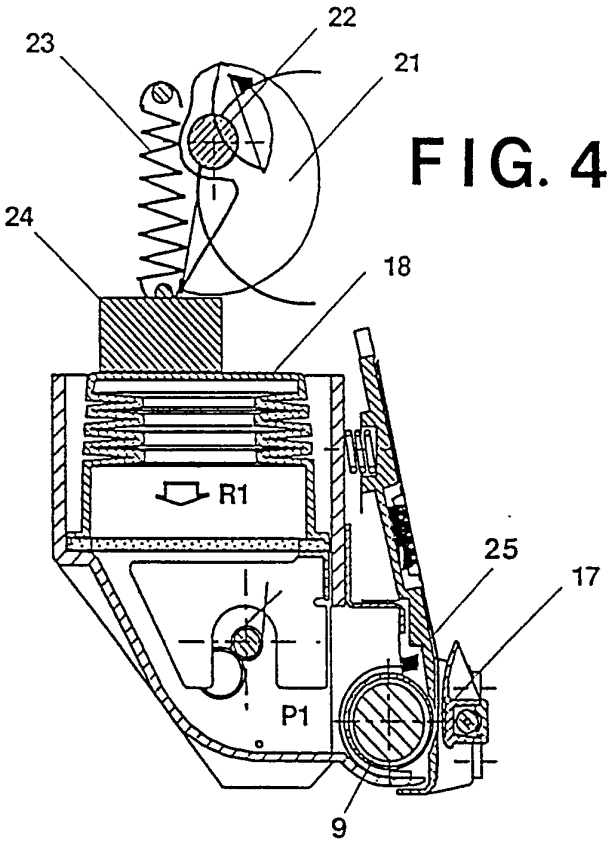


FIG. 4

FIG. 5

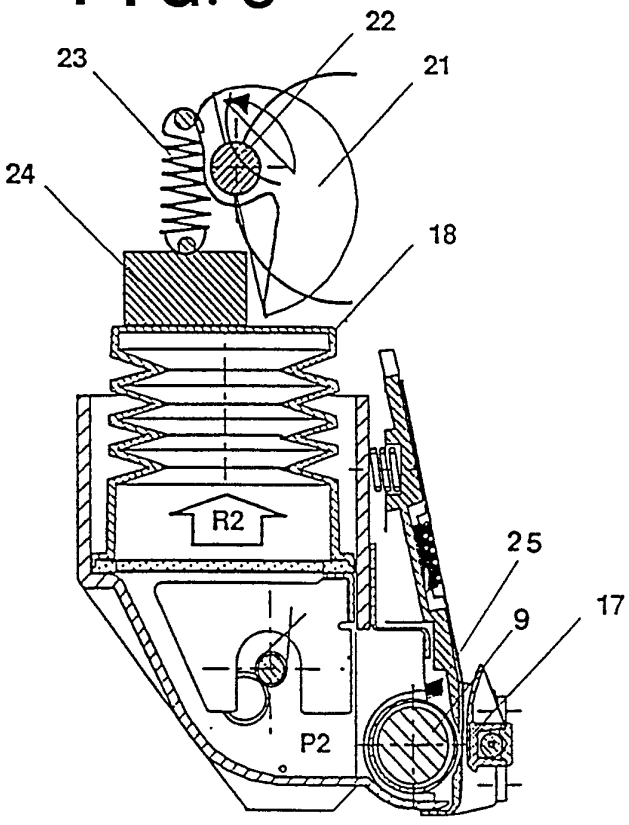


FIG. 6

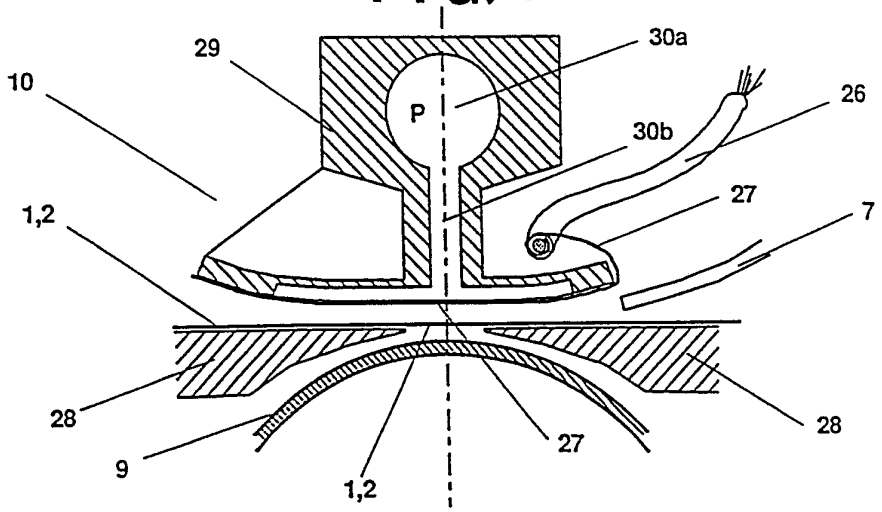


FIG. 7

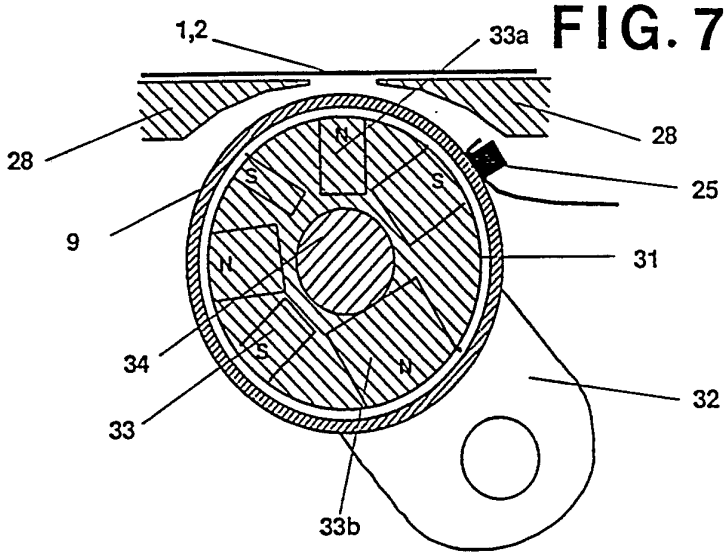


FIG. 8

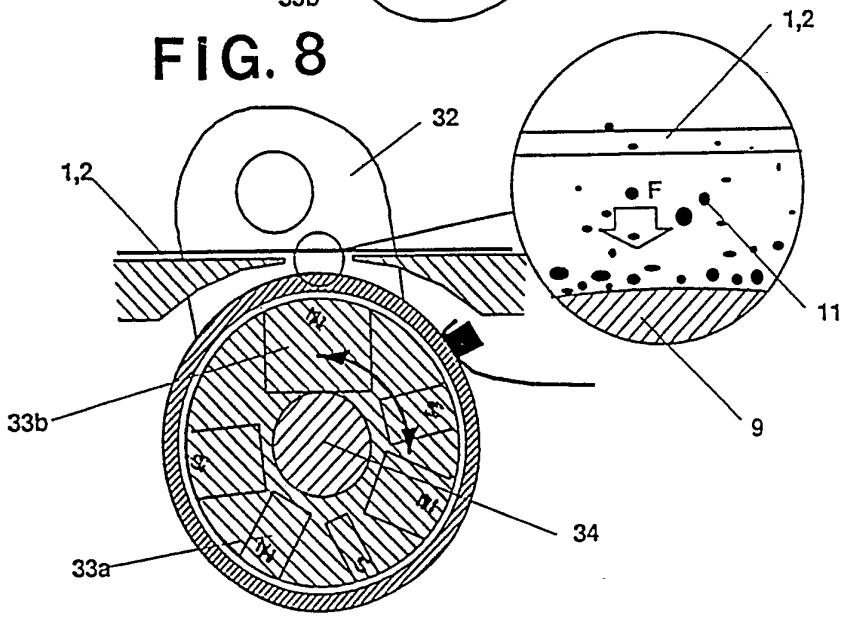


FIG. 9

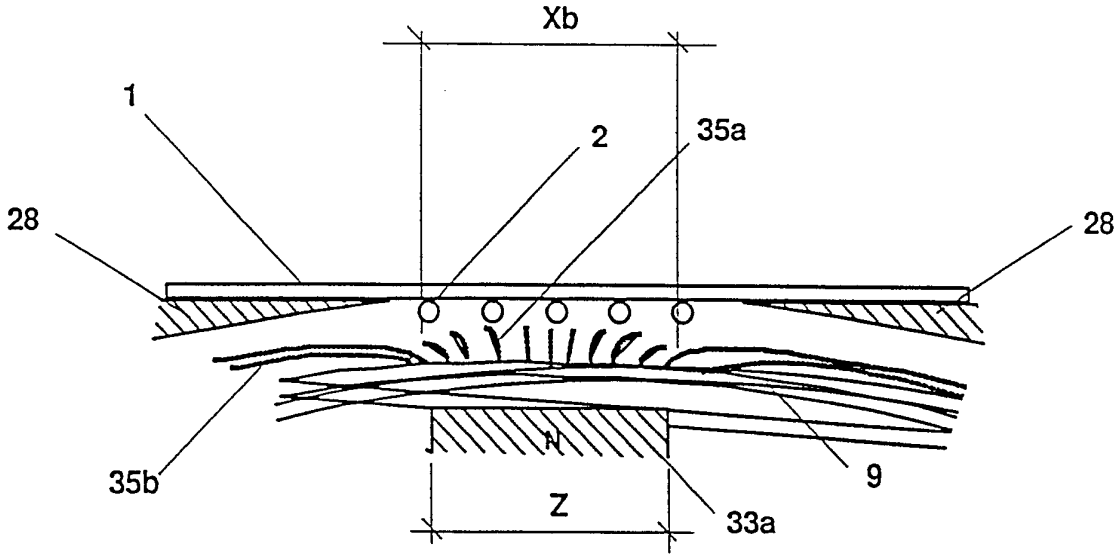


FIG.10

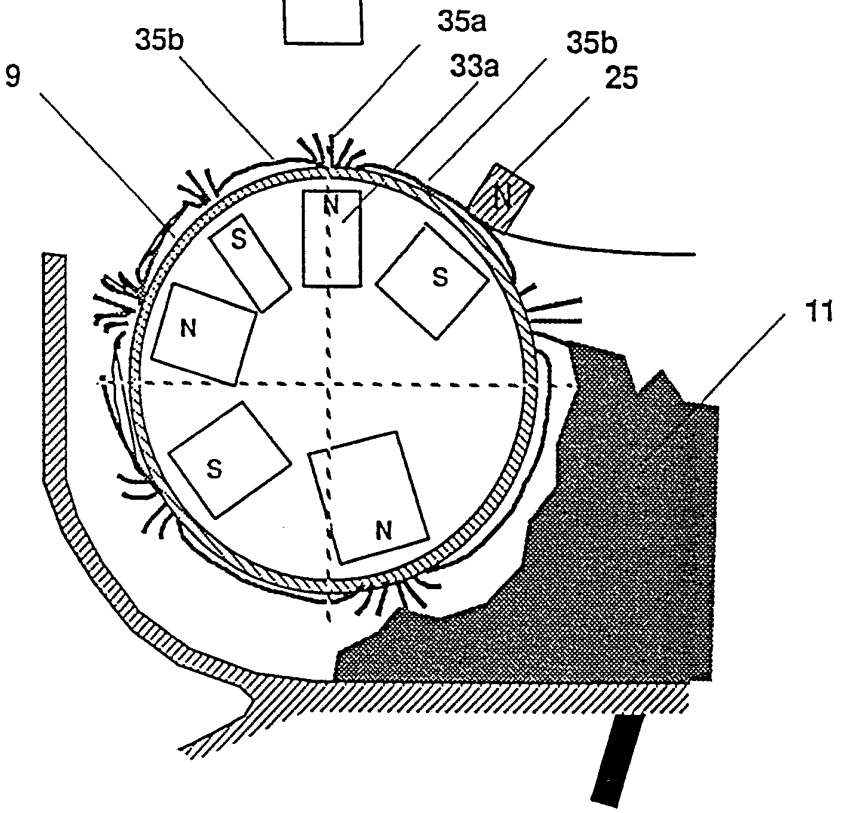
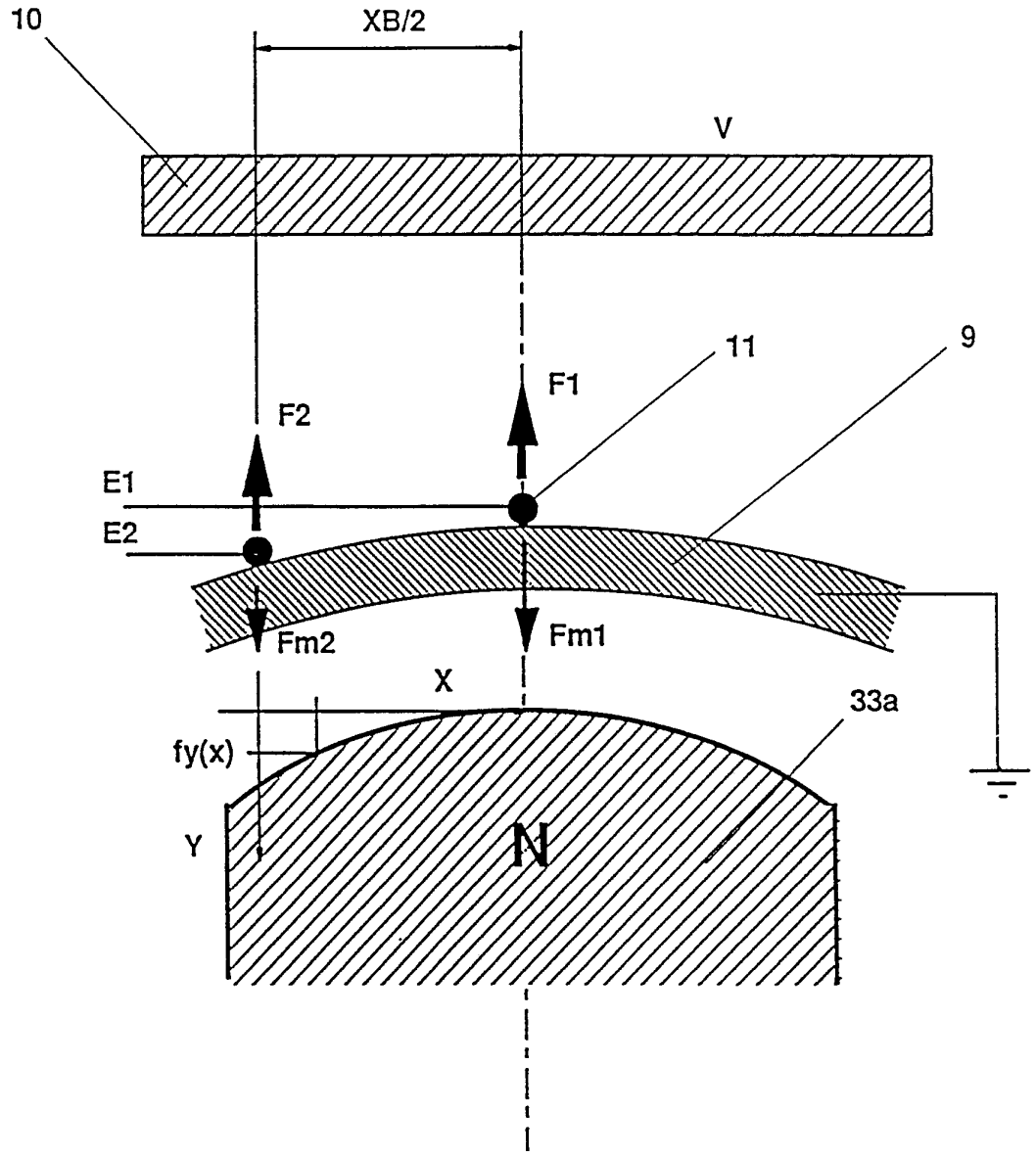


FIG. 11



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00394

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

IPC5: B 41 J 2/415,2/005, G 01 K 15/14

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	B 41 J, G 06 K, G 03 G

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in Fields Searched[8]

SE,DK,FI,NO classes as above

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]
X	EP, A2, 266960 (XEROX CORPORATION) 11 May 1988, see the whole document --	1
A	Patent Abstracts of Japan, Vol 10, No 147, P460, abstract of JP 60-263964, publ 1985-12-27 KONISHIROKU SHASHIN KOGYO K.K. --	1
A	Patent Abstracts of Japan, Vol 10, No 142, M481, abstract of JP 60-264264, publ 1985-12-27 KONISHIROKU SHASHIN KOGYO K.K. --	1
A	DE, A1, 2853141 (COMPAGNIE INTERNATIONALE POUR L'INFORMATIQUE CII-HONEYWELL BULL) 13 June 1979, see the whole document --	2

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* Special categories of cited documents: [10]

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

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"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
31st August 1990	1990 -09- 07
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Jan Silfverling

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 90/00394

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 Swedish Patent Office EDP file on 90-08-02
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A2- 266960	88-05-11	NONE		
DE-A1- 2853141	79-06-13	FR-A-B-	2411435	79-07-06
		GB-A-B-	2013108	79-08-08
		JP-A-	54087226	79-07-11
		US-A-	4348684	82-09-07