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(54) Titre : ARRANGEMENT ET PROCEDE DE RECUPERATION D'ENERGIE SUR UNE MACHINE A PAPIER
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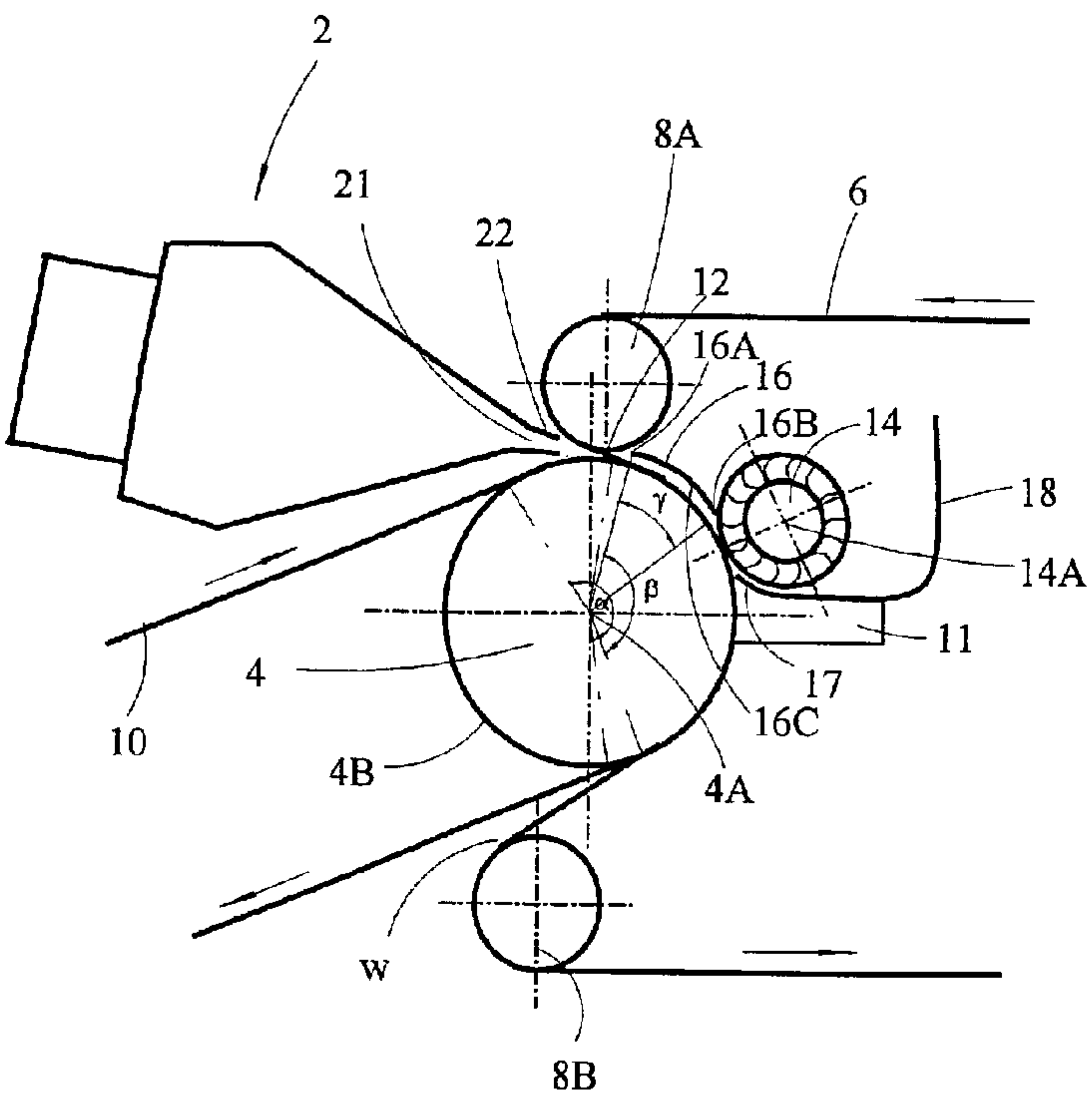

(57) Abrégé/Abstract:
The invention relates to a method of recovering energy in a forming section of a papermaking or boardmaking machine, wherein stock from a headbox (2) is fed into a forming zone of a forming section, said forming zone including at least one looped forming fabric (6; 10) curving along a convex surface of a support member, and water is drained from the stock (21) through said at least one forming fabric (6; 10) in the forming zone to form a paper or board web (W), the water passing through said at least one fabric (6; 10) being thrown out from the forming zone and possessing kinetic energy, characterized by placing a movable component (14) in the water thrown out from the forming zone, so as to cause the water to move the component (14), and thereby recovering part of the kinetic energy. The invention also relates to an arrangement in a papermaking or boardmaking machine.

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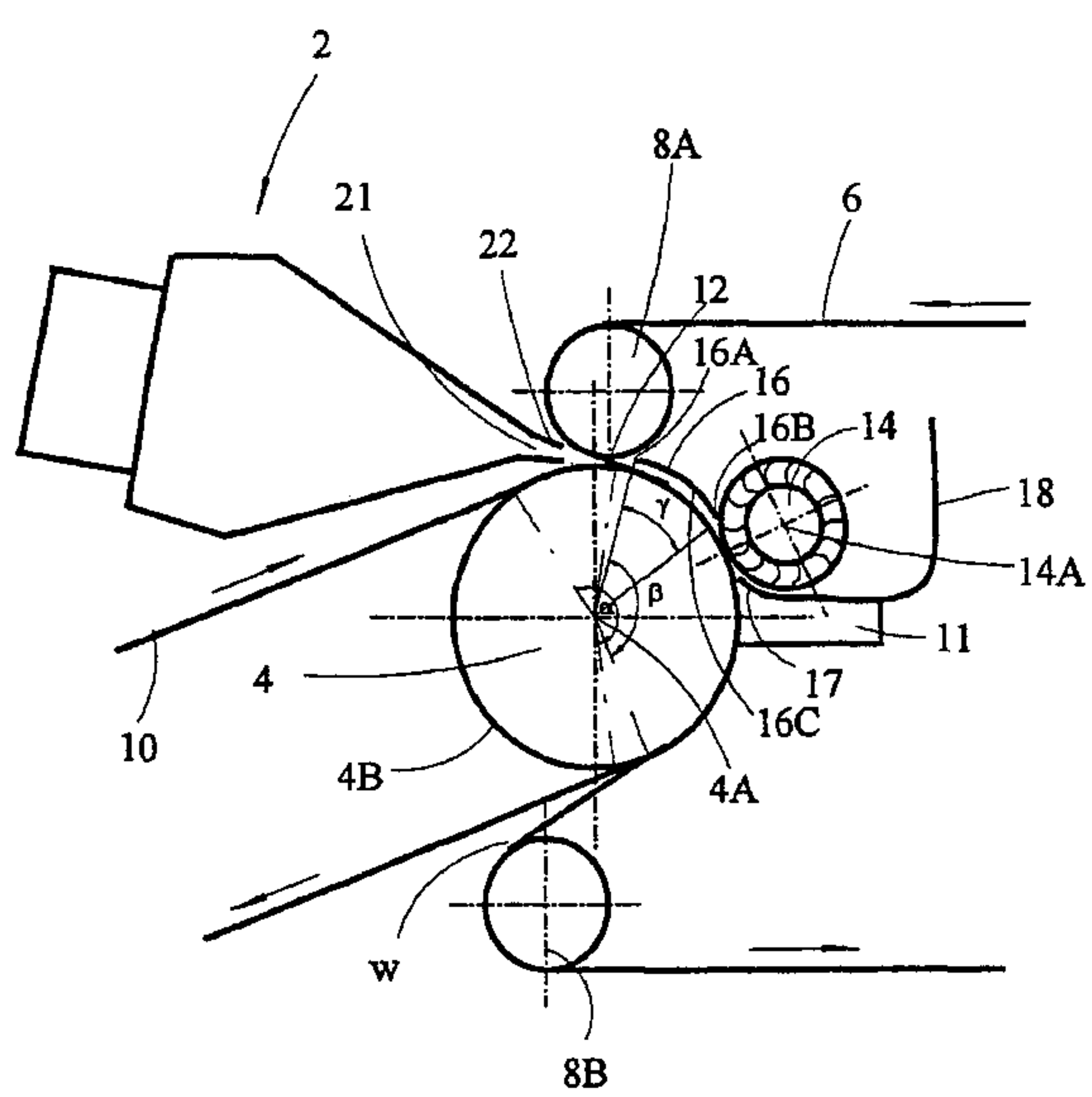
(54) Title: ARRANGEMENT AND METHOD FOR RECOVERY OF ENERGY IN A PAPER MACHINE



(57) Abstract: The invention relates to a method of recovering energy in a forming section of a papermaking or boardmaking machine, wherein stock from a headbox (2) is fed into a forming zone of a forming section, said forming zone including at least one looped forming fabric (6; 10) curving along a convex surface of a support member, and water is drained from the stock (21) through said at least one forming fabric (6; 10) in the forming zone to form a paper or board web (W), the water passing through said at least one fabric (6; 10) being thrown out from the forming zone and possessing kinetic energy, characterized by placing a movable component (14) in the water thrown out from the forming zone, so as to cause the water to move the component (14), and thereby recovering part of the kinetic energy. The invention also relates to an arrangement in a papermaking or boardmaking machine.

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ARRANGEMENT AND METHOD FOR RECOVERY OF ENERGY IN A PAPER MACHINE

TECHNICAL FIELD

This invention relates to a method of recovering energy in a forming section of a papermaking or boardmaking machine, wherein stock from a headbox is fed into a forming zone of a forming section, said forming zone including at least one looped forming fabric curving along a convex surface of a support member, and water is drained from the stock through said at least one forming fabric in the forming zone to form a paper or board web, the water passing through said at least one fabric being thrown out from the forming zone and possessing kinetic energy. Moreover, the invention relates to an arrangement in a papermaking or boardmaking machine.

STATE OF THE ART

Paper and board is today produced at very high speeds, and especially tissue paper, newsprint, and magazine paper. For tissue the machine speed has today reached 2000 m/min. When forming the fibre web, e.g. in a double wire former, stock is injected by the headbox inbetween two forming clothings, which both run a wire support, e.g. such as a forming roll. The outer clothing is a wire, which is permeable to water. The other clothing (e.g. a felt or a wire) is intended to carry the web for further processing. The stock has a fibre concentration of between 0.1 to 0.5 % and the flow is about 0.5 m^3/sec and cross sectional meter. The forming of the web occurs by means of the water within the stock being drained through the outer flexible fabric, i.e. the wire, such that only a minor portion of the water is carried on by the fibre web. The water is squeezed out by the static pressure which is applied by means of the wire which is pretensioned by means of lead rolls against the forming roll. Due to the above mentioned force the water that leaves through the wire will theoretically normally have a larger speed than the peripheral speed of the forming roll. Since enormous amounts of water are drained, e.g. in a normal large tissue machine (6 meters wide), the flow of drainage water is about 3 m^3/sec, it is realized that large amounts of energy are released at this point of a paper machine. Hitherto, none of this energy has been recovered, at least not the kinetic part thereof, but has merely been collected in a white water tray for recirculation. The same problem is relevant also in connection with single wire formers using a single wire and a forming roll or in a blade former type of a forming section, wherein a forming roll is not required.

BRIEF DESCRIPTION OF THE INVENTION

It is an object of the invention to minimize the above mentioned disadvantages by providing a method and an apparatus for recovery of a substantial part of the kinetic energy of the drained white water in a paper machine. This is achieved by a method of recovering energy in a forming section of a papermaking or boardmaking machine, wherein stock from a headbox is fed into a forming zone of a forming section, said forming zone including at least one looped forming fabric curving along a convex surface of a support member, and water is drained from the stock through said at least one forming fabric in the forming zone to form a paper or board web, the water passing through said at least one fabric being thrown out from the forming zone and possessing kinetic energy, characterized by placing a movable component in the water thrown out from the forming zone, so as to cause the water to move the component, and thereby recovering part of the kinetic energy, by connecting said recovered energy to drive another device or unit, e.g. an electric generator.

By the invention surprisingly large amounts of energy may be recovered from the kinetic energy of the water which is taken out from the stock during the dewatering process in connection with the forming of the web. Calculations show that for a tissue twin wire machine having a 6 m wide headbox and a machine speed of 1800 m/min up to 800 kW can be recovered, which implies a saving of about 2 million SEK/year. Since the investment cost is relatively moderate, the pay-off time can be made very short depending on the price of electricity.

Further preferred aspects of the invention are defined by:

- providing a turbine preferably a reaction turbine, for use as the movable component, and mounting the turbine so as to be rotated by the water that has passed through said at least one forming fabric;
- providing two looped forming fabrics in a twin wire former arrangement, said two looped forming fabrics curving along the convex surface of the support member and defining a converging forming zone, draining water from the stock through at least an outer one of the two fabrics in the forming zone in relation to the convex surface of the support member to form a paper or board web (W) and mounting the movable component inside the loop of said outer one of the forming fabrics;
- supporting the two forming fabrics on a rotatable forming roll, said roll being included in the support member;
- supporting the two forming fabrics on a forming shoe having a convex support surface for supporting the fabrics, said shoe being included in the support member;

- supporting the two forming fabrics on a curved series of dewatering blades spaced from one another in the machine direction, said blades being included in the support member and the convex support surface thereof;
- at least one guide plate guiding the moving water into the turbine;
- the water moving along a curved path along the major part of said guide plate;
- the radius (R2) of a major part of said curved path being substantially constant and larger than the radius (R1) of the forming roll, but smaller than 120 % of R1, i.e. R1<R2<R1 x 1,2;
- the angular extension (γ) of the guide plate covering between 20 to 90° of the circumference of the forming roll;
- the forming roll being a vacuum roll with perforations in its surface and that the angular extension of the guide plate is between 20 to 50°, preferably 25 to 40°;
- the forming roll having an impermeable surface and that the angular extension γ of guide plate is between 40 and 80°, preferably 50 to 70°;
- the speed of the web (w) being more than 1000 m/min, preferably more than 1500 m/min more preferred more than 1800 m/min;
- at least 0,2 m^3/sec/m being squeezed out through the said wire, preferably at least 0,3 m^3/sec and more preferred at least 0,4 m^3; and
- using an electric generator to transform said kinetic energy to electric energy, preferably by supplying said electric energy to a pump, and more preferred to a stock pump.

The invention also relates to an arrangement in papermaking or board machine, for performing the method according to claim 1, comprising a headbox for supplying a stock, a forming section, including at least one looped forming fabric and a support member with a convex surface, said fabric is arranged to run a part of said convex surface of said support member and so to define a forming zone, wherein a paper or board web is formed, the stock is supplied by said headbox into said forming zone and water is drained from the stock through said at least one forming fabric in the forming zone to form the paper or board web, the water passing through said at least one fabric being thrown out from the forming zone and possessing kinetic energy, characterised in that a movable component is positioned adjacent said forming zone to recover at least some of the kinetic energy of the water that is drained from the stock, whereby said movable component is converting the recovered kinetic energy into driving of another device/unit.

According to further aspects of the invention:

- the turbine is of the reaction type, preferably a Banki turbine;
- a guiding arrangement for guiding the moving water that is squeezed out through the wire into the turbine;
- said guiding arrangement comprises a guide plate which is positioned in close relationship to the periphery of the forming roll;
- a major part of said guide plate has a radius R2 which is substantially constant and equal to or larger than the radius R1 of the forming roll, wherein preferably $R1<R2<R1 \times 1,2$
- said guide plate has an upstream end and a downstream end and the angular extension γ between said end points 16A, 16B is between 20 to 90°, preferably 30 to 70°;
- the angular extension α of the flexible fabric is larger than the angular extension β of the wire and the angular extension γ of the guide plate is less than the angular extension of the wire;
- said guide arrangement comprises a second guide plate downstream of said guide plate, which second guide plate has a cross sectional length which is substantially shorter than the cross sectional length of the guide plate;
- said second guide plate is curved and its curvature is opposite to the curvature of the guide plate;
- the axial extension of the turbine is substantially the same as the axial extension of the wire, which preferably has an axial extension which is substantially the same as the axial extension of the forming roll;
- the outer diameter of the turbine ϕT is substantially smaller than the radius R1 of the forming roll, wherein preferably $R1 x0,5<\phi T<R1 x0,9$;
- the turbine is positioned with its axis in parallel with the axis of the forming roll and the turbine and the forming roll are positioned in relationship such that the smallest distance between the periphery of the turbine and the periphery of the forming roll is between 5-700 mm, preferably 20-200 mm;
- the shaft of the turbine is connected to an electric generator, preferably a three phase synchronous motor;

BRIEF DESCRIPTION OF THE DRAWINGS

In the following the invention would be described in more detail with reference to the attached drawings, in which:

- Fig. 1 shows a schematic side view of an arrangement according to the invention;
- Fig. 2 shows a side view of essential parts of a preferred embodiment according to the invention;
- Fig.3 shows a modification of the embodiment shown in Fig. 2;
- Fig. 4 shows a second modification of the embodiment shown in Fig. 2;
- Fig. 5 shows a third modification of the embodiment shown in Fig. 2;
- Fig. 6 shows a perspective view of essential parts of the invention;
- Fig. 7 shows the invention in connection with a so called “C-former”;
- Fig. 8 shows the principle of the invention in connection with a so called “S-former”;
- Fig. 9 shows the principles of the invention in connection with a C-former having a vacuum roll;
- Fig. 10 shows the principles of the invention in connection with a so called speed former;
- Fig. 11 shows the principles of the invention in connection with a speed former in a horizontal position;
- Fig. 12 shows in principle the same as Fig. 10, but with a vacuum roll as the forming roll;
- Fig. 13 shows in principle the same as Fig. 11, but with a vacuum roll as the forming roll; and
- Fig. 14 shows an alternate embodiment of using the invention with a speed former.

DETAILED DESCRIPTION OF THE INVENTION

The invention may be used together with all kinds of double wire formers, i.e. wherein two clothings (two wires or one wire and a felt e.g. depending on the need of drainage capacity) run on top of each other around a forming unit, e.g. a forming roll. In Fig. 1 there is shown a so called crescent former comprising a headbox 2, a forming roll 4, a wire 6 and a felt 10. The forming roll 4 has an outer surface 4B which is impermeable, i.e. a so called solid surface. The forming roll 4 rotates about an axis 4A. The felt 10 runs around the forming roll, in contact with its outer surface 4B, with an angular extension of contact α which is slightly more than 180°. The wire 6 runs around the forming roll 4 on top of the felt 10 with an angular extension of contact β which is less than 180°. The wire 6 is pressed against the felt on top of the surface 4B of the forming roll 4 by means of an upper guiding roll 8A and a lower guiding roll 8B. The headbox 2 injects stock 21 through its discharge opening 22 into a nip 12, which is formed where the wire 6 meets the felt 10. According to the invention there is positioned a turbine 14 in close proximity to the periphery of the forming roll 4. A guide plate 16 having a radius R2 which is slightly larger than the radius R1 of the forming roll 4 (see Fig. 2) is positioned at a distance above the forming roll 4 between the nip 12 and the turbine 14. The angular extension γ of the guide plate 16 is about 35°, and its upstream edge 16A is positioned close to the nip 12, whereas its downstream end 16B is positioned close to the turbine 14. Downstream of the turbine 14 close to the periphery of the forming roll 4 there is positioned a second guide plate 17, behind and below the turbine 14. The axis 14A of the turbine is connected to an electric generator 11 (schematically shown), preferably by means of a transmission (not shown). The turbine 14 is of a reaction type, preferably a so called Banki turbine, which is also called a cross-flow turbine due to its function. This kind of turbine is especially suitable in connection with an arrangement according to the invention, since it is very well suited for recovering energy from water moving with relatively high speed, as will be the case according to the invention. The guide plate 16 has a constant curvature R2, which is slightly larger than the radius R1 of the forming roll 4, preferably 1.05 x the radius R1 of the forming roll 4. The guide plate 16 is positioned such that its concave surface 16C, which forms the path along which the water is guided is positioned about 20 to 50 mm above the surface of the wire 6. There is a white water tray 18.

The function of an arrangement according to the invention is as follows. Once the felt 10 and the wire 6, of the forming section, are running at the desired speed, e.g. 1500 m/min, stock 21 is injected by means of discharge opening 22 of the headbox 2. The stock is supplied into the nip 12 and thereafter it follows between the two clothings 6, 10 around the forming roll 4. In connection herewith, a major amount of the water contained in the stock 21 will be squeezed out through the wire 6 by wire tension. As a result the water, which is squeezed out, will have a slightly higher speed than the peripheral speed of the forming roll 4. Tests show that if the peripheral speed is 30 m/sec, the speed of the water droplets will be about 30.4 m/sec. For a roll with an impermeable surface as used in Fig. 1, the dewatering will occur along about 60° of an angular zone starting at the nip 12. The dewatering flow is largest during the first 10°, then it slightly decreases. The droplets will be collected on a curved surface 16C of the guide plate 16, which is formed to create as little turbulence as possible, which is achieved by having the surface 16C with as little irregularities as possible and by using a constant curvature. The water will collect along the guide plate 16 and finally be guided into the turbine 14 with an optimal direction of flow to recover as much of the kinetic energy as possible. For a cross-flow turbine (e.g. Banki turbine) 14, about 80 % of the energy is recovered during the flow into the turbine and about 20 % during the flow out of the turbine. This cross-flow function is the reason why a Banki turbine is specially suitable. Downstream of the turbine 14 there is a second guide plate 17, which has a reversed curvature in relation to the first guide plate 16 to guide a further amount of water into the turbine 14. The rotation of the turbine 14, which is caused by the water, will be transferred by its axis 14A to a transmission (not shown) and thereafter into an electric generator for producing electric energy. A transmission is favourable in most applications to transform the rotational speed of the turbine 14 to a rotational speed which is optimal for the generator 11. It is evident that different kinds of generators may be used, e.g. alterntor or continuous current generator, depending on the circumstances.

In the preferred embodiment the electrical power which is produced by the generator 11 is supplied to the stock pumps (not shown), which feed the headbox 2.

Thanks to the invention, large amount of energy may be recovered. With an optimised arrangement the total yield may be about 60 %. If the stock flow is about 0.5 m^3/sec and cross sectional meter, the power that can be recovered for a six meter wide machine is about 810 kW. At a price of 0.30 SEK/kW, this will lead to an annual saving of about 2 MSEK with 350 days of operation per year. Considering further aspects of the invention, e.g. environmental friendly, it is realised that the achievements of the invention are surprisingly positive.

Fig. 2 shows a more detailed view of an embodiment according to the invention. The basic principles thereof are exactly the same as in relation to Fig. 1, except the positioning of the arrangement and the use of a second wire instead of the felt 10. In Fig. 2 the headbox 2 is positioned below the centre 4A of the forming roll 4 and the injection discharge opening 22 is directed upwardly. The radius R1 of the forming roll is 760 mm. The radius R2 of the guide plate 16 is constant and about 810 mm. The centre of the constant curvature of the guide plate 16 is offset in relation to the centre 4A of the forming roll, i.e. 50 mm above the centre 4A of the forming roll 4. The shortest distance l_1 between the guide plate and the periphery of the forming roll (wire 6) is about 35 mm. Due to the offset location of the centre 16E of curvature of the guide plate 16 the distance increases constantly upwardly. The distance between the turbine 14 and the periphery 4B of the forming roll 4 is about 50 mm. (Normally the distance should be between 10 and 100 mm, preferably between 20 and 70 mm.)

The second guide plate 17, which is substantially flat, is positioned with its edge 17A close to the periphery 4B of the forming roll 4, e.g. about 10 mm between the edge 17A and the wire 6. The cross sectional length l_2 of the second guide plate 17 is about 50 mm. (The width of the guide plates, however, would normally be the same, i.e. same as the turbine.) Accordingly the first guide plate 16 directs the major part of the moving water into the turbine 14 with a first direction adapted to the angle of the turbine blades at the position of the downstream end 16B of the guide plate at that position. The direction of the extension of the second guide plate 17 is adapted to the optimal angle of the turbine blades at that position. Around the turbine 14 there is a housing 19. The housing comprises several parts; a innermost upper part 19A, an outermost lower part 19B, a lowermost inner part 19C, and a lowermost base part 19D. The different parts are attached to each other by means of flanges 19F. At the bottom of the housing 19, there are flanges 19E for attachment of the housing to the white water tray 18 of the paper machine. The uppermost part of the housing 19A (positioned downstream of the guide plate 16) is fitted to enclose, at a short distance, a large part of the periphery 14B of turbine in order to guide the water in a correct manner, to be more explained in relation to Fig. 3. The diameter ϕT is 500 mm. The inner diameter of the turbine ϕI is 340 mm.

Fig. 3 shows an embodiment which is similar to Fig. 2, with the exception that the turbine 14 is positioned further away from the forming roll 4. As a consequence, the last part of the inner surface 16C of the guide plate is made flat. It is important that the transition from the constant curvature to this straight part is made in a smooth way without formation of any turbulence creating features. Also, the second guide pate 17 is different. In order to guide the water, it is made substantially longer, such that its extension l_3 is about ¼ of the radius R1 of the forming roll, i.e. about 200 mm. The second guide plate is curved in an opposite manner in comparison with the first guide plate 16.

The lines F_1 to F_4 show different flow patterns of the water entering into the turbine. The major part of the water will pass through the turbine 14 along the flow line F_1. Accordingly, the water is first redirected and leaving energy to the turbine wheel 14 at the entrance, which gives the flow line F_1 through the inner of the turbine and finally the moving water hits the turbine crosswise, i.e. from the inside moving out and leaving its last kinetic energy thereto. The water entering into the turbine by means of the second guide plate 17 will move through the turbine along a flow pattern according to F_4. This cross-flow pattern of the Banki turbine is especially suitable for use in connection with the invention.

In Fig. 4 there is shown a number of guide plates 17, 17', 17" downstream of the turbine 14. The different guide plates are positioned such that the innermost edges 17A, 17A', 17A" are about equally spaced apart. In other aspects, this embodiment is similar to what is described in relation to Fig. 2.

In Fig. 5 there is shown a further embodiment using several devices for guiding the water downstream of the turbine. Instead of using a single guide plate, V-shaped elements 17, 21; 17', 23 are used to direct the water for the first two guiding devices. A first device 17, 21 comprises a guide plate 17 which is substantially positioned as shown in Fig. 4. Joined with its front edge 17A there is a further guide plate 21 which is positioned substantially tangentially in relation to the periphery of the forming roll 4. Behind its rear end 21B there is formed an opening between it and the downstream end 17'A of the second guide plate 17'. In a similar manner there is a second tangentially positioned guide plate 23, which has its front end 23A joined with the front end 17A' of the second guide plate 17', such that a second opening is formed to allow the water to be directed along a third downstream guide plate 17". Also here the different flow patterns (F_1 to F_4) of the water coming from the different guide plates can be seen.

In Fig. 6 there is shown a prospective view of some essential parts of the arrangement according to the invention, except for the headbox and the electric generator, which are not shown. As can be seen, the width of different parts 4, 6, 8, 10, 14, 16 are substantially the same. For the functioning thereof it is referred to Fig. 1. It should be noted that the turbine, the cover parts 19A, 19B and the guide plate 16 are not shown in their working positions. As can be seen, the turbine 14 is divided into sections by means of annular support plates 14E, 14F, 14G, such that each section is about 1 to 1.8 m wide.

In the following the invention will be shown arranged in different positions in relation to some known kinds of formers.

In Fig. 7 there is shown a C-former (as well as in Fig. 1), wherein the headbox 2 is positioned underneath the forming roll 4. Consequently, the web W is formed during an upward motion around the forming roll 4. The other parts 6, 10, 8, 14, 16, 17 of the invention are arranged accordingly, i.e. the guide plate 16 is positioned below the turbine 14 (but upstream thereof as in Fig. 1). Also in Fig. 7 (as well as in Fig. 1) the forming roll 4 has an impermeable surface.

In Fig. 8 there is also shown an impermeable forming roll 4 but of the so called S-former type. According to an S-former the wire moves around one of the lead rolls 8A and then again around a third lead roll 8C. The wire 6 is guided substantially along the same principles as within the C-former, i.e. around two lead rolls 8A, 8B which urges it against the forming roll 4. The arrangement of the other parts 14, 16, 17 of this embodiment of the invention is in principle the same as described above.

In Fig. 9 there is shown a C-former with a vacuum roll as the forming roll 4. Accordingly, the guide plate 16 may preferably have about half the angular extension γ as if the forming roll 4 has an impermeable surface, e.g. about 25 to 40°. Furthermore, it is shown that a second turbine 14' is arranged on the opposite side, as compared to the position of the first turbine 14. It has been shown that in connection with the vacuum roll 4 about 60 % of the water is drained within the first part, i.e. at the area where the guide plate 16 is positioned. The remaining amount, i.e. 40 %, is drained after the vacuum section of the roll. The vacuum section of the roll 4 begins shortly in front of the nip 12 and extends somewhat downstream (the same direction as the rotation of the forming roll) of the position where the wire 10 gets out of contact with the surface of the forming roll 4. Accordingly, the water which has been sucked into the wire and the forming roll 4 will leave it at this position and the kinetic energy thereof is recovered in the second turbine 14 in the same way as in connection with the first turbine 14. Thus, there is a first guide plate 16' and a second guide plate 17' for guiding the remaining amount of the water into this second turbine 14'.

In Fig. 10 there is shown a speed former with an arrangement according to the invention. In the speed former the wires 6 and 10 jointly move with the web W therebetween, firstly over the forming roll 4, thereafter over a blade former 5, and thereafter over a vacuum roll 3, whereafter the wire 6 and the web W are separated from the wire 10, which is moved around a second lead roll 8A. The principles for the use of the energy recovering parts 14, 16, 17, 19 according to this embodiment are generally the same as described above. Alternatively the forming roll 4 may be substituted by a blade former (not shown).

In Fig. 11 substantially the same arrangement as in Fig. 10 is shown, except for the difference that the speed former has been displaced about 90°.

In Fig. 12 there is shown a speed former positioned in the same way as shown in Fig. 10. Contrary to what is shown in Fig. 10, there is used a vacuum roll as the forming roll 4. Two energy recovering units 14, 16; 14', 16' are used to recover energy from the drained water, substantially in the same way as described in relation to Fig. 9.

Fig. 13 is the same as Fig. 12 but with the speed former positioned displaced 90° .

Fig. 14 also shows in principle the same as Fig. 12 but with the speed former displaced 180°.

The invention is not limited to the embodiments shown above but they may be varied within the scope of the appending claims. For instance, it is evident for the person skilled in the art that other kinds of recovering means than a Banki turbine may be used, e.g. other kind of turbines or even a device working along the principles of an endless chain conveyor. Furthermore, it is evident that the recovered energy may be used to directly drive another unit/machine, e.g. to drive a pump via an appropriate transmission. For the person skilled in the art it is also obvious that the invention may be used in connection with a forming roll and a single wire former, forming with different types of wire support. However, in this case the water will not be squeezed out through the forming clothing but drained therethrough by gravitation or by means of a vacuum box, as is known per se. In order to recover the kinetic energy the sides of the vacuum box will have to be adopted to the direction of movement of the water leaving the forming clothing, such that it is guided in an optimal manner to a turbine or some other means which is positioned to receive the guided water in an optimal manner, essentially in the same manner as described above in relation to the guiding plate. Moreover the principles of the invention may also be used in connection with a dewatering section where the water flow is directed to the sides of the paper machine, where turbines are positioned to recover the energy in accordance with the principles of the invention as described above. This latter embodiment would normally not be preferred since the moving water would have to be guided a long distance from the forming roll to the position where its kinetic energy is recovered. Tests have shown that the kinetic energy decreases exponentially in relation to a distance that the water has to flow along the guiding plate, before entry into the turbine. Accordingly, it is preferred to have the turbine positioned adjacent the forming roll as described in connection with the embodiments shown in the figures. Moreover, it is obvious for the skilled man that a felt 10 may in many installations be exchanged by a wire and vice versa. Finally, it is evident for the skilled man that the invention may be used in connection with double-wire formers which do not use any roll in the forming zone, e.g. in connection with a former described in US 4,308,097, US 4,416,730 or US 5,853,544.

CLAIMS

1. A method of recovering energy in a forming section of a papermaking or boardmaking machine, wherein stock from a headbox is fed into a forming zone of a forming section, said forming zone including at least one looped forming fabric curving along a convex surface of a support member, and water is drained from the stock through said at least one forming fabric in the forming zone to form a paper or board web (W), the water passing through said at least one fabric being thrown out from the forming zone and possessing kinetic energy, wherein the method includes the step of placing a movable component in the water thrown out from the forming zone, so as to cause the water to move the component, and thereby recovering part of the kinetic energy.

2. The method according to claim 1, including the further step of providing a turbine for use as the movable component, and mounting the turbine so as to be rotated by the water thrown out from the forming zone, preferably water that has passed through said at least one forming fabric.

3. The method according to claim 2 wherein the turbine is a reaction turbine.

4. The method according to any one of claims 1 to 3, including the further step of providing two looped forming fabrics in a twin wire former arrangement, said two looped forming fabrics curving along the convex surface of the support member and defining a converging forming zone, draining water from the stock through at least an outer one of the two fabrics in the forming zone in relation to the convex surface of the support member to form a paper or board web (W) and mounting the movable component inside the loop of said outer one of the forming fabrics.

5. The method according to claim 4, including the further step of supporting the two forming fabrics on a rotatable forming roll, said roll being included in the support member.

6. The method according to claim 4, including the further step of supporting the two forming fabrics on a forming shoe having a convex support surface for supporting the fabrics, said shoe being included in the support member.

7. The method according to claim 3, including the further step of supporting the two forming fabrics on a curved series of dewatering blades spaced from one another in the machine direction, said blades being included in the support member and the convex support surface thereof.

8. The method according to claim1, wherein at least one guide plate guides the moving water into the turbine.

9. The method according to claim 8, wherein the water moves along a curved path along the major part of said guide plate.

10. The method according to claim 6, wherein the radius (R2) of a major part of said curved path being substantially constant and larger than the radius (R1) of the forming roll, but smaller than 120% of R1, i.e. Rl<R2< Rl x 1.2.

11. The method according to claim 9, wherein the angular extension (γ) of the guide plate covers between 20° to 90° of the circumference of the forming roll.

12. The method according to claim 11, wherein the forming roll is a vacuum roll with perforations in its surface and the angular extension of the guide plate is between 20° to 50° .

13. The method according to claim 11, wherein the angular extension of the guide plate is between 25° to 40°.

14. The method according to claim 11, wherein the forming roll has an impermeable surface and the angular extension (γ) of guide plate is between 40° and 80°.

15. The method according to claim 11, wherein the angular extension (γ) of guide plate is between 50° and 70°.

16. The method according to claim 1, wherein the speed of the web (w) is more than 1000 m/min.

17. The method according to claim 1, wherein the speed of the web (w) is more than 1500 m/min.

18. The method according to claim 1, wherein the speed of the web (w) is more than 1800 m/min.

19. The method according to claim 1, wherein at least 0.2 m^3/sec/m is squeezed out through the said wire.

20. The method according to claim 1, wherein at least 0.3 m^3/sec/m is squeezed out through the said wire.

21. The method according to claim 1, wherein at least 0.4 m^3/sec/m is squeezed out through the said wire.

22. The method according to claim 1, wherein an electric generator is used to transform said kinetic energy to electric energy.

23. The method according to claim 1, wherein electric energy is supplied to a pump.

24. The method according to claim 1, wherein electric energy is supplied to a stock pump.

25. An arrangement in a papermaking or board machine, for performing the method according to claim 1, comprising a headbox for supplying a stock, a forming zone, including at least one looped forming fabric and a support member with a convex surface, said fabric is arranged to run a part (α) of said convex surface of said support member and so to define a forming zone, wherein a paper or board web (W) is formed, the stock is supplied by said headbox into said forming zone and water is drained from the stock through said at least one forming fabric in the forming zone to form the paper or board web (W), the water passing through said at least one fabric being thrown out from the forming zone and possessing kinetic energy, wherein a movable component is positioned adjacent said forming zone to recover at least some

of the kinetic energy of the water that is drained from the stock.

26. The arrangement according to claim 25, wherein said movable component is a turbine, which is positioned so as to be rotated by water that has passed through said at least one forming fabric.

27. The arrangement according to claim 26, wherein the movable component is a reaction turbine.

28. The arrangement according to any one of claims 25 to 27, wherein there are two looped forming fabrics in a twin wire former arrangement, wherein the second forming fabric is arranged to run a certain angular extension (β) on top of the first forming fabric curving along said convex surface of said support member to form a converging forming zone, wherein water is drained through at least said second forming fabric and in that the movable component is positioned inside the loop of said second forming fabric.

29. The arrangement according to claim 28, wherein said convex surface forms a part of a rotatable forming roll.

30. The arrangement according to claim 28, wherein said convex surface forms a part of a forming shoe.

31. The arrangement according to claim 28, wherein said convex surface is formed by a series of dewatering blades spaced from one another in the machine direction.

32. The arrangement according to either claim 26 or claim 27, wherein the turbine is of the reaction type.

33. The arrangement according to claim 32 wherein the turbine is a Banki turbine.

34. The arrangement according to claim 25, wherein a guiding arrangement guides the moving water that is squeezed out through the fabric into the turbine.

35. The arrangement according to claim 34, wherein said guiding arrangement comprises a guide plate which is positioned in close relationship to the convex surface of the forming zone.

36. The arrangement according to claim 35, wherein a major part of said guide plate has a radius (R2) which is substantially constant and equal to or larger than the radius (Rl) of said convex surface.

37. The arrangement according to claim 36, wherein Rl< R2<Rl x 1.2.

38. The arrangement according to claim 35, wherein said guide plate has an upstream end and a downstream end and that the angular extension (γ) between said end points is between 20° to 90°.

39. The arrangement according to claim 38, where angular extension (γ) is between 30° to 70°.

40. The arrangement according to claim 38 or claim 39, wherein the angular extension (α) of the first forming fabric is larger than the angular extension (β) of the second forming fabric and that the angular extension (γ) of the guide plate is less than the angular extension (β) of the second forming fabric.

41. The arrangement according to claim 35, wherein said guide arrangement comprises a second guide plate downstream of said guide plate, which second guide plate has a cross sectional length (1_2) which is substantially shorter than the cross sectional length of the guide plate.

42. The arrangement according to claim 41, wherein said second guide plate is curved and that its curvature is opposite to the curvature of the guide plate.

43. The arrangement according to claim 26, wherein the axial extension of the turbine is substantially the same as the axial extension of the wire, which preferably has an axial extension which is substantially the same as the axial extension of the forming zone.

44. The arrangement according to claim 43, wherein the outer diameter of the turbine ØT is substantially smaller than the radius (R1) of the said convex surface.

45. The arrangement according to claim 44, wherein R1x0.5<ØT<R1x0.9.

46. The arrangement according to claim 26, wherein the turbine is positioned with its axis in parallel with the axis of a forming roll and that the turbine and the forming roll are positioned in relationship such that the smallest distance (Z) between the periphery of the turbine and the periphery of the forming roll is between 5 mm-700 mm.

47. The arrangement according to claim 46, wherein the smallest distance (Z) is between 5 mm and 200 mm.

48. The arrangement according to claim 16, wherein the shaft of the movable component is connected to an electric generator.

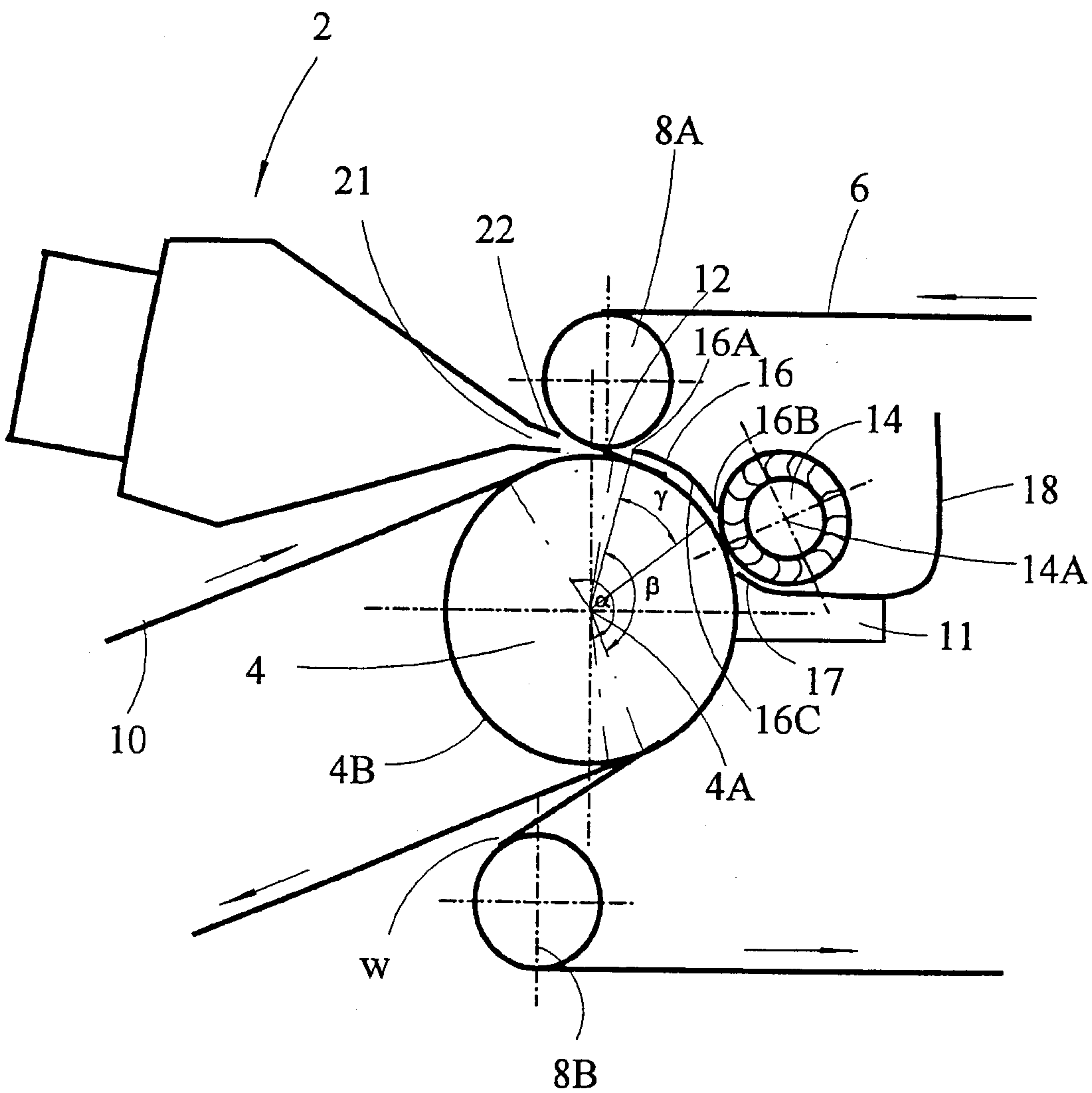

Fig. 1

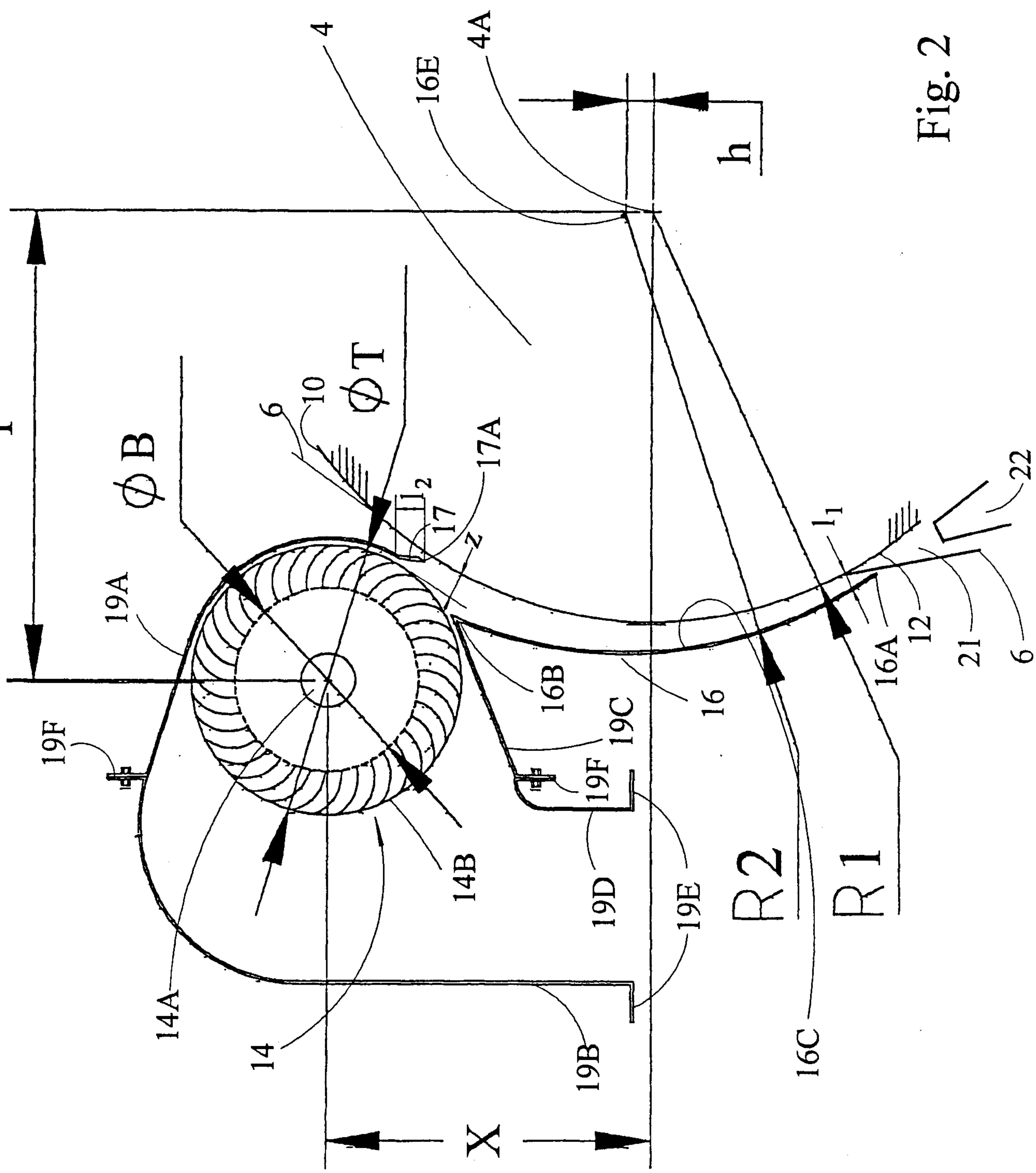
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Fig. 2

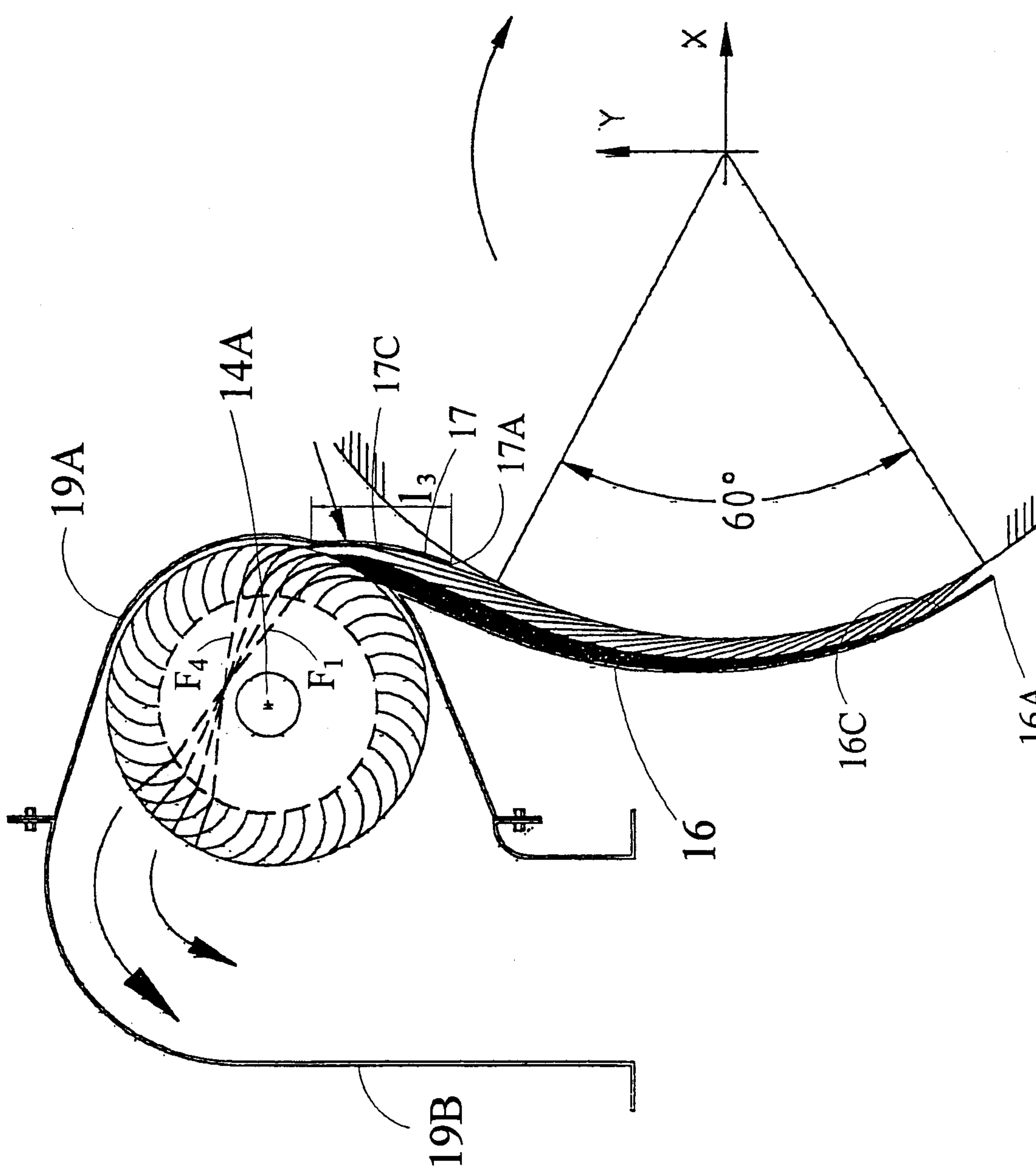


Fig. 3

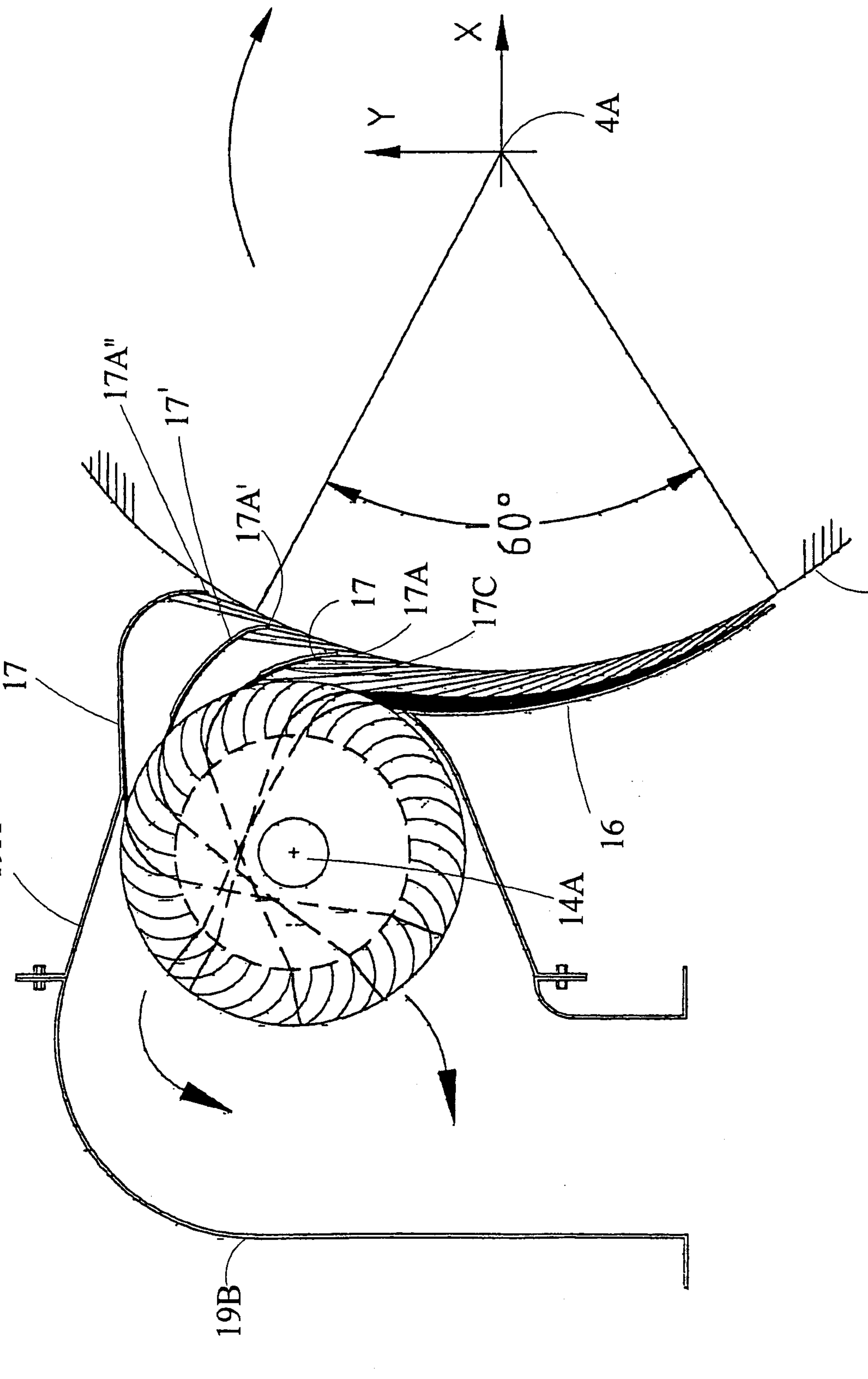


Fig. 4

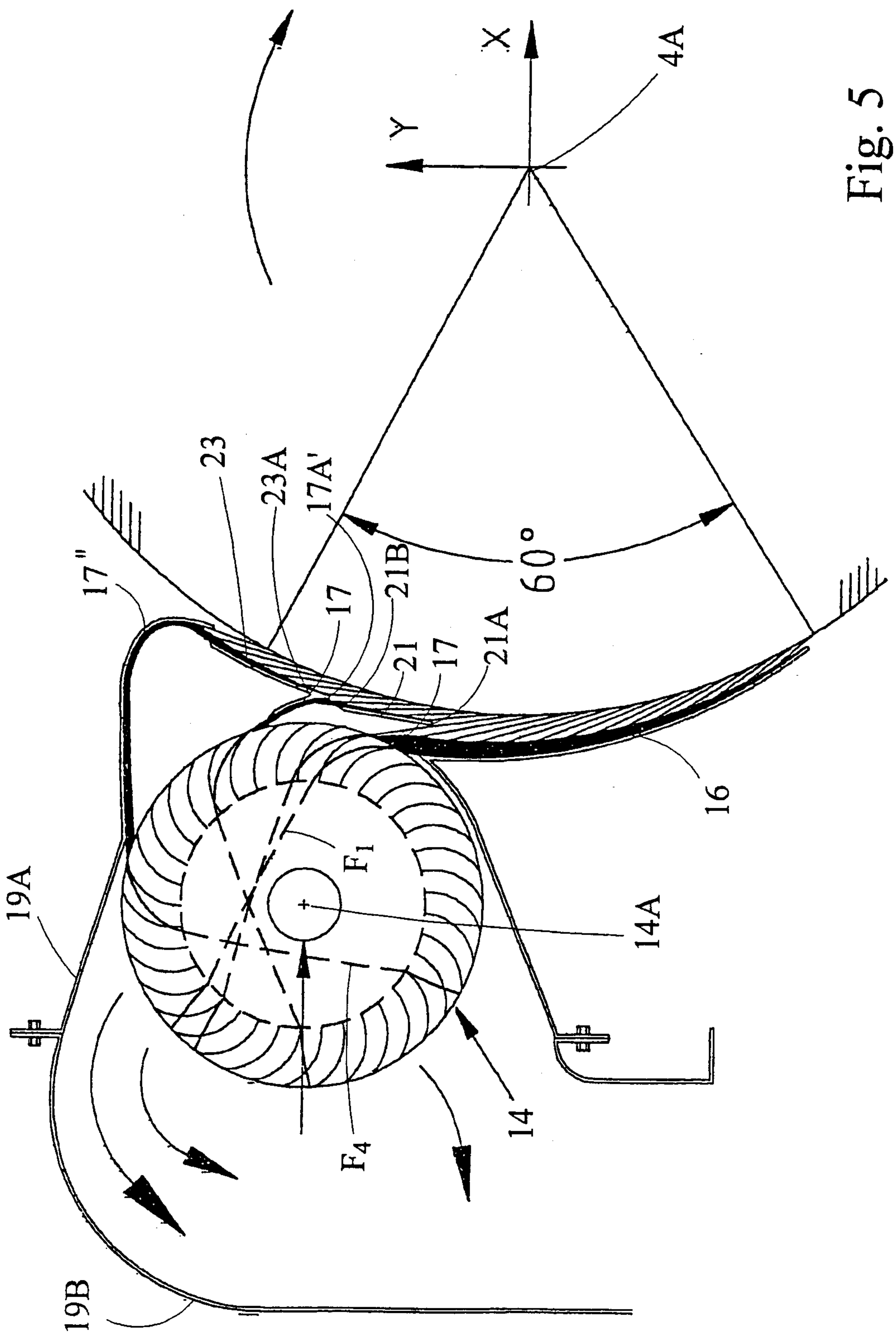


Fig. 5

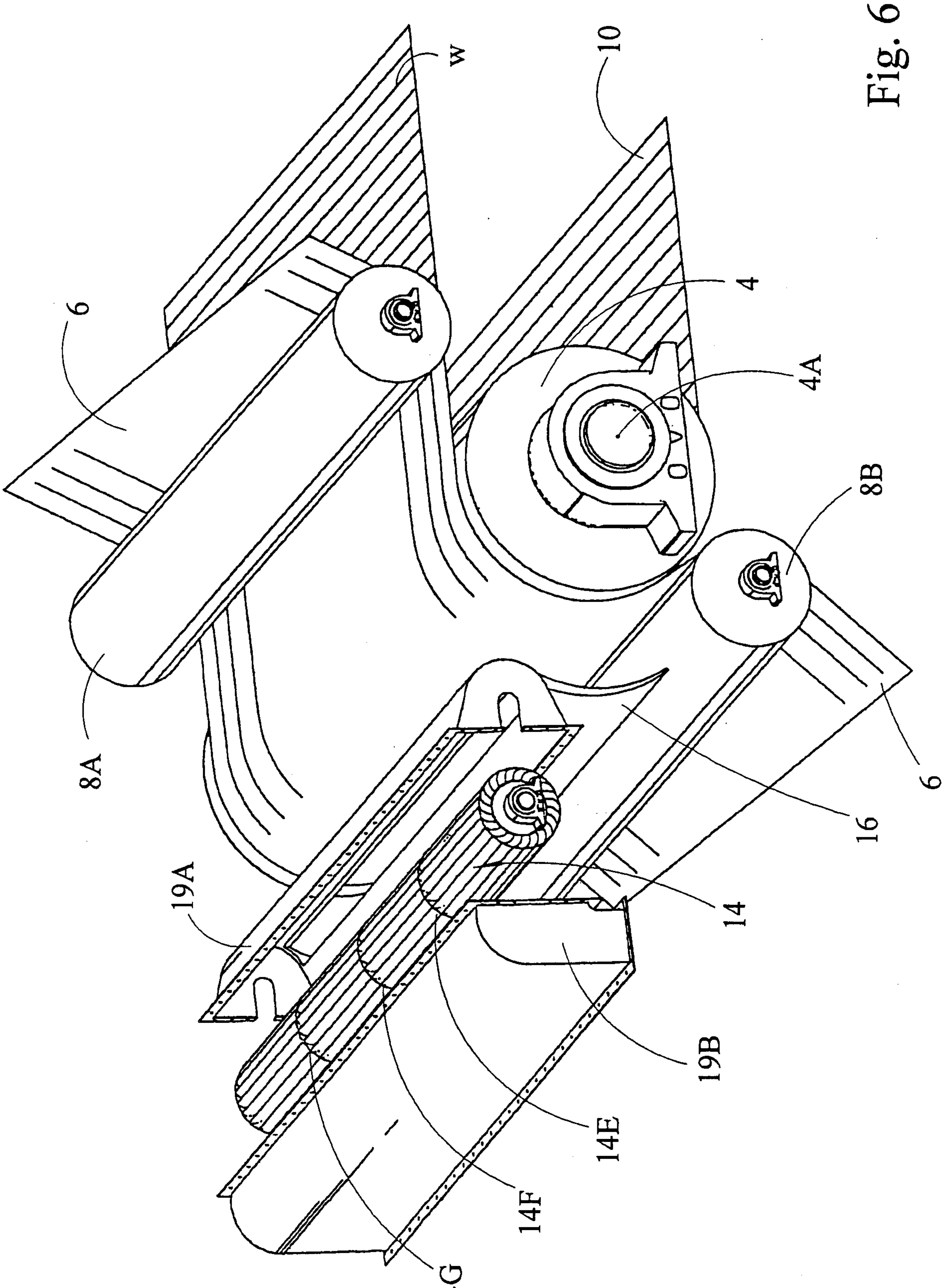


Fig. 6

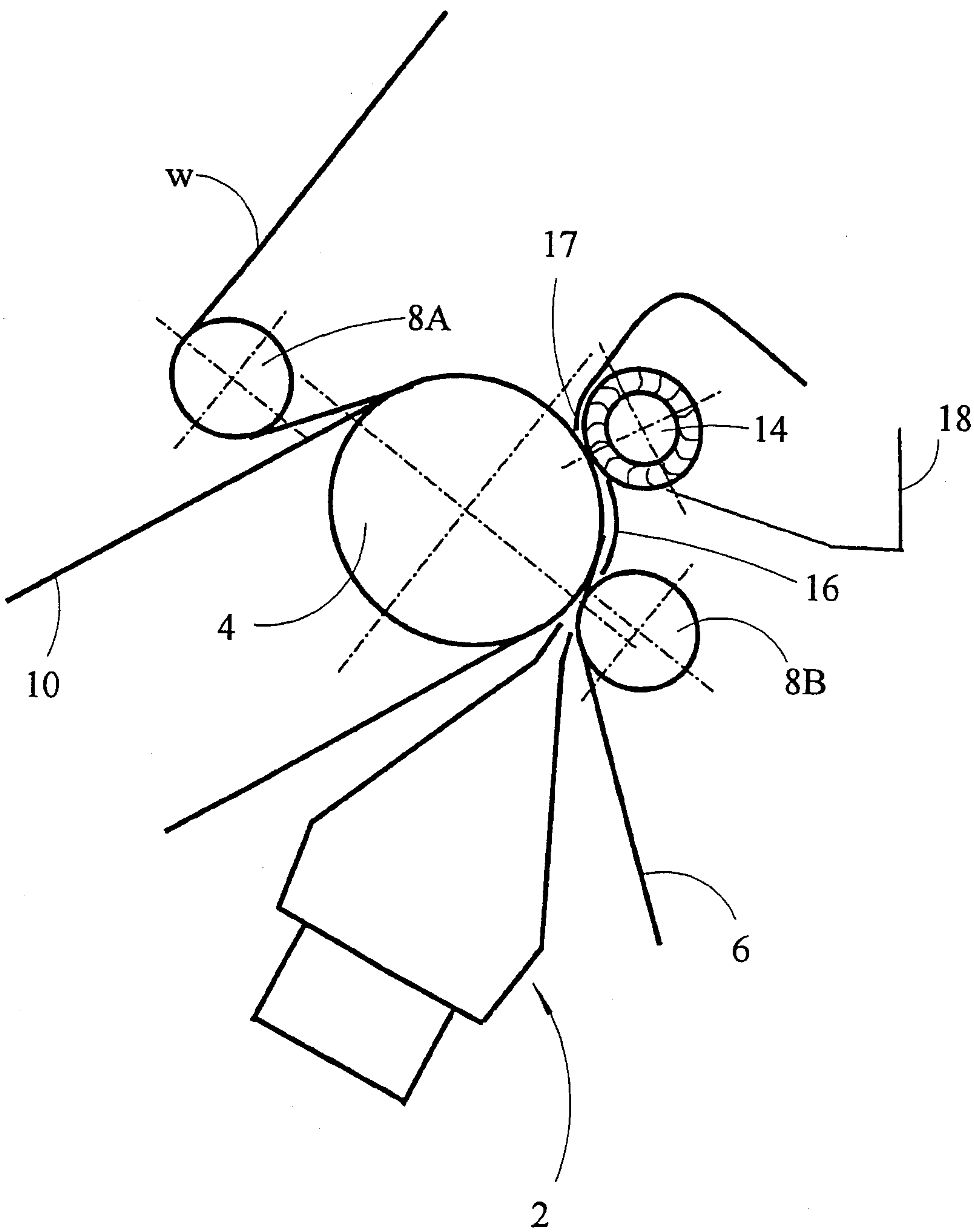


Fig. 7

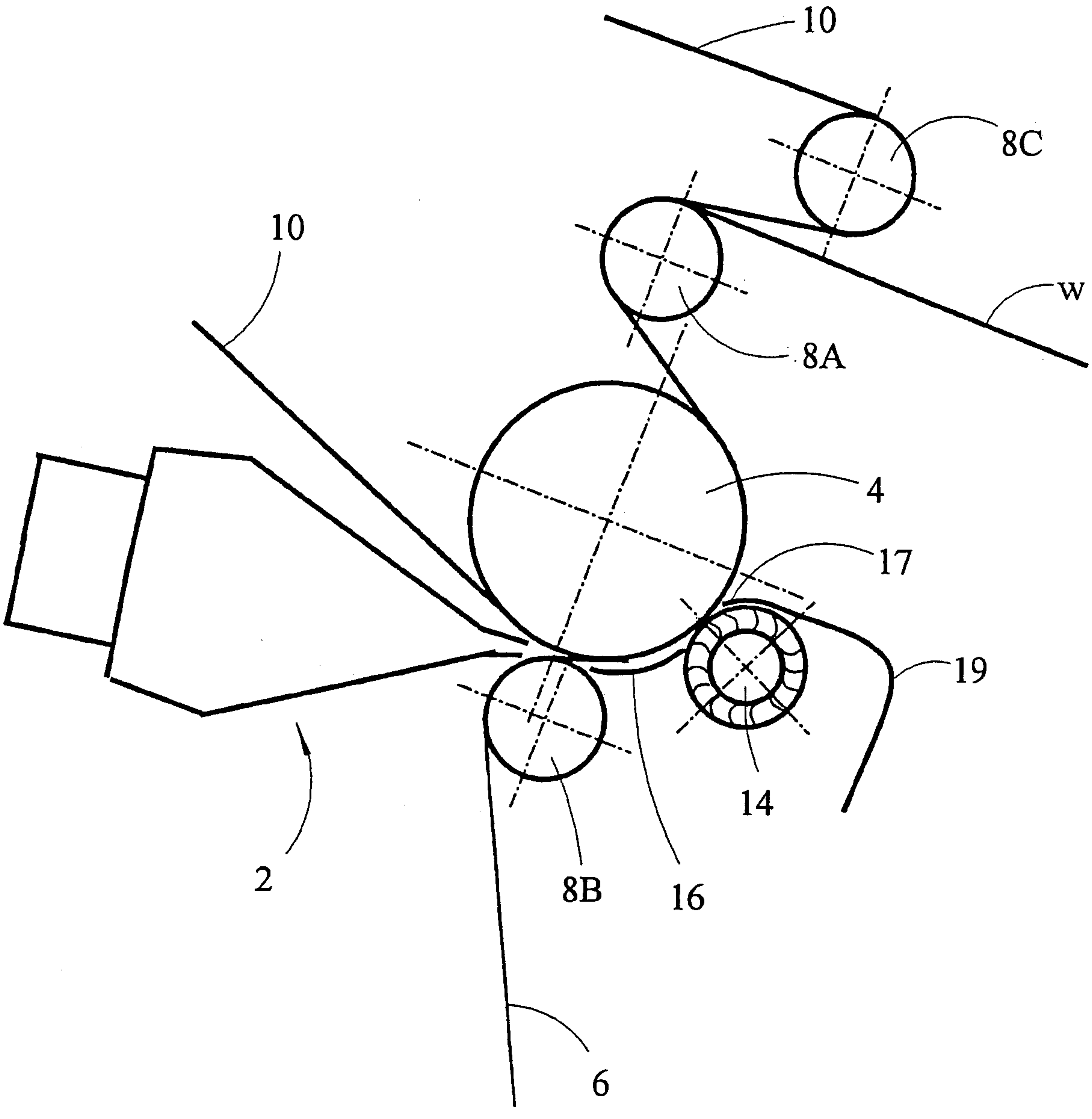


Fig. 8

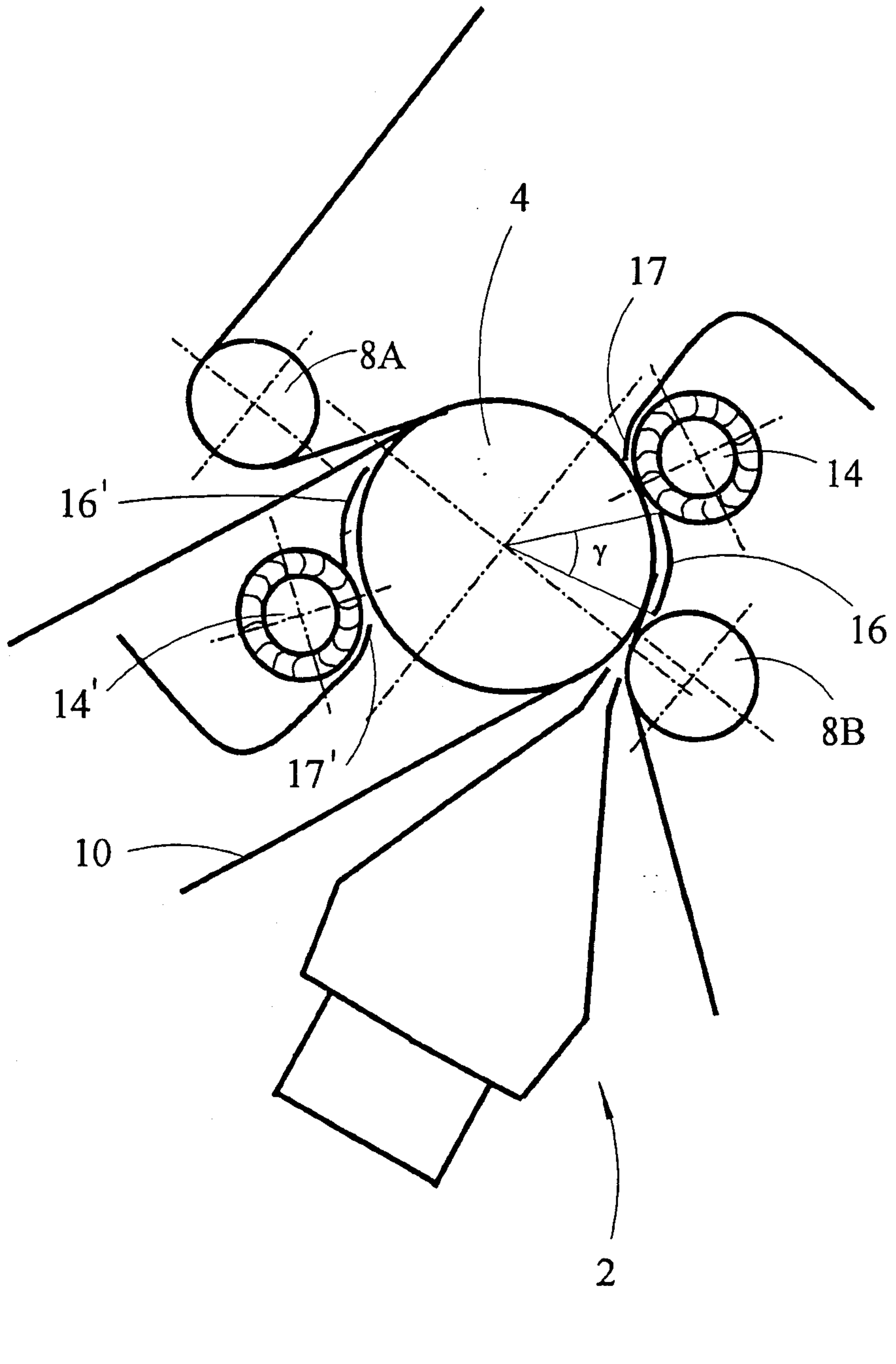


Fig. 9

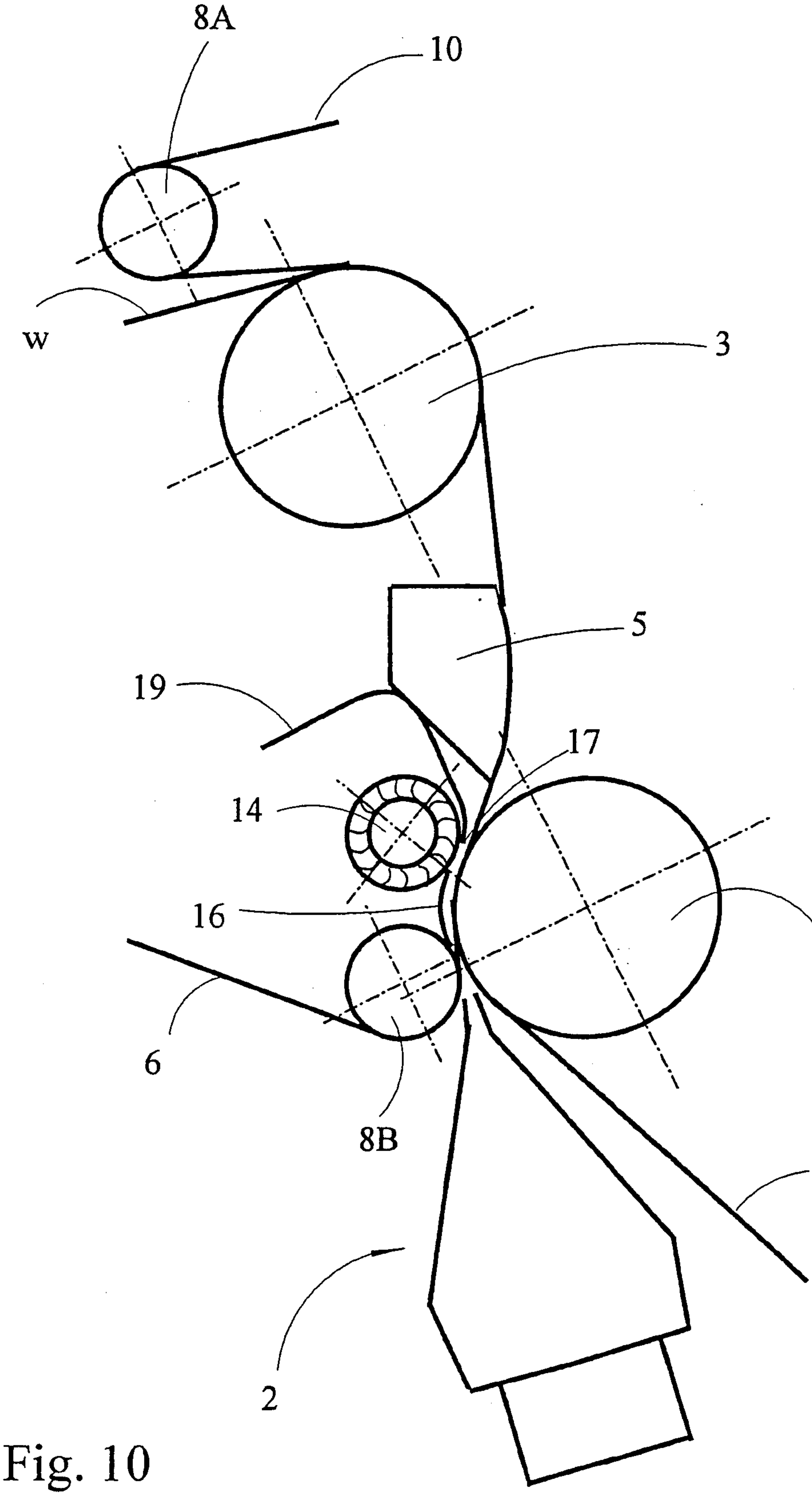


Fig. 10

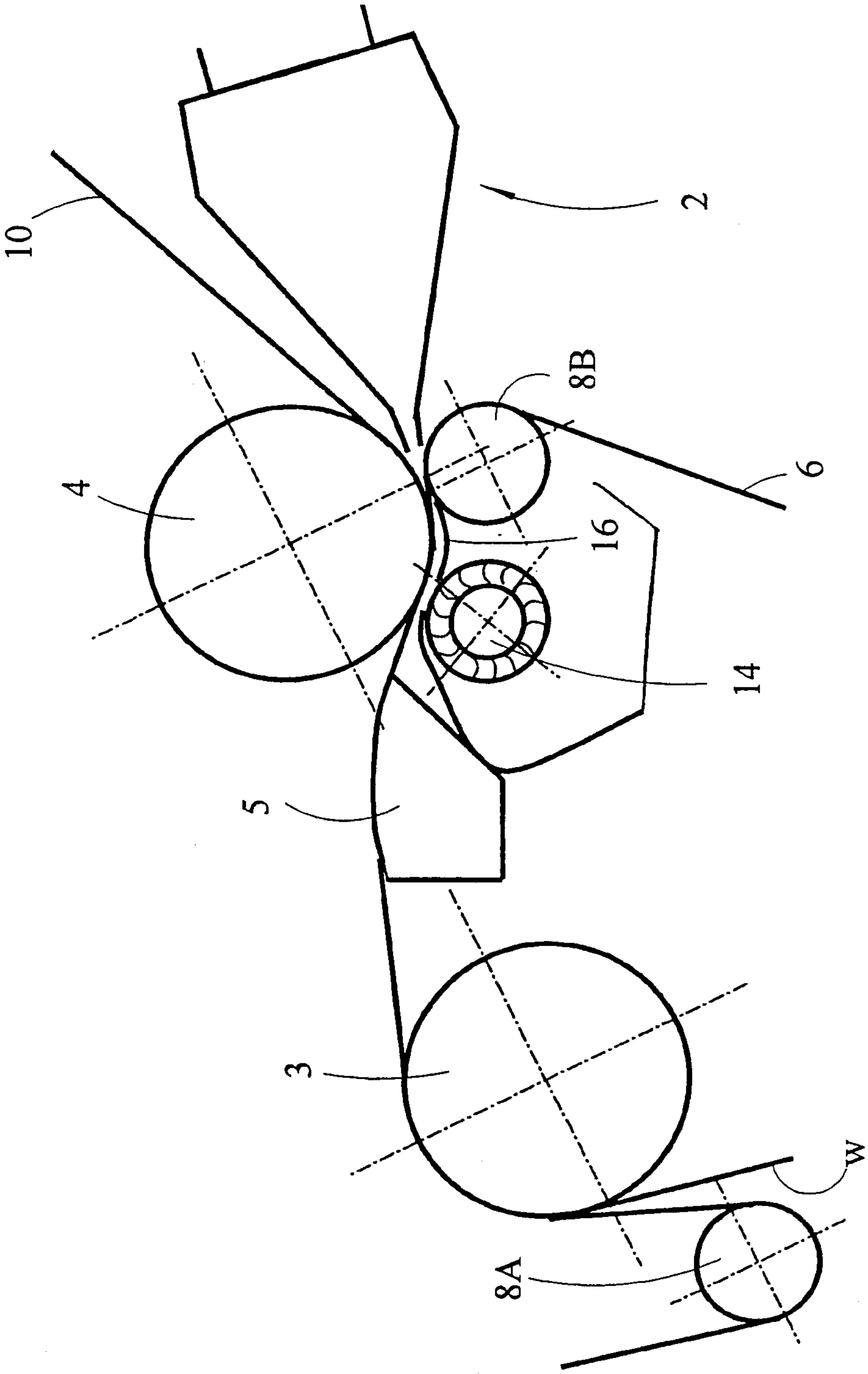


Fig. 11

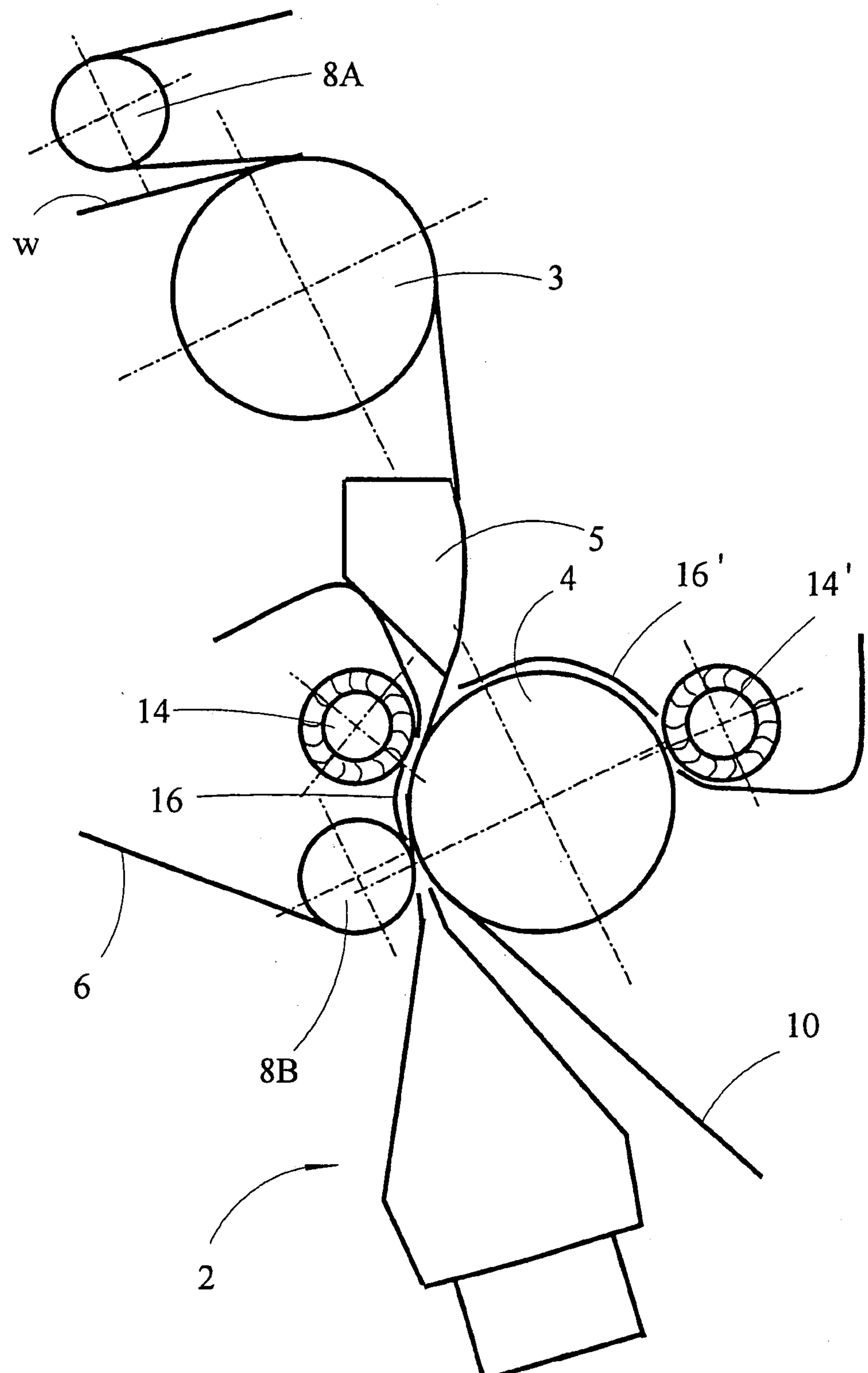


Fig. 12

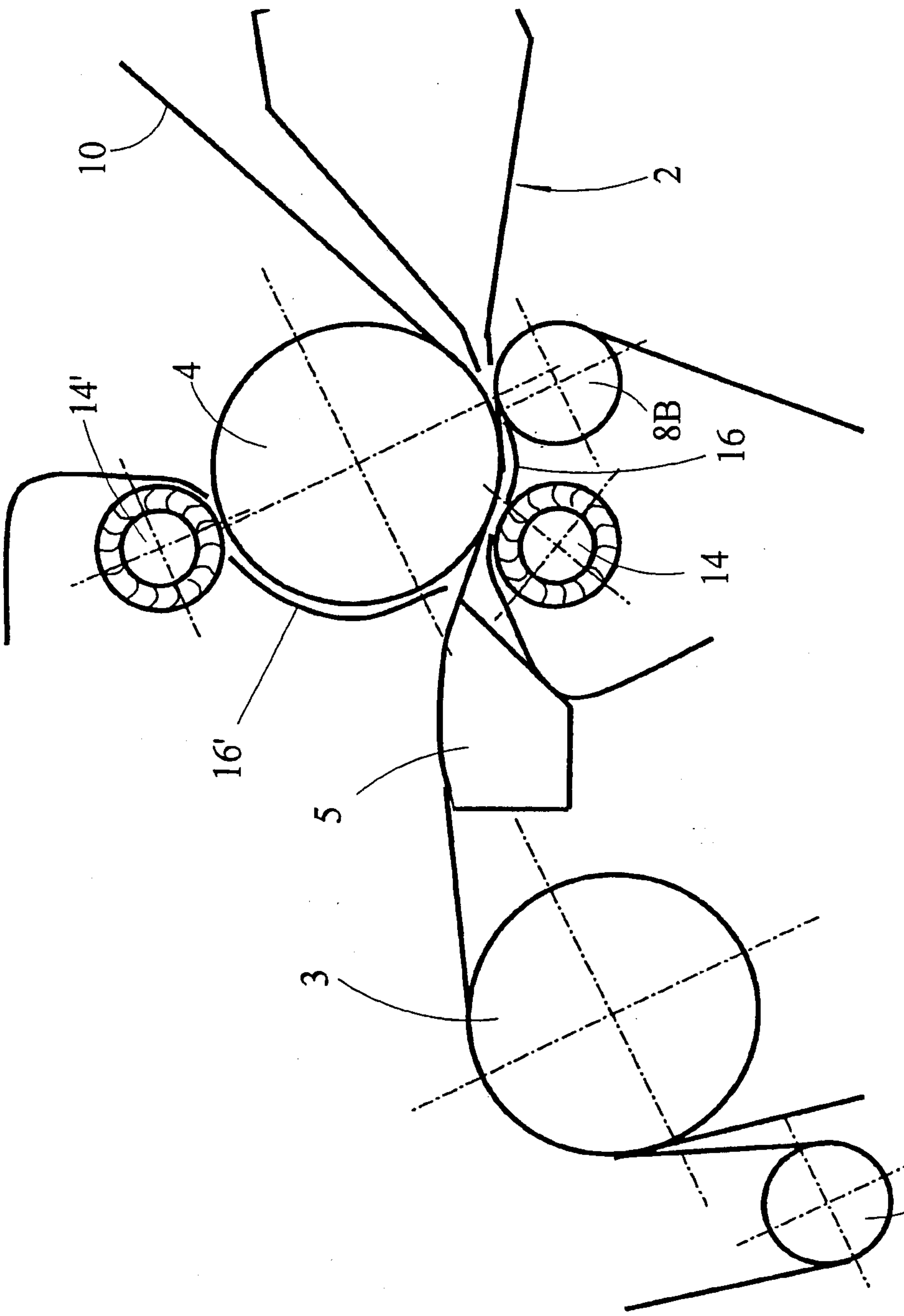


Fig. 13

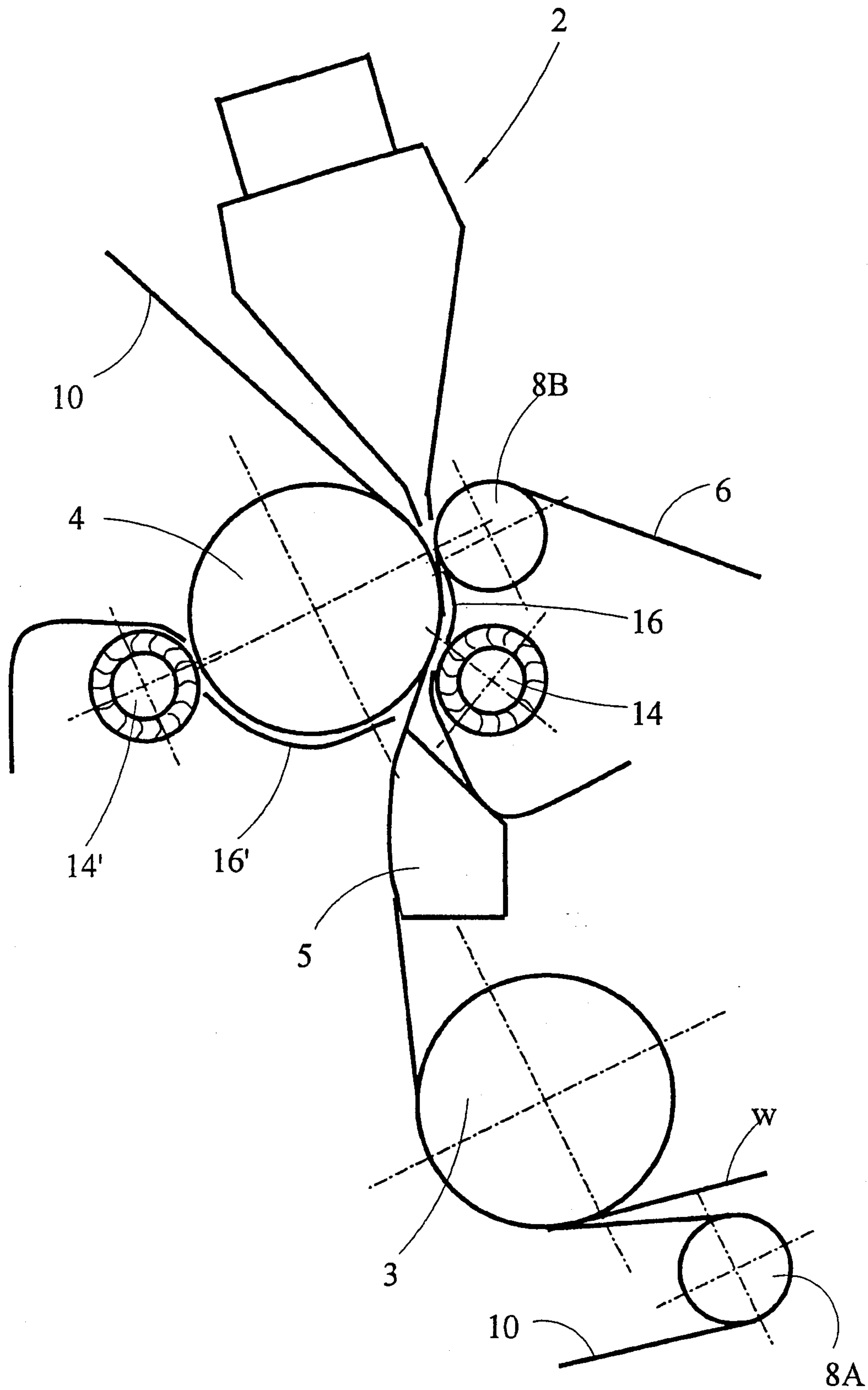
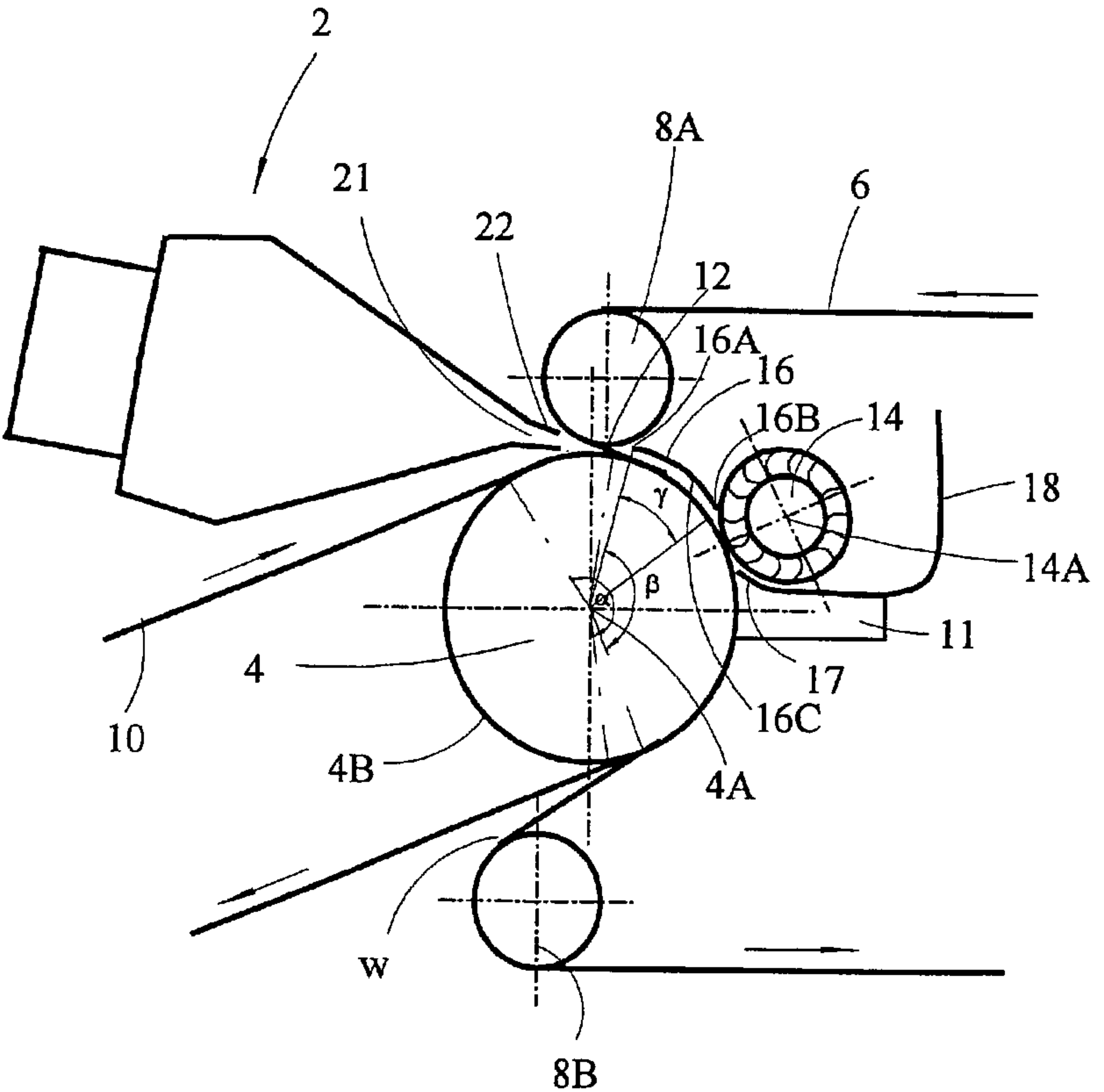


Fig. 14



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