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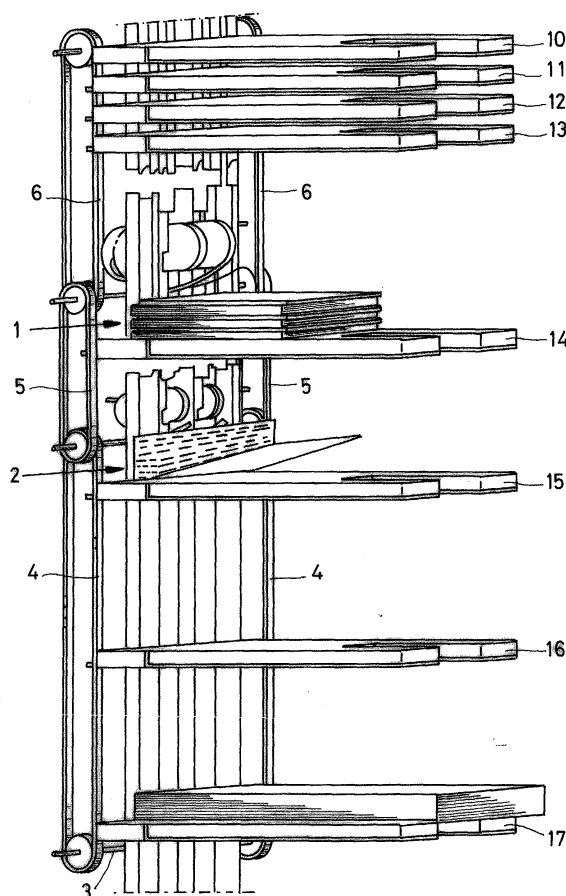
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(54) **Sheet deposition system having multiple support detachably suspended in multiple guide members**

(57) A sheet deposition system having multiple supports (10-17) detachably suspended in multiple guide members (4-6) is disclosed, wherein a support can be placed in a sheet deposition location (1,2) or the distance between supports can be altered by adequately driving the guide members. Multiple sheet deposition locations (1,2) may be provided. The system enables that supports can be easily removed, added or relocated either manually or in an automated way.



**FIG. 1**

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention is related to a system for depositing printed sheets on a selected one of multiple supports. The system may be part of an image-forming system such as a printing or copying system.

### BACKGROUND OF THE INVENTION

**[0002]** In order to reproduce images, it is generally known to feed a medium in sheet or web form through the image forming part of an image reproduction system such as a printing and/or copying system to form images of a marking substance thereon. The printed medium may be subjected to all kind of finishing treatments including but not limited to cutting, punching, inverting, sorting, stapling and folding such as to obtain finished sheets, sets of finished sheets or booklets, hereinafter referred to as sheets. The sheets are forwarded to a sheet deposition location of a sheet deposition system where the sheets are deposited usually on a selected one of multiple trays, hereinafter referred to as supports. The sheet deposition system may be a stand-alone system or may be an integral part of the image reproduction system.

**[0003]** Of particular interest are sheet deposition systems with multiple supports and multiple sheet deposition locations. An example of such a system is a sheet deposition system equipped with two sheet deposition locations, being a sorting sheet deposition location where sheets are directed to in a sorting mode and a non-sorting sheet deposition location where sheets are directed to in a non-sorting mode. Typically a single support is available for ejecting sheets thereon in the non-sorting mode when facing the non-sorting sheet deposition location, while an assembly of supports is available which can be moved up and down such that a selected support of the assembly faces the sorting sheet deposition location for ejecting sheets thereon.

**[0004]** In US 5,934,669 a system having a non-sorting exit, a non-sorting bin, a sorting exit and an assembly of sorting bins is disclosed. The assembly of sorting bins can be moved up and down and impart movement to the non-sorting bin. Although the non-sorting bin is movable within a limited range, the flexibility of the system is very limited as the non-sorting bin can not be used as a sorting bin, or in other words the non-sorting bin can not be guided such as to face the sorting exit. Moreover, at least a part of the sorting bins can not be guided such as to face the non-sorting exit. A further disadvantage of the system disclosed in US 5,934,669 is that the spacing between adjacent sorting bins can not be changed. By consequence, the sheet stacking capacity of the respective bins can not be adjusted responsive to the size of the job submitted.

**[0005]** In US 6,227,539 a sheet deposition system is

disclosed being provided with a single sheet deposition location and multiple bins. The spacing between selected adjacent bins can be adjusted to control the sheet stacking capacity of a selected bin. The bin capacity adjustment system comprises two pairs of coaxial independently rotatable screw threaded bin movement members, each being provided with a separate drive motor. The bin capacity adjustment solution disclosed in US 6,227,539 is only suitable for a single sheet deposition location and does not enable the user to add or remove bins manually neither in an automated way.

### OBJECTS OF THE INVENTION

**[0006]** It is an object of the invention to provide a flexible sheet deposition system for depositing sheets on a selected one of multiple supports facing a selected one of multiple sheet deposition locations. Particularly drive means and guide members should be provided such that each support can be moved up and down such as to face each sheet deposition location and such that the distance between adjacent supports can be adjusted.

It is another object of the invention to provide a flexible sheet deposition system for depositing sheets on a selected one of multiple detachable supports. Particularly to increase overall flexibility and sheet stacking capacity, guide members should be provided enabling to manually remove, relocate or add supports. Preferably, the system should be such as to enable to detach supports in an automated way.

It is yet another object of the invention to provide a flexible sheet deposition system equipped with inexpensive means to drive and position the supports.

### SUMMARY OF THE INVENTION

**[0007]** In a first aspect of the invention, a sheet deposition system is disclosed for depositing sheets on at least one of multiple supports comprising:

deposition means for selectively depositing sheets in N sheet deposition locations, N being an integer number  $\geq 1$  ;

N+1 guide members for guiding the supports, each of said guide members being provided with a plurality of points of suspension for detachably suspending the supports thereon, said guide members being vertically arranged such that each of said sheet deposition locations has an associated lower guide member being positioned essentially below the sheet deposition location and an associated higher guide member being positioned essentially above the sheet deposition location;

multiple supports, each of said supports being detachably suspended on one of said plurality of points of suspension of said guide members and arranged one above another; and

drive means for driving said guide members such

as to place one of said supports in a sheet deposition location or to alter the distance between supports. The sheet deposition system may be a stand-alone system or may be an integral part of an image reproduction system such as e.g. a printing or copying system.

Images reproduced by the reproduction system on a printing medium are directed, optionally after buffering and/or storage, to a sheet deposition location of a sheet deposition system. Before arriving at the sheet deposition system, the printed medium may be subjected to all kind of finishing treatments including but not limited to cutting, punching, inverting, sorting, stapling and folding such as to obtain finished sheets, sets of finished sheets or booklets, hereinafter referred to as sheets. The printing medium is typically composed of paper, film, cardboard, label stock, plastic or textile.

**[0008]** In an embodiment of the invention, the N+1 guide members of the sheet deposition system are endless. Examples of endless guide members are guide members composed of one or more belts or one or more chains, or one or more wires. As the supports are detachably suspended in the guide members in a vertical arrangement, the use of endless guide members enables to deposit the lowest support suspended in the lowest guide member in an automated way on a dolly positioned underneath said lowest support by moving the lowest guide member downwards. This solution is particularly advantageous for removing supports loaded with a large stack of sheets. An advantageous consequence of using supports, which are detachably suspended in the guide members according to the present invention, is that no drive means are attached to the supports themselves, which is beneficial with respect to cost, ease of use and reliability.

**[0009]** In another embodiment of the invention, the sheet deposition system according to the present invention is provided with multiple sheet deposition locations, or in other words  $N \geq 2$ . In such case, although also applicable when  $N=1$ , it may be advantageous to provide at least N+2 supports. The provision of multiple sheet deposition locations enables to direct sheets to a particular sheet deposition location dependent on the reproduction mode. For instance, in case of two sheet deposition locations, sheets produced in a sorting mode are directed to a first sheet deposition location where they are deposited on (a) selected one(s) of multiple supports while sheets produced in non-sorting mode are directed to the other sheet deposition location where they are deposited on a bulk support. Alternatively, the respective sheet deposition location may also be selected dependent on format, e.g. A3 vs. A4, or dependent on the finishing steps applied, e.g. single sheets versus booklets.

**[0010]** In another embodiment of the invention, adjacent guide members of the sheet deposition system according to the present invention are endless and partially overlapping.

**[0011]** In yet another embodiment of the present invention, each of the N+1 guide members of the sheet deposition system according to the present invention has an associated clutch for transmitting drive thereto. Each of the clutches can be selectively activated, i.e. engaged or disengaged, by control means. To facilitate and ensure synchronisation of the movement of the respective guide members, preferably said clutches are tooth clutches, more preferably integer revolution tooth clutches.

**[0012]** In a further aspect of the invention, a sheet deposition system is disclosed for depositing sheets on at least one of multiple supports comprising:

deposition means for selectively depositing sheets in at least one sheet deposition location;

a first endless guide member being positioned essentially above said sheet deposition location and a second endless guide member being positioned essentially below said sheet deposition location, said first endless guide member and said second endless member partially overlapping each other, said first endless guide member being provided with a first plurality of points of suspension being spaced equidistant at a first pitch, P1, for detachably suspending supports thereon, said second endless guide member being provided with a second plurality of points of suspension being spaced equidistant at a second pitch, P2, for detachably suspending supports thereon;

at least 2 supports, each of said supports being detachably suspended on one of said plurality of points of suspension of said endless guide members and arranged one above another; and drive means for driving said endless guide members such that a support suspended on a point of suspension of said first guide member passes to a point of suspension of said second guide member or vice versa. Preferably, the drive means drive the endless guide members such that a support suspended in the first guide member can pass to the second guide member or vice versa without stopping either of the endless guide members.

## BRIEF DESCRIPTION OF THE DRAWINGS

### **[0013]**

Fig.1 depicts a schematic representation of a sheet deposition system according to an embodiment of the present invention.

Fig.2a and Fig.2b depict different modes of operation of the sheet deposition system as presented in Fig.1.

Fig.3 depicts an enlarged view of the overlapping region between two adjacent guide members of a sheet deposition system according to an embodiment of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0014]** In relation to the appended drawings, the present invention is described in detail in the sequel. Several embodiments are disclosed. It is apparent however that a person skilled in the art can imagine several other equivalent embodiments or other ways of executing the present invention, the scope of the present invention being limited only by the terms of the appended claims.

**[0015]** In fig.1 a sheet deposition system according to a preferred embodiment of the present invention is depicted. The sheet deposition system comprises two sheet deposition locations, 3 guide members (4) (5) (6), and 8 supports detachably suspended on points of suspension of said guide members. Each of the guide members is composed of a pair of endless chains. The respective chains of each pair are connected via a rod (3) enabling to move them synchronously. The guide members are vertically arranged one above the other. The first sheet deposition location (1) has an associated lower guide member (5) being positioned essentially below the sheet deposition location and an associated higher guide member (6) being positioned essentially above the sheet deposition location. The associated lower guide member (5) and the associated higher guide member (6) partially overlap each other. The second sheet deposition location (2) has an associated lower guide member (4) being positioned essentially below the sheet deposition location and an associated higher guide member (5) being positioned essentially above the sheet deposition location. The associated lower guide member (4) and the associated higher guide member (5) partially overlap each other. A group of four supports (10) (11) (12) (13) is suspended in the guide member (6) being positioned essentially above the first sheet deposition location. In normal operation, i.e. when sheets are ejected in a selected sheet deposition location on a selected support, only the guide members positioned essentially below the selected sheet deposition location are driven actively or by inertia. Because the upper guide member (6) is not moved in normal operation, this guide member can be used for storing spare supports. Spare supports are unloaded supports waiting to be moved in an operative position upon selection. An operative position is a position adjacent a sheet deposition location where sheets can easily be ejected on the selected support. The selected support located in operative position may be unloaded, i.e. empty, or loaded, i.e. already carrying a stack of sheets. In the latter case, sheets are deposited on top of the stack of sheets already present on the support. Spare supports may be manually added on free points of suspension of the upper guide member, even in normal operation. Alternatively, loaded supports may be moved to the upper guide member (6). Doing so increases the overall sheet stacking flexibility and capacity of the sheet deposition system. This overall sheet stacking flexibility and capacity

is even further increased by the ability to manually remove or displace loaded supports. The guide member (5) positioned essentially between the two sheet deposition locations carries a single detachable loaded support (14). The lower guide member (4) carries three detachable supports (15) (16) (17). The support (15) is in an operative position with respect to the second sheet deposition location (2).

**[0016]** The spacing between supports suspended in the same pair of chains is fixed and remains constant during movement as long as they are suspended in the same pair of chains. Each support can pass from any guide member wherein it is suspended to an adjacent guide member. For instance a support suspended in the upper guide member (6) can pass via the middle guide member (5) to the lower guide member (4) and back. This movement is enabled by adequately driving and controlling the respective guide members. In an embodiment of the present invention, each of the guide members is provided with an associated clutch (not shown) which can be selectably engaged or disengaged. Control means (not shown) are provided to selectably and independently engage or disengage the clutches. When the clutch is engaged drive can be submitted to the associated guide member. The configuration may be such that a single drive motor is used to drive the respective guide members. For instance, the drive motor may be positioned such that, when the clutch is engaged, the drive generated by said motor, e.g. a DC motor, is transmitted via one or more gears to one of the chains of the lower guide member (4). As the chains of each pair of chains are interconnected, they always move synchronously. Moreover, when the clutch associated with the middle guide member is also engaged, the drive transmitted to the lower guide member is also transmitted to the middle guide member such that both middle and lower guide member move in conjunction. Finally, when also the clutch associated with the upper guide member (6) is engaged, all three guide members can be driven in conjunction. Preferably, the clutches used are integer revolution tooth clutches. An integer revolution tooth clutch is a tooth clutch having a revolution distance being an integer multiple of the pitch of the points of suspension of the associated guide member. The use of such clutches enables to initiate movement of the associated guide member only on discrete positions corresponding to positions of the points of suspension on the guide member to thereby ensure position synchronisation between points of suspension of the respective guide members. This configuration is advantageous with respect to a configuration wherein multiple independently controlled drive motors are provided to drive the respective guide members not only for reasons of costs but mainly because of the inherent synchronisation of the movement of the respective guide members. Amongst others, the synchronised movement of the respective guide members facilitates the transfer of a support from the guide member where the support is sus-

pended in to an adjacent guide member.

**[0017]** In operation the sheet deposition system is typically used in conjunction with an image reproduction system such as e.g. a printing or copying system. Upon selection of the reproduction mode the image reproduction system directs sheets to the selected output(s). The outputs have to be construed in relation to the sheet deposition locations such that the sheets arriving at an output at a corresponding sheet deposition location can easily be deposited by deposition means on a selected support, which is in an operative position with respect to said sheet deposition location. Further referring now to fig.1, fig.2a and fig.2b, the sheet deposition system depicted has two sheet deposition locations. Therefore multiple reproduction modes are selectable. For instance, in a first reproduction mode, sheets are directed by the image reproduction system (not shown) to a first output (not shown) corresponding to the first sheet deposition location (1). Once arrived at the first deposition location, see fig. 2b, the sheets are deposited by deposition means (not shown) on a selected support (20) in operative position, in this example the support is a loaded support. In a second reproduction mode, sheets are directed by the image reproduction system to a second output corresponding to the second sheet deposition location (2). Once arrived at the second sheet deposition location, see fig.1 and fig.2a, the sheets are deposited by deposition means (not shown) on a selected support (15) in operative position. Particularly, the first reproduction mode may be the sorting mode, while the second reproduction mode is the non-sorting mode. Alternatively, the respective mode may also be selected dependent on format, e.g. A3 vs. A4, or dependent on the finishing steps applied, e.g. single sheets versus booklets. Also a mixed reproduction mode can be applied, wherein the image reproduction system is controlled such that dependent on the control signal sheets may be directed to the first output corresponding to the first deposition location or to a second output corresponding to the second deposition position. To increase productivity, or in order to deposit sheets at a lower rate as the reproduction rate, also a dual reproduction mode may be provided, wherein the image reproduction system directs sheets both to the first output corresponding to the first deposition location and to the second output corresponding to the second deposition position. In the latter mode, care should however be taken to adequately drive the guide members such that at each sheet deposition location the selected support is maintained in an operative position till the reproduction is finished or till at least one of the supports reaches a capacity limit, e.g. when fully loaded with sheets.

**[0018]** When sheets are deposited at a deposition location on a selected support, the support is progressively lowered with increasing stack of sheets. This may be done actively by adjusting the position of the support responsive to the output signal of a position sensor indicative for the vertical position of the support. Alternatively,

the lowering of the support may be executed passively solely by inertia. Anyhow, not only the support at the deposition location whereon sheets are being deposited is lowered, but all the supports suspended in the same guide member as that support are lowered simultaneously. As indicated in fig. 2b, it may be advantageous not only to move the guide member (5) wherein the support in operative position is suspended, but also to move any other guide member (4) positioned essentially below that guide member (5). Doing so increases flexibility as supports (20) (21) can be lowered without the risk of being blocked by support (22) as this support and support (23) are also lowered. In other words, the spacing between the respective supports, and particularly between supports (21) and (22), is maintained, and the depositing of sheets at the sheet deposition location 2 in fig.2b may continue till the deposition job is finished or interrupted. This interrupt may for instance be generated because the sheet stacking capacity limit of support (20) is reached or because support (23) is at the end of range. In the latter case, an end of range sensor may be provided for detecting whether a support reaches a bottom position such that responsive thereto the depositing of sheets can be stopped. Alternatively, one could also opt to position a dolly underneath the sheet deposition system at about said bottom position, such that when a support contacts the supporting surface of the dolly, it is detached from the guide member and retained on the dolly. A support, unloaded or loaded, may already be present on the dolly. In the latter case a stack of supports may be formed on the dolly. This solution is made possible because the guide members are endless and the supports are detachably suspended therein, and is particularly advantageous for removing supports loaded with a large stack of sheets. Moreover, overall flexibility and productivity of the sheet deposition system is increased, as the depositing of sheets does not need to be interrupted when a support reaches its end of range.

**[0019]** When no sheets are deposited, the respective supports can be repositioned e.g. to maximise the overall sheet stacking capacity, or to bring an unloaded support in to an operative position, or to increase the sheet stacking capacity of an individual support by adjusting the spacing between adjacent supports. For instance, the spacing between support (15) and support (16) may be adjusted as described hereinafter. Initially guide member (4) is driven such that the supports suspended therein move upwards, while guide members (5) and (6) stand still. In an embodiment of the invention, when support (15) approaches the overlapping region between guide member (4) and (5), the upward movement of guide member (5) is initiated such that in said overlapping region support (15) can pass from a point of suspension of guide member (4) to a point of suspension of guide member (5) while both associated guide members (4) (5) move upwards. Alternatively, guide member (4) is moved upwards till the support (15) reaches the

overlapping region between guide member (4) and (5). Then the movement of guide member (4) is stopped and the upward movement of guide member (5) is initiated to allow support (15) to pass from guide member (4) to guide member (5). Supports (15) and (16) are now suspended in different guide members. The spacing between these supports (15) (16) can now be adjusted by further moving only guide member (4) upwards to decrease the spacing between the respective supports or downwards to increase the spacing between the respective supports. Once the spacing is adjusted, one may opt to lower support (15) again and let it pass to guide member (4).

**[0020]** According to an embodiment of the invention and referring to figure 3, a sheet deposition system is disclosed for depositing sheets on (at least) one of multiple supports. The sheet deposition system comprises deposition means for selectively depositing sheets in at least one sheet deposition location on (a) selected support(s) located in an operative position. The sheet deposition system further comprises a first endless guide member being positioned essentially above each sheet deposition location and a second endless guide member being positioned essentially below each sheet deposition location, said first endless guide member and said second endless member partially overlapping each other. Each guide member is composed of a pair of chains which are movable in conjunction. Only one chain of said pair of chains is depicted in fig.3. Chain (31) is part of the first endless guide member and is provided with a first plurality of points of suspension (33) being spaced equidistant at a first pitch, P1, for detachably suspending supports thereon. Chain (30) is part of the second endless guide member and is provided with a second plurality of points of suspension (32) being spaced equidistant at a second pitch, P2, for detachably suspending supports thereon. Each support (34) is suspended in a pair of chains with two forks (35), which rest on the points of suspension of the chains. Each support can pass from a pair of chains wherein it is suspended to any adjacent pair of chains. For instance, support (34) can pass from the upper pair of chains (31) to the lower pair of chains (30). This may be done as described above by lowering the support (34) suspended on points of suspension (36) till the overlapping region between the respective pair of chains (31) (30) is reached, while the lower pair of chains (30) stands still. In the overlapping region, the support (34) passes points of suspension (37) associated with the lower pair of chains, which take over the support (34) such that its forks (35) no longer rest on points of suspension (36) of the upper pair of chains. Then, the movement of the upper pair of chains is stopped. Thereafter, the movement of the lower pair of chains having the support suspended therein is started to thereby complete the pass over. Further according to an embodiment of the present invention, stopping of the chains to establish the pass over of a support can be prevented provided drive means are provided

being controlled by control means such as to satisfy the following condition:

$$V1 \times P2 = V2 \times P1,$$

wherein V1 is the propagation speed of the upper pair of chains,  
V2 is the propagation speed of the lower pair of chains.

## Claims

1. A sheet deposition system for depositing sheets on at least one of multiple supports comprising:

deposition means for selectively depositing sheets in N sheet deposition locations, N being an integer number  $\geq 1$  ;

N+1 guide members for guiding the supports, each of said guide members being provided with a plurality of points of suspension for detachably suspending the supports thereon, said guide members being vertically arranged such that each of said sheet deposition locations has an associated lower guide member being positioned essentially below the sheet deposition location and an associated higher guide member being positioned essentially above the sheet deposition location;

multiple supports, each of said supports being detachably suspended on one of said plurality of points of suspension of said guide members and arranged one above another; and

drive means for driving said guide members such as to place one of said supports in a sheet deposition location or to alter the distance between supports.

2. The sheet deposition system as recited in claim 1, wherein said N+1 guide members are endless.
3. The sheet deposition system as recited in claim 1 and 2, wherein the number of supports is at least N+2.
4. The sheet deposition system as recited in claims 1 to 3, wherein  $N \geq 2$ .
5. The sheet deposition system as recited in claim 4, wherein each of said N+1 guide members is composed of one or more belts, or one or more chains, or one or more wires.
6. The sheet deposition system as recited in claim 5, wherein said associated lower guide member and said associated higher guide member is partially overlapping.

7. The sheet deposition system as recited in claim 6, wherein each of said N+1 guide members has an associated clutch for transmitting drive thereto, said system further comprising control means for selectively activating at least one of said clutches. 5
8. The sheet deposition system as recited in claim 7, wherein said clutches are tooth clutches.
9. A sheet deposition system for depositing sheets on at least one of multiple supports comprising: 10
- deposition means for selectively depositing sheets in at least one sheet deposition location; 15
- a first endless guide member being positioned essentially above said sheet deposition location and a second endless guide member being positioned essentially below said sheet deposition location, said first endless guide member and said second endless member partially 20
- overlapping each other, said first endless guide member being provided with a first plurality of points of suspension being spaced equidistant at a first pitch, P1, for detachably suspending supports thereon, said second endless guide 25
- member being provided with a second plurality of points of suspension being spaced equidistant at a second pitch, P2, for detachably suspending supports thereon; 30
- at least 2 supports, each of said supports being detachably suspended on one of said plurality of points of suspension of said endless guide members and arranged one above another; and 35
- drive means for driving said first and said second endless guide member such that a support suspended on a point of suspension of said first guide member passes to a point of suspension of said second guide member or vice versa. 40
10. The sheet deposition system as recited in claim 9, wherein each of said first and second guide member has an associated tooth clutch for transmitting drive thereto. 45

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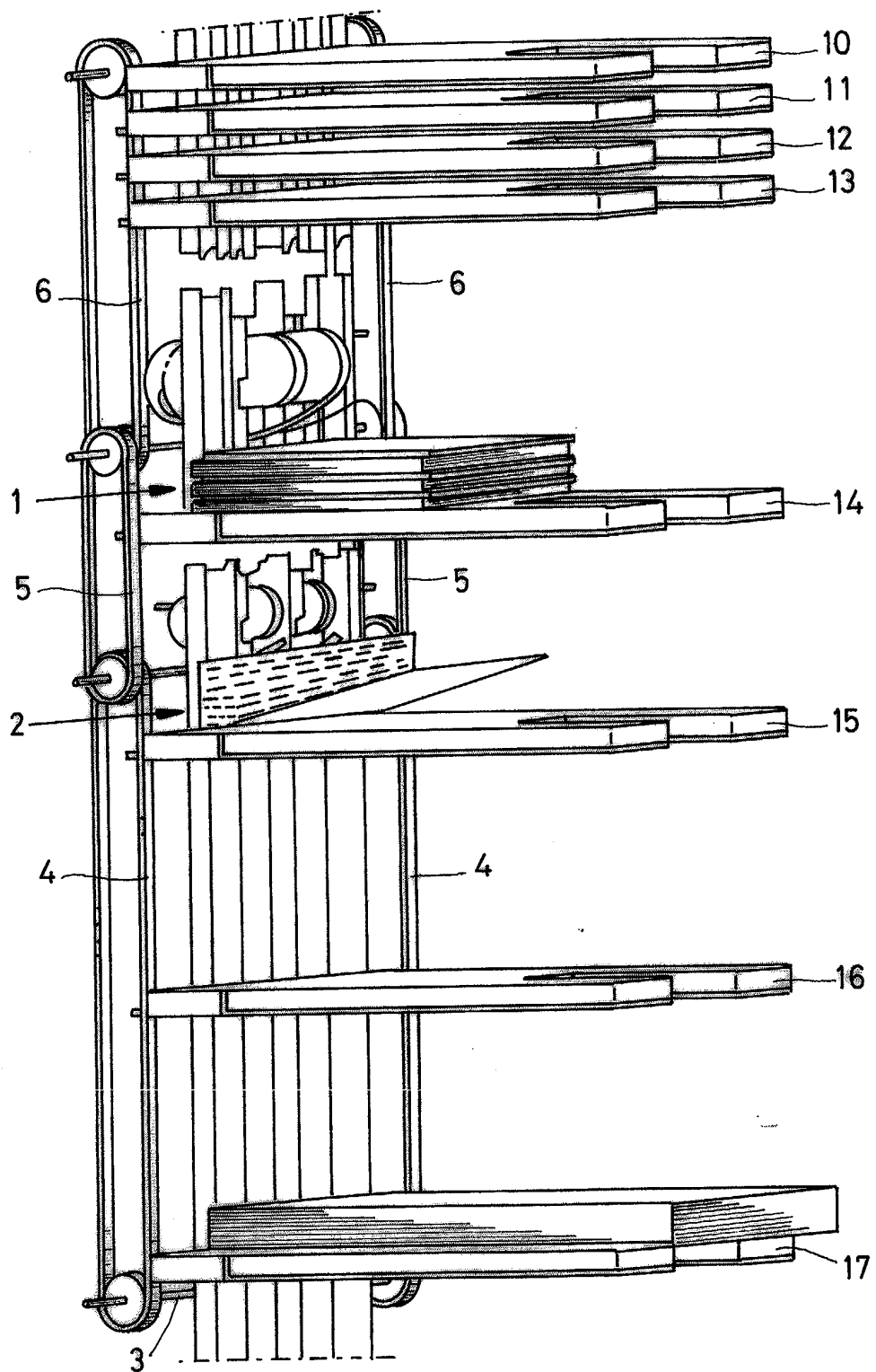


FIG. 1



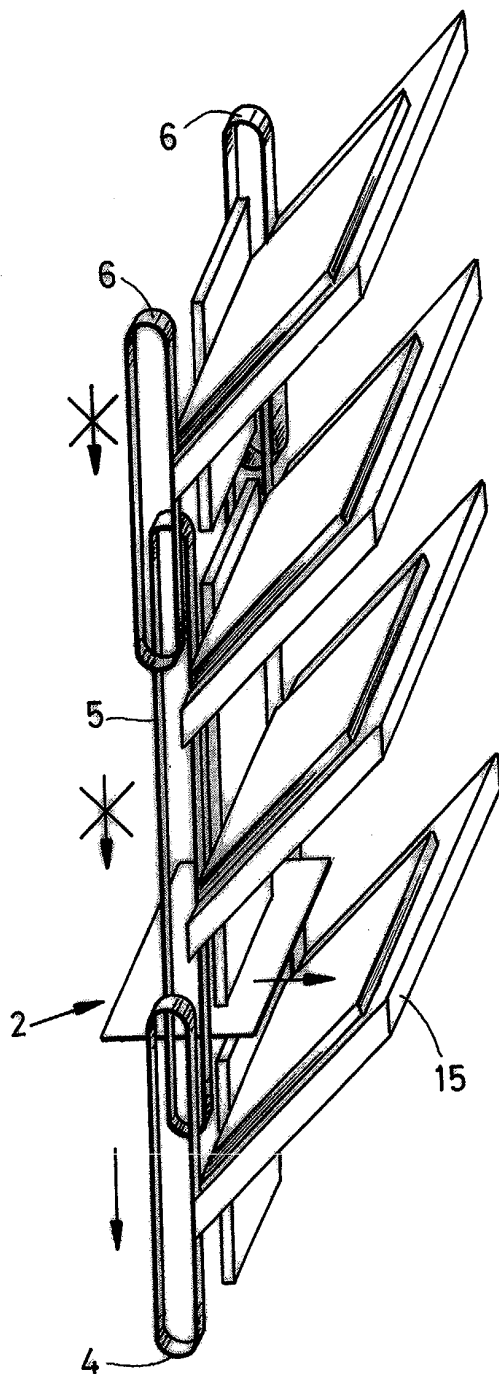


FIG 2a

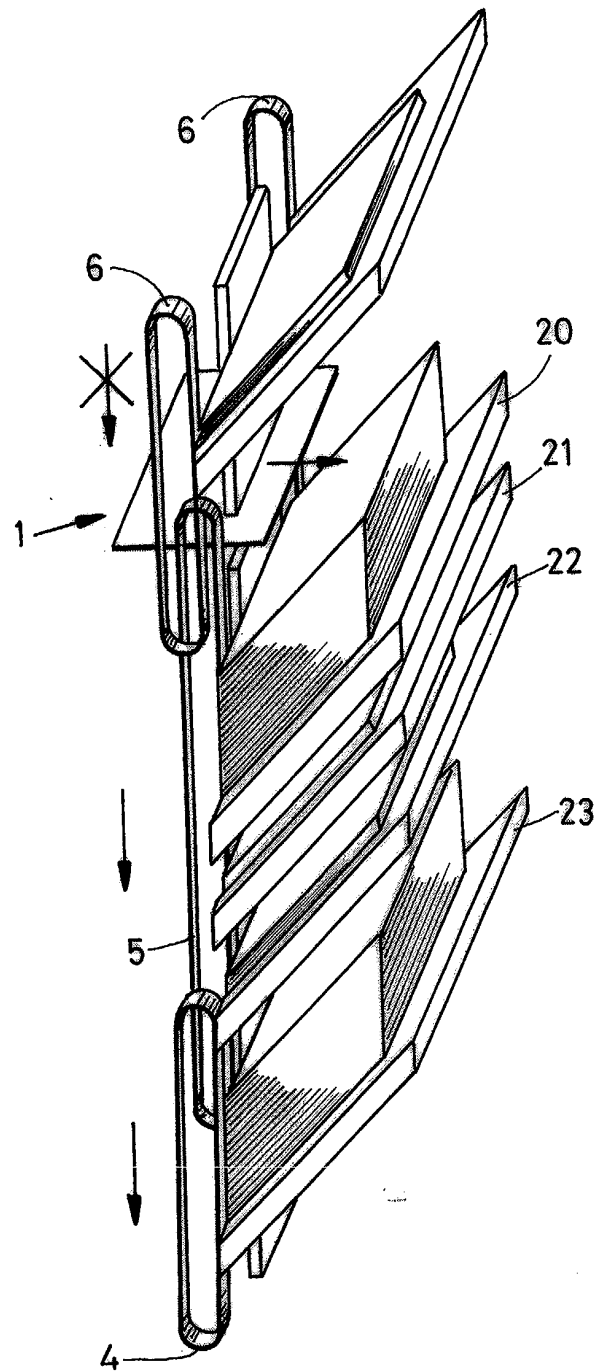


FIG. 2b

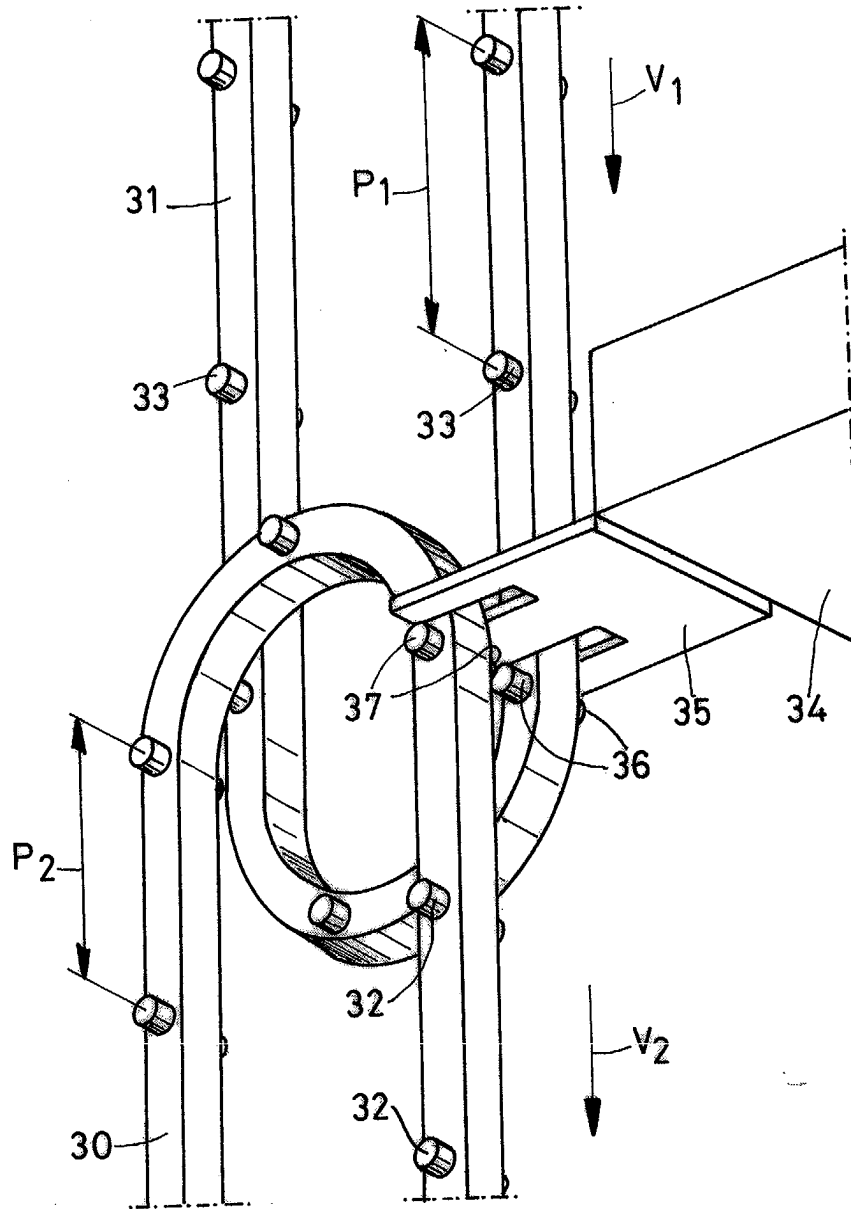


FIG. 3



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 03 07 7832

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 November 2003	Examiner Thibaut, E
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 03 07 7832

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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