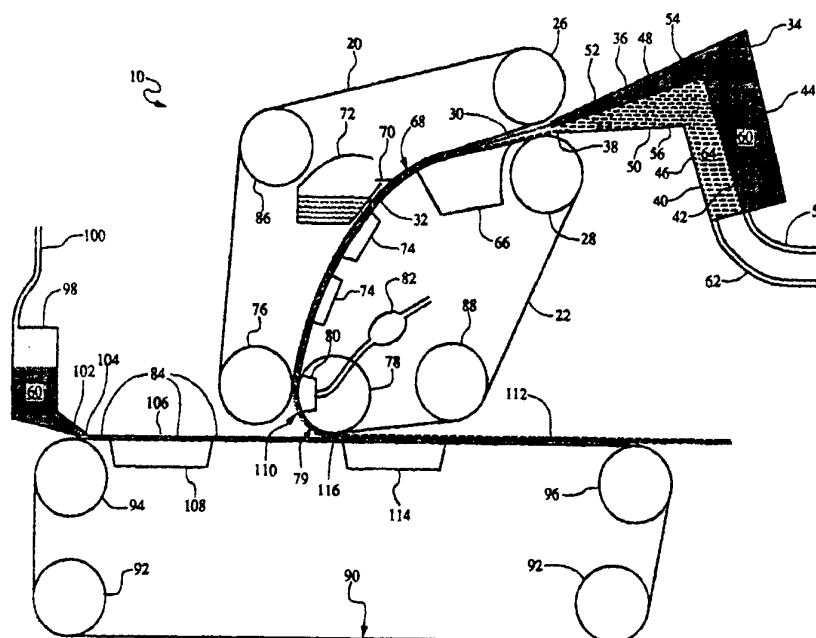


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(54) Title: MACHINE AND METHOD FOR FORMING MULTI-PLY LINERBOARD FROM TWO SHEETS

**(57) Abstract**

Two webs of paper (68, 84), without the necessity of a glue or starch shower, are joined together to form multi-ply linerboard (112). Two surfaces of two sheets having the same freeness and furnish are brought together and thus readily bonded together without a binder. To form multi-ply linerboard one of the webs is formed as a multi-ply web, one exterior ply of the multi-ply web matches the freeness and furnish of the other web and so bonds readily to it.

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(1)

PATENT APPLICATION
**MACHINE AND METHOD FOR FORMING MULTI-PLY LINERBOARD
FROM TWO SHEETS**

FIELD OF THE INVENTION

This invention relates to papermaking machines. More particularly, this invention relates to papermaking machines for the manufacture of multi-ply linerboard.

BACKGROUND OF THE INVENTION

Achieving an effective bond between the plys on multi-ply board formers has commonly presented a problem. One known method employs multi-web forming stock jets directed through a slice from a single headbox into a forming zone between converging forming surfaces in a papermaking machine. In this process, a multi-ply board is co-formed and limited intermixing between the layers forms a good bond between the layers. However, as the board thickness increases, dewatering and excessive mixing between the layers can be a problem.

In other linerboard machines hereto available, mini-fourdriniers and other twin-wire top formers form the top ply first and then bond it to the base sheet with a starch shower which bonds or glues the plies together. The use of costly starch showers and their inherent adverse effects on cleanliness, runnability and operating costs presents a less than ideal solution.

What is needed is an apparatus and method for forming multi-ply linerboard from two or more sheets which does not require gluing the sheets together.

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SUMMARY OF THE INVENTION

The method and apparatus of this invention forms multi-ply linerboards from two webs of paper joined together. The webs are joined without the necessity of a glue or starch shower because the two surfaces of the two sheets which are brought together have the same freeness and furnish and will thus readily bond together without a binder.

Webs which have the same furnish are composed of identical fibers. Webs that have the same degree of freeness are formed of fibers that have been mechanically beaten for the same amount of time. Thus, webs that have the same freeness and furnish are webs that have been made from the same stock of pulp fibers suspended in water.

Multi-ply linerboard is normally constructed to have a high quality surface ply, suitable for printing or the like, and one or more additional plies formed of low cost, unbleached or waste fibers which add stiffness and bulk to the linerboard. Thus, the surface ply of high quality fibers and the base ply of low cost fibers will not normally bond without the imposition of a binder such as provided through a starch shower.

The present invention achieves the desired result by forming a top ply having a surface layer of high-quality bleached fibers and a lower layer of the same fiber composition as the base ply. When the composite top ply is brought into contact with the base ply, and the top ply lower layer which is of the same fiber composition as the base ply is pressed together with the base ply, a bond is formed therebetween.

It is an object of the present invention to provide an apparatus for forming a multi-layer web and co-joining it to another web without a binder.

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It is another object of the present invention to provide a method for forming multi-ply linerboard from two sheets, at least one of which is multi-layered.

It is a further object of the present invention to provide an apparatus and method for forming thicker linerboard.

It is yet another object of the present invention to provide a method and apparatus for forming multi-ply linerboard at higher web speeds.

Further objects, features, and advantages of the invention will be apparent from the following detailed description when taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat schematic, side-elevational view of a forming section of a papermaking machine constructed and operated in accordance with the principles of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the Figure, wherein like numbers refer to similar parts, a multi-ply linerboard forming machine **10** is shown. A top ply of linerboard is formed between a first looped forming wire **20** and a second looped forming wire **22**. The looped forming wires **20**, **22** may be of metal wire or plastic fabric, and are arranged to travel in runs defined by guide rolls.

The upper breast roll **26** and the lower breast roll **28** are guide rolls over which the second wire **22** and the first wire **20** turn and which bring the forming wires **20**, **22** into opposition. The opposed wires **20**, **22** define a forming throat **30** which leads into a forming zone **32**.

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A headbox **34** has a slice **36** which directs two streams of paper-forming stock into the forming throat **30** through a slice opening **38**. The slice **36** communicates with the main chamber **40** of the headbox **34**. A wall **42** in the main chamber divides the headbox **32** into an upper sub-chamber **44** and a lower sub-chamber **46**. The slice main chamber **40** is defined by spaced walls **48, 50**. A baffle **52** extends at an angle from the wall **42** and divides the slice main chamber **40** into an upper flow channel **54** and a lower flow channel **56**. The upper flow channel **54** is aligned with and communicates with the upper sub-chamber **44**. The lower flow channel **56** communicates with the lower sub-chamber **46**.

The upper sub-chamber **44** has a supply duct **58** which supplies the upper headbox sub-chamber **44** with a first stock **60**, which will preferably be of an unbleached or semi-bleached low value fiber.

The lower sub-chamber **46** has a lower supply duct **62** which supplies a second stock **64**, preferably of a bleached, high value fiber. The unbleached stock **60** is injected into the forming throat **30** through the upper flow channel **54**, and the bleached stock **64** is injected into the throat **30** through the lower flow channel **56**. The slice baffle **52** keeps the two fibers separated as they are ejected through the slice opening **38** into the forming throat **30**.

A suction box **66** is located adjacent to the forming throat **30** and serves to dewater the stock to form a paper web **68**, shown schematically in the drawing as a series of dots. As the web **68** progresses through the forming zone **32**, it is progressively dewatered by an upper skimmer blade **70**. The skimmer blade rides on the upper wire **20** and deflects water into a save-all **72**. One or more additional suction boxes **74** are positioned downstream of the skimmer blade **70** to continue dewatering the web **68**.

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The web **68** then passes between an upper couch roll **76** and a lower couch roll **78**. The web **68** is retained on the surface **79** of the second wire **22** which is wrapped around the lower couch roll **78** by a suction gland **80**. The Suction gland **80** has a suction control means **82** so as to control the amount of water removed from the web **68**. In this manner, the web **68** can be left sufficiently moist for optimal bonding with a base web **84**. After the upper wire and lower wire **22** pass over the couch rolls **76**, **78**, they return by an upper guide roll **86** and a lower guide roll **88** respectively.

The base web **84** is formed on a third wire **90**. The third wire **90** may be of metal wire or plastic fabric, and forms a continuous loop around two lower guide rolls **92**, a forming roll **94** and a couch roll **96**. A second headbox **98** is supplied with stock **60** by a supply duct **100**. The stock **60** is identical to the stock **60** supplied to the upper sub-chamber **44** of the first headbox **34**. The slice **102** of the second headbox **98** has an opening **104** positioned over the forming roll **94** and leading into a fourdrinier table **106**.

The second headbox **98** supplies stock **60**, preferably composed of unbleached or semi-bleached low value fiber, to the fourdrinier table **106** where it is dewatered by a suction box **108** to form the base web **84**, indicated schematically as a series of dashes. Because the base web **84** and the base layer **110** of the multi-ply web **68** are composed of fibers of the same type (same furnish) which have been beaten or prepared in the same way for the same length of time (same freeness), the base layer **110** will readily adhere to the base web **84** when joined thereto. The joining is accomplished with the lower couch roll **78** together with web **68**, which is opposed for a distance, and is in closely spaced engaged relation to the third wire **90**, thus joining the base layer **110** to the base web **84**, to form a multi-ply linerboard web **112**. A suction box **114** is located under the trailing edge **116** serves to assure the transfer of

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the web 68 onto the wire 90 super-positioned and in intimate contact with the base web 84. The suction box 114 may also cause some moisture from the two-part web 68 to transfer downwardly through the base web 84, further ensuring a good bond between the layers. The liner board web 112 is removed from the wire 90 at the couch roll 96, where it passes into the pressing and drying section (not shown) of a papermaking machine.

It should be understood that wherein the multi-ply web 68 is shown as having two layers, and wherein the base web 84 is shown as composed of a single ply of fiber, both webs 68, 84 could contain a multiplicity of fiber layers, so long as the layers of fibers brought into opposition to form the bond between the web 68 and the base web 84 have the same furnish and freeness and thereby affect a tight bond without the necessity of a starch shower or the like.

It should also be understood that various methods of forming two paper webs fall within the scope of this invention, so long as one web is composed of at least two layers, one layer of which has the same furnish and freeness as one layer of a second web, wherein the layers of similar furnish and freeness are joined.

It should be understood that wherein a fiber board is described as composed of multi-plys comprising bleached and unbleached fibers, other liner boards combining various fiber types could be constructed in accordance with this invention.

It is understood that the invention is not confined to the particular construction and arrangement of parts herein illustrated and described, but embraces such modified forms thereof as come within the scope of the following claims.

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CLAIMS

I claim:

1. An apparatus for making two paper webs from stocks having a slurry of fibers in a liquid carrier and joining them to form a multi-ply sheet comprising:

a first looped forming wire (20) and a second looped forming wire (22);

a first guide (26) and a second guide (28) within the first forming wire (20) and the second forming wire (22) respectively, wherein the guides train the wires to define a forming run (32) therebetween;

a first headbox (34) having a main chamber (40) communicating with a slice chamber (36) defined by spaced walls (48,50) which lead to a slice opening (38), wherein the main chamber (40) is divided into at least a first stock sub-chamber (44) and a second stock sub-chamber (46);

a first stock (60) which is supplied to the first stock sub-chamber (44), and a second stock (64) which is supplied to the second stock sub-chamber (46), wherein the furnish and freeness of the first and second stocks are different;

at least one divider (52) in the slice chamber (36) dividing the slice chamber (40) into separate flow passages (54,56) aligned with different headbox sub-chambers to receive streams of the first and second stocks (60,64) from the first sub-chamber (44) and the second sub-chamber (46) respectively, wherein the divider (52) maintains the streams separated, and wherein each of the flow passages (54,56) leads to a slice opening (38) for discharging the streams into the forming zone (30) to form a multi-ply paper web having a bottom layer formed of the first stock (60), and a top layer formed of the second stock (64);

a third looped forming wire (90) having a stock receiving surface (106);
and

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a second headbox (98) which is supplied with stock of substantially the same freeness and furnish as the first stock (60), wherein the second headbox (98) has a slice (102) positioned to discharge stock onto the stock receiving surface (106) of the third wire (90) for forming a second web of paper, and wherein the second wire (22) has a surface (79) on which the first paper web (68) is retained after the second wire (22) travels through the forming run, and wherein the third wire surface (106) is conveyed to engage the first web (68) arrayed on the second wire surface (79), and wherein the engagement of the first web (68) and the second web (84) brings the lower layer (110) of the first web (68) into contact with the second web (84) to join the first web to the second web to form a multi-ply sheet.

2. The method of Claim 1 wherein the first stock (60) of fiber is comprised of unbleached fibers, and wherein the second stock (64) of fibers is comprised of bleached fibers.

3. The apparatus of Claim 1 further comprising a suction box (66) positioned beneath the third wire (90) where it is opposed to the second wire (22).

4. The apparatus of Claim 1 further comprising at least one suction box positioned beneath the second looped forming wire within the forming run (32).

5. The apparatus of Claim 1 further comprising a skimmer blade (70) positioned to overlie the first forming wire (20) as it passes through the forming run (32), and to remove water from a web formed therebetween.

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6. The apparatus of Claim 6 further comprising a save-all (72) positioned in receiving relation beneath the skimmer blade (70) for receiving water.

7. A method of forming a multi-ply paperboard sheet comprising the steps of:

forming a first multi-layered web (68) composed of at least two fiber types (60,64), wherein a lower fiber layer (110) in the web is formed of a first fiber;

forming a second web (84) of a second fiber (64), the second fiber having a furnish and freeness substantially the same as the first fiber;

bringing the first web lower fiber layer into opposition with the second web (84); and

pressing the first web (68) and the second web (84) together, so forming a bond without the necessity of a binder to produce a multi-ply sheet.

8. The method of Claim 7 wherein the first fiber type (60) and the second fiber type (62) are the same and have identical furnish and freeness.

9. The method of Claim 7 wherein the second web (84) is composed of unbleached fiber.

10. The method of Claim 7 wherein the first multi-layer web (68) is formed from a layer of bleached, high value fibers and the lower layer is formed of unbleached, low value fibers.

11. The method of Claim 7 wherein the first multi-layer web (68) is formed between two wires (20,22) which define a forming zone (32).

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12. The method of Claim 7 wherein the step of forming a first multi-layer web comprises the steps of:

supplying two different fiber stocks (60,64) to a multi-chamber headbox;
passing the two different stocks through a slice which keeps the stocks separate; and
injecting the two stocks through a slice opening into a forming zone between two opposed wires.

13. An apparatus for forming multi-ply linerboard comprising:

a first headbox (34) divided into at least a first sub-chamber (44) and a second sub-chamber (46);
a first stock (60) which is supplied to the first headbox first sub-chamber (44);
a second stock (64) of a freeness and furnish which is different than the freeness and furnish of the first stock (60), wherein the second stock (64) is supplied to the first headbox second chamber (46);
a first looped forming wire (20) which travels over a plurality of rotatable rollers;
a second looped forming wire (22) which travels over a plurality of rotatable rollers, wherein the first forming wire (20) and the second forming wire (22) are turned by respective rollers to define a narrowing throat (30) which receives the first stock (60) and the second stock (64) which are discharged from the first headbox (34);
a forming zone (32) defined between the two forming wires (20,22) subsequent to the throat (30) in which the two forming wires (20,22) are engaged on either side of the discharged stocks to form the stocks into a top web (68) having an upper layerformed

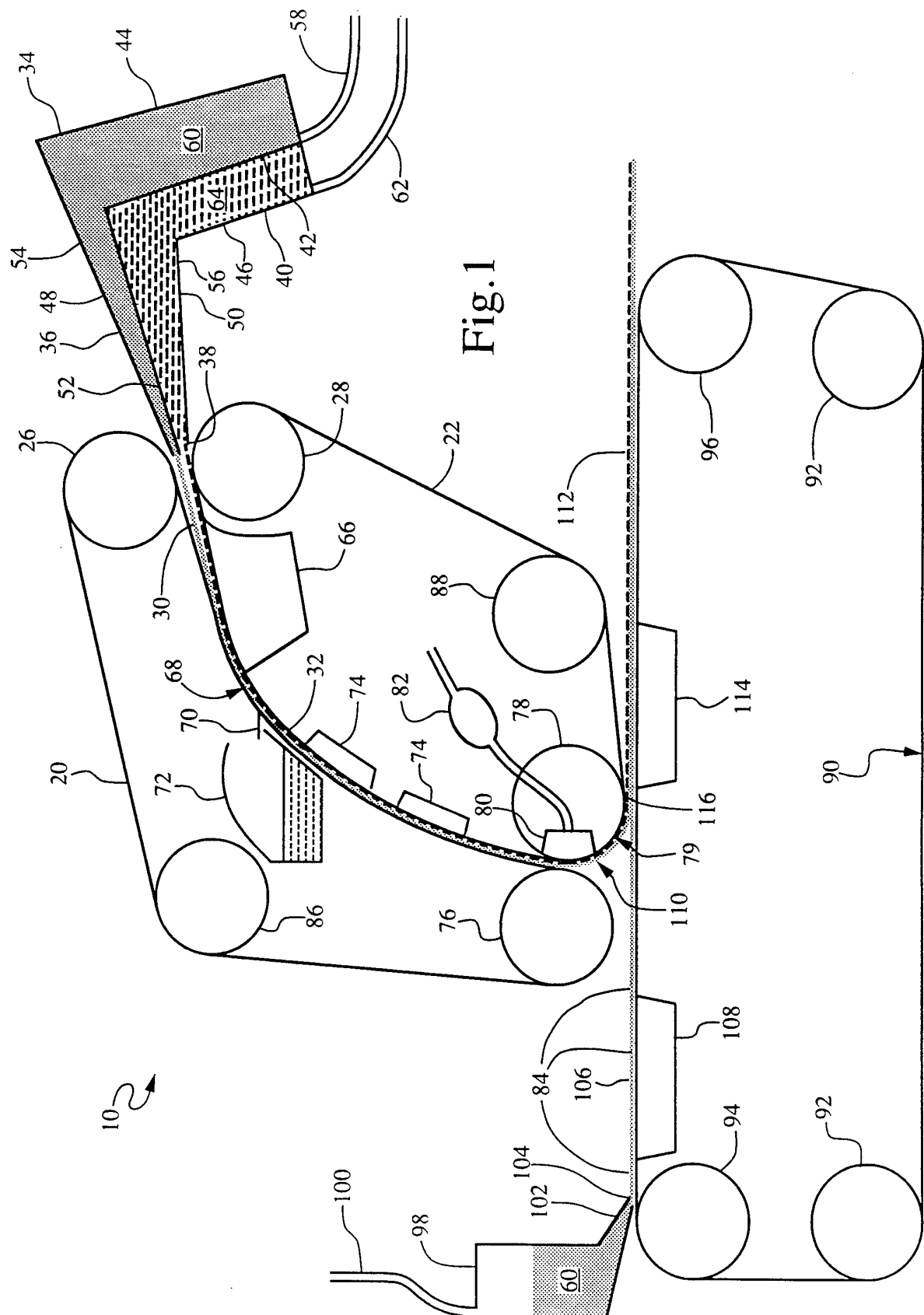
(11)

of the first stock (60) and a lower layer formed of the second stock (64);

a third looped forming wire (90); and

a second headbox (98) supplied with a third stock of substantially the same freeness and furnish as the second stock (64), wherein the second headbox (98) discharges the third stock onto the third forming wire (90) to form a bottom web (84), and wherein the third forming wire (90) conveys the bottom ply and engages the bottom web (84) with the top web (68) on the second forming wire (22), such that the top web lower layer is engaged and pressed together with the bottom web which is substantially the same freeness and furnish to form a single linerboard web (112).

14. The apparatus of Claim 13 further comprising means for drawing suction on the second wire (22) subsequent to the forming zone (32) to cause the top ply to travel along the second wire (22) and separate from the first wire (20) prior to engagement with the third wire (90).



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 94/14039

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D21F11/04 D21F9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 312 512 (SCA DEVELOPMENT AB) 19 April 1989 see the whole document ---	1,7,8,13
A	EP,A,0 511 186 (INTERNATIONAL PAPER COMPANY) 28 October 1992 ---	
A	US,A,3 994 771 (MORGAN, JR ET AL) 30 November 1976 -----	



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Patent family members are listed in annex.

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Date of the actual completion of the international search

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Information on patent family members

International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-312512	19-04-89	SE-B- 459263	19-06-89
		SE-A- 8704040	17-04-89

EP-A-511186	28-10-92	JP-A- 5230787	07-09-93
		US-A- 5169496	08-12-92

US-A-3994771	30-11-76	AT-B- 367351	25-06-82
		AU-B- 509230	01-05-80
		AU-A- 1390476	17-11-77
		BE-A- 842308	29-11-76
		CA-A- 1052158	10-04-79
		CH-A- 615719	15-02-80
		DE-A- 2623905	09-12-76
		FR-A,B 2312600	24-12-76
		GB-A- 1543346	04-04-79
		JP-A- 52021405	18-02-77
		LU-A- 75050	15-02-77
		NL-A- 7605733	02-12-76
		SE-B- 428941	01-08-83
		SE-A- 7605986	01-12-76
