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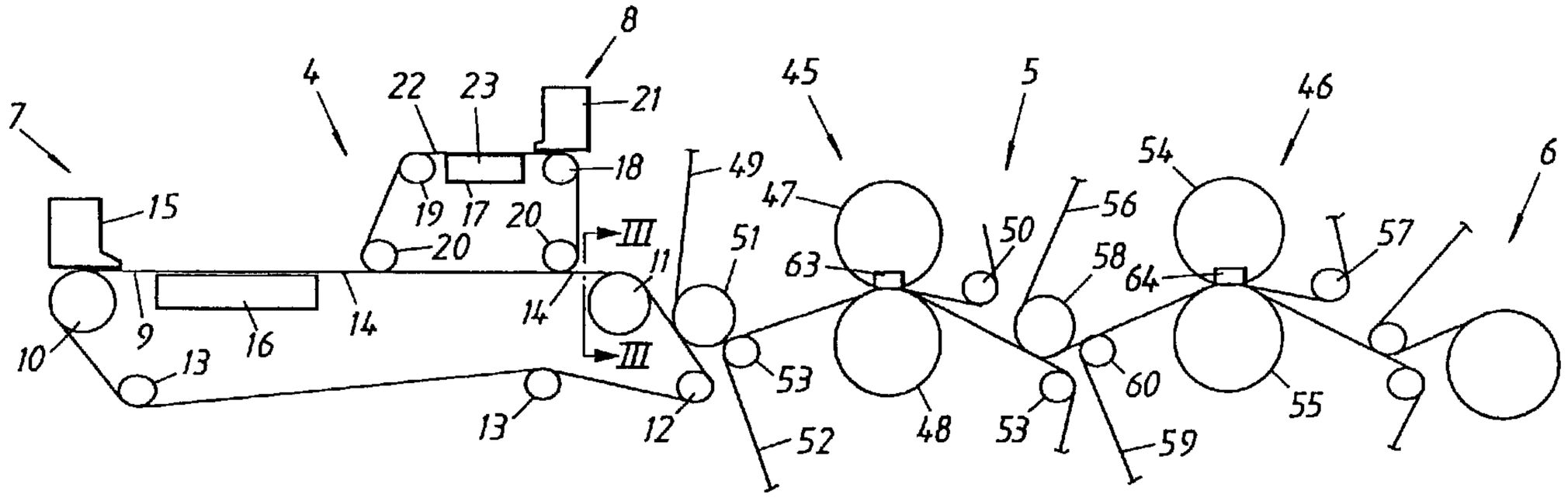
(54) Titre : MACHINE A CARTON ET PROCEDE DE FABRICATION D'UNE FEUILLE CONTINUE DE CARTON MULTICOUCHE

(54) Title: BOARD MACHINE AND METHOD OF MANUFACTURING A MULTILAYER CARDBOARD WEB



(57) Abrégé/Abstract:
A board machine for manufacturing a multilayer cardboard web (1) with a printable surface layer (2), comprising a press section (5) with at least one double-felted press (45) and a wet section (4) with a first forming unit (7) for forming a first layer (2) and one or more further forming units (8) for forming one or more further layers (3). In accordance with the invention, the first forming unit (7) forms the printable surface layer (2) and, with its forming wire, transfers the web (1), which is couched by several layers (2, 3), to the upper press felt (49) with the surface layer (2) facing downwards in the press nip to contact the lower press felt (52), which exerts a greater adhesion force on the web than the upper press felt and which encompasses the lower press roll (48) by a pre-determined minimum sector angle. The invention also relates to a method for manufacturing a multilayer cardboard web by means of such a board machine.

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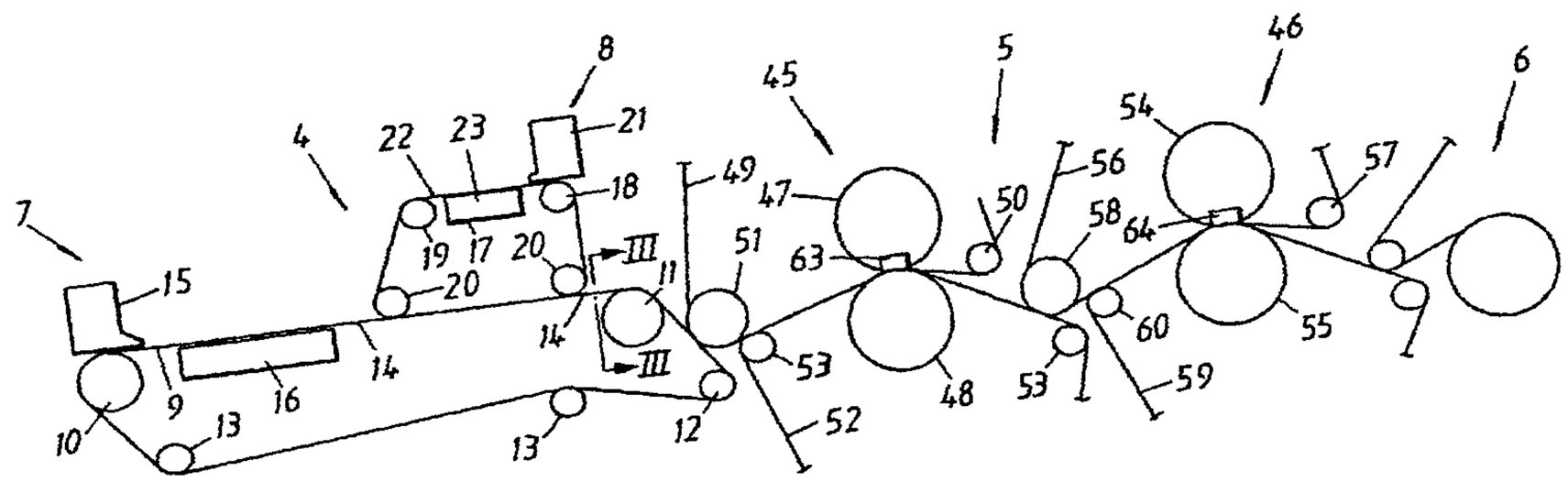
(54) Title: BOARD MACHINE AND METHOD OF MANUFACTURING A MULTILAYER CARDBOARD WEB



(57) Abstract: A board machine for manufacturing a multilayer cardboard web (1) with a printable surface layer (2), comprising a press section (5) with at least one double-felted press (45) and a wet section (4) with a first forming unit (7) for forming a first layer (2) and one or more further forming units (8) for forming one or more further layers (3). In accordance with the invention, the first forming unit (7) forms the printable surface layer (2) and, with its forming wire, transfers the web (1), which is couched by several layers (2, 3), to the upper press felt (49) with the surface layer (2) facing downwards in the press nip to contact the lower press felt (52), which exerts a greater adhesion force on the web than the upper press felt and which encompasses the lower press roll (48) by a pre-determined minimum sector angle. The invention also relates to a method for manufacturing a multilayer cardboard web by means of such a board machine.

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Board machine and method of manufacturing a multilayer cardboard web

The present invention relates to a board machine for manufacturing a multilayer cardboard web with a printable surface layer, comprising a wet section and a press section, which wet section includes a first forming unit for forming a first layer, which first forming unit has at least one forming wire, running in an extended loop up to the press section to form a pick-up point for the multilayer cardboard web, and one or more further forming units for forming one or more further layers and for couching the same with said first layer on said extended forming wire of the first forming unit to form the multilayer cardboard web, which press section includes at least one double-felted press, having an upper press element, a lower press element in the shape of a press roll, which press elements create a press nip with each other, an upper press felt, running in a loop around a plurality of guide rolls and a pick-up roll, arranged at said pick-up point for transferring the multilayer cardboard web to the upper press felt, and a lower press felt, running in a loop around a plurality of guide rolls.

The invention also relates to a method of manufacturing a multilayer cardboard web with a printable surface layer in a board machine, comprising a wet section and a press section, according to which a first layer is formed in a first forming unit in the wet section, which first forming unit has at least one forming wire, running in an extended loop up to the press section to form a pick-up point for the multilayer cardboard web, and one or more further layers are formed in one or more further forming units and couched with said first layer on said extended forming wire to form the multilayer cardboard web, which is dewatered in the press section, which includes at

least one double-felted press, having an upper press element, a lower press element in the shape of a press roll, which press elements create a press nip with each other, an upper press felt, running in a loop around a plurality of guide rolls and a pick-up roll, arranged at said pick-up point for transferring the multilayer cardboard web to the upper press felt, and a lower press felt, running in a loop around a plurality of guide rolls.

As used herein, the expression "the 0 line of the press", is defined, for a roll press, as the tangent perpendicular to a straight line intersecting the centres of the press rolls and, for a shoe press, as the tangent of the transition from the concave curvature to the convex curvature of the shoe at the exit of the press nip.

One side of a multilayer cardboard web is often used for printing. This side, denoted the front side of the finished cardboard product, is formed by a surface layer that must have a high degree of surface smoothness to provide good printability. Special pulps are used for manufacturing the surface layer. Short-fibre pulps result in surface layers with improved printability. The pulp intended for the printable surface layer is preferably, but not necessarily, bleached. It may consist of a mixture of short-fibre and long-fibre pulps, in which the short-fibre proportion of the pulp may constitute 50-70 per cent by weight of the mass. However, the short-fibre proportion may constitute 100 per cent. The layer to be printed may also be made of 100 per cent bleached long-fibre pulp. Short-fibre pulp can be pulp from birch or eucalyptus, for instance, while long-fibre pulp can be pulp from pine, for instance.

Methods and machines for manufacturing multilayer cardboard webs are plentifully described in patent literature and the following are mentioned by way of example: EP-0 511 186, WO 92/06242, US-4,961,824, EP-0 511 185, US-5,074,964, EP-0 233 058 and SE-506 611.

US-5,639,349 (corresponding to DE-4401761) describes a method for improving the quality of multilayer papers in the wet section of a paper machine by recirculating the drainage water within each forming unit. The outer layer of the paper web is made of stock of higher quality than the stock for the core. The patent specification does not mention cardboard or board and the problem associated with providing a printable surface layer on a multilayer cardboard web. Neither does the patent specification touch upon the problem relating to the press section and the web run in the same, in particular not in pressing of a multilayer cardboard web with a printable surface layer.

US-4,957,778 describes a paper machine for manufacturing two-layer carbonless copy paper. The paper machine has upper and lower fourdrinier formers, the layers of which being combined by couching to a coherent paper web, which is pressed in a press with two single-felted press nips, created by two press rolls and a counter roll shared by the same. Multilayer cardboard webs are not touched upon in this patent specification and, consequently, neither are the problems associated with pressing a multilayer cardboard web.

In practice, the predominant technique for manufacturing a multilayer cardboard web is to manufacture the surface layer with a forming unit, for instance an upper fourdrinier former, arranged relative to at least one other forming unit, for instance a lower fourdrinier former, in such a way that the surface layer is couched

with a subjacent layer and the cardboard web emerges from the wet section with the surface layer facing upwards. This makes demands on the configuration of the press section. In accordance with conventional techniques, a double-felted roll press is employed as the first press. It is also known to use a double-felted shoe press with the shoe in top or bottom position as the first press. A first double-felted press of known kind has an upper felt acting as a pick-up felt to transfer the cardboard web to the press nip, while the lower felt is intended to carry the cardboard web subsequent to its passage through the press nip. Said surface layer of the cardboard web thus comes into direct contact with the upper felt. Accordingly, to be able to satisfy the requirement of high surface smoothness of the surface layer, the structure of the web-contacting surface of the upper felt must not be too rough. If, on the other hand, the structure of the web-contacting surface of the lower felt were to be too smooth or fine to ensure the correct web run after the press nip, the lower felt will not be sufficiently open to allow permeation of water and will relatively quickly become clogged with fibres, which entails that reconditioning of the lower felt cannot be accomplished with desired result and that the service life of the lower felt becomes relatively short. In practice, the two contradictory requirements for the properties of the upper felt and the lower felt entail that the differences between their surfaces structures with respect to roughness or smoothness become relatively small and there is, therefore, a risk of the cardboard web sometimes having a tendency to accompany the upper felt after the press nip instead of the lower felt as intended, even if the lower felt has the smoother surface. To ensure the correct web run in a shoe press with the shoe in bottom position the lower felt must be passed over the downstream edge of the shoe and the upper felt passed approximately in the direction of the

so-called 0 line, but this is not an acceptable solution as the web is then subjected to detrimental shear forces during its passage over said shoe edge.

The object of the present invention is to provide an improved board machine and an improved method of manufacturing a multilayer cardboard web. The invention thus enables the manufacture of a multilayer cardboard web having a printable surface layer with a desired high degree of surface smoothness and maximum dry-solids content after the press section, whilst safeguarding the web run in the press section.

The board machine, in accordance with the invention, is characterized in that said first forming unit is arranged to form said printable surface layer and arranged with its said extended forming wire to transfer the multilayer cardboard web to the upper press felt of the press with said printable surface layer facing downwards to contact the lower press felt in the press nip; in that the lower press felt has a finer web-contacting surface to exert a greater adhesion force on the multilayer cardboard web than the upper press felt; and in that the lower press felt is arranged to encompass the lower press roll by a pre-determined minimum sector angle α measured from a point in the press nip intersected by the 0 line of the press, as defined herein for a roll press and a shoe press, respectively.

The method, in accordance with the invention, is characterized in that said printable surface layer is formed in said first forming unit; in that said extended forming wire transfers the multilayer cardboard web to the upper press felt of the press with said printable surface layer facing downwards so that it is in contact with the lower press felt in the press nip; in that the lower press felt exerts a greater adhesion force on the

multilayer cardboard web than the upper press felt by means of it having a finer web-contacting surface; and in that the lower press felt is caused to encompass the lower press roll by a pre-determined minimum sector angle α measured from a point in the press nip intersected by the 0 line of the press, as defined herein for a roll press and a shoe press, respectively.

The invention will be further explained in the following with reference to the drawings.

Figure 1 shows schematically parts of a board machine for manufacturing a multilayer board web in accordance with a first embodiment of the invention.

Figure 2 shows schematically parts of a board machine for manufacturing a multilayer cardboard web in accordance with a second embodiment of the invention.

Figure 3 is a cross section along the line III-III in Figure 1.

Figure 4 shows schematically a part of a shoe press used in the board machines shown in Figures 1 and 2.

Figure 5 shows schematically a roll press in a board machine for manufacturing a multilayer cardboard web in accordance with a third embodiment of the invention.

Figures 1 and 2 show schematically parts of a board machine for manufacturing a cardboard web 1, consisting of a first layer 2 and a further layer 3. In the embodiment shown and in accordance with the present invention, the first layer 2 forms a surface layer in the finished two-layer cardboard web, while the further layer 3 forms its core. Alternatively, a cardboard web is

manufactured, consisting of said first layer and several further layers, one of which is said core.

The board machines comprise a wet section 4, a press section 5 and a drying section 6.

The wet section 4 comprises a first forming unit 7 for manufacturing the first layer 2 and a second forming unit 8 for manufacturing the second layer 3.

In the embodiment shown in Figure 1, the two forming units 7, 8 consist of a first fourdrinier former, located upstream, and a second fourdrinier former, located downstream, whilst, in the embodiment in accordance with Figure 2, they consist of a first twin-wire former or gap former, located upstream, and a second twin-wire former or gap former, located downstream. In this context, the expressions "upstream" and "downstream" indicate the relative locations of the forming units viewed in the machine direction.

The first fourdrinier former 7, located upstream according to Figure 1, is extended in the machine direction and has a fourdrinier wire 9, running in a loop around an upstream breast roll 10, a downstream suction couch 11, a wire turning roll 12 and a plurality of other types of guide rolls 13, such as alignment rolls and tension rolls. The upper part 14 of the fourdrinier wire 9, dewatering the stock and forming the layer and web, between the breast roll 10 and the suction couch 11 is plane and horizontal. The first fourdrinier former 7, located upstream, further comprises a headbox 15, arranged close to the breast roll 10 to emit a jet of stock onto the upper part 14 of the fourdrinier wire 9, and dewatering members 16 for dewatering the stock to form the first layer 2.

The second fourdrinier former 8, located downstream according to Figure 1, has a fourdrinier wire 17, running in a loop around a breast roll 18, an upper guide roll 19 and two lower guide rolls 20, which lower guide rolls are arranged in close proximity to the upper part 14 of the fourdrinier wire 9 of the first fourdrinier former 7 for couching the formed second layer with the formed first layer. The second fourdrinier former 8 comprises a headbox 21, arranged close to the breast roll 18 to emit a jet of stock onto the upper, plane part 22 of the fourdrinier wire 17, and dewatering members 23 for dewatering the stock to form the second layer.

The first twin wire former, located upstream according to Figure 2, has first and second forming wires 25, 26, which run together in a forming zone. The first forming wire 25 runs in an upper loop around a plurality of guide rolls 27. The second forming wire 26 runs in a lower loop around an upstream forming roll 28 and a downstream suction couch 29, a wire turning roll 30 and a plurality of other guide rolls 31, comprising alignment rolls and tension rolls. The lower forming wire 26 is extended up to the press section so that the suction couch 29 is located downstream of the second twin wire former 8. In the loop of the first forming wire 25, dewatering means 32 are arranged within said forming zone. A headbox 33 is arranged to emit a jet of stock into a gap defined by the forming roll 28 and a guide roll 27 located adjacently to the same in the upper wire loop 25.

The second twin wire former 8, located downstream according to Figure 2, has first and second forming wires 34, 35, which run together in a forming zone. The first forming wire 34 runs in a loop around a plurality of guide rolls 36 and has a lower, linear part 37, passing along the lower forming wire 26 of the first twin wire former 7 to create a couching zone. The second forming

wire 35 runs in a loop around a forming roll 38 and two guide rolls 39. In the loop of the first forming wire 34, dewatering means 40 are arranged within said forming zone. A headbox 41 is arranged to emit a jet of stock into a gap defined by the forming roll 38 and a guide roll 36 located adjacently to the same in the first wire loop 34.

The first forming unit 7, located upstream, is arranged to create a surface layer 2 suitable for printing in the finished cardboard web, whilst the second forming unit 8, located downstream, is arranged to create a core 3, which encounters the surface layer so that the two layers are couched together with each other to a coherent two-layer cardboard web, see Figure 3, which leaves the forming wire 9, 26 of the first forming unit 7 with the surface layer facing downwards.

The press section 5 in the board machines shown in Figures 1 and 2 comprises a first double-felted press 45 and a second double-felted press 46, which presses 45, 46 are arranged directly one after the other. The first press 45 comprises an upper press element 47 and a lower press element 48, which press elements create a press nip with each other. The first press 45 further comprises an upper press felt 49, which runs in a loop around a plurality of guide rolls 50, comprising a pick-up suction roll 51 for transferring the multilayer cardboard web 1 to the upper press felt 49, and a lower press felt 52, which runs in a loop around a plurality of guide rolls 53, and which together run through the press nip with the web 1 enclosed therebetween in a sandwich construction. The second press 46 comprises an upper press element 54 and a lower press element 55, which press elements create a press nip with each other. The second press 46 further comprises an upper press felt 56, which runs in a loop around a plurality of guide rolls 57, comprising a

pick-up suction roll 58 for transferring the multilayer cardboard web 1 to the upper press felt 56, and a lower press felt 59, which runs in a loop around a plurality of guide rolls 60, and which together run through the press nip with the web 1 enclosed therebetween in a sandwich construction.

The lower press felt 52, 59 of each press 45, 46 has a finer surface structure than the upper press felt 49, 56 with the purpose of ensuring that the web 1 adheres to the lower press felt 52, 59 and not to the upper press felt 49, 56 after the press nip. This difference in surface structure or adhesive capability is a first parameter to assist in safeguarding the correct web run.

The lower press element 48, 55 in each press is a press roll, around which the lower press felt 52, 59 runs in contact with the envelope surface of the press roll after the press nip by a pre-determined minimum sector angle α measured from a certain point in the press, depending on which type of press is used, see below. The web has a tendency to accompany the press felt with the greatest part which surrounds the press roll after the press nip. This circumstance is a second parameter to assist in safeguarding the correct web run. In accordance with the present invention, said first and second parameters are utilized in one and the same press, whilst the printable surface layer 2 simultaneously faces downwards, enabling an increased difference between the degrees of surface smoothness of the lower and upper felts, whilst simultaneously maintaining a controlled, definite part which surrounds the lower press roll, all to safeguard the correct web run.

The press sections 5 shown in Figures 1 and 2 are alike and their presses consist of a first shoe press 45 with a press shoe 63 and a subsequent, second shoe press 46 with

a press shoe 64. Each shoe press 45 has a shoe roll 47, 54 in the upper position and a counter roll 48, 55 in the lower position. Each counter roll 48, 55 can have a blind-drilled, grooved or smooth envelope surface. Each shoe roll or one of the shoe rolls has an envelope surface 65, see Figure 4, in the shape of a press belt that is smooth, blind-drilled or grooved. From the point of view of operability, a blind-drilled or grooved press belt 65 is preferable, as this provides a large open volume behind the upper press felt 49, 56 so that the cardboard web acquires a high dry-solids content whilst the upper press felt simultaneously remains open towards the open surface behind the upper press felt to enable ventilation of the same. Said high dry-solids content is further improved by employing a blind-drilled or grooved counter roll, thus providing a large open volume behind the lower press felt 52, 59. In especially difficult operating conditions, i.e. high web speed and low surface weight, a counter roll with a smooth envelope surface is used, the open volume, which in this case is reduced, not being required, as smaller quantities of water (low surface weight) need to be removed and an extra great vacuum pulse is created in the lower press felt, which results in the "attraction" of the web to the same being increased still further. Placing the shoe rolls in a top position creates enhanced possibilities for guiding the cardboard web to the lower press felt by arranging the same to encompass the counter roll to a greater extent.

The lower press felt 52 is arranged to encompass the counter roll 48 with a pre-determined minimum sector angle α of 10° measured from a point on the periphery of the shoe 63, at which point the concave curvature of the shoe changes into a convex curvature, the tangent of this point being denoted the 0 line 61 of the shoe. The part of the upper press felt 49 surrounding the counter roll 48 is adjustable within a range from +5° to -5° measured

as an angle β between the upper press felt 49 and said 0 line 61, positive angle values being located below and negative angle values above this 0 line 61.

Alternatively, the first press 45 can consist of a roll press as shown in Figure 5. The second press 46 in such a press section can be a similar roll press or a shoe press as described above. The upper and lower press rolls 47, 48 of the roll press can have smooth, blind-drilled or grooved envelope surfaces. The lower press felt 52, see Figure 5, is arranged to encompass the lower press roll 48 by a pre-determined minimum sector angle α of 10° measured from a point on the periphery of the lower press roll 48, the tangent of which point being perpendicular to a straight line intersecting the centres of the press rolls, which tangent is denoted as the 0 line 62 of the roll press. This angle α is normally in the range 10°-25° for a roll press. The part of the upper press felt 49 surrounding the lower press roll 48 is adjustable within a range from +10° to -5° measured as an angle β between the upper press felt 49 and said 0 line 62, positive angle values being located below and negative angle values above this 0 line 62.

CLAIMS

1. A board machine for manufacturing a multilayer cardboard web with a printable surface layer, comprising a wet section and a press section, which wet section includes a first forming unit for forming a first layer, which first forming unit has at least one forming wire, running in an extended loop up to the press section to form a pick-up point for the multilayer cardboard web, and one or more further forming units for forming one or more further layers and for couching the same with said first layer on said extended forming wire of the first forming unit to form the multilayer cardboard web, which press section includes at least one double-felted press, having an upper press element, a lower press element in the shape of a press roll, which press elements create a press nip with each other, an upper press felt, running in a loop around a plurality of guide rolls and a pick-up roll, arranged at said pick-up point for transferring the multilayer cardboard web to the upper press felt, and a lower press felt, running in a loop around a plurality of guide rolls, characterized in that said first forming unit is arranged to form said printable surface layer and arranged with its said extended forming wire to transfer the multilayer cardboard web to the upper press felt of the press with said printable surface layer facing downwards to contact the lower press felt in the press nip; in that the lower press felt has a finer web-contacting surface to exert a greater adhesion force on the multilayer cardboard web than the upper press felt; and in that the lower press felt is arranged to encompass the lower press roll by a pre-determined minimum sector angle α measured from a point in the press nip intersected by a 0 line of the press, as defined herein for a roll press and a shoe press, respectively.

2. A board machine as claimed in claim 1, characterized in that said minimum sector angle α is 10°.

3. A board machine as claimed in claim 1 or 2, characterized in that the press section comprises a first double-felted shoe press with an extended press nip and a second double-felted shoe press with an extended press nip; and in that each shoe press has an upper press shoe and a lower counter roll.

4. A board machine as claimed in claim 3, characterized in that each shoe press has an upper shoe roll, including said press shoe.

5. A board machine as claimed in claim 3 or 4, characterized in that the peripheral arc of contact of the upper press felt around the counter roll is adjustable within the range from +5° to -5° measured as an angle β between the upper press felt and said 0 line, wherein positive angle values are located below, and negative angle values are above said 0 line.

6. A board machine as claimed in claim 1 or 2, characterized in that the press section includes a first double-felted roll press and a second double-felted roll press.

7. A board machine as claimed in claim 6, characterized in that the part of the upper press felt surrounding the lower press roll is adjustable within the range from +10° to -5° measured as an angle β between the upper press felt and said 0 line, wherein positive angle values are located below, and negative angle values are above said 0 line.

8. A method of manufacturing a multilayer cardboard web with a printable surface layer in a board machine, comprising a wet section and a press section, according to which a first layer is formed in a first forming unit in the wet section, which first forming unit has at least one forming wire, running in an extended loop up to the press section to form a pick-up point for the multilayer cardboard web, and one or more further layers are formed in one or more further forming units and are couched with said first layer on said extended forming wire to form the multilayer cardboard web, which is dewatered in the press section, which includes at least one double-felted press, having an upper press element, a lower press element in the shape of a press roll, which press elements create a press nip with each other, an upper press felt, running in a loop around a plurality of guide rolls and a pick-up roll, arranged at said pick-up point for transferring the multilayer cardboard web to the upper press felt, and a lower press felt, running in a loop around a plurality of guide rolls, the method comprising the steps of:

a) forming said printable surface layer in said first forming unit;

b) transferring the multilayer web from the extended forming wire to the upper press felt of the press with said printable surface layer facing downwards so that it is in contact with the lower press felt in the press nip;

c) applying a greater adhesion force on the multilayer cardboard web from the lower press felt then the upper press felt by means of the lower press felt having a finer web-contacting surface; and

d) causing the lower press felt to encompass the lower press roll by a pre-determined minimum sector angle α measured from a point in the press nip intersected by a 0 line of the press, as defined herein for a roll press and a shoe press, respectively.

9. A method as claimed in claim 8, wherein said minimum sector angle α is 10°.

10. A method as claimed in claim 8 or 9, further comprising the step of dewatering the multilayer cardboard web in the press section, which includes a first double-felted shoe press with an extended press nip and a second double-felted shoe press with an extended press nip; and in that each shoe press has an upper press shoe and a lower counter roll.

11. A method as claimed in claim 10, further comprising the step of setting the part of the upper press felt surrounding the counter roll within the range from +5° to -5° measured as an angle ß between the upper press felt and said 0 line.

12. A method as claimed in claim 8 or 9, further comprising the step of dewatering the multilayer cardboard web in the press section, including a first double-felted roll press and a second double-felted roll press.

13. A method as claimed in claim 12, further comprising the step of setting the part of the upper press felt surrounding the lower press roll within the range from +10° to -5° measured as an angle ß between the upper press felt and said 0 line.

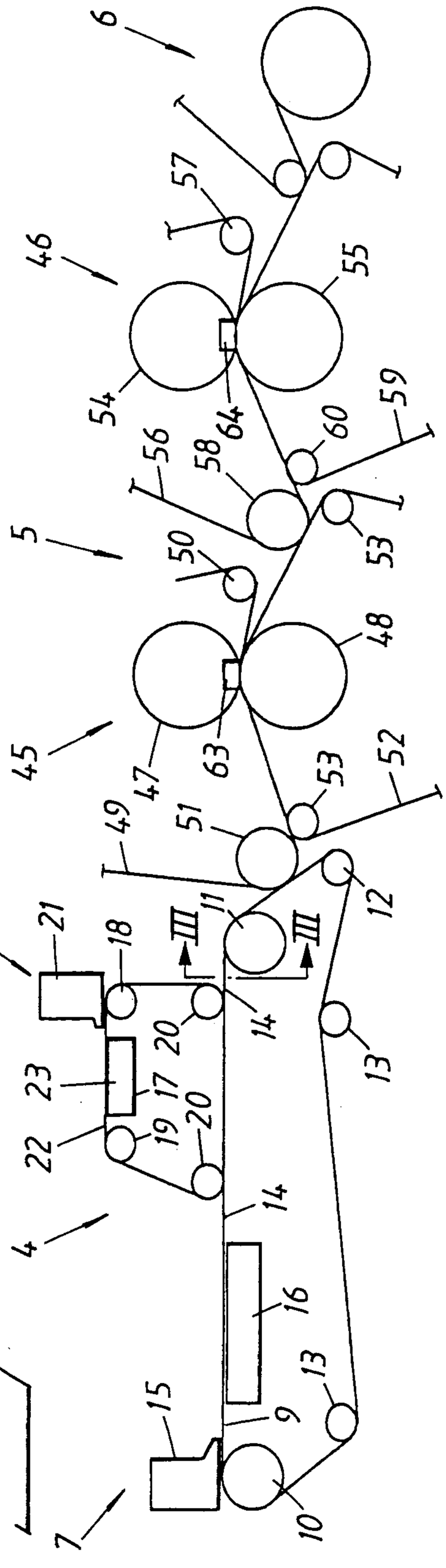
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Fig. 1

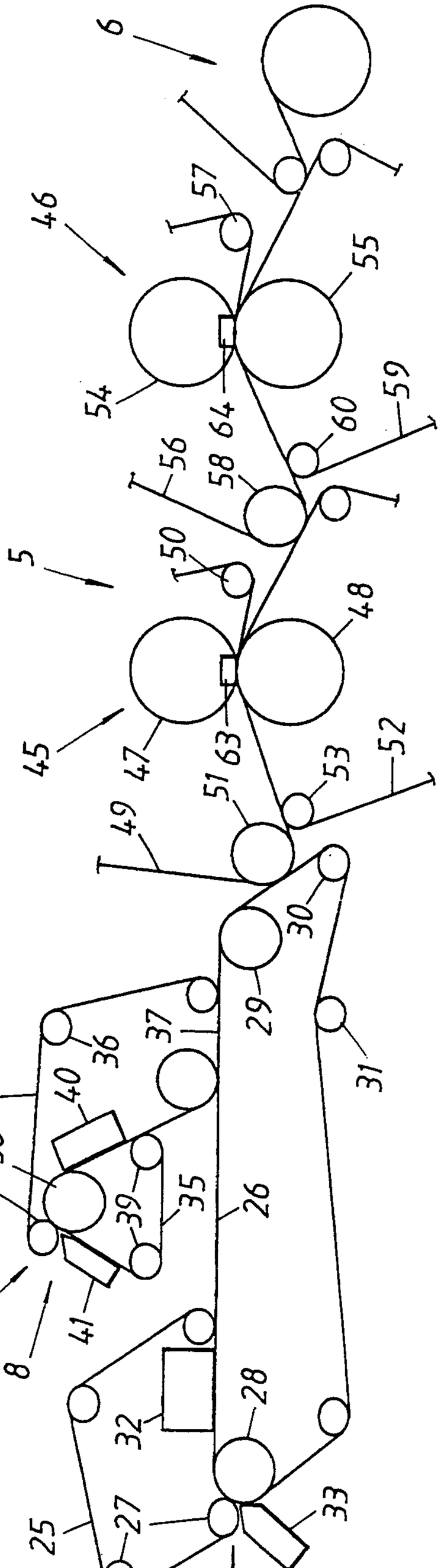
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Fig. 2

Fig. 2

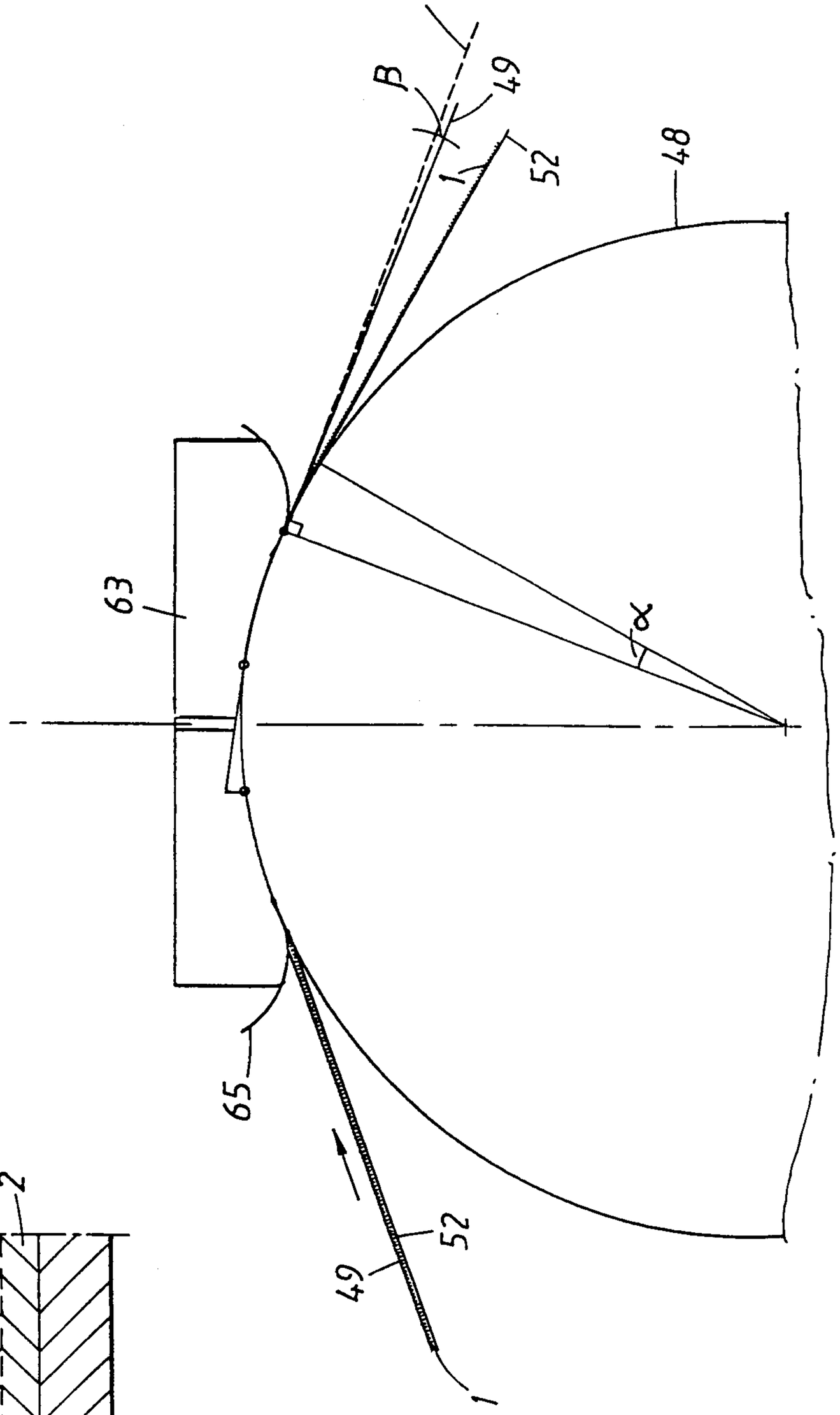


Fig. 3

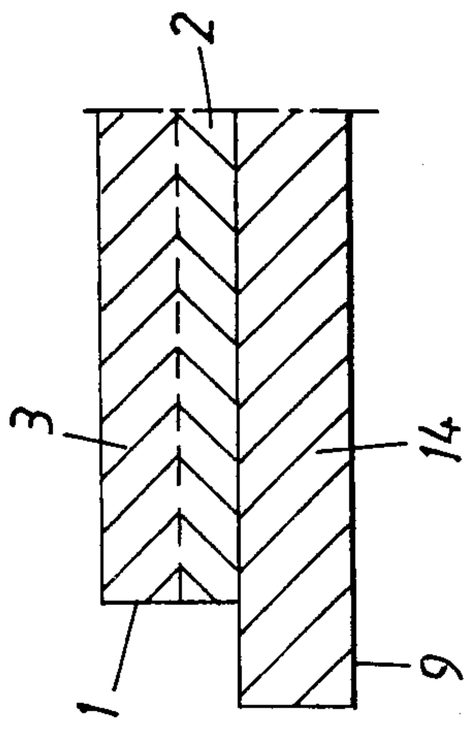
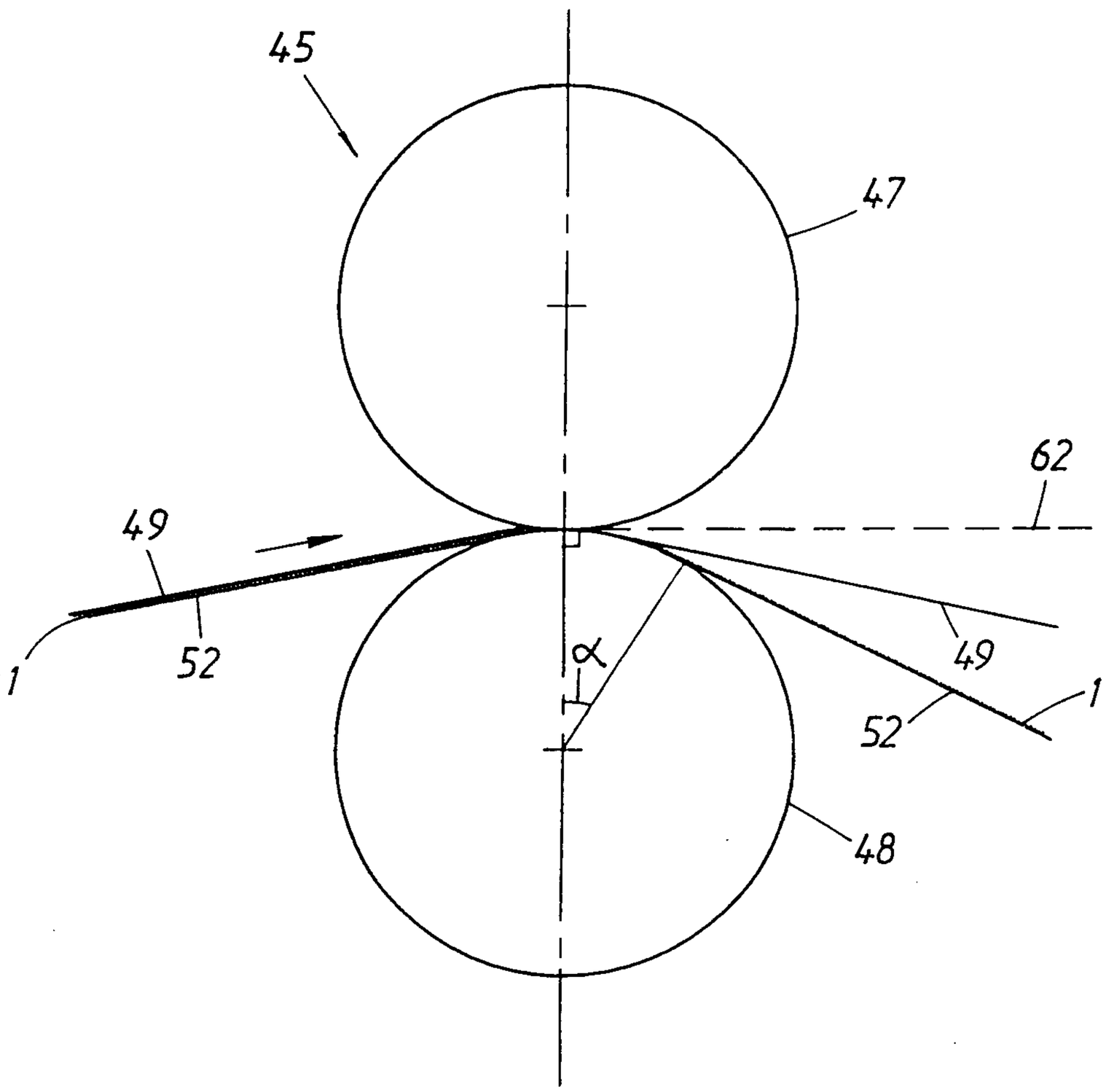
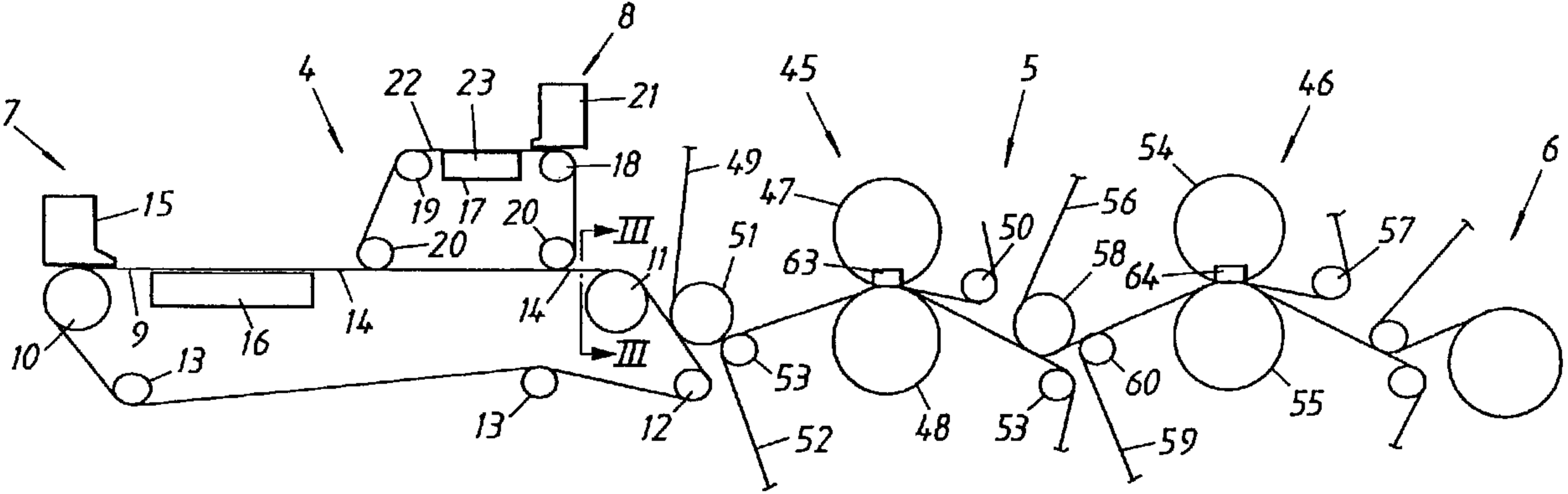


Fig.5

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