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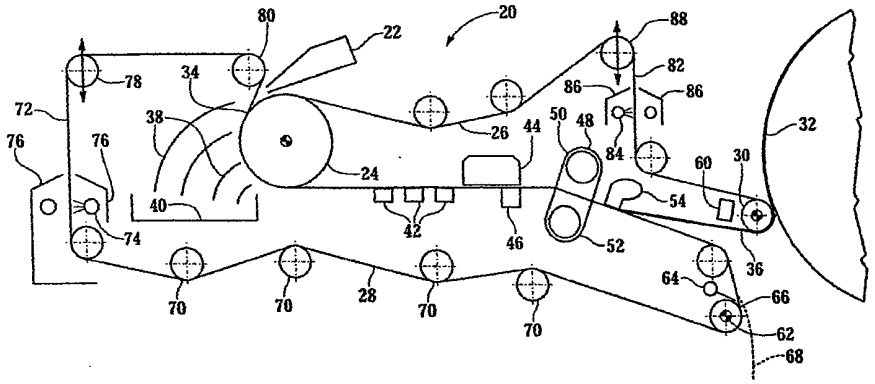
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(54) Title: PAPERMAKING MACHINE FOR FORMING TISSUE EMPLOYING AN AIR PRESS



(57) Abstract: A web of tissue is formed in a crescent former, followed by an air press for water removal in the pressing section, passing onto a Yankee dryer (32). A headbox (22) injects stock between upper and lower dryer fabrics (26, 28) brought together on a breast roll (24). The fabrics move over vacuum boxes (42), and the web is heated with steam and passed between an upper pressure box (50) and lower vacuum box (52) forming an air press (48) which dewaters the web. A sheet transfer pickup vacuum box (54) holds the sheet to the upper fabric as the lower fabric diverges from the upper fabric. A pressure roller (30) transfers the web onto a Yankee dryer. The fabrics are cleaned on vertical runs (82) before returning to the breast roll. A second upper fabric or transfer fabric operating at a lower speed than the first can be used to form a rush transfer between the forming fabrics and the Yankee dryer which increases web bulk and absorbency. Instead of a second fabric, a vacuum pressure roll may perform the rush transfer between the lower forming fabric and the Yankee dryer. The lower fabric may be divided into two fabrics, and the second fabric which passes through the air press, can be used to mold a texture into the web. The rush transfer and the molding fabric may be combined in one machine. A twin wire former may be used instead of crescent former in each of the above configurations.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Papermaking Machine for Forming Tissue Employing an Air Press

BACKGROUND OF THE INVENTION

The present invention relates to papermaking machines used in forming tissue grades of paper in general and to machines employing crescent formers and twin wire formers in particular.

Tissue is a lightweight grade of paper which is formed, pressed and dried on a single large dryer called a Yankee dryer. The tissue is creped from the surface of the Yankee dryer by a doctor blade creating a soft absorbent tissue. Tissue is widely used in products such as toilet paper, paper towel, napkins, and facial tissues.

A typical tissue forming machine consists of a fourdrinier former which transfers the web to a press felt which conducts the tissue web through a pressing section. Following the pressing section the web is pressed against a Yankee dryer

roll to firmly adhere the web to the surface of the roll. The transfer roll may have a nip loading of approximately 200 pounds per linear inch and sometimes various sprays are used to increase adherence to the surface of the Yankee dryer roll. The tissue web is rapidly dried on the surface of the Yankee dryer which may have a diameter of over 22 feet. The dried web is scraped off the surface of the dryer by a doctor blade in a process known as creping which increases the bulk and absorbency of the tissue.

When attempting to modernize a typical older tissue making machine, the forming section, which has limited water handling capacity, which impacts formation potential, and needs substantial upkeep due to age, is advantageously replaced with a modern twin wire former or crescent former. Updating the pressing section, however, presents problems: modern fabrics are stiff and cannot be bunched up and threaded through the threading openings on older machines.

The existing pressing section typically cannot sufficiently reduce the water content of the higher speed web produced by the new crescent or twin-wire former. Because drying capability is limited by the maximum size and temperature of the Yankee dryer, if the performance of older machines is to be increased without increased drying capability, a solution which improves the capacity of the pressing section must be found. At the same time, it is necessary to eliminate the long spans where the web is supported by a felt, which have the potential for sheet drop-offs and hole formation.

What is needed is a combination of tissue forming section and press section which can be used to improve the performance of existing tissue making machines.

SUMMARY OF THE INVENTION

The papermaking machine of this invention forms a web of tissue in a crescent former, followed by an air press for water removal in the pressing section. The web is then pressed onto a Yankee dryer for drying. The crescent former employs a breast roll around which a upper fabric and a lower fabric are brought together. A headbox injects a stream of stock between the two fabrics as they are brought together on the breast roll. The upper fabric engages the breast roll first, and water is driven off through the lower fabric due to centrifugal acceleration as the wires move together around the breast roll. The two forming fabrics move together over a series of vacuum boxes, and the sheet is heated with steam and passed between an upper pressure box and a lower vacuum box forming an air press which dewaters the web by forcing air through the web. A sheet transfer pickup vacuum box holds the sheet to the upper fabric as the lower fabric diverges away from the upper fabric. A pressure roller transfers the web onto the surface of a Yankee dryer. A tail cutter is located between the sheet transfer box and the pressure roller. Each of the fabrics has a vertical run of fabric before it returns to the breast roll. The vertical runs allow the forming fabrics to be cleaned while baffles prevent the cleaned fabric from being sprayed.

Various modifications can be made to the basic design. A second upper fabric or transfer fabric operating at a lower speed then the first upper fabric can be used to form a rush transfer between the forming fabrics and the Yankee dryer which increases web bulk and absorbency. Instead of a second fabric, a vacuum pressure roll may perform the rush transfer between the lower forming fabric and the Yankee dryer.

The lower fabric may be divided into two fabrics, and the second fabric which passes through the air press, can be used to mold a texture into the web.

The rush transfer and the molding fabric may be combined in one machine.

A twin wire former may be used instead of a crescent former in each of the above configurations.

It is a feature of the present invention to provide a replacement forming and pressing section to an existing papermaking machine for forming tissue.

It is another feature of the present invention to provide a pressing section of shorter length.

It is a further feature of the present invention to provide for cleaning forming fabrics as they move upwardly along a vertical path.

It is a further feature of the present invention to increase the speed at which a tissue forming papermaking machine operates.

It is yet another feature of the present invention to provide means for integrating an air press into a papermaking machine for forming tissue grades of paper.

A yet further feature of the present invention is to provide an improved tissue former which utilizes portions of an existing machine and thus reduces costs.

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

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a crescent former and pressing section employing an air press for forming and pressing a tissue web.

FIG. 2 is a fragmentary schematic review of an alternative transfer apparatus for creating a rush transfer between the pressing section and the Yankee dryer of FIG.1 or FIG. 5

FIG. 3 is a schematic view of an alternative embodiment of the forming and pressing section of FIG.1 wherein a second lower felt allows molding the formed web.

FIG. 4 is a schematic view of a yet further embodiment of the forming and pressing section of FIG. 1 combining the features of the apparatus of FIG. 2 and FIG. 3.

FIG. 5 is a still further alternative embodiment of the forming and pressing sections of FIG. 1 wherein a twin wire former is employed.

FIG. 6 is a further fragmentary schematic view of an apparatus for creating a rush transfer of a tissue web from the pressing section of FIG. 1 or FIG. 5

FIG. 7 is a schematic view of another alternative embodiment combining the features of FIG. 5 with the second lower felt used for molding of FIG. 3 .

FIG. 8 is a schematic view of another alternative embodiment apparatus combining the features of FIG. 6 and FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring more particularly to FIGS. 1– 8 wherein like numbers refer to similar parts, a papermaking machine 20 for forming tissue grades of paper is shown in FIG.1. The apparatus 20 has a headbox 22 which is positioned over a breast roll 24 to inject a stream of stock into a nip 34 formed between an upper forming fabric 26 and a lower forming fabric 28. The upper forming fabric 26 forms an endless loop which contains the breast roll 24 and a pressure roll 30 which presses the upper forming fabric 26 against a Yankee dryer 32. The nip 34 is formed where the lower forming fabric 28 is wrapped onto the upper forming fabric 26 as it wraps around the breast roll 24. A tissue web 36 is formed as water is removed from the stock by suction into the breast roll 24 and by the action of centrifugal force which causes water to be thrown outwardly where curved baffles 38 direct it into a saveall 40.

The upper fabric 26 and lower fabric 28 with the web 36 sandwiched therebetween passes over a series of vacuum boxes 42 which further dewater the web 36. The web is then heated by a steam shower 44 positioned over a vacuum box 46. Heating the web reduces the viscosity of the water contained in the web. The web 36 sandwiched between the upper fabric 26 and the lower fabric 28 then passes through an air press 48 consisting of an upper pressure box 50 and a lower vacuum box 52. The air press 48, which is described more fully in U.S. Application No. 08/962,110, filed October 31, 1997, entitled Air Pressing Equipment and Processes, which is incorporated herein by reference. U.S. Patent No. 5,225,0422 Eaton et al. which is incorporated herein by reference, describes a apparatus for dewatering a web formed by a twin wire former. Eaton et al. describes pressure dome on one side of a sandwich of two forming fabrics and a web held therebetween and a opposed curved vacuum box which receives water from the web. Eaton et al. uses the terminology pressure dome and water collecting chamber to refer to the disclosed air

press. Such terminology is analogous to the terminology used herein of a pressure box opposed to a vacuum box.

The air press 48 is positioned about the upper forming fabric 26 and the lower forming fabric 28 and the web 36 is positioned therebetween. Air is supplied to the pressure box 50 and flows through the relatively permeable upper forming fabric 26, through the web 36, and finally through the relatively permeable lower forming fabric 28.

The large area of the pressure box 50, which may be six inches wide in the machine direction, as compared to a jet of air, means that air flows with relatively low velocity through the web and applies a relatively high pressure of about fifteen to thirty psi to the web 36 as it passes between the pressure box 50 and the vacuum box 52. Pressure in the vacuum box 52 is typically about fifteen inches of Mercury below atmospheric or about seven psi vacuum. Thus the total pressure drop across the web 36 is approximately twenty to thirty-five psi and almost all the pressure drop occurs through the web 36 thickness. The web 36 is relatively thin, approximately a few hundredths of an inch or less, as air moves through the web it sees the twenty to thirty-five psi pressure drop, by dividing pressure drop by the thickness of the web, a value for the pressure gradient across the web can be calculated, demonstrating the large pressure gradient through the web.

The effect of the rapid expansion of air as it passes through the web 36 is to remove water from the web. As described in U.S. Application No. 08/962,110, an air press device used on a tissue web having a solids content of about twenty-five percent and a thickness of about three hundredths of an inch was able to increase the solids content to approximately thirty-three percent. Although the precise mechanism is not clearly understood, the use of pressurized air is more effective than vacuum alone because of the higher pressures available and the greater air volume forced through the web. The upper fabric 26 and the lower fabric 28 are substantially more permeable then the web so that almost all the pressure drop occurs across the web 36.

The mechanism of the air press 48 is distinct from a system using jets of air directed at a web. A jet of air is difficult to maintain with uniformly along the

machine direction. Further the magnitude of the dynamic pressure differential which can be developed is generally lower than the static air press pressure developed in the enclosed air press frame 50.

Following the air press 48, the lower fabric 28 is directed away from the upper fabric 26 and a sheet transfer pickup box 54 draws a vacuum on the upper fabric 26 to cause the web 36 to follow the upper forming fabric 26. The web 36 then travels around a pressure roller 30 which presses against the Yankee dryer 32 with a pressure of approximately two hundred pounds per linear inch and transfers the web 36 to the surface of the Yankee dryer 32. A tail cutter 60 may be located above the upper fabric 26 between the pickup box 54 and the pressure roller 30. And similarly, sheet trim apparatus (not shown) may be located between the pickup box 54 and the pressure roller 30.

The lower fabric 28 continues down around a drive roll 62. A spray 64 creates a flooded nip 66 between the upper side of the drive roll 62 and the lower fabric 28. The flooded nip causes the web 68 if it has not been transferred by the pickup box 54 to become saturated and leave the lower fabric 28 under the influences of gravity. The lower forming fabric 28 returns to the forming section of the papermaking machine 20 through a series of idler rolls 70. The lower fabric 28 enters a vertical run 72 where water showers 74 contained within baffles 76 clean the fabric 28 before it returns to the breast roll 24. A stretcher roll 78 allows the tension in the lower fabric 28 to be adjusted and a guide roll 80 guides the fabric 28 into engagement with the breast roll 24.

After leaving the press roll 30, the upper fabric 26 moves through a vertical run 82 where it is washed by water showers 84 within baffles 86. The upper fabric 26 passes over an adjustable stretcher roll 88 and returns to wrap around the breast roll 24.

FIG. 2 shows an addition of a second upper fabric 90 between the air press 48 and the press roll 30. The addition of the second fabric 90 involves the elimination of the web transfer pickup box 54 shown in FIG.1, and the addition of a suction pickup roll 92 which takes the web 36 from the lower fabric 28. The pickup roll 92 is adjustable and the second upper fabric 90 is operated at a lower speed than

the lower fabric 28 so that a rush transfer is created wherein a creping like action takes place as the web transfers from the lower fabric 28 to the slower speed fabric 90. The second upper fabric 90, after wrapping around the press roll 30, enters an inclined cleaning run 94 where a water shower 96 is followed by an air knife 98. The second upper fabric 90 then turns around a helper drive roll 100 to a stretcher roll 102 and returns to the suction pickup roll 92. The use of a rush transfer increases the bulk and absorbency of the web 36 without additional fiber.

Rush transfer can also be accomplished with a vacuum pressure roll 104 as shown in FIG. 6 . The vacuum pressure roll 104 is positioned between the Yankee dryer 32 and the lower fabric 28. The tail cutter 60 is positioned below the lower fabric 28 as shown in FIG. 6 . A trim means (not shown) can also be positioned above the lower fabric 28.

A second lower fabric 106 can be employed with the papermaking machine 20 of FIG.1. As shown in FIG. 3, a vacuum pickup roll 108 is added to the upper fabric 26 just in front of the steam shower 44 to pick the web off the lower forming fabric 28. A drive roll 110 is added inside the loop formed by the lower fabric 28. The second lower fabric 106 incorporates a shower 112 and an air knife 114 downstream of the flooded nip 66 to clean the second lower fabric 106. By dividing the lower fabric into two parts the ability to mold the web 36 into a specialized fabric is created. Thus the second lower fabric 106 may have a texture which imparts specialized functionality or appearance to the web 36.

The ability to create a rush transfer as described with respect to FIG. 2 in combination with molding the web 36 with a second lower fabric 106 is shown in FIG. 4.

An alternative embodiment papermaking machine 116 for forming tissue grades of paper is shown in FIG. 5 . The papermaking machine 116 employs a twin wire former 118 formed by an upper forming fabric 120 and a lower forming fabric 122 which wrap around a breast roll 124. The breast roll 124 is inside the loop formed by the lower fabric 22. The upper fabric 120 comes together with the lower fabric 122 to form a nip 126. A headbox 128 injects a stream of stock into the nip 126. Centrifugal force causes water to be thrown outwardly and be captured by

baffles 130 which direct water to a saveall 132. In all other respects, the papermaking machine 116 is similar to the machine 20 shown in FIG.1.

Various modifications to the basic machine 116 can be made by incorporating a second upper fabric 90 as shown in FIG. 2, or a vacuum pressure roll 104 as shown in FIG. 6.

FIG. 7 is similar to FIG. 3 and shows the addition of a second lower fabric 106 which provides the ability to mold a pattern into the web 36. The features of FIG. 2 can be incorporated with the configuration of FIG. 7 to produce the configuration of FIG. 8 which is similar to the crescent former of FIG. 4.

It should be understood that the breast roll used in the crescent former or the twin wire former may be a vacuum roll or may be a plain roll depending on various factors including the speed and thickness of the web being formed.

It should be understood that wherein a rush transfer is described, a drag transfer where the web is stretched is also possible.

It should be understood that the suction pickup roll 92 shown in FIG. 2 and generally as shown in FIGS.4 and 8 could be a suction shoe which does not rotate.

In interpreting the drawing rolls shown with opposed dark sectors near the center are drive rolls or assistant drive rolls. Rolls with an arrow passing through them are mounted to move to adjust tension in a forming fabric. Rolls which show a pivot line as in FIG. 6 symbolize the mounting of the roll to pivot as indicated by the arrows.

Certain grades of paper, such as tissue paper or creped papers, are typically formed by pressing the web onto a large diameter Yankee dryer, and creating a soft absorbent web by scraping the web off the dryer surface with a doctor blade. Alternative approaches hold out the possibility of increasing absorbency and increased forming speed while living within the limitations of an existing single large diameter Yankee dryer. Rush transfer is an alternative means of increasing absorbency in the formation of a tissue web. New approaches may lead to more cost-effective approaches to manufacturing these important and widely used grades of paper.

It is understood that the invention is not limited 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.

CLAIMS

We claim:

1. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop which contains the breast roll and the press roll, the first forming fabric being urged against the Yankee dryer by the press roll;

a second forming fabric forming a second endless loop, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the second forming fabric comes into engagement with the first forming fabric on the breast roll;

an air press comprising a pressure box positioned to engage the inside of one of the forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other forming fabric so that the first and second forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the second fabric.

2. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop which contains the breast roll;

a second forming fabric forming a second endless loop, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the second forming fabric comes into engagement with the first forming fabric on the breast roll;

an air press comprising a pressure box positioned to engage the inside of one of the first and second forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other of the first and second forming fabrics so that the first and second forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the second fabric

a third forming fabric defining a third endless loop which engages the second forming fabric at a position downstream of the air press, the press roll positioned within the third forming fabric and engaging the third forming fabric and the web against the Yankee roll; and

a suction pickup within the third forming fabric which engages the third forming fabric with the second forming fabric downstream of the air press, wherein the third forming fabric is operated at a lower speed than the second forming fabric so that a rush transfer is created wherein a creping like action takes place as the web transfers from the second forming fabric to the slower speed third forming fabric.

3. The apparatus of Claim 2, wherein the third forming fabric, after wrapping around the press roll, enters an inclined cleaning run where a water shower is directed onto the third forming fabric and is followed by an air knife.

4. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a first forming fabric forming an endless loop and extending around the breast roll;

a second forming fabric forming a second endless loop, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the second forming fabric comes into engagement with the first forming fabric on the breast roll;

an air press comprising a pressure box positioned to engage the inside of one of the forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other forming fabric so that the first and second forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the second fabric;

a vacuum pressure roll positioned between the Yankee dryer and the second forming fabric and engaging the second forming fabric, wherein the first forming fabric departs from the second forming fabric upstream of the vacuum pressure roll, and the web transfers from the vacuum pressure roll to the Yankee dryer.

5. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop which contains the breast roll and the press roll, the first forming fabric being urged against the Yankee dryer by the press roll;

a second forming fabric forming a second endless loop, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the second forming fabric comes into engagement with the first forming fabric on the breast roll;

a third forming fabric forming a third endless loop downstream of the second forming fabric, the third forming fabric defining a joint run with the first forming fabric with the web engaged therebetween;

an air press comprising a pressure box positioned to engage the inside of one of the first and the third forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other of the first and the third forming fabrics so that the first and third forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the third fabric; and

a vacuum pickup roll positioned within the looped first forming fabric upstream of the air press to pick the web off the second forming fabric.

6. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop which contains the breast roll;

a second forming fabric forming a second endless loop, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the second forming fabric comes into engagement with the first forming fabric on the breast roll;

a third forming fabric forming a third endless loop downstream of the second forming fabric, the third forming fabric defining a joint run with the first forming fabric with the web engaged therebetween;

an air press comprising a pressure box positioned to engage the inside of one of the first and the third forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other of the first and the third forming fabrics so that the first and third forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the third fabric; and

a vacuum pickup positioned within the looped first forming fabric upstream of the air press to pick the web off the second forming fabric;

a fourth forming fabric defining a fourth endless loop which engages the third forming fabric at a position downstream of the air press, the press roll being positioned within the fourth forming fabric and engaging the fourth forming fabric and the web against the Yankee roll; and

a suction pickup roll within the fourth forming fabric which engages the fourth forming fabric with the third forming fabric downstream of the air press, wherein the fourth forming fabric is operated at a lower speed than the third forming fabric so that a rush transfer is created wherein a creping like action takes place as the web transfers from the third forming fabric to the slower speed fourth forming fabric.

7. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop which contains the press roll, the first forming fabric being urged against the Yankee dryer by the press roll;

a second forming fabric forming a second endless loop which surrounds the breast roll, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the first forming fabric comes into engagement with the second forming fabric on the breast roll;

an air press comprising a pressure box positioned to engage the inside of one of the forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other forming fabric so that the first and second forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the second fabric.

8. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop which contains the press roll, the first forming fabric being urged against the Yankee dryer by the press roll;

a second forming fabric forming a second endless loop which surrounds the breast roll, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the first forming fabric comes into engagement with the second forming fabric on the breast roll;

a third forming fabric defining a third endless loop downstream of the second forming fabric and defining a joint run with the portions of the first forming fabric;

an air press comprising a pressure box positioned to engage the inside of one of the first and the third forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other of the first and the third forming fabrics so that the first and third forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the third fabric.

9. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop;

a second forming fabric forming a second endless loop which surrounds the breast roll, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the first forming fabric comes into engagement with the second forming fabric on the breast roll;

a third forming fabric defining a third endless loop downstream of the second forming fabric and defining a joint run with the portions of the first forming fabric;

an air press comprising a pressure box positioned to engage the inside of one of the first and the third forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other of the first and the third forming fabrics so that the first and third forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box;

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the third fabric;

a fourth forming fabric defining a fourth endless loop which engages the third forming fabric at a position downstream of the air press, the

press roll positioned within the fourth forming fabric and engaging the fourth forming fabric and the web against the Yankee roll; and

a suction pickup within the fourth forming fabric which engages the fourth forming fabric with the third forming fabric downstream of the air press, wherein the fourth forming fabric is operated at a lower speed than the third forming fabric so that a rush transfer is created wherein a creping like action takes place as the web transfers from the third forming fabric to the slower speed fourth forming fabric.

10. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop;

a second forming fabric forming a second endless loop which surrounds the breast roll, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the first forming fabric comes into engagement with the second forming fabric on the breast roll;

an air press comprising a pressure box positioned to engage the inside of one of the forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside of the other forming fabric so that the first and second forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the

pressure box through the first fabric, a paper web contained therebetween, and the second fabric;

a third forming fabric defining a third endless loop which engages the second forming fabric at a position downstream of the air press, the press roll positioned within the third forming fabric and engaging the third forming fabric and the web against the Yankee roll; and

a suction pickup within the third forming fabric which engages the third forming fabric with the second forming fabric downstream of the air press, wherein the third forming fabric is operated at a lower speed than the second forming fabric so that a rush transfer is created wherein a creping like action takes place as the web transfers from the second forming fabric to the slower speed third forming fabric.

11. A papermaking machine for manufacturing a creped paper web, comprising:

a breast roll;

a Yankee dryer;

a press roll;

a first forming fabric forming an endless loop;

a second forming fabric forming a second endless loop which surrounds the breast roll, the second forming fabric coming into engagement with the first forming fabric and being wrapped around a portion of the breast roll and running parallel to and engaged with the first forming fabric along an extended run after the first forming fabric and the second forming fabric leave the breast roll;

a headbox positioned to inject a stream of paper forming stock between the first forming fabric and the second forming fabric as the first forming fabric comes into engagement with the second forming fabric on the breast roll;

an air press comprising a pressure box positioned to engage the inside of one of the forming fabrics, and a vacuum box in spaced parallel relation to the pressure box, the vacuum box positioned to engage the inside

of the other forming fabric so that the first and second forming fabrics pass between the pressure box and the vacuum box;

a source of pressure connected to the pressure box; and

a source of vacuum connected to the vacuum box so air flows from the pressure box through the first fabric, a paper web contained therebetween, and the second fabric;

a vacuum pressure roll positioned between the Yankee dryer and the second forming fabric and engaging the second forming fabric, wherein the first forming fabric departs from the second forming fabric upstream of the vacuum pressure roll, and the web transfers from the vacuum pressure roll to the Yankee dryer.

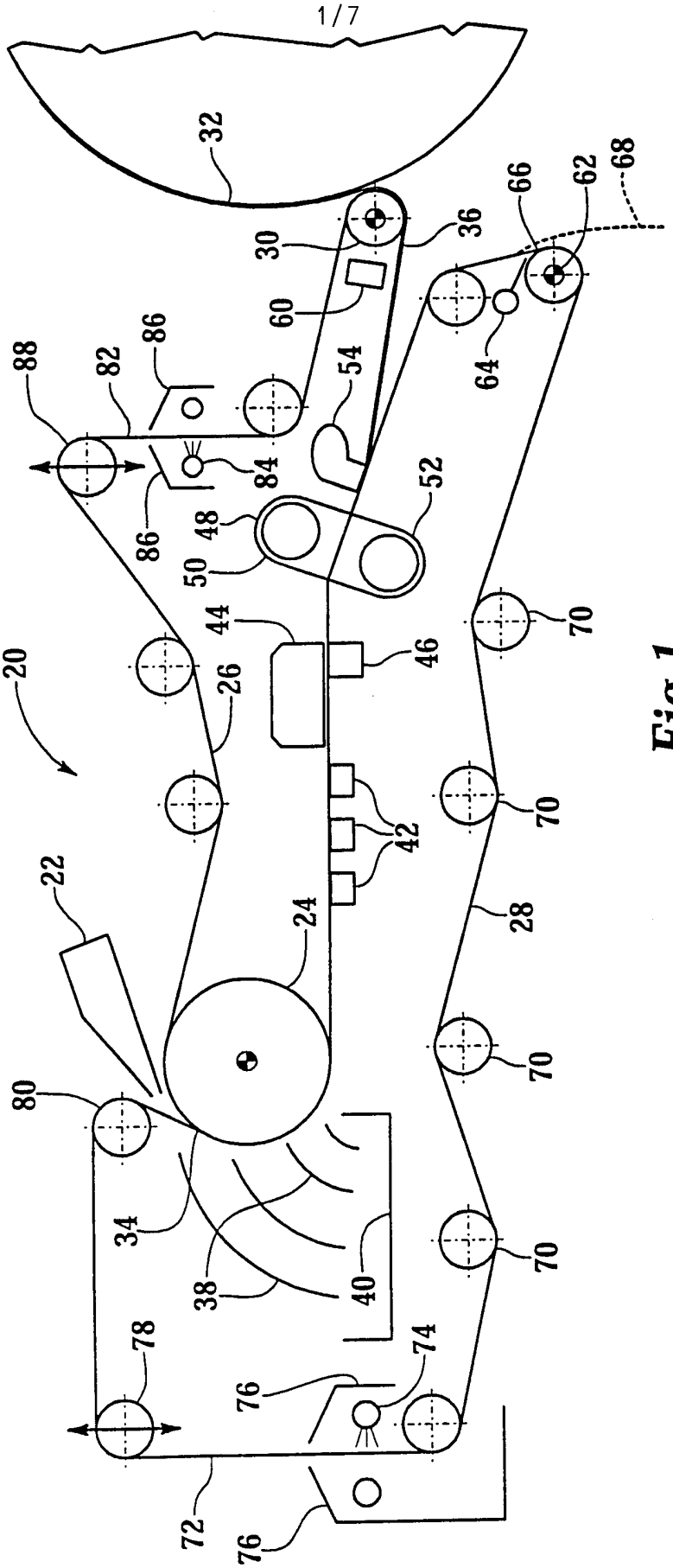

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Fig.1

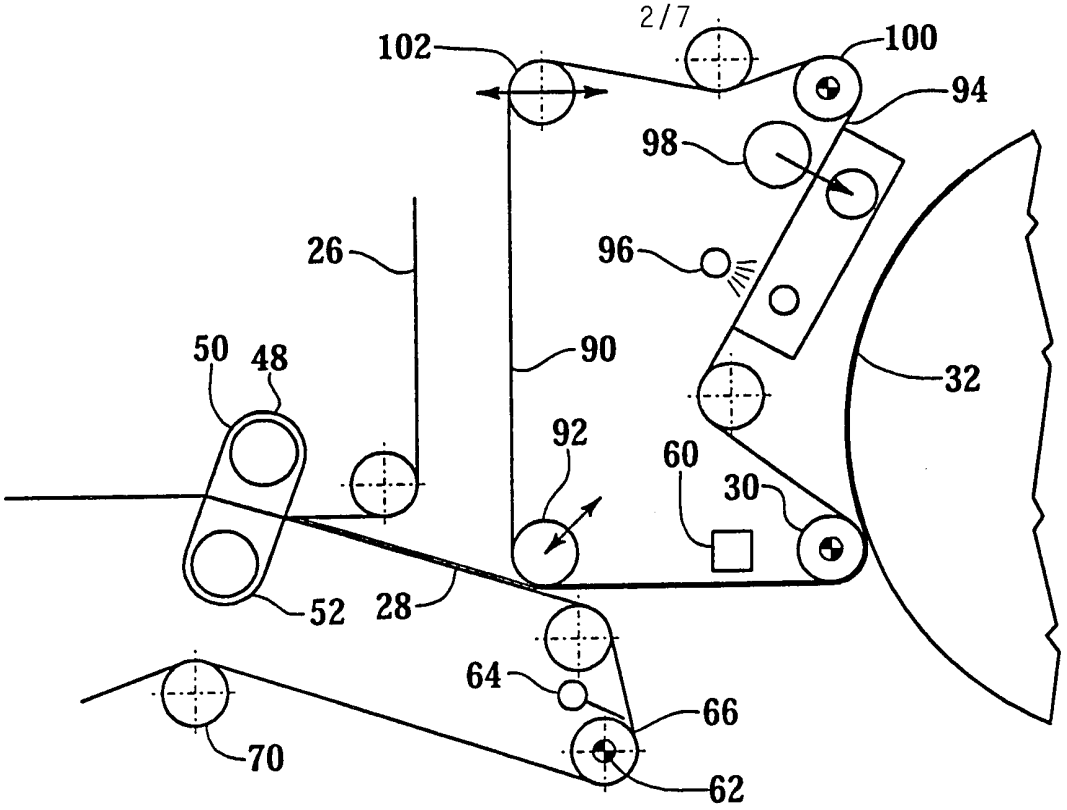

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Fig.2

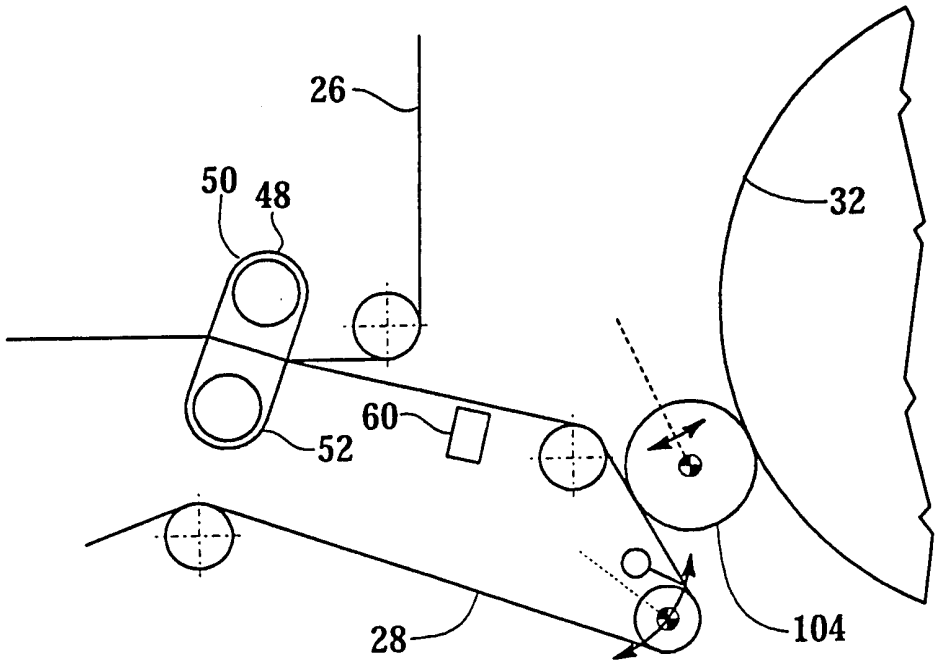

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Fig.6

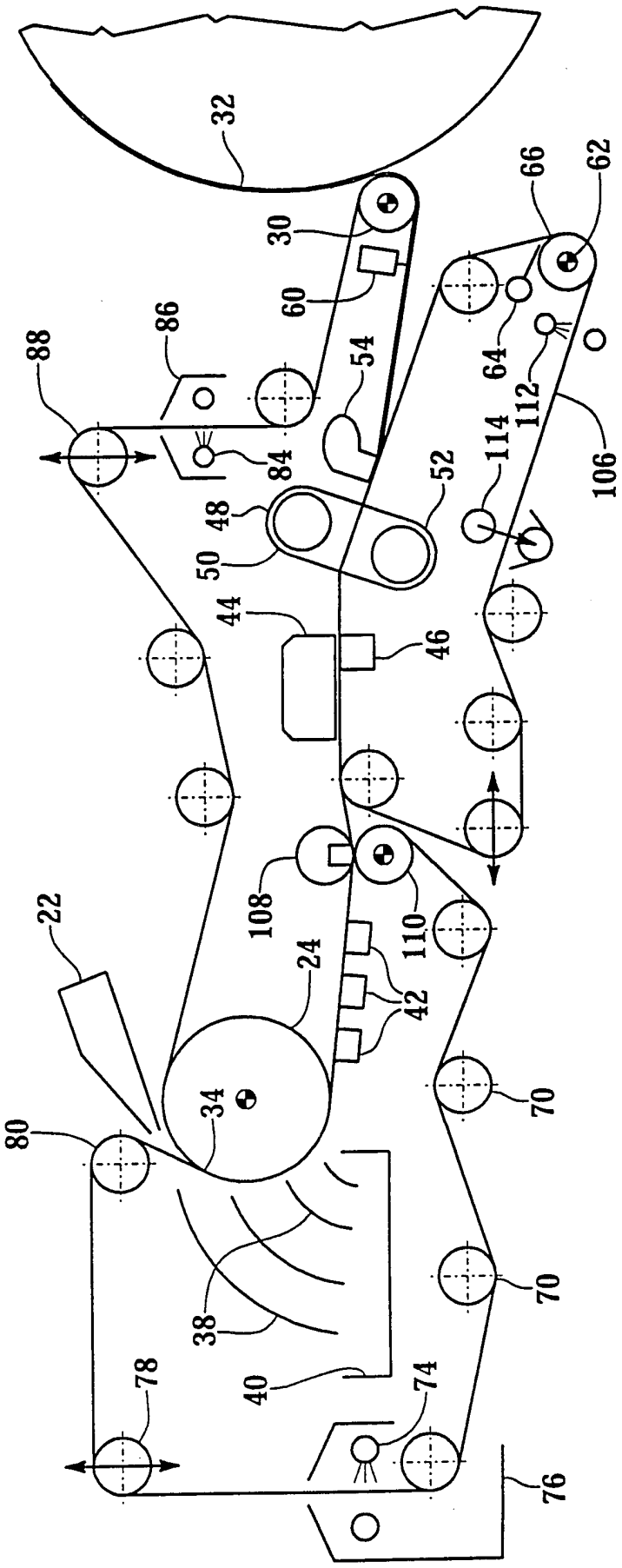

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Fig.3

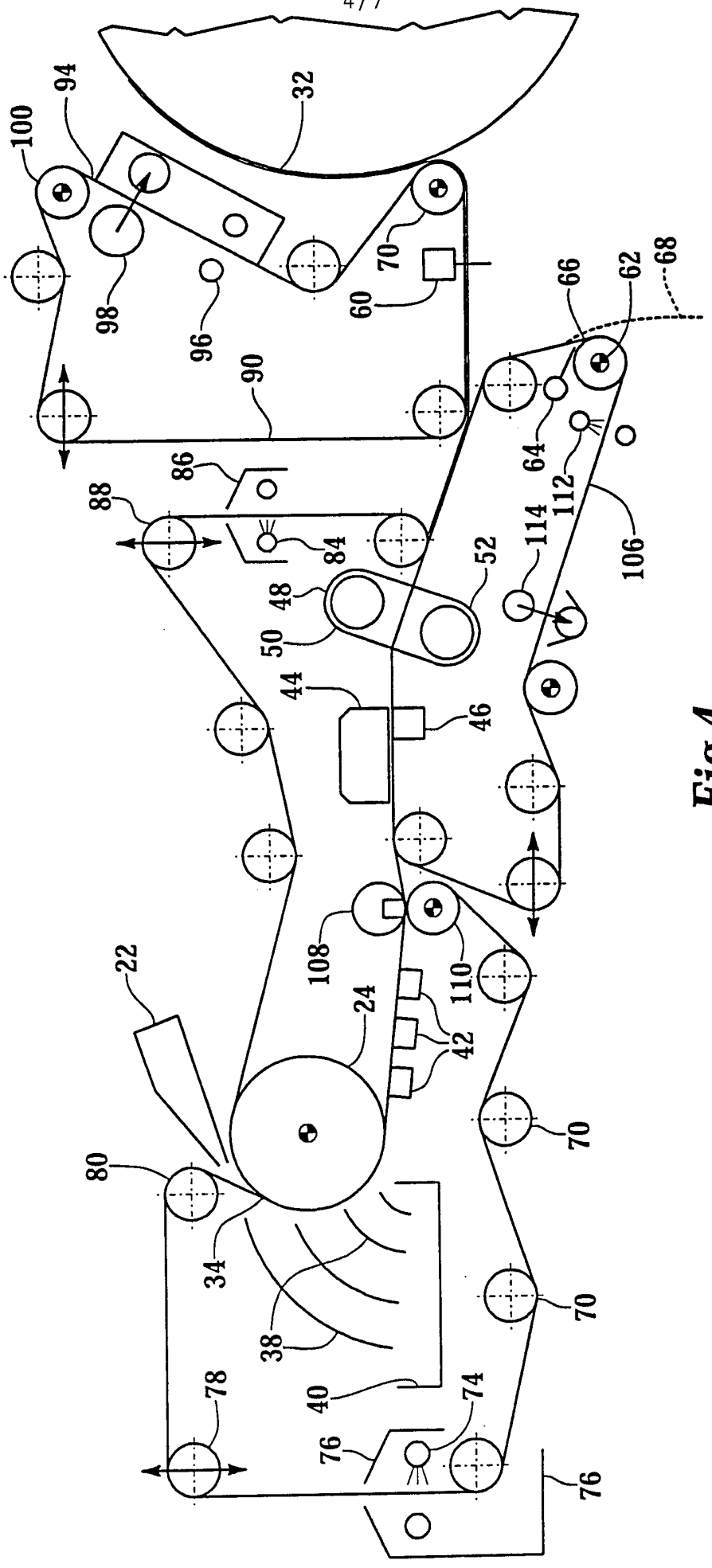

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Fig.4

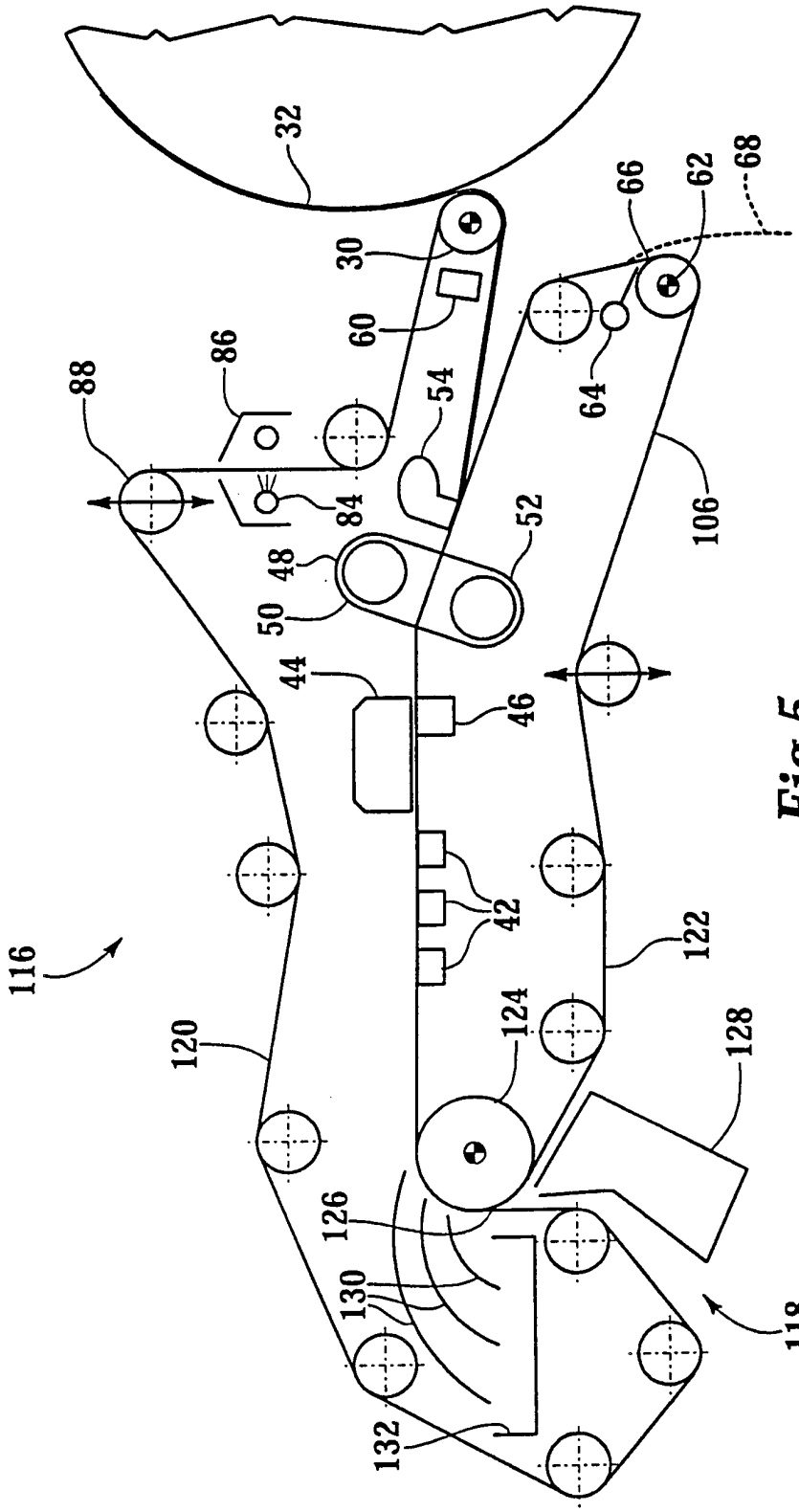

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Fig.5

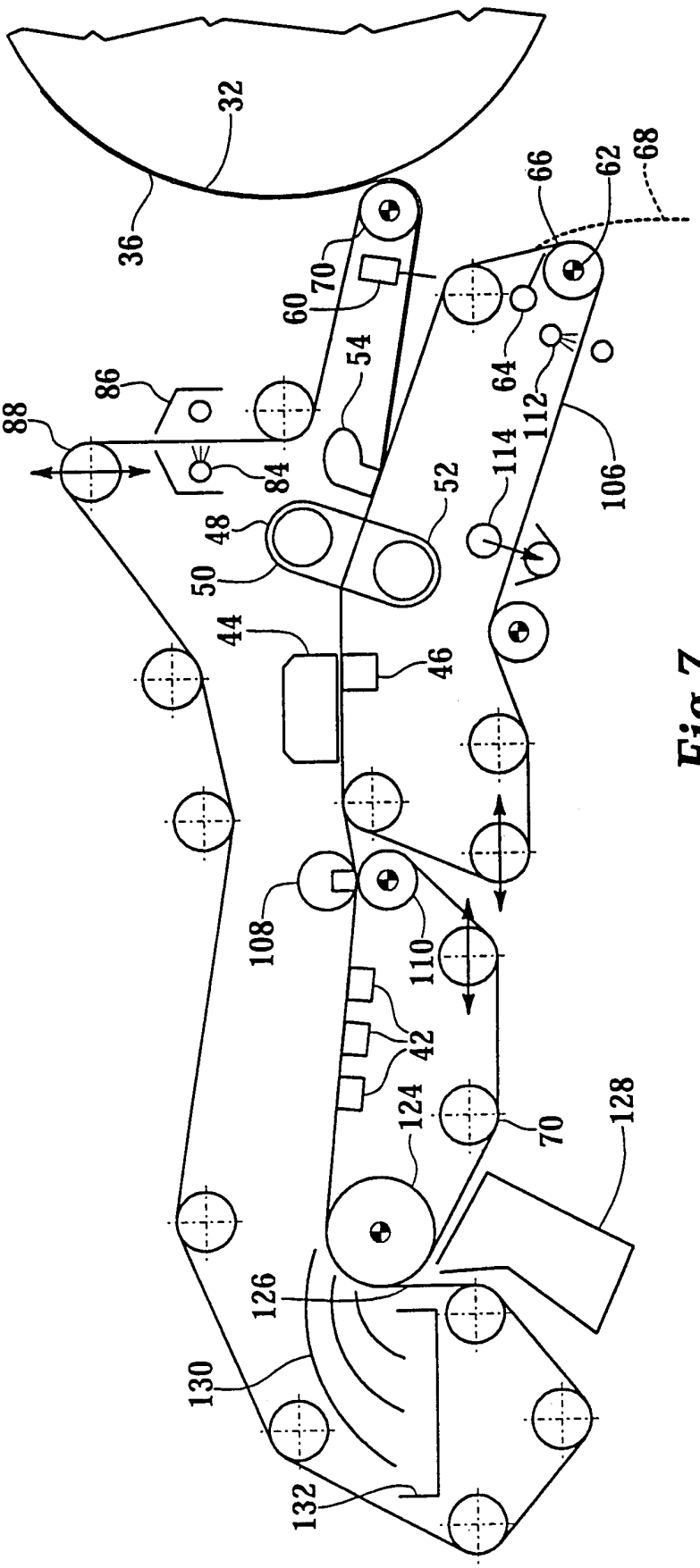

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Fig.7

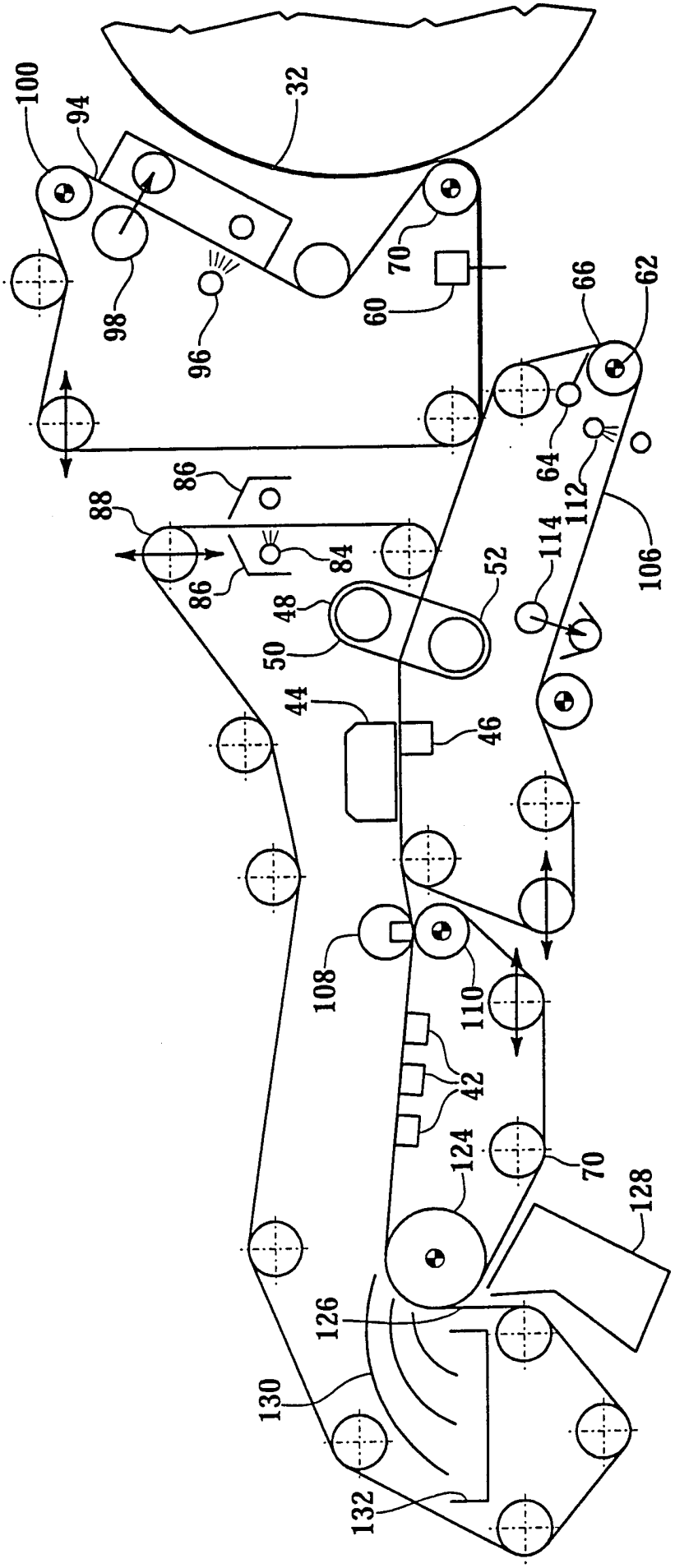

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Fig.8

INTERNATIONAL SEARCH REPORT

Internatic Application No
PCT/US 00/14900

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 D21F11/14 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 7 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)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 23298 A (KIMBERLY CLARK CO) 14 May 1999 (1999-05-14)	10
A	page 30, line 26 -page 31, line 21; figure 3	1-9,11
A	US 5 230 776 A (ANDERSSON INGMAR A ET AL) 27 July 1993 (1993-07-27) abstract; figures	1-11

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 October 2000	31/10/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Helpiö, T.

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INTERNATIONAL SEARCH REPORT

Internati Application No
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