(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 269 110 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification : **26.07.95 Bulletin 95/30**

(51) Int. Cl.^{6} : **G21K 4/00**

(21) Application number : **87117494.2**

(22) Date of filing : **09.04.85**

(54) **Method of conveying a stimulable phosphor sheet.**

(30) Priority : **06.04.84 JP 69583/84**
06.04.84 JP 69585/84
06.04.84 JP 69586/84
06.04.84 JP 69587/84
06.04.84 JP 69588/84
29.08.84 JP 180124/84
06.04.84 JP 69584/84

(43) Date of publication of application : **01.06.88 Bulletin 88/22**

(60) Publication number of the earlier application in accordance with Art. 76 EPC : **0 159 613**

(45) Publication of the grant of the patent : **26.07.95 Bulletin 95/30**

(84) Designated Contracting States : **BE DE FR GB NL**

(56) References cited :
EP-A- 0 094 843

(73) Proprietor : **FUJI PHOTO FILM CO., LTD.**
No. 210, Nakanuma
Minami-Ashigara-shi
Kanagawa-ken (JP)

(72) Inventor : **Tamura, Kaori - c/o Fuji Photo Film Co. Ltd.**
No. 798, Miyanodai, Kaisei-machi
Ashigara-kami-gun, Kanagawa (JP)
Inventor : **Matsuda, Terumi - c/o Fuji Photo Film Co. Ltd.**
No. 798, Miyanodai, Kaisei-machi
Ashigara-kami-gun, Kanagawa (JP)
Inventor : **Torii, Shupeita - c/o Fuji Photo Film Co. Ltd.**
No. 798, Miyanodai, Kaisei-machi
Ashigara-kami-gun, Kanagawa (JP)

(74) Representative : **Patentanwälte Grünecker, Kinkeldey, Stockmair & Partner**
Maximilianstrasse 58
D-80538 München (DE)

EP 0 269 110 B1

Description

The present invention relates to a method of conveying a stimulable phosphor sheet.

Description of Prior Arts

For obtaining a radiation image, there has been conventionally employed a radiography utilizing a combination of a radiographic film having a sensitive silver salt material layer and an intensifying screen.

As a method replacing the above-mentioned conventional radiography, a radiation image recording and reproducing method utilizing a stimulable phosphor as described, for instance, in US-A-4 239 968, has been developed and paid much attention. The method involves steps of causing a stimulable phosphor to absorb a radiation having passed through an object or having radiated from an object; sequentially exciting (or scanning) the phosphor with an electromagnetic wave such as visible light or infrared rays (stimulating rays) to release the radiation energy stored in the phosphor as light emission (stimulated emission); photoelectrically detecting the emitted light to obtain electric signals; and reproducing the radiation image of the object as a visible image, numerals, symbols, etc. from the electric signals.

In the radiation image recording and reproducing method, a radiation image is obtainable with a sufficient amount of information by applying a radiation to the object at a considerably smaller dose, as compared with the conventional radiography. Accordingly, the radiation image recording and reproducing method is of great value, especially when the method is used for medical diagnosis.

In performing the radiation image recording an reproducing method, a stimulable phosphor is generally employed in the form of a stimulable phosphor sheet (also referred to as a radiation image storage panel, and generally in the form of a sheet of rectangle, square, etc.) which comprises a support and a phosphor layer provided thereon. The phosphor layer comprises a stimulable phosphor and a binder. Further, a protective film made of a transparent plastic film is provided on a surface of the phosphor layer to protect the phosphor layer from physical and chemical deterioration.

The stimulable phosphor sheet does not serve to finally record image information, but only stores the information temporarily to provide the image or the like or an independently prepared final recording medium as described above. Accordingly, the stimulable phosphor sheet can be repeatedly used and such repeated use brings about economical advantage.

The repeated use of the stimulable phosphor sheet is particularly advantageous, for instance, in the case that a radiation image information recording and reading device employing the stimulable phosphor sheet is mounted on a traveling station such as a radiographic apparatus-carryig car to conduct mass radiographic examination in various places. More in detail, it is inconvenient to carry a great number of stimulable phosphor sheets on a traveling station, and there is a limitation on the number of sheets capable of being carried on a car such as a radiographic apparatus-carrying car. Accordingly, it is practically useful that the stimulable phosphor sheets are mounted on a radiographic car under such conditions that the stimulable phosphor sheets are repeatedly used; radiation image information of an object is recorded on each stimulable phosphor sheet and read out to obtain image information as a signal; and the obtained signal is transferred to a recording medium having a great recording capacity such as a magnetic tape so as to repeatedly use the stimulable phosphor sheet in cycle. This means that radiation images of a number of objects can be obtained by the use of a small number of stimulable phosphor sheets. Further, the combination of the repeated uses of the stimulable phosphor sheets with a continuous radiographic process enables to perform rapid radiography in the mass radiographic examinations. This combination is of great value in practical use.

In the case of performing repeated uses of the stimulable phosphor sheets in cycle, after the radiation energy stored in the stimulable phosphor sheet is read out and aimed image information is obtained, the remaining energy in the sheet is released and erased in a manner as disclosed, for instance, in JP-A-56-11392 and JP-A-56-12599. By employing such manner, the stimulable phosphor sheet can be efficiently and repeatedly used in cycle. Thus, the radiation image information recording and reading device, in one aspect, is desirably mounted on a traveling station such as a radiographic apparatus-carrying car in the form of a united built-in device which comprises an image recording means for exposing a stimulable phosphor sheet to a radiation having passed through an object so as to record and store a radiation image in the stimulable phosphor sheet, a read-out means for reading out the radiation image stored in the stimulable phosphor sheet, an erasure means for releasing and erasing radiation energy remaining in the stimulable phosphor sheet for the next use of the stimulable phosphor sheet, and a conveyance means for moving the stimulable phosphor sheet in cycle to each of the above-mentioned means. The radiation image information recording and reading device having the above-mentioned constitution have various advantages not only in mounting in the traveling station such as a radiographic apparatus-carrying car but also in setting in hospitals, so that the above device is convenient in practical use.

The radiation image information recording and reading device utilizing the above-mentioned system of repeatedly and cyclically using the stimulable

phosphor sheet is disclosed in JP-A-58-66730. In the device, the stimulable phosphor sheet is occasionally conveyed vertically or almost vertically for the purpose of making the device compact.

If a stimulable phosphor sheet has physical deterioration such as a scratch on a surface thereof (a phosphor layer-side surface of the sheet), the quality of image or the accuracy of image information provided by the phosphor sheet tends to decrease markedly. For this reason, it is necessary to select the means for conveying a stimulable phosphor sheet with such a careful consideration that the surface of the stimulable phosphor sheet is not damaged. From this viewpoint, as a means for conveying a stimulable phosphor sheet, a belt conveyor made of a soft sheet-material is generally employed. However, while the belt conveyor is suitable for conveying the stimulable phosphor sheet horizontally, it is unsuitable for conveying the stimulable phosphor sheet in the direction other than the horizontal direction, particularly in the vertical or almost vertical direction. More in detail, in the process for conveying a stimulable phosphor sheet vertically or almost vertically using a belt conveyor, it is necessary to arrange a pair of belt conveyors in such a manner that the belt conveyors are in face to face contact with each other so as to convey the stimulable phosphor sheet under the condition that the stimulable phosphor sheet is sandwiched between that pair of belt conveyors. However, said conveying device is complicated in structure, and it is difficult to make the device compact. Further, there are other problems such that the surface of the stimulable phosphor sheet tends to suffer scratches when the rate of one belt conveyor is made different from that of the other, even if the difference therebetween is very small.

SUMMARY OF THE INVENTION

A method of conveying a sheet in accordance with the preamble of claim 1 is known from EP-A-0 034 269. This document discloses a recirculating document feeder for a copying machine, by which the document is moved in a horizontal direction relative to a document glass. If more than one copy is to be made, the document is circulated by means of a curved guide plate. The document is moved upwardly by a horizontally applied driving power of a couple of rollers in combination with the curved inner surface of the guide plate. Accordingly, the surface of the document is continuously and repeatedly wrapped by the edge and the inner surface of the guide plate. This provides no problems, as far as paper documents are concerned, because such small scratches do not cause any harmful effect to the documents. If however, a stimulable phosphor sheet having a relatively harder phosphor layer is moved upwardly by such a device, the surface of that phosphor sheet will be destroyed by those scratches.

It is therefore the object of the present invention, to provide a method for conveying a stimulable phosphor sheet, which allows the conveying of a phosphor sheet without any damages of the sheet surface.

This object is solved according to the invention by the subject matter of claim 1.

Preferred embodiments of the invention are subject matter of the subclaims.

The present invention provides a method suitable for conveying a stimulable phosphor sheet, particularly suitable for conveying a stimulable phosphor sheet in the vertical or almost vertical direction which is highly required in the radiation image information recording and reading device in which the stimulable phosphor sheet is repeatedly used in cycle.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view illustrating the constitution of a conventional stimulable phosphor sheet, and

Fig. 2 is a schematic view illustrating the constitution of the device preferably employed in the method of conveying a stimulable phosphor sheet according to the present invention.

Fig. 3-(1) is a schematic view illustrating the constitution of another device preferably employed in the conveying method. Fig. 3-(2) is a side view of the device of Fig. 3-(1) seen along the indicated arrow A.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will be described more in detail hereinafter referring to the accompanying drawings.

The general constitution of the conventional stimulable phosphor sheet which is an object of the conveyance in the present invention is well known. The stimulable phosphor sheet is generally employed, as described above, in the form of a sheet comprising a support and a phosphor layer provided thereon which comprises a stimulable phosphor and a binder. On the surface of the phosphor layer is provided a protective film of a transparent plastic material, because the phosphor layer is easily affected by physical shocks.

Fig. 1 schematically illustrates the constitution of the conventional stimulable phosphor sheet.

In Fig. 1, the stimulable phosphor sheet comprises a support 11, a phosphor layer 12 and a protective film 13. Examples of the support material include plastic films such as films of cellulose acetate and polyethylene terephthalate, metal sheets such as aluminum foil, ordinary papers, baryta paper, and resin-coated papers. On the surface of the support (phosphor layer-side surface of the support) may be provid-

ed other functional layers such as an adhesive layer, a light-reflecting layer and a light-absorbing layer.

The phosphor layer essentially comprises stimulable phosphor particles dispersed in a binder. A great number of stimulable phosphors are known. The stimulable phosphor employed in the invention can be selected from the known stimulable phosphors. Examples of the known stimulable phosphor include a divalent europium activated alkaline earth metal fluorohalide phosphor ($M^{II}FX:Eu^{2+}$, 6in which M^{II} is at least one alkaline earth metal selected from the group consisting of Mg, Ca and Ba; and X is at least one halogen selected from the group consisting of Cℓ, Br, and I); an europium and samarium activated strontium sulfide phosphor (SrS:Eu,Sm); an europium and samarium activated lanthanum oxysulfide phosphor (La_2O_2S:Eu,Sm); an europium activated barium aluminate phosphor ($BaO{\cdot}A\ell_2O_3$:Eu); an europium activated alkaline earth metal silicate phosphor (M^{2+}-$O{\cdot}SiO_2$:Eu, in which M^{2+} is at least one alkaline earth metal selected from the group consisting of Mg, Ca and Ba); a cerium activated rare earth oxyhalide phosphor (LnOX:Ce, in which Ln is at least one rare earth element seletected from the group consisting of La, Y, Gd and Lu; and X is at least one halogen selected from the group consisting of Cℓ, Br and I) and the like.

A transparent protective film is then provided on the surface of the phosphor layer to physically and chemically protect the phosphor layer. Examples of the material employable for the preparation of the transparent protective film include cellulose acetate, polymethyl methacrylate, polyethylene terephthalate and polyethylene. The transparent protective film generally has a thickness within the range of approx. 0.1 - 20 μm.

The stimulable phosphor sheet can be colored with an appropriate colorant as described in US-A-4 394 581. Further, white powder may be dispersed in the phosphor layer as described in US-A-4 350 893.

Figs. 2 and 3 [(1) and (2)] are schematic views of the conveying device which are preferably employed in the method of conveying a stimulable phosphor sheet according to the present invention. The method of conveying a stimulable phosphor sheet of the invention is described hereinafter, by referring to an embodiment employing the conveying devices shown in Figs. 2 and 3.

The conveying device preferably employed in the method of conveying a stimulable phosphor sheet according to the invention is a device basically comprising guiding members 22 and 23 (22a, 23a, 22b, 23b, ...)[32 and 33 (32a, 33a, 32b, 33b, ...)[for keeping both sides of a stimulable phosphor sheet 21[31], and two or more driving members 24 (24a, 24b, 24c, ...)[34 (34a, 34b, 34c, ...)] arranged along the conveying direction (direction along the indicated arrow) for providing a driving force on both surfaces of the stimulable phosphor sheet 21[31], in which the distance between said two driving members which adjoin each other along the conveying direction (e.g., 24b and 24c)[e.g., 34b and 34c] is smaller than the length of the stimulable phosphor sheet measured in the conveying direction.

The guiding members of the device keep the stimulable phosphor sheet at the both sides thereof. The guiding members prevent the sheet from bending in the vertical direction against the surface plane of the sheet (namely, flexure) and from moving laterally. The guiding member is, for instance, U-shaped in the section. Accordingly, the guiding member is not necessarily in contact with the stimulable phosphor sheet to keep it. As is evident from Figs. 2 and 3, between the two driving members 24[34], the surface of the sheet on which the radiation image is stored and recorded is kept being from contact with members of the device, since the stimulable phosphor sheet 21 is kept by the guiding members 22 and 23[32 and 33] at both sides of the sheet which do not participate in storing and recording the radiation image. Accordingly, the surface of the sheet is hardly damaged. The shape of the guiding member is not restricted to one as shown in Figs. 2 and 3, and any shape can be optionally used, as far as the guiding member has the above-described functions. Further, there is no specific limitation on the material of the guiding member. The guiding member is not necessarily employed in the form of individually separated member as shown in Figs. 2 and 3, and a united guiding member, for instance, a member in which one guiding member 22[32] is combined with another guiding member 23[33] on the back surface-side of the stimulable phosphor sheet 21[31] (support side-surface of the sheet) in Figs. 2 and 3, can be employed with appropriate selection of the driving members as described hereinafter.

The driving members of the conveying device apply a driving force to the surface(s) of the stimulable phosphor sheet, and make it possible to convey (i.e., move) the stimulable phosphor sheet in a given direction. The driving members comprises at least two members, and the distance (ℓ) between the two driving members which are adjacent to each other along the conveying direction is smaller than the length (m) of the stimulable phosphor sheet in the conveying direction. Two or more driving members having the above-described constitution can convey the stimulable phosphor sheet with little error.

Representative examples of the driving member for providing a driving force on the surfaces of the stimulable phosphor sheet are a driving member comprising a pair of rollers as shown in Figs. 2 and 3. The length of the roller is preferably as almost the same as width of the stimulable phosphor sheet (length measured in the lateral direction, but the length of the roller is not restricted to the above-mentioned length.

The roller may comprise a plurality of short rollers. The driving member may not consist a pair of rollers, and for example, a driving member comprising a driving roller and a fixed supporting member which is associated with the roller is employable. Further, other driving members than the above-mentioned rollers can be employed in the invention.

The surface of the driving member, especially the surface thereof which are to be in contact with the surface of the stimulable phosphor sheet, are preferably formed by a soft and elastic material such as rubber. By employing a driving member having a surface of such material, the surface of the stimulable phosphor sheet can be protected from physical shock so as not to be damaged.

The driving force is generally supplied to the driving members 24 (24a, 24b, 24c, ...)[24 (34a, 34b, 34c, ...)] from a means 26[37] such as a motor through a driving power-transmitting means 25[36] such as a chain and a belt. This driving force is then supplied to the stimulable phosphor sheet 21[31] under rotation via surfaces thereof.

The guiding member and driving members are supported by an appropriate means such as a fixing means or a supporting means so as to fulfill each function in the area.

In the method of conveying a stimulable phosphor sheet according to the present invention, the stimulable phosphor sheet can be easily and reliably conveyed in directions other that horizontal direction, particularly in the vertical or almost vertical direction, (upward and/or downward conveying), without damaging the surfaces of the sheet. The vertical or almost vertical conveyance giving no damage to the surface of stimulable phosphor sheet has been hardly attained in the conventional method using a belt conveyor. The method of conveying the stimulable phosphor sheet of the invention can be effectively used not only in the conveyance of a stimulable phosphor sheet in the vertical or almost vertical direction but also in the conveyance with alteration of the direction (e.g. L-turn and U-turn). Further, the method of the invention can be effectively employed in the conveyance of a stimulable phosphor sheet in the horizontal direction. A belt conveyor is conventionally used in the conveyance thereof in such direction. Furthermore, the method of the present invention can be employed in combination with a conventional method using a belt conveyor in conveying the stimulable phosphor sheet in a radiation image information recording and reading device.

The device illustrated in the Fig. 3 is further provided with a guiding means 35 (35a, 35b, 35c, ...) for guiding the front end of the stimulable phosphor sheet. The guiding means 35 is arranged in the vicinity of the driving means 24, for instance, just in front of the driving means 34. The guiding means 35 serves to smoothly engage the coming stimulable phosphor sheet with the driving means. Although the stimulable phosphor sheet essentially comprising a support and a phosphor layer is considerably rigid, flexure may occasionally happen on most of the conventional stimulable phosphor sheet used in a relatively thin plate having a width of approx. 30 - 60 cm at the front end. If flexure takes place at the front end of the stimulable phosphor sheet, the front end sometimes suffers damage, or in the worst case, the conveying action is stopped by unsuitable engagement between the sheet and the driving means. The guiding means 35 for guiding the front end of the stimulable phosphor sheet is very effective to enable smooth engagement between the stimulable phosphor sheet and the driving means.

There is no specific limitation on the shape, size, and location of the front end-guiding means, as far as it serves to enable the smooth engagement. Otherwise, the front end-guiding means can be in the form of a roller arranged in the vicinity of the driving means. The front end-guiding means can be arranged merely on one side of the conveyor. The front end-guiding means is generally made of plastic material and metal.

As described above, the method of the invention is suitable for conveying a stimulable phosphor sheet in the vertical or almost vertical direction. Accordingly, from the viewpoint of making the device compact, the method of the invention can be preferably and practically employed in the radiation image information recording and reading device in which the stimulable phosphor sheet is required to be conveyed in such direction so as to be repeatedly used in cycle.

Claims

1. A method of conveying a stimulable phosphor sheet comprising applying a driving force to a surface of the stimulable phosphor sheet (21,31) by means of a plurality of driving members (24,34) in the form of rotatable rollers wherein the axis of rotation of the driving members is arranged in a substantially horizontal direction and wherein distance between two driving members (24,34) adjoining each other along the vertical direction is smaller than the length of said stimulable phosphor sheet, and guiding the lateral edges of said stimulable phosphor sheet by guiding members **characterized in that**
said driving members (24,34) are rotatable rollers being arranged in pairs, to convey the stimulable phosphor sheet in a substantially vertical direction, that the sheet (24,31) is to be engaged between said pair of driving members, that at least one member (24,34a) of each pair of the guiding members are U-shaped and have a distance to each other at least of the traverse dimension of

the sheet (22,31) for guiding both edges of said sheet.

2. The method of claim 1, **characterized in that** said stimulable phosphor sheet (31) is smoothly engaged between said pair of driving members (24,34) by guiding means (35) arranged in the vicinity of said driving members (24,34).

3. The method of claim 1, **characterized in that** said stimulable phosphor sheet (31) is conveyed upward using at least three pairs of driving members (24,34).

4. The method of claim 1, **characterized in that** each of said driving members (24,34) is a rotatable roller having a long length that said length is substantially the same as the length of the traverse direction (i.e., lateral length) of the stimulable phosphor sheet.

5. The method of claim 1, **characterized in that** each of the driving members (24,34) of each pair has substantially the same diameter as each other.

Patentansprüche

1. Ein Verfahren zum Fördern eines anregbaren, flächigen Leuchtstoffelements bzw. -folie, umfassend Anwenden einer Antriebskraft auf eine Oberfläche des anregbaren, flächigen Leuchtstoffelements (21, 31) mittels einer Vielzahl von Antriebselementen (24, 34) in der Form von drehbaren Walzen, wobei die Drehachse der Antriebselemente in einer im wesentlichen horizontalen Richtung angeordnet ist, und wobei der Abstand zwischen zwei Antriebselementen (24, 34), die einander entlang der vertikalen Richtung folgen, kleiner als die Länge des genannten anregbaren, flächigen Leuchtstoffelements ist, und Führen der Seitenkanten des genannten anregbaren, flächigen Leuchtstoffelements durch Führungselemente, **dadurch gekennzeichnet**, daß die genannten Antriebselemente (24, 34) drehbare Walzen sind, die in Paaren angeordnet sind, um das anregbare, flächige Leuchtstoffelement in einer im wesentlichen vertikalen Richtung zu fördern, daß das flächige Element (24, 31) zwischen dem genannten Paar Antriebselemente in Eingriff zu bringen ist, daß wenigstens ein Element (24, 34a) von jedem Paar von Führungselementen U-förmig ist und einen Abstand voneinander von wenigstens der Querabmessung des flächigen Elements (22, 31) zum Führen beider Ränder des genannten flächigen Elements aufweisen.

2. Das Verfahren des Anspruchs 1, **dadurch gekennzeichnet**, daß das genannte anregbare, flächige Leuchtstoffelement (31) glatt zwischen dem genannten Paar von Antriebselementen (24, 34) durch eine Führungseinrichtung (35) in Eingriff gebracht wird, die in der Nähe der genannten Antriebselemente (24, 34) angeordnet ist.

3. Das Verfahren des Anspruchs 1, **dadurch gekennzeichnet**, daß das genannte anregbare, flächige Leuchtstoffelement (31) aufwärts gefördert wird, wobei wenigstens drei Paare von Antriebselementen (24, 34) verwendet werden.

4. Das Verfahren des Anspruchs 1, **dadurch gekennzeichnet,** daß jedes der genannten Antriebselemente (24, 34) eine drehbare Walze ist, die eine lange Länge aufweist, daß die genannte Länge im wesentlichen die gleiche wie die Länge der Querrichtung (d.h. die seitliche Länge) des anregbaren, flächigen Leuchtstoffelements ist.

5. Das Verfahren des Anspruchs 1, **dadurch gekennzeichnet,** daß jedes der Antriebselemente (24, 34) von jedem Paar im wesentlichen den gleichen Durchmesser hat.

Revendications

1. Procédé pour transporter une feuille de phosphore stimulable, comprenant les étapes consistant à :
   - appliquer une force d'entraînement à une surface de la feuille de phosphore stimulable (21, 31) au moyen d'une pluralité d'éléments d'entraînement (24, 34) sous la forme de rouleaux rotatifs, et l'axe de rotation des éléments rotatifs est agencé dans une direction sensiblement horizontale, et la distance entre deux éléments d'entraînement (24, 34) qui sont mutuellement juxtaposés le long de la direction verticale est inférieure à la longueur de ladite feuille de phosphore stimulable, et
   - guider les bords latéraux de ladite feuille de phosphore stimulable au moyen d'éléments de guidage,

   caractérisé en ce que :
   lesdits éléments d'entraînement (24, 34) sont des rouleaux rotatifs qui sont agencés en paires, afin de transporter la feuille de phosphore stimulable dans une direction sensiblement verticale,
   en ce que la feuille (24, 31) doit être engagée entre ladite paire d'éléments d'entraînement, et
   en ce qu'au moins un élément (24, 34a) de

chaque paire d'éléments de guidage a une forme en U et ces éléments présentent une distance l'un de l'autre qui est au moins la dimension transversale de la feuille (22, 31) pour guider les deux bords de ladite feuille.

2. Procédé selon la revendication 1, caractérisé en ce que ladite feuille de phosphore stimulable (31) est doucement engagée entre ladite paire d'éléments d'entraînement (24, 34) par des moyens de guidage (35) agencés au voisinage desdits éléments (24, 34).

3. Procédé selon la revendication 1, caractérisé en ce que ladite feuille de phosphore stimulable (31) est transportée vers le haut en utilisant au moins trois paires d'éléments d'entraînement (24, 34).

4. Procédé selon la revendication 1, caractérisé en ce que chacun desdits éléments d'entraînement (24, 34) est un rouleau rotatif qui a une longueur telle que ladite longueur est sensiblement la même que la longueur de la direction transversale (c'est-à-dire la longueur latérale) de la feuille de phosphore stimulable.

5. Procédé selon la revendication 1, caractérisé en ce que les éléments d'entraînement (24, 34) de chaque paire ont chacun sensiblement les mêmes diamètres les uns par rapport aux autres.

FIG. 1

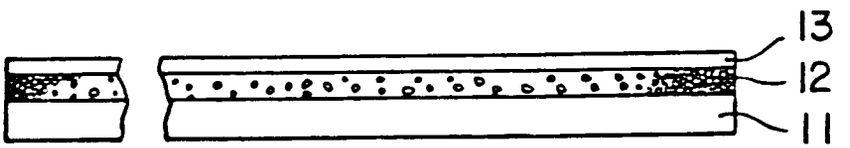


FIG. 2

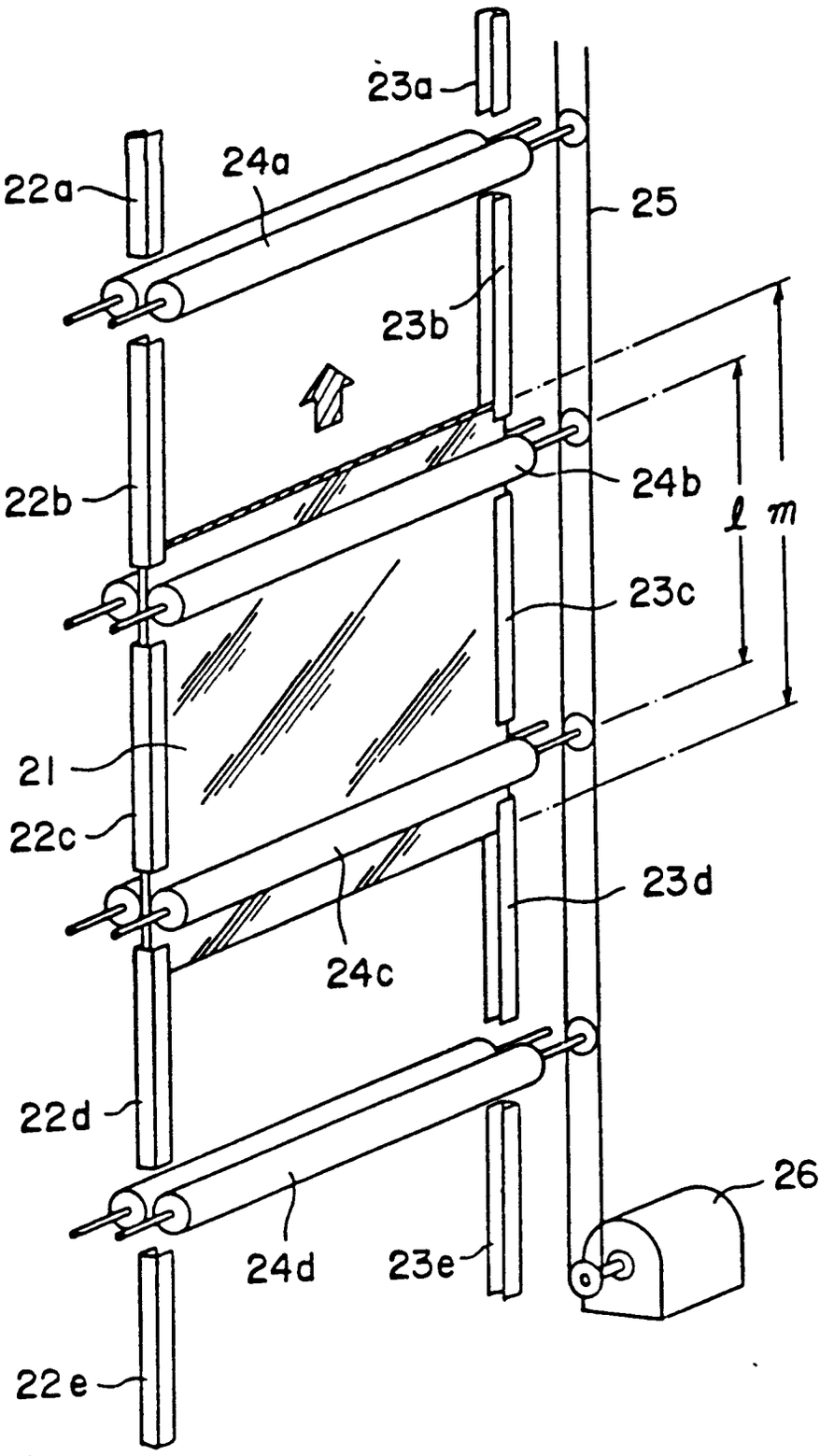
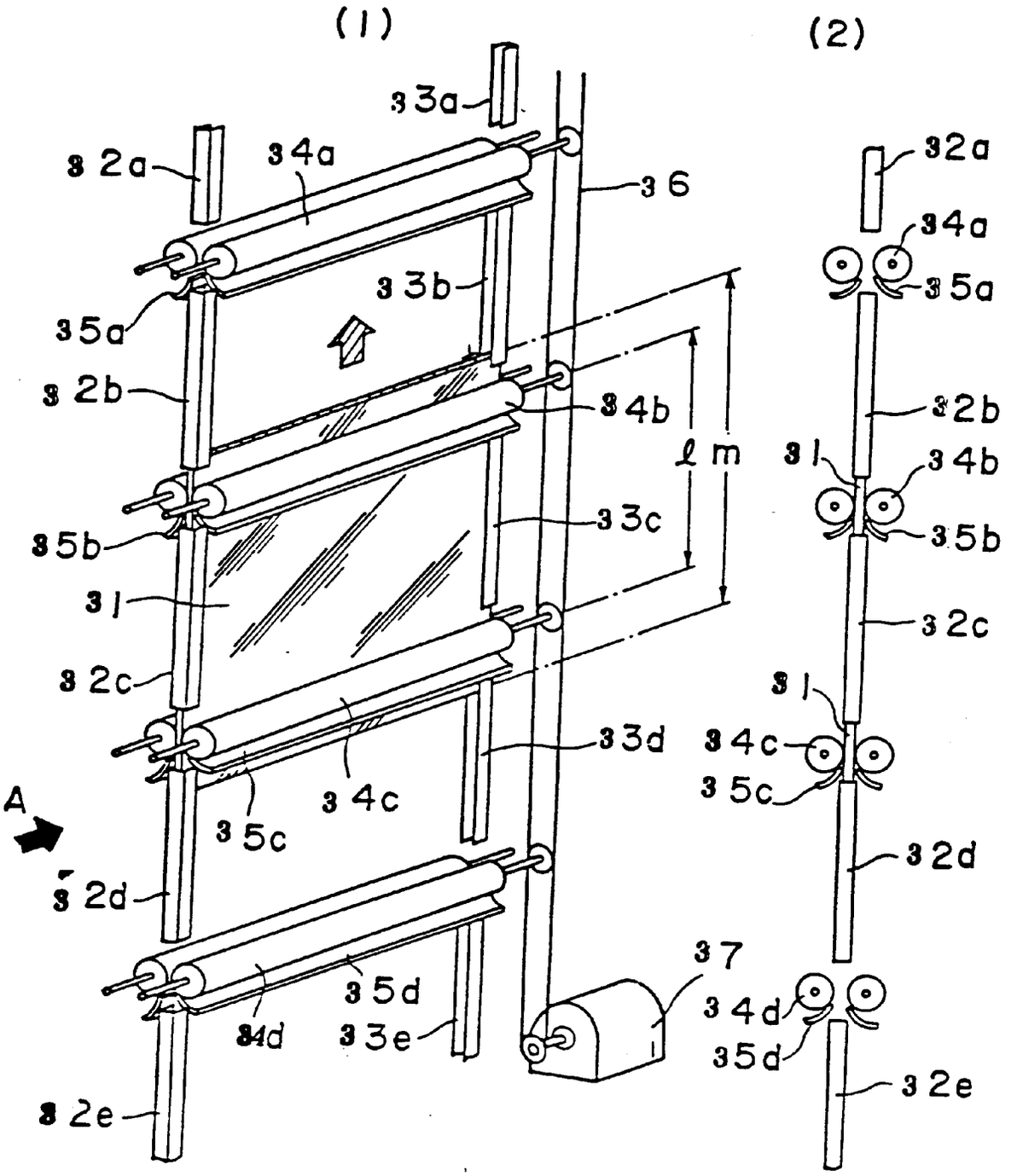

23a
22a
24a
25
23b
22b
24b
l
m
23c
21
22c
23d
24c
22d
26
24d
23e
22e

FIG. 3


(1)
(2)
33a
32a
34a
36
32a
34a
35a
33b
35a
32b
34b
ℓ
m
32b
31
34b
35b
33c
35b
31
32c
32c
31
33d
34c
35c
A
34c
35c
32d
32d
37
35d
34d
33e
34d
35d
32e
32e