

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 318 107
A1

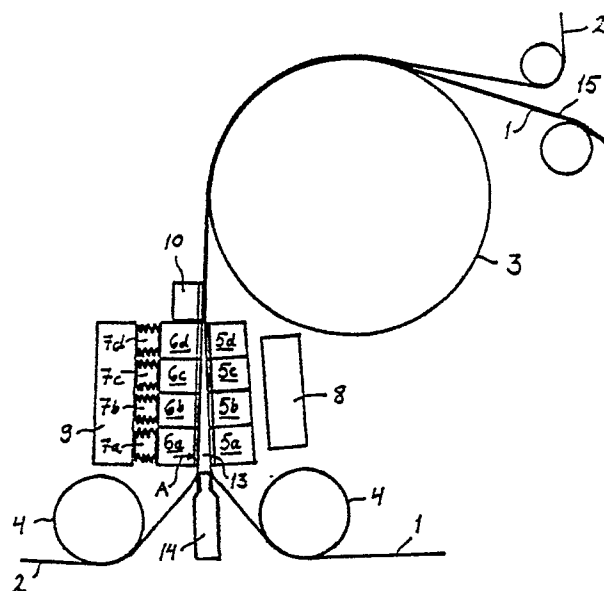
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EUROPEAN PATENT APPLICATION

(21) Application number: **88202647.9**(51) Int. Cl.4: **D21F 9/00**(22) Date of filing: **24.11.88**(30) Priority: **25.11.87 FI 875196**(43) Date of publication of application:
31.05.89 Bulletin 89/22(84) Designated Contracting States:
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(54) **Method of formation of a fibrous web in a papermachine and apparatus for accomplishing the method.**

(57) In a method for forming a fibrous web in a papermachine, stock suspension is supplied into a wedge-like space or a gap (13), converging in the direction of supply of the stock and being formed between fabrics (1,2) pervious to water, such as wires. The fabrics (1,2) are supported on deck elements of dewatering spaces (5,6). The deck elements of the dewatering space (6) on the side of one (2) of the fabrics effect a load with a desired force resiliently on said fabric (2).



a

Fig. 1

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Method of formation of a fibrous web in a papermachine and apparatus for accomplishing the method

The invention relates to a method of forming a fibrous web by draining in a papermachine, the method being more precisely defined in the preamble of Claim 1. The invention also relates to a web forming zone by means of which said method can be accomplished and which is defined in the preamble of Claim 6.

The twin-wire web forming zones of a papermachine, so called formers, have been the object of intensive development work during the past two decades. The known constructions can be divided in three basic types, namely roll formers, blade formers and forcibly-guided gap formers.

It is characteristic of roll formers that a jet from a head-box is guided to a gap formed by two wires. Both wires travel over a roll having a large diameter and, as a rule, an open surface. Due to the tension of the outer wire, pressure is effected in the web, squeezing water out of the suspension and thus filtering fibrous suspension so as to form a paper web. The dewatering takes place quickly, even violently. Consequently, the formation of the web becomes grain-like and the filler particles as well as the fines of the fibres contained in the suspension are washed off. Their retention in the paper is, however, desirable for the sake of printability of paper.

The so-called blade formers include a gap formed by two wires as well, but in this case the curvature is achieved by means of the blades of the foils being mounted along the direction of the web at the periphery of a large circle. The radius of curvature may be several metres. If the web travelled following the arc of said circle, the average pressure so formed would be lower. The wires and the web therebetween travel, however, straight from one blade to another, forming a polygon and the blades of the foils impart pressure impacts to the web as it travels over the blade. This results as a rule in a better formation of the bottom of the web and consequently in better quality of paper in comparison to the above-mentioned case, but the even more effective washing away of fines than in case of roll formers constitutes a drawback. Further, wear of said foils and a great need for service and driving energy as the consequences are drawbacks.

Further, the forcibly-guided gap being constituted of stationary dewatering means is well known. This type forms the object of the present invention. The gap is adjustable and it converges in the travelling direction of the web. The pressure developed in the web presses water through decks having holes or slits and into dewatering boxes

divided into separate chambers in the cross machine direction. From each chamber the water is removed via a control valve back to the circulation. By adjusting the valves the pressure and consequently also the dewatering circumstances can be largely controlled. A gap former of the above type is disclosed e.g. in Finnish publication No. 63077 of accepted patent application and in US-Patents Nos. 3 823 062 and 3 847 731.

Forces causing deflection in the boxes, originating from the pressure, constitute a disadvantage in the construction of the above-mentioned former, and the control over these forces becomes more difficult in connection with present great machine widths. Moreover, the construction requires a complicated control system in order to reach a satisfying dewatering result.

It is an object of the invention to provide a method and an apparatus making it possible to avoid the disadvantages discussed above and to eliminate the disadvantages of all the above mentioned types of formers, but at the same time making it possible to incorporate the advantages thereof.

According to the invention, the purpose is achieved with a method the characteristics of which are presented by the characterising portion of Claim 1. The apparatus making it possible to achieve the above-mentioned advantages comprises features presented by the characterising portion of Claim 6. As the deck elements of the dewatering spaces are arranged to effect a load with a desired and suitable force on the stock layer travelling between the wires, a controlled filtering of water from the stock suspension can be achieved and the deflection of the boxes as a result of pressure is avoided.

The accompanying subclaims show some preferred characteristics of the invention. Thus, the deck elements can be arranged to effect a load separately from each other, each with a desired force on the wire. The forming of flocks can also be prevented by means of a suitable mechanical high-frequency vibration or steam implosion. The invention has further various advantageous constructional alternatives, e.g. the deck elements can be supported in the frame of the machine by means of resilient means effecting resiliency either in such a manner that they are fastened onto the dewatering spaces, which in turn are fixed through said resilient means on the machine frame or on a part stationary in relation to the frame during the dewatering, or in such a manner that the resilient means allowing the resiliency support the deck elements on the structure of the dewatering spaces

and the latter are stationary in relation to the machine frame or to a part stationary in relation to the frame during the dewatering. The dewatering spaces can be adjustable with mechanisms known per se into a suitable position with regard to the machine frame for adjusting the width of the gap.

The generating of the resilient load force in accordance with the invention, i.e. the load pressure, on the stock suspension creates a filtering pressure therein and effects controlled drainage making it possible to obtain an evenly growing fibrous layer deposited on both wires. The layer acts as a filter for the remaining suspension. The invention makes it possible to effect drainage in so slow a manner as possible in a long narrow gap and the filtering can be so effected that a thinner region which naturally is more pervious to water than the surrounding regions receives more flow of fibres. The formation of flocks can so be avoided in order to obtain best possible quality of paper.

In addition, it is necessary that, due to the great variety of paper types and available raw material components of paper, the dewatering is controllable in particular at this initial stage. It is also important, that the formation of flocks, which the fibres tend to do, can be prevented and flocks that are already formed can be broken down until later dewatering stages where flocks are no more formed after the fibres are bound together to a uniform fibrous network.

As said filtering layer has been deposited on the wire, the rest of the suspension is rapidly drained so that the spontaneous formation of flocks is prevented or it will stay at as low level as possible.

The invention will be explained in more detail in the following description with reference to the accompanying drawings, wherein

Figs. 1a and 1b are side views of the web forming zone according to the invention, and

Fig. 2 is a side view of a preferred embodiment of the deck elements according to the invention.

A gap 13 of the web forming zone of the invention is formed by a wedge-shaped space that is formed between two wires 1 and 2. The wires 1 and 2 travel in a manner known per se over their respective breast rolls 4 and after wrapping round said rolls within a predetermined sector they converge, travelling upwards towards each other, forming the above-mentioned space, and join on a forming roll 3 with a large diameter (2000 mm).

The wires 1 and 2 travel at the location of the gap 13 following a straight path and forming the walls of the gap. In this portion the wires are supported by dewatering boxes on their opposite sides, said boxes having decks provided with slits.

The boxes supporting the wire 1 are designated 5 and the boxes supporting the wire 2 are designated 6.

Fig 1b shows the construction of the gap in more detail. The wire 1, constituting in this case the primary wire, is supported by deck elements 11a, 11b, etc. of the dewatering boxes 5a, 5b, etc. being situated one after the other in the direction of travel of the wire. The dewatering boxes 5 are in turn rigidly supported by a frame beam 8 in the machine. The wire 2, constituting in this case the secondary wire, is on its opposite side supported by deck elements 12a, 12b, etc. of the dewatering boxes 6a, 6b, etc. being situated one after the other in the direction of travel of the wire, and the deck elements are provided with holes or slits. Said deck elements are fixed on the dewatering boxes 6 immovably with regard to the boxes. In order to effect a load with a desired force on the face of the wire 2 by means of the deck elements, the bottom parts of the dewatering boxes 6 are at least at both ends of the boxes resiliently supported by a frame beam 9 in the machine through pneumatic bellows 7 (Fig. 1a). In the longitudinal direction of a single box, i.e. in the cross machine direction, there is preferably several bellows 7 supporting it. On the side of the secondary wire 2, there is in the case shown by the Figure a wet suction box 10 being situated after the plurality of the resiliently supported boxes 6, and this box supports both wires before they are wrapped round the roll 3.

As seen in the direction of travel of the wire, the wire 2 is supported by a plurality of successive boxes 6a, 6b, each of them being mounted on the frame beam 9 through its own bellows 7a, 7b respectively. The bellows are supported on one side on the bottom parts of their respective boxes and on the other side they are fixed on the frame beam 9. Since said dewatering boxes are arranged successively in the direction of travel of the web and each of them is separately caused to effect a load with a predetermined force on the wire, it is possible to obtain such dewatering profile as desired in the machine direction of the former.

The dewatering boxes 6 can further be adjustable with the aid of any known suitable mechanism into a suitable predetermined position before the dewatering process is started, so that the width of the gap can be adjusted.

The following is a description of the dewatering events in the direction of travel of the web.

Fibrous suspension, i.e. stock, is introduced in a vertical direction upwards into the gap 13 through a supply device 14, wherefrom the stock passes into the gap where dewatering starts immediately through the wires 1 and 2. At the inlet of the gap 13, a high-frequency mechanical vibration, preferably within ultrasonic range, is supplied into the

stock for breaking down the flocks, or at this point steam implosion is utilised. The point of breaking down the flocks is designated by arrow A in Fig. 1. The mechanical vibration can be effected e.g. by means of the first resiliently supported deck element 12a as seen in the direction of supply of the stock.

The gap 13 tapers slowly in the direction of travel of the wires so as to bring about gentle dewatering. Unnecessary violent changes in pressure, possible damages and a complicated control system which otherwise would be present are avoided in fact by arranging the above-mentioned boxes 6a, 6b etc. on the side of the secondary wire 2 to be resiliently supported by the frame of the machine. The resiliency is accomplished by introducing into the bellows assemblies 7a, 7b etc. a suitable pressure of a compressible medium, such as air, in which event each deck element 12a, 12b, etc. is used in effecting a load with a desired force Fa, Fb, etc., respectively, on the wire without any deflection of the boxes in their longitudinal direction. Even a slight deflection in a box would result in variations in thickness in the web in cross machine direction, which in turn would result in the paper so manufactured being refuse.

Each deck element 12a, 12b, etc. is caused to effect a load with a desired force Fa, Fb, etc., respectively, on the wire 2 separately of each other. This results in a controlled dewatering process along the length of the gap.

As the deck elements are pressed against the wire 2 due to a suitable pressure prevailing in the bellows 7a, 7b etc., they bring about an external pressure into the stock layer. Because the liquid in question is flowing with a great velocity, the external pressure causes a decrease in velocity in such a manner, that the resulting static pressure is equal to the external pressure according to the law of Bernoulli. The flow generated in the stock layer and having the direction of the plane of the layer is necessary for breaking down flocks formed and for conveying new stock at points where the dewatering through the wire occurs most easily.

The water drained through the wires 1 and 2 on both sides is squeezed into the boxes 5 and 6, wherefrom it is led back into the circulation system in a manner known per se. Because the dewatering is effected by means of the filtering pressure, no suction is needed in this case. However, the dewatering boxes can be provided with reduced pressure for example by means of a so-called suction-leg. Further, it is important to be able to control the amount of water drained away from the different sides of the web. This can be realised in the former of the invention in two ways, on one hand in a manner of well-known forcibly-guided formers by adjusting the amount of water removed from the

boxes e.g. using flow restricting devices, as described in Finnish publication No. 63077 of accepted patent application and in US-Patent 3 823 062, or alternatively by equipping the boxes with replaceable deck elements having varying open area.

After the fibrous layers has been deposited on the surfaces of both wires and they join together at the outlet end of the gap, the second portion of the former is reached, this portion of the former being formed by a roll 3 with an open surface and a large diameter (2000 mm). The joint run of the wires wraps round the periphery of the roll over a predetermined sector and it will be directed on the side of the primary wire 1. At this location the dewatering takes place due to the tensioning of the secondary wire 2, and the dewatering pressure is now constant, giving optimum retention as result.

After the roll 3 the wires are so guided that they become separated from each other and the web 15 travels, supported by the primary wire 1, further into the press section of the paper machine, which is not shown in more detail in this connection.

Fig. 2 illustrates one embodiment of the apparatus according to the invention, shown as a side view. The embodiment includes stationary dewatering spaces and deck elements with the resilient load upon the wire and being supported by the dewatering spaces. The single dewatering box 6 is divided in compartments 6a, 6b etc. Corresponding deck elements 12a, 12b etc. at the location of respective compartments are loose from the dewatering box 6. Each deck element comprises elongate support bars 16, aligned parallelly to the direction of travel of the wire 2 and including ceramic dewatering ribs or foils 17 fixed on the bars, extending transversely in relation of the direction of travel of the wire and lying against the reverse side of the wire 2. The deck elements are connected to each other successively through an endwise joining arrangement of the supporting bars 16 by means of notched junctions 18 being formed at the ends of the support bars and enabling the bars 16 to move in a direction perpendicular to the plane of the wire 2. At the location of each notched junction there is a transverse support bar 19, supporting the point of junction of two successive deck elements. At each partition wall separating successive compartments 6a, 6b from each other there is disposed a trough- or gutter-shaped elongate member 20 extending transversely in relation to the direction of travel of the wire and accommodating a pneumatic load-hose or -tube 7', which is in contact with the support bar 19 at the junction of the deck elements and extends parallelly to said bar. The operational principle of the pneumatic load-hose or -tube 7' is similar to that of the bellows in Fig. 1a. The adjust-

ment of the pressure prevailing within the hose or tube 7' results in a movement due to the deformation of the hose or tube, the movement causing a change in the position of the successive deck elements 12a, 12b with regard to the dewatering box 6. A desired filtering pressure can be created in the flow passing within the gap at the location of each deck element 12a, 12b, etc. according to the invention.

As the wires travel in vertical direction, the lowermost deck element with resilient load can be supported at its lower edge by the suction box 6 and the following elements can be successively supported by the upper edges of the respective preceding lower elements by means of the notched junctions 18. The mounting of the deck elements is ensured with the aid of safety springs 20 attached thereto and which at their opposite end can be affixed for example onto the bottom part of the dewatering spaces 6a, 6b, etc.

The invention can be of course be modified without departing from its idea represented by the accompanying claims. It is essential that the invention provides a long gap converging in the direction of the travel and making it possible to produce paper from stock as a result of a controllable drainage. This control is based on creating a filtering pressure by dewatering boxes, which exert load with a desired and suitable force on the stock layer travelling between the wires. Due to the long gap the stock layer is at each portion of the gap exposed to a uniform pressure for a sufficiently long time resulting in equalising of grammage in the web so produced.

Claims

1. Method of forming a fibrous web in a paper-machine, in which method stock is introduced into a wedge-like space or a gap 13, converging in the direction of supply of the stock and being formed by a space located between fabrics (1, 2) pervious to water, such as wires, which are situated within a web forming zone, the fabrics (1, 2) being supported by a deck element/deck elements of dewatering spaces (5, 6), characterised in that the deck element/deck elements (12) of the dewatering space (6) on the side of at least one (2) of the fabrics effects a load with a desired force (F) resiliently on said fabric (2).

2. Method as claimed in claim 1, characterised in that the deck element/deck elements (12) of the dewatering space (6) on the side of one (2) of the fabrics effects a load with a desired force (F) resiliently on said fabric (2) while the deck element/deck elements (11) of the dewatering

space (5) on the side of the other (1) of the fabrics is stationary in respect of the frame (8) during the dewatering.

3. Method as claimed in claims 1 or 2, characterised in that the resilient load is effected by means of deck elements (12a, 12b) which are situated successively in the direction of travel of the fabric (2) and effect a load with a desired force (Fa, Fb) on the fabric (2) separately from each other.

4. Method as claimed in any of preceding claims, characterised in that the formation of flocks is prevented by supplying into the gap (13) energy in the form of a mechanical high-frequency vibration, preferably in the ultrasonic range, or in the form of steam implosion, said energy causing the breaking down of flocks.

5. Method as claimed in any of preceding claims, characterised in that the filtering pressure in the gap (13) increases continuously in the direction of travel of the web.

6. Web-forming zone in a papermachine, the zone comprising a wedge-like space converging in the direction of supply of the stock and being situated between two fabrics (1, 2), such as wires, i.e. a gap (13), the fabrics (1, 2) being supported by deck elements of dewatering spaces (5, 6), characterised in that the deck element/deck elements (12) of the dewatering space (6) on the side of at least one (2) of the fabrics is resiliently supported through resilient means (7; 7') by a part (9) being stationary in respect of the frame of the machine during the dewatering for effecting a load on said fabric (2) with a desired force (F).

7. Web-forming zone as claimed in claim 6, characterised in that the deck element/deck elements of the dewatering space (6) on the side of one (2) of the fabrics are supported resiliently and the deck element/deck elements (11) of the dewatering space (5) on the side of the other (1) of the fabrics are arranged to be in a stationary position in respect of the frame (8) of the paper-machine during the dewatering.

8. Web-forming zone as claimed in claims 6 or 7, characterised in that the deck elements (12a, 12b) are situated successively in the direction of travel of the fabric (2) and are separated from each other, and are each mounted through their respective resilient means (7a, 7b; 7') on the frame (9) of the machine.

9. Web-forming zone as claimed in any of claims 6 to 8, characterised in that the dewatering space (6) comprises successive dewatering spaces (6a, 6b) separated from each other and being at their bottom parts supported resiliently through resilient means (7a, 7b) by a part being stationary in respect of the machine frame during the dewatering.

10. Web-forming zone as claimed in any of claims 6 to 8, characterised in that the deck elements (12a, 12b) are resiliently supported through resilient means (7') by a part being stationary in respect of the machine frame during the dewatering, such as by the dewatering space (6) .

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11. Web-forming zone as claimed in any of claims 6 to 10, characterised in that the resiliency of the resilient means (7) is adjustable for adjusting the load force (F) exerted upon the fabric.

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12. Web-forming zone as claimed in claim 11, characterised in that the resilient means are constituted of bellows, hoses, tubes, or the like (7; 7') being adjustable by means of pressure of a medium.

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13. Web-forming zone as claimed in claim 12, characterised in that the medium is a compressible medium such as air.

14. Web-forming zone as claimed in any of claims 6 to 10, characterised in that it comprises means for supplying into the gap (13) of energy breaking down flocks formed, such as a high-frequency mechanical vibration, preferably within ultrasonic range, or energy obtained by means of steam implosion.

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15. Web-forming zone as claimed in claim 14, characterised that said means are constituted of one or several deck elements (12) of the dewatering space (6), said elements being located at the inlet of the gap (13).

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16. Dewatering zone as claimed in claim 15, characterised in that the deck element/elements constituting the vibration means are formed by the deck element/deck elements (12) supported resiliently through the resilient means (7) as claimed in claim 6.

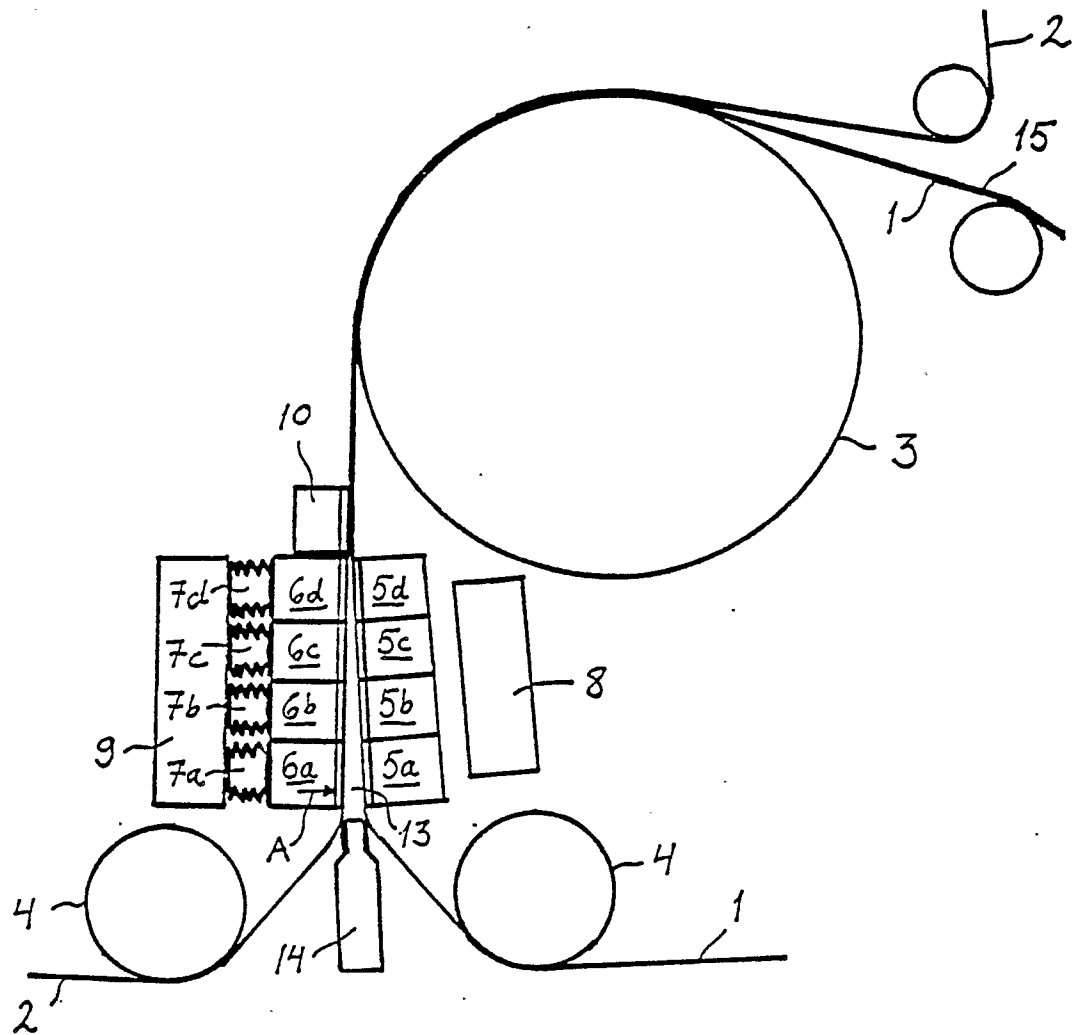
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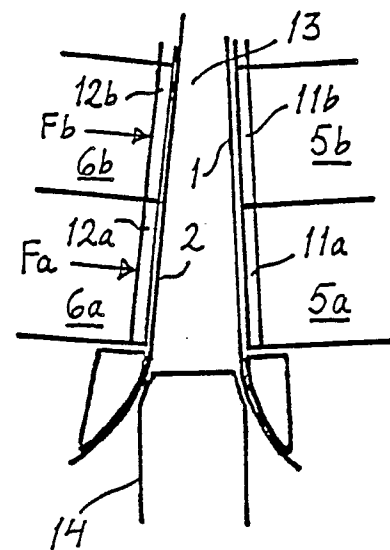
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Fig. 1

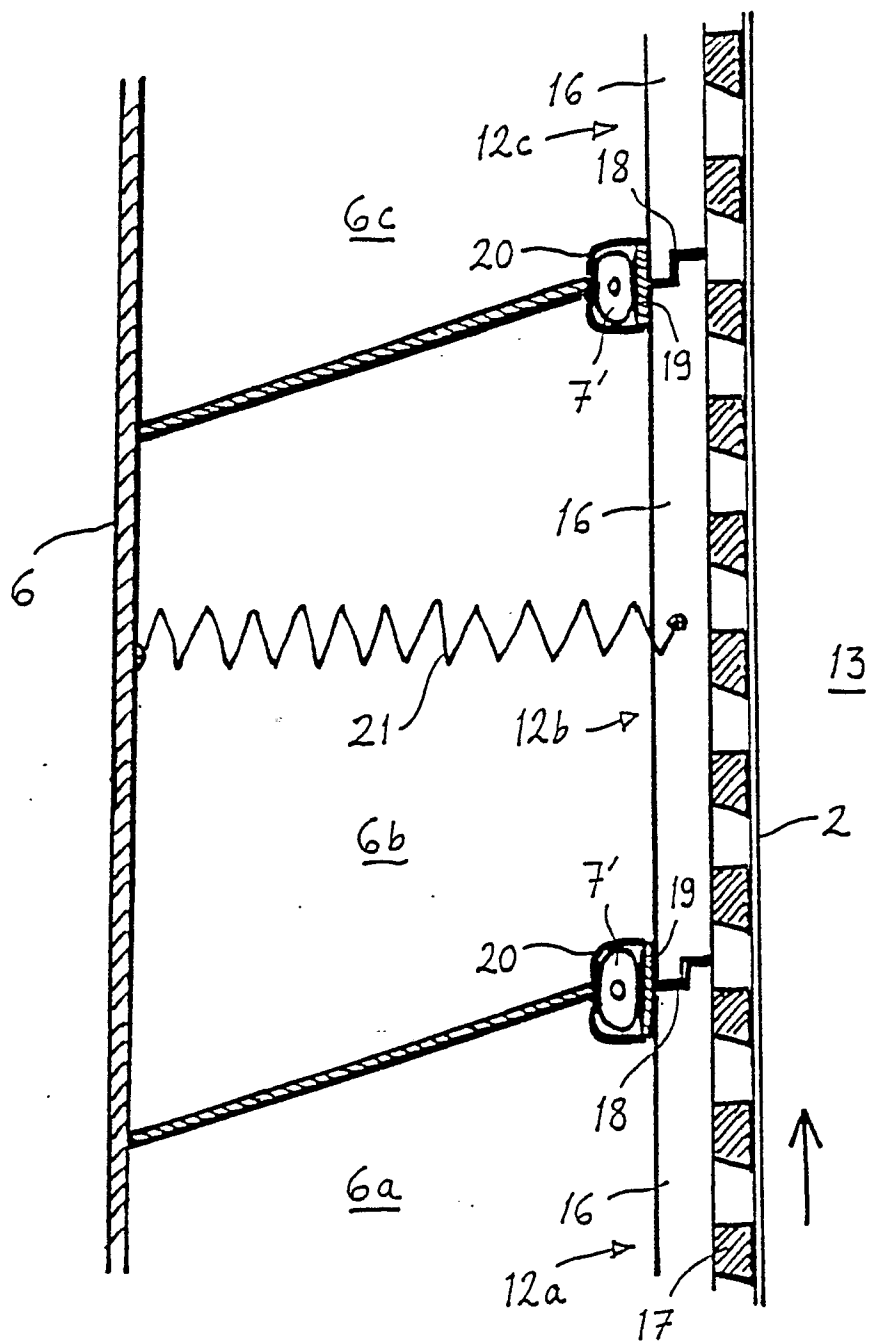


Fig. 2



European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 88 20 2647

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.4)
A	DE-B-1277203 (ALBERT KLEIN) ----		D21F9/00
A	US-A-1723051 (MANTIUS) ----		
A	DE-A-2152959 (ESCHER WYSS) ----		
A	GB-A-2174120 (O. DORRIES) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			D21F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23 FEBRUARY 1989	Examiner DE RIJCK F.
CATEGORY OF CITED DOCUMENTS 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 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 I : document cited for other reasons & : member of the same patent family, corresponding document			