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(72) Inventeurs/Inventors:
BACKMAN, HANS-ERIK, FI;
CESARIO, DON, US;
ERIKSSON, BERTIL, SE;
HYENSJO, MARKO, SE;
KRUMENACKER, RAY, US;
LINDEN, ANDERS, SE;
LUOMA, HEIKKI, CA;
...

(73) Propriétaire/Owner:
METSO PAPER, INC., FI

(74) Agent: GOWLING LAFLEUR HENDERSON LLP

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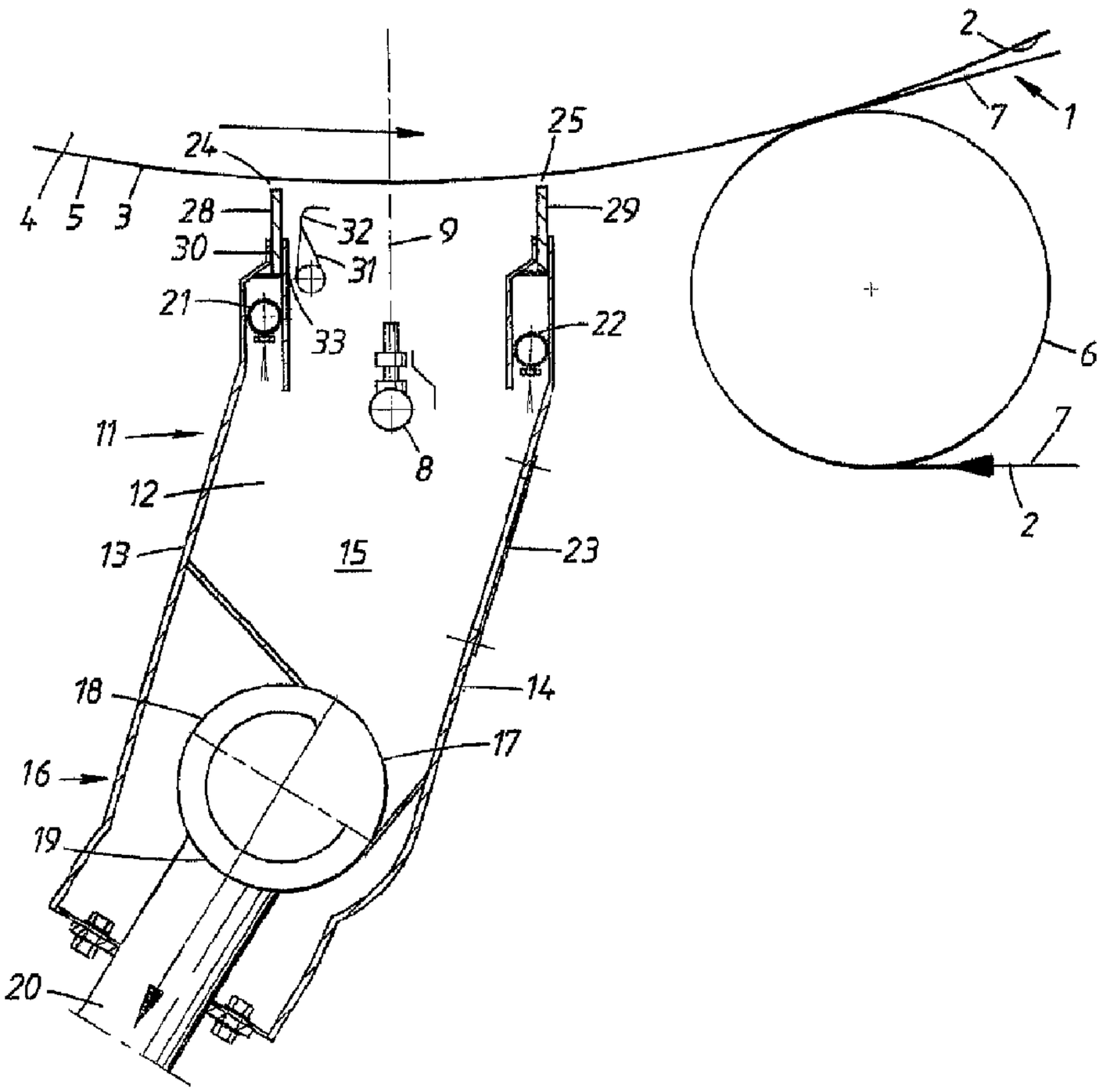
(54) Title: PROTECTING DEVICE FOR SPRAYING EQUIPMENT AND METHOD OF PROTECTING IT AND ITS SURROUNDINGS



(57) Abrégé/Abstract:
A device for protecting a spraying equipment (8) and its surroundings in a paper or board machine, for applying a treatment medium onto a moving surface (3), comprises a protecting cover (11) having a space (12), which forms a single chamber in which

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(72) Inventeurs(suite)/Inventors(continued): NYMAN, PER-ARNE, SE; OLSSON, ROBERT, SE; PONKA, PHIL, CA; PUUMALA, MAURI, CA; SALO, IAN, CA

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the spraying equipment is located and which is open towards the moving surface in connection with an application zone, and two wall elements (13, 14) which extend cross to the machine direction on either side of the application zone, and define machine-wide gaps (24; 40 and 25; 26; 41, respectively) between themselves and the moving surface. According to the invention, the protecting cover has a sealing arrangement arranged in connection with said gaps for restricting passage of air and contaminations through the gaps in a controlled manner; a system for a controlled supply of capture air for capturing contaminations occurring within the space; and an evacuating system for a controlled, continuous evacuation of the capture air with contaminations from the chamber. The invention also relates to a method of protecting such a spraying equipment and its surroundings while using such a device.

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(71) Applicant *(for all designated States except US)*: **METSO PAPER KARLSTAD AB** [SE/SE]; Box 1014, S-651 15 Karlstad (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BACKMAN, Hans-Erik** [FI/FI]; Inkerinkatu 2, FIN-20660 Littoinen (FI). **CESARIO, Don** [US/US]; 1656 Emerald Drive, Green Bay, WI 54311 (US). **ERIKSSON, Bertil** [SE/SE]; Åshammargatan 7, S-654 61 Karlstad (SE). **HYENSJÖ, Marko** [SE/SE]; Kung Eriks väg 4, S-656 38 Karlstad (SE). **KRUMENACKER, Ray** [US/US]; 4008 Sandy Branch, Buford, GA 30519 (US). **LINDÉN, Anders** [SE/SE]; Höoksgatan 2 C, S-652 29 Karlstad (SE). **LUOMA, Heikki** [CA/CA]; 202 Newcastle Drive, Thunder Bay, ON P7G 1C2 (CA). **NYMAN, Per-Arne** [SE/SE]; Malmtorgsgatan 18, S-653 40 Karlstad (SE). **OLSSON, Robert** [SE/SE]; Rönnliden 19, S-667 33 Forshaga (SE). **PONKA, Phil** [CA/CA]; 306 Canterbury Cresent, Thunder Bay (CA). **PUUMALA, Mauri** [CA/CA]; 380 Montclair Street, Thunder Bay, ON P7A 1M6 (CA). **SALO, Ian** [CA/CA]; 531 Current Avenue, Thunder Bay, ON P7A 2H7 (CA).

(74) Agent: **L-O LUNDQUIST PATENTBYRÅ AB**; P.O. Box 80, S-651 03 Karlstad (SE).

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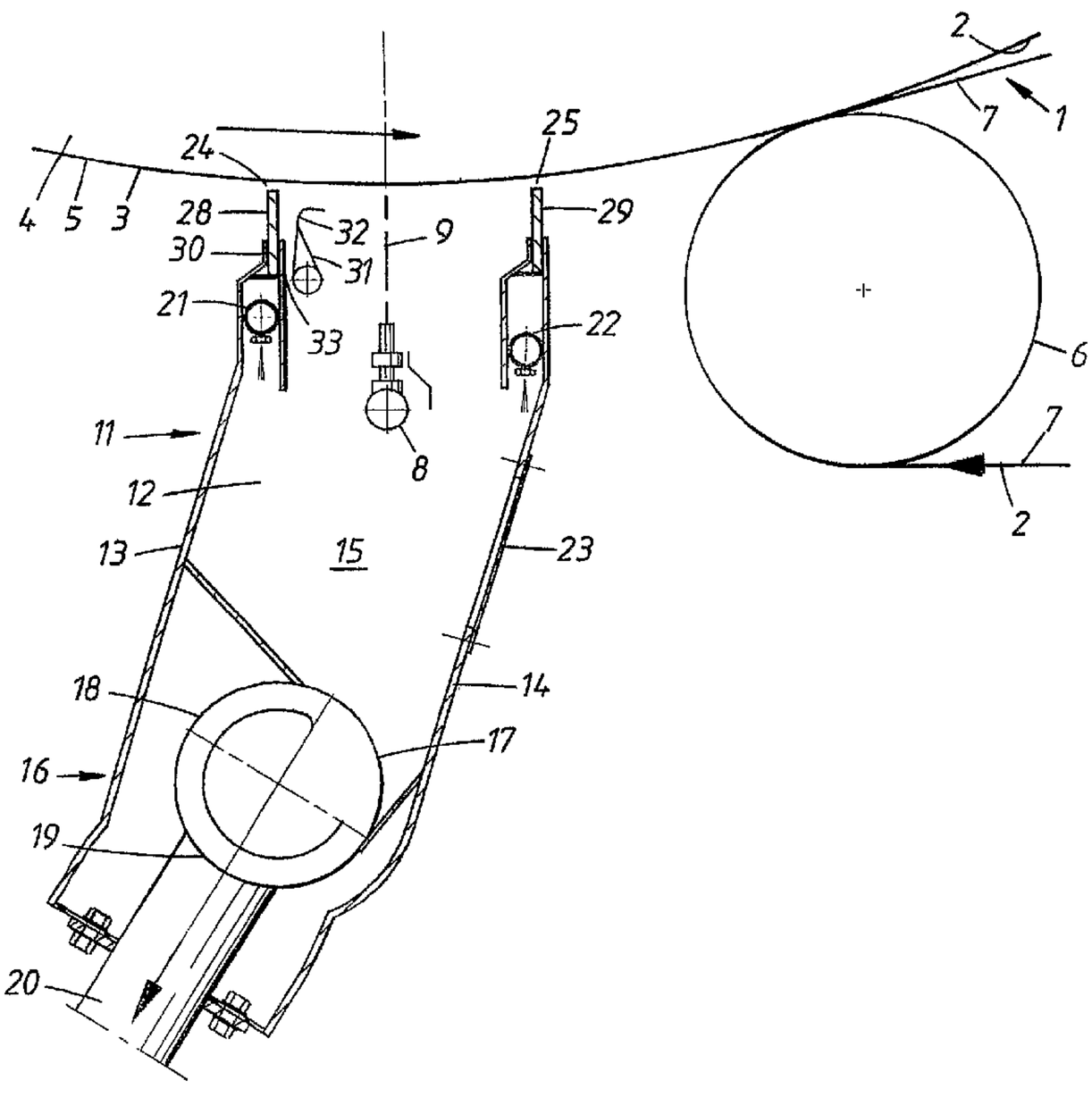
(54) Title: PROTECTING DEVICE FOR SPRAYING EQUIPMENT AND METHOD OF PROTECTING IT AND ITS SURROUNDINGS



(57) Abstract: A device for protecting a spraying equipment (8) and its surroundings in a paper or board machine, for applying a treatment medium onto a moving surface (3), comprises a protecting cover (11) having a space (12), which forms a single chamber in which the spraying equipment is located and which is open towards the moving surface in connection with an application zone, and two wall elements (13, 14) which extend cross to the machine direction on either side of the application zone, and define machine-wide gaps (24; 40 and 25; 26; 41, respectively) between themselves and the moving surface. According to the invention, the protecting cover has a sealing arrangement arranged in connection with said gaps for restricting passage of air and contaminations through the gaps in a controlled manner; a system for a controlled supply of capture air for capturing contaminations occurring within the space; and an evacuating system for a controlled, continuous evacuation of the capture air with contaminations from the chamber. The invention also relates to a method of protecting such a spraying equipment and its surroundings while using such a device.

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Protecting device for spraying equipment and method of protecting it and its surroundings

The present invention relates to a device for protecting a spraying equipment and the surroundings about the spraying equipment mounted in a paper or board machine in connection with a first moving surface of the machine in order to apply a treatment medium onto the first moving surface within a machine-wide application zone, said device comprising a machine-wide protecting cover arranged to enclose the spraying equipment and said application zone and having an internal space, which forms a single chamber in which the spraying equipment is located and which is open towards the first moving surface in connection with said application zone, said protecting cover comprising first and second, machine-wide wall elements, said wall elements extending cross to the machine direction on either side of said application zone, said first wall element being located upstream said application zone, as seen in relation to the direction of movement of the first moving surface onto which the treatment medium is applied, and defines a machine-wide, first gap between itself and the first moving surface, and the second wall element defines a machine-wide, second gap between itself and the first moving surface or a second moving surface.

The invention also relates to a method of protecting a spraying equipment and the surroundings about the spraying equipment mounted in a paper or board machine in connection with a first moving surface of the machine for applying a treatment medium onto the first moving surface within a machine-wide application zone, said application zone being enclosed by means of a protecting cover so that an internal space of the protecting cover, which

space forms a single chamber in which the spraying equipment is located, is open towards the first moving surface so that a machine-wide, first wall element of the protecting cover is located upstream said application zone, as seen in relation to the direction of movement of the first moving surface onto which the treatment medium is applied, and defines a machine-wide, first gap between itself and the first moving surface, and a machine-wide, second wall element of the protecting cover defines a machine-wide, second gap between itself and the first moving surface or a second moving surface.

An adhesive and protecting coating is applied continuously on the shell surface of a drying cylinder, e.g. a Yankee cylinder, in a tissue machine by means of a spraying equipment, which includes a plurality of spray nozzles arranged for providing a continuous, machine-wide spray pattern on the shell surface in a position located before the transfer nip that is formed by the Yankee cylinder and a press roll. The spray nozzles emit a spraying liquid which is a mixture of water and special chemicals which are to form said coating. The purpose of the coating is to control the adhesion of the paper web against the Yankee cylinder and to protect the shell surface against wear as well as chemical attacks. The spraying liquid discharged from the spray nozzles has a high pressure, typically 3-5 bar, and hits the shell surface at a high velocity. A portion of the chemicals adheres in the desired way to the hot shell surface, which can have a temperature of e.g. 90-100°C. When the aqueous spraying mixture hits the hot shell surface, a mist is created which contains vapour and non-evaporated water from the spraying liquid, but also residues of chemicals which are not attaching to the shell surface or do not reach the shell surface for some reason, e.g. as a

result of the spraying liquid being influenced in an undesired way by lateral forces from the boundary layer air flows which are created along the shell surface as a result of the high speed of rotation of the Yankee cylinder. The chemical-containing mist is carried away from the place of application by local air streams which mainly are produced by the fast production of said water vapour, by convection, by said boundary layer air flows along the shell surface, and by air streams along a clothing running around the adjacent press roll, e.g. a felt or wire running around a suction press roll. The local air streams created in this way and bringing the chemical-containing mist with them, are difficult to control and they can spread out into the surroundings both in the dry end of the tissue machine as well as outside of it, with accompanying problems. Dust from cellulose fibres being released from the paper web and brought along by the surrounding air streams is accumulated in different places of the paper machine. A portion of the chemical-containing mist can get into contact with such dust-coated places, whereby the adhesive chemicals easily adhere to and form a mix with the dust. Furthermore, before the mist reaches these dust-coated places, it can intermix with cellulose fibres occurring in surrounding air streams, when said local air streams get into contact with and intermix with the surrounding air streams. These accumulations of a mixture of said chemicals and dust of cellulose fibres constitute an increased risk of fire with resulting production stops and loss of production, and increase the maintenance costs for cleaning the tissue machine. Furthermore, the chemical-containing air streams can escape from the machine, where the chemicals can be a risk to the machine operators, e.g. undesired inhalation of the chemicals and an annoying or hazardous accumulation of the chemicals on

e.g. floor surfaces, so that the floors become slippery and the accumulation has an influence on the environment. There are similar problems also in other places of the described machine and in other paper machines as well as board machines, where a spraying equipment is arranged in connection with a moving surface onto which a coating is applied.

US-6,248,407 describes applicators for applying an atomized coating agent onto a paper web by means of a spray nozzle. In one embodiment, the applicator comprises a housing having a chamber in which the spray nozzle is located. Steam is supplied to the chamber continuously for creating and maintaining a humid atmosphere inside the chamber in order to prevent the droplets and particles of the coating agent from drying on their way towards the web, thereby maintaining a low viscosity of the coating agent, so that the produced coating attains a smooth surface. Any excess of treatment liquid is drained through an outlet from the chamber. The housing with its chamber for maintaining a humid atmosphere is thus an integral part of the applicator itself. The patent neither describes nor indicates the problems ensuing from a spraying equipment and its surroundings, as discussed above, but is exclusively about creating a humid atmosphere for the coating agent in its application stage.

US-6,203,858 describes applicators for coating a web with a coating agent which first is applied onto a roll encountering the web. The applicators include a spray nozzle and a vacuum chamber enclosing the spray nozzle and possibly an additional chamber. In the latter case the inlet side of the vacuum chamber is closed by means of a mechanical scraping device. In the first case, i.e.

without said additional chamber, the vacuum chamber forms gaps at its inlet and outlet sides through which air is sucked into the vacuum chamber. Via a special internal gap formed by a baffle plate surplus spray mist is sucked into the vacuum chamber and out of it via an outlet, while coating agent attaching onto the insides of the vacuum chamber runs down therefrom and is drawn off through a special outlet in order to be recovered. The fact that air flows into the vacuum chamber both at the inlet side and at the outlet side indicates that a rotation at a low speed is concerned when applying chemicals onto the roll in order to form a coating which subsequently is to be transferred to the web, and that no special measures have been made or disclosed in order to seal the vacuum chamber in relation to the coating-transferring roll, neither in connection therewith for providing and maintaining a controlled supply and removal of air and through-flow of air in the vacuum chamber in connection with the more difficult operating conditions prevailing in a high speed machine. Neither does the patent touch upon the above-discussed problems concerning an unprotected spraying equipment at a hot Yankee cylinder and the environment surrounding it, especially when high speed machines are concerned.

The object of the present invention is to reduce the above-mentioned problems essentially and to create conditions for an improved hygiene both inside and outside the paper or board machine, a reduced fire hazard in the dry end of the paper or board machine as a result of accumulation of dust, such as fibres and fibre parts, and chemicals on the machine stands, an improved working environment for the operating staff and, in addition, an improved efficiency when applying the coating onto a cylinder surface or a supported paper or board web.

The device according to the invention is characterized in that the protecting cover comprises:

- a sealing arrangement arranged in connection with said gaps for restricting at least essentially passage of air and contaminations through the gaps in a controlled manner;
- a system for a controlled supply of capture air for capturing contaminations occurring within the space; and
- an evacuating system for a controlled, continuous evacuation of the capture air with contaminations from the said single chamber through which the capture air is flowing.

The method according to the invention is characterized by the following steps:

- sealing the protecting cover while using a sealing arrangement in connection with said gaps in order to restrict at least essentially passage of air and contaminations through the gaps in a controlled manner;
- supplying capture air in a controlled manner in order to capture contaminations occurring within the space; and
- continuous and controlled evacuating of the capture air with contaminations from the said single chamber through which the capture air is flowing.

The expression "contaminations" primarily relates to residues of spraying liquid, such as chemicals, vapour, water particles, but also dust particles, primarily constituting fibres and fibre parts which have been torn loose from the web and which are captured by air streams

of which small quantities, under certain circumstances, can follow the moving web into the protecting cover.

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

Figure 1 shows schematically a spraying equipment and portions of a drying cylinder, where the application of an adhesive protective coating takes place according to prior art without taking any consideration for the environment.

Figure 2 shows schematically portions of a drying section of a paper machine being equipped with a protecting device according to a first embodiment of the invention.

Figures 3, 4 and 5 show schematically portions of a drying section of a paper machine being equipped with a protecting device according to a second embodiment of the invention, the three Figures showing different alternatives for aligning the spraying equipment.

Figure 6 shows schematically portions of a section of a paper machine being equipped with a protecting device according to a third embodiment of the invention.

Figure 7 shows a portion of the protecting device according to Figure 6.

Figure 1 shows a machine-wide spraying equipment 8, which is arranged in connection with a shell surface 5 of a drying cylinder 4, and which discharges a jet 9 of chemical-containing spraying liquid for applying an adhesive and protecting coating onto an exposed portion of the shell surface 5. Figure 1 illustrates the

above-discussed prior art, wherein the arrows being directed obliquely downwards illustrate a mist consisting of residues of spraying liquid, primarily in the form of an excess of chemicals and water in vapour form and liquid form, said mist causing some of the above-mentioned problems.

Figures 2 and 3 show schematically portions of a section 1 of a paper or board machine being operated at a high speed for manufacturing a web 2, e.g. a paper machine for manufacturing a web of soft paper such as tissue and other hygiene paper products, said section 1 having a first moving surface 3. Such a moving surface generally can be formed by the web 2 per se, a shell surface of a smooth roll, etc. In Figures 2 and 3, the section 1 is constituted of a drying section including a rotating drying cylinder 4 covered by a hood (not shown) and having a shell surface 5 which is exposed within a portion in order to form said moving surface 3 which is to be treated. In the indicated example (i.e. a tissue machine), conveniently the drying cylinder 4 is a Yankee cylinder. A roll 6 is arranged for interacting with the drying cylinder 4 in order to form a transferring nip, in which the web 2 is transferred to the hot, cylindrical shell surface 5 of the drying cylinder 4 from a clothing 7 which runs in a loop between a section (not shown) being located upstream and the drying section 1 in which it is running around the roll 6. The web 2 is carried by the clothing 7 in contact with its outside up to the transferring nip. From the transferring nip, the web 2 is running in contact with the hot shell surface 5 of the drying cylinder 4 in order to be dried to a predetermined dry content. At the outlet side of the drying section, a creping doctor (not shown) is arranged in connection with the shell surface 5 of the drying cylinder for creping

loose the dried web 2 from the shell surface 5. Furthermore, the drying section 1 is provided with a machine-wide spraying equipment 8 for discharging a jet 9 of a treatment medium in the form of a chemical-containing spraying liquid in order to apply an adhesive and protecting coating onto the shell surface 5 of the drying cylinder 4 in connection with said exposed portion of the shell surface which is obtained after having creped loose the dried web 2, said exposed portion extending up to said transferring nip and forming said moving surface 3. Before the spraying equipment 8, as seen in the direction of rotation of the drying cylinder 4, there can be one or several cleaning doctors (not shown) for levelling out residues of the previously applied coating. The spraying equipment 8 is thus arranged in a place that is located between such a possible cleaning doctor and the roll 6. The spraying equipment 8 comprises a plurality of nozzles, overlapping each other, and a spray bar carrying the nozzles.

In the drying section 1 according to Figure 2, the roll 6 is a smooth, non-perforated press roll, and the clothing 7 transfers the web 2 from a drying device (not shown) being located upstream. Alternatively, the roll 6 can be a shoe press roll.

In the drying section 1 according to Figure 3, the roll 6 is a suction press roll and the clothing 7 is a felt or wire which transfers the web 2 from a section (not shown) being located upstream. The suction press roll 6 has a suction zone 10 which encloses a predetermined sector angle, typically about 120°, and being located entirely or at least mainly upstream the transferring nip.

The drying sections 1 being shown in Figures 2 and 3 are equipped with a specific protecting device for the spraying equipment 8 and its surroundings, said protecting device comprising a machine-wide protecting hood 11 which is arranged to enclose the spraying equipment 8 and the jet 9 of spraying liquid being discharged therefrom and directed towards the moving surface 3 of the drying cylinder 4 within a machine-wide application zone which is thus located within said exposed portion, i.e. the moving surface 3, of the shell surface 5. The protecting cover 11 is thus entirely open in a direction towards the moving surface 3 of the drying cylinder and has an internal unitary, i.e. undivided, space 12, which thereby forms a single chamber within which the spraying equipment 8 is located. The space 12 is defined by first and second, machine-wide wall elements 13, 14 and two side wall elements 15 which connect the machine-wide elements 13, 14 (the front side wall element is removed in the shown embodiments in order to expose the inside of the protecting cover). The two side wall elements 15 are thus extending in the machine direction, whereas the machine-wide wall elements 13, 14 are extending cross to the machine direction on either side of the application zone. The first wall element 13 is located upstream the application zone, as seen in relation to the direction of movement of the moving surface 3 onto which the treatment medium is applied. The wall elements 13, 14 and the side wall elements 15 are enclosing the spraying equipment 8 completely in order to protect it in its entirety also from dust-carrying air streams occurring inside the machine. As mentioned above the space 12 is unitary, i.e. undivided, which means that the space 12 forms a single, functional chamber. Accordingly, the space 12 is not divided into two chambers, for instance, by any partition, e.g. by such a

portion that extends between the machine wide wall elements in connection to the spraying equipment so that this is located in both of said chambers which are communicating with each other. In other words, the unitary space 12 is free from chamber-defining elements which impede a free through-flow of air from the air inlet of the space to the air outlet thereof. The said single chamber thus admits free passage for the air so that this air is allowed to flow freely through the chamber from the air inlet to the air outlet thereof.

Furthermore, the protecting device comprises a system for a controlled supply of capture air for capturing contaminations occurring in the space 12, as well as an evacuating system for a controlled, continuous evacuation of a mixture of the capture air, residues of spraying liquid, and supplied water, which has been used for internal cleaning, out from the space 12 of the protecting cover 11. The evacuating system comprises an outlet portion 16 which is a part of the protecting cover 11 and located at a distance from and radially outside the spraying equipment 8, as seen in relation to the drying cylinder 4. The outlet portion 16 comprises a horizontal, machine-wide outlet pipe 18 which communicates with said space 12 of the protecting cover 11 via a machine-wide, continuous outlet gap 17 and having at one of its ends an outlet opening 19 facing downwardly and opening into a downwardly-directed outlet pipe 20. Suitably, the outlet pipe 18 has a circular shape in order to obtain an advantageous Venturi effect in a direction towards the outlet opening 19.

The protecting cover 11 is provided with an inspection opening 23, which can be suspended from a hinge joint. In the embodiment according to Figure 2, the inspection

opening 23 is arranged in the second wall element 14, whereas the inspection opening 23 in the embodiment according to Figure 3 is arranged in the first wall element 13. As is evident from Figure 3, the second wall element 14 is pivotally arranged around a hinge so that the wall element 14 can be lowered in order to provide an additional possibility of getting access to the internal space 12 for maintenance and cleaning when this is required.

In the embodiments being shown in Figures 2 and 3, a spray pipe 21 is arranged on the inside of the first wall element 13 in order to create an ejector action by means of its discharged liquid jets along and towards said inside in a direction towards the outlet gap 17. The discharged liquid jets also have a cleaning effect in that they remove any accumulations of contaminations from the inside of the wall element 13, but also a protecting effect in that they prevent contaminations from getting into contact with and attaching to the inside. Furthermore, the discharged liquid has a cooling effect on the vapour in said residues of spraying jets so that the vapour is condensed. The cooling effect can be increased by means of lowering the temperature of the liquid being discharged from the spray pipe 21. A similar spray pipe 22 for providing said ejector action, cleaning effect, protecting effect and cooling effect is arranged on the inside of the second wall element 14 of the protecting device according to Figures 2 and 3.

In the embodiments according to Figures 2 and 3, the first wall element 13 defines a machine-wide, first gap 24 between itself and the moving surface 3. In the embodiment according to Figure 2, the second wall element 14 defines a machine-wide, second gap 25 between itself

and said moving surface 3, whereas in the embodiment according to Figure 3 a machine-wide, second gap 26 is defined by the second wall element 14 and a second moving surface 27, as will be described in greater detail below. As used herein, the expression "first gap" refers to the gap which is located at the inlet side of the protecting cover 11, i.e. the side where the moving surface 3 runs into the protecting cover or, in other words, the gap which is located upstream the application zone, as seen in relation to the direction of movement of the moving surface 3.

Furthermore, the protecting device comprises a sealing arrangement which is arranged in connection with said gaps 24, 25; 26 in order to restrict passage of air and contaminations through the gaps in a controlled manner. The sealing arrangement thus decreases essentially the possibility that residues of spraying liquid escape through the gaps, but also prevents large quantities of air from flowing in towards the application place and the spraying equipment onto which dust particles present in the in-flowing air can deposit. On the other hand, the restricting function of the sealing arrangement on the passage of air and contaminations implies that a predetermined quantity of air is allowed to enter through at least the first gap 24 in Figures 2 and 3 in order to be guided through the protecting cover 11 and carry the residues of spraying liquid with it in a direction towards the evacuating system without interfering with the spraying process, said predetermined quantity of air containing dust particles in an amount which is so small that the risk of larger deposits on the spraying equipment is negligible, especially since the capture air flowing through the space 12, now containing residues of spraying liquid and a small quantity of dust particles,

will get into contact with the spraying equipment to a very small extent, but will be handled by the cooperating evacuating system in a controlled efficient way so that the through-flowing air is guided away from the spray equipment. The said air of predetermined amount, that forms said air through-flowing in the space 12, is according to the invention denoted capture air. In the embodiments according to Figures 2 and 3, for each gap 24, 25; 26 and wall element 13, 14, the sealing arrangement comprises a machine-wide, mechanical sealing device in the form of a sealing strip 28 and 29, respectively, wherein each wall element 13, 14 comprises a holder 30 for carrying the sealing strip 28, 29 thus defining said gap 24, 25; 26 between itself and the moving surface 3 (Figure 2) or the moving surfaces 3, 27 (Figure 3) by means of its free surface. The sealing strip 28, 29 can consist of a suitable plastic or rubber material and is suitably detachably mounted in the holder 30 in order to be easy to replace with a corresponding or a different sealing strip with respect to the size in order to provide the same or another size of the gap, respectively. Alternatively, the sealing strip 28, 29 is adjustable in relation to the moving surface 3 or the moving surfaces 3, 27 in order to enable a simple and rapid adjustment of the size of the gap 24, 25; 26 according to each requirement. The gap 24 that is located at the first wall element 13 is adjusted by means of the sealing strip 28 in order to restrict passage of air and contaminations, said restriction allowing the passage of a determined quantity of capture air into the protecting cover 11 in order to operate the evacuation of residues of spraying liquid therein. In certain cases, if desired, the sealing strip 28 can be removed in order to increase the size of the gap 24. The drying cylinder 4 is rotating at a high speed, so that a boundary layer air flow is

created along the shell surface 5. In operation, a radial inner layer of this boundary layer air flow will be brought into the protecting cover 11 through the gap 24 in order to form said capture air, whereas the remaining part, being a main part, of the boundary layer air flow hits the wall element 13 and is diverted along its outside away from the protecting cover 11 without disturbing the spraying process. Thus, said inner layer is to form said determined quantity of capture air which is to be allowed to penetrate into the protecting cover 11, wherein an air barrier is created which prevents residues of spraying liquid from escaping through the gap 24. The gap 24 has a size which is within the range of 1-75 mm, preferably 25-30 mm. A machine-wide deflector 31 is arranged inside the space 12 of the protecting cover 11 in the vicinity of the holder 30 for the sealing strip 28, i.e. in a position between the gap 24 and the spray pipe 21. The deflector 31 comprises a plate 32, extending along the holder 30 of the first wall element 13 in order to form a narrow channel 33 therebetween having an inlet opening facing the drying cylinder 4, and an outlet opening facing the outlet portion 16 of the protecting cover 11 and being located just behind the spray pipe 21. At its upper portion, the plate 32 is bent in a direction away from the gap 24 in order to form an edge portion, thus being directed towards the spraying liquid 9, and a tapering shape of the inlet opening. The ejector action created by the liquid jets from the spray pipe 21 will result in a pressure reduction in the narrow deflector channel 33, so that a portion of the air being introduced through the gap 24 and a portion of the residues of spraying liquid being thrown off from the application place are sucked into the inlet opening of the deflector channel 33 and through the deflector channel 33 in order to be passed on towards the outlet portion 16 of the

protecting cover 11. Suitably, the deflector 31 is arranged pivotally in order to be rotated into a position in which it is blocking the path for the jet of spraying liquid 9 when, for some reason, it is desired temporarily to interrupt the application onto the moving surface 3.

In the embodiment according to Figure 2, the protecting cover 11 is arranged at a distance from the roll 6. This means that the shell surface of the drying cylinder 4 is exposed and visible after the protecting cover 11 and up to the transferring nip. The gap 25 that is located at the second wall element 14 is adjusted by means of the sealing strip 29 so that the gap 25 becomes as small as possible, but without the sealing strip 29 coming in contact with the moving surface 3 and its coating, in order to minimize emissions of residues of spraying liquid into the environment, i.e. to restrict passage of air and contaminations through the gap 25. The gap 25 has a size which is within the range of 1-50 mm, preferably 25-30 mm, and which usually is smaller than the size of the gap 24. In this embodiment, the evacuating system comprises a fan and separating arrangement (not shown) to which the protecting cover 11 is connected via its outlet pipe 20. The fan and separating arrangement includes a fan, which is arranged for creating a negative pressure inside the protecting cover 11, and a separating device for separating water.

In the embodiment according to Figure 3, the protecting cover 11 is arranged for enclosing also a portion of the suction press roll 6. In this case, the gap 26 is defined by the sealing strip 29 of the second wall element 14 and the suction press roll 6 or, more specifically, the web 2 running around the suction press roll 6 together with the clothing 7 and which forms said second moving surface 27.

In the same way as the first gap 24, which is located at the first wall element 13, said second gap 26 is adjustable by means of its sealing strip 29 in order to allow passage of a fixed quantity of air into the protecting cover 11. The gap 26 has a size which is within the range of 1-50 mm, preferably 25-30 mm. Also in this case, because of the high machine speed, a boundary layer air flow is created along the second moving surface 27, i.e. the web 2. In operation, a radial inner layer of this air flow will be brought into the protecting cover 11 through the gap 26, whereas the remaining part, being a main part, of the air flow hits the wall element 14 and is diverted along its outside away from the protecting cover 11 without disturbing the spraying process. Thus, said inner layer is to form a proportion of said fixed quantity of capture air which is to be allowed to penetrate into the protecting cover, whereby an air barrier is created, preventing residues of spraying liquid from escaping through the gap 26. The second wall element 14 is arranged for enclosing a portion of the circumference of the suction press roll 6 which is so large that at least its suction zone 10 becomes enclosed within the space 12 of the protecting cover 11. A proportion of the air being introduced through the gap 26 follows along the web 2 in order to be partially sucked into the suction press roll 6. The capture air being introduced into the protecting cover 11 through the two gaps 24 and 26 creates a positive pressure inside the upper portion of the space 12 of the protecting cover. This positive pressure can be utilised for transporting away the capture air with its content of residues of spraying liquid from within the protecting cover via the cooperating evacuating system. In this way, it is possible to dispense with a fan system and to use only a separating system for handling water and chemicals

dissolved or dispersed therein which are removed from the protecting cover 11. If a fan system needs to be used, this can be made smaller and cheaper than the fan system being used at the protecting cover according to Figure 2. If desired, a deflector similar to the one being arranged at the first wall element 13 can be arranged also at the second wall element 14. Of course, the protecting cover 11 according to Figure 3 can be used in a drying section according to Figure 2 which has a solid press roll, for enclosing a portion of this press roll in the same fashion in order to utilize the advantage of obtaining an air barrier in the gap.

In Figure 3, the spraying equipment 8 is arranged for emitting a jet 9 of spraying liquid straight towards the moving surface 3, whereas, in Figure 4, it is arranged for emitting a jet 9 of spraying liquid into the nip between the drying cylinder 4 and the suction press roll 6 obliquely towards the moving surface 3. The protecting cover 11 according to Figure 4 corresponds to the one in Figure 3.

In Figure 5, the spraying equipment is arranged for emitting a jet 9 of spraying liquid towards the web 2 which in this case forms a first moving surface 3, whereas the shell surface 5 of the drying cylinder 4 forms a second moving surface 27. A coating on the web 2 obtained in this way is then transferred to the shell surface 5, when the web 2 comes into contact with the shell surface 5. From a structural point of view, the protecting covers in Figures 3 and 5 are similar, but the wall elements as well as the two moving surfaces have turned functions. Thus, the protecting cover 11 has first and second wall elements 53, 54, wherein the first wall element 53 is located upstream the application zone, as

seen in relation to the direction of movement of the first moving surface 3 which thus is formed by the web 2, onto which surface 3 the treatment medium is applied, and defines a machine-wide, first gap 24 between itself and the first moving surface 3, whereas the second wall element 54 defines a machine-wide, second gap 26 between itself and the second moving surface 27 which thus is formed by the shell surface 5.

Figure 6 shows a protecting device which substantially, with the exception of the sealing arrangement per se, is similar to the one in Figure 2. The same or similar structural elements and components have therefore been given the same reference numerals as in Figure 2. The wall elements 13, 14 of the protecting cover and the moving surface 3 define therebetween machine-wide, first and second gaps 40, 41, the sizes of which being not critical as in the previously described embodiments, since the sealing arrangement in this case comprises a machine-wide fluid sealing device for each gap 40, 41 and wall element 13, 14, said fluid sealing device comprises at least one fluid jet 42, 43 and at least one nozzle 44 (see Figure 7) which is arranged in a holder 45 of the wall element 13, 14. In the embodiment shown the nozzle 44 is arranged for emitting a fluid jet 42, 43 perpendicularly or substantially perpendicularly to the moving surface 3. The holder 45 is also carrying two machine-wide liquid distributing pipes 46, 47 which are arranged on either side of the nozzle 44 and each having a longitudinal slit 48 for discharging a liquid layer, a first folded guide plate 49 being arranged in connection with said slit 48. A further second folded guide plate 50 extends on the inside and outside, respectively, of the holder 45 from the inside of the first guide plate 49 in order to receive the discharged and deflected liquid

layer via a gap defined by the two guide plates 49, 50, said deflected liquid layer following along the surface of the first guide plate 49 while forming a liquid film covering the second guide plate 50 so that contaminations are prevented from attaching to and accumulating onto the guide plate 50 which thereby is kept clean. The above-mentioned elements 46, 47, 48, 49, 50 constitute a cleaning system which efficiently prevents the deposition of contaminations, said deposits otherwise could disturb the function of the fluid sealing device. Each nozzle 44 is protected by a cover 52 having an opening for the fluid jet 42, 43. Each fluid jet 42, 43 is adjusted and regulated so that it is acting with such a force that it creates a barrier inside the gap 40, 41 that prevents air from flowing through the gap 40, 41. The fluid jet is acting all the way to the moving surface 3 and becomes impenetrable or almost impenetrable for the air streams occurring along the moving surface 3 and which can contain contaminations. A gas, usually air, or a liquid, usually water, can be used as a fluid. When air is used, a portion of the air jet 42, 43 will flow into the space in a controllable manner in order to be used as capture air for the residues of spraying liquid and then continuously be sucked out through the evacuating system. When a liquid is used as a fluid such a capture air has to be supplied directly to the protecting cover, suitably in connection to one or both gaps 40, 41, from an external source which then suitably is free from contaminations.

In the embodiment according to Figure 6, conveniently the spraying equipment 8 is arranged pivotally in order to be rotated into a position in which the jet 9 of spraying liquid is directed away from the moving surface 3 so that it hits the inside of the wall element 14 instead when a

temporary interruption of the application onto the moving surface 3 is desired.

The invention can be applied to a spraying equipment in any type of paper or board machine being operated at a high speed, and in any section where a spraying equipment and its surroundings should be protected. It is particularly applicable for a spraying equipment in a soft paper machine and especially in such a machine for the manufacture of creped soft paper. The moving surface 3, which is to be treated with a chemical-containing spraying liquid, can be a shell surface of a roll, e.g. a drying cylinder, as has been described, or a paper web, as has been described, or a board web, said paper or board web being supported by a clothing or a roll or by a clothing and a roll.

The two side wall elements 15 of the protecting cover are sealed in a suitable way at adjacent structural elements in order to avoid leakage to the sides.

The invention is particularly applicable to high speed machines, where the moving surface has a speed of at least about 1200 m/min, e.g. 1200-2500 m/min, whereby boundary layer air flows are created along the moving surface.

CLAIMS

1. A device for protecting a spraying equipment (8) and the surroundings about the spraying equipment (8) mounted in a paper or board machine in connection with a first moving surface (3) of the machine in order to apply a treatment medium onto the first moving surface (3) within a machine-wide application zone, said device comprising a machine-wide protecting cover (11) arranged to enclose the spraying equipment (8) and said application zone and having an internal space (12), which forms a single chamber in which the spraying equipment (8) is located and which is open towards the first moving surface (3) in connection with said application zone, said protecting cover (11) comprising first and second, machine-wide wall elements (13, 14; 53, 54), said wall elements extending cross to the machine direction on either side of said application zone, said first wall element (13; 53) being located upstream said application zone, as seen in relation to the direction of movement of the first moving surface (3) onto which the treatment medium is applied, and defines a machine-wide, first gap (24; 40) between itself and the first moving surface (3) , and the second wall element (14; 54) defines a machine-wide, second gap (25; 26; 41) between itself and the first moving surface (3) or a second moving surface (27), characterized in that the protecting cover (11) comprises:

– a sealing arrangement arranged in connection with said gaps (24, 25; 26; 40, 41) for at least substantially restricting passage of air and contaminations through the gaps (24, 25; 26; 40, 41) in a controlled manner;

– a system for a controlled supply of capture air for capturing contaminations occurring within the space (12); and

– an evacuating system for a controlled, continuous evacuation of the capture air with contaminations from the said single chamber through which the capture air is flowing.

2. The device according to claim 1, characterized in that the evacuating system comprises an outlet portion (16) which constitutes a portion of the protecting cover (11) and is located at a distance from and outside the spraying equipment (8), as seen in relation to the first moving surface (3).

3. The device according to claim 2, characterized in that the outlet portion (16) has a machine-wide, continuous outlet gap (17) which extends between two side walls (15) of the protecting cover (11) , and comprises a machine-wide outlet housing (18) which communicates with said space (12) of the protecting cover (11) via said outlet gap (17) and has an outlet opening (19) at one of its ends.

4. The device according to any one of claims 1 to 3, characterized in that the sealing arrangement comprises a machine-wide, mechanical sealing device for each gap (24, 25; 26).

5. The device according to claim 4, characterized in that the sealing device is replaceable with a corresponding sealing device which provides the same gap size, or with another sealing device which provides a larger or smaller size as required.

6. The device according to claim 4, characterized in that the sealing device is adjustable in order to set the size of the gap as required.

7. The device according to any one of claims 4 to 6, characterized in that the sealing device is a sealing strip (28, 29).

8. The device according to any one of claims 1 to 7, characterized in that the first gap (24) has a size which is within the range of 1 to 75 mm.

9. The device according to claim 8, characterized in that the first gap is within the range of 25 to 30 mm.

10. The device according to any one of claims 4 to 9, characterized in that the supply system for capture air is formed of at least the sealing device (28) for the first gap (24) in that the sealing device (28) is arranged for allowing the introduction of the reguired capture air.

11. The device according to any one of claims 8 to 10, characterized in that also the second gap (25) is defined by the first moving surface (3) and that it has a size of 1 to 50 mm.

12. The device according to claim 11, characterized in that the second gap has a size of 25 to 30 mm.

13. The device according to any one of claims 4 to 10, characterized in that the second gap (26) is defined by said second moving surface (27), said supply system for capture air being formed of the two sealing devices (28,

29) in that they are arranged for allowing together the introduction of the required capture air.

14. The device according to claim 11, characterized in that the second gap (26) has a size which is within the range of 1 to 50 mm.

15. The device according to claim 14, characterized in that the second gap has a size within the range of 25 to 30 mm.

16. The device according to any one of claims 1 to 3, characterized in that the sealing arrangement comprises a machine-wide fluid sealing device for each gap (40, 41).

17. The device according to claim 16, characterized in that the fluid sealing device comprises at least one fluid jet (42, 43) and at least one nozzle (44) arranged in the wall element (13, 14) for emitting said fluid jet (42, 43) in a direction towards the moving surface.

18. The device according to claim 17, characterized in that the fluid jet (42, 43) is arranged for creating a barrier between the nozzle (44) and the moving surface which is impenetrable or almost impenetrable for external and internal air streams and contaminations therein.

19. The device according to either one of claims 17 or 18, characterized in that the fluid jet (42, 43) is a gas jet, said supply system for capture air being formed of the air jets in that at least a proportion of this air is guided into the protecting cover (11), said proportion constituting the required capture air.

20. The device according to claim 19, characterized in that the fluid jet is an air jet.

21. The device according to either one of claims 17 or 18, characterized in that the fluid jet is a liquid jet, said supply system for capture air comprises a separate, external source of compressed air, said source being connected to the protecting cover in the vicinity of the gaps (40, 41) without disturbing the function of the liquid jets.

22. The device according to claim 21, characterized in that the fluid jet is a water jet.

23. The device according to any one of claims 1 to 15, characterized in that a machine-wide spray pipe (21, 22) is arranged on the inside of each wall element (13, 14; 53, 54) for discharging liquid jets along said inside in order to keep the inside clean from contaminations and in order to create an ejector action on the capture air passing through the protecting cover (11).

24. The device according claim 23, characterized in that a machine-wide deflector (31) is arranged in the vicinity of the inside of the first wall element (13; 53) in a position between said gap (24) and the spray pipe (21), said deflector (31) defining a narrow channel (33) between itself and the wall element (13; 53) which is arranged for being subjected to a negative pressure by means of the ejector action of the spray pipe (21) so that at least a proportion of the capture air flowing in through the gap (24), and contaminations are sucked through said deflector channel (33) and further towards the evacuating system.

25. The device according to any one of claims 19 to 21, characterized in that each wall element (13, 14) comprises a holder (45) for mounting the nozzle (44), and that a liquid distributing pipe (46, 47) is mounted in the holder (45) on either side of the nozzle (44), said holder (45) being provided with guide plates (49, 50) arranged for guiding liquid films discharged by the liquid distributing pipes (46, 47) in order to keep the insides and outsides of the holder (45) clean from contaminations and thereby ensure the operating ability of the nozzle (44).

26. A method of protecting a spraying equipment (8) and the surroundings about the spraying equipment (8) mounted in a paper or board machine in connection with a first moving surface (3) of the machine for applying a treatment medium onto the first moving surface (3) within a machine-wide application zone, said application zone being enclosed by means of a protecting cover (11) so that an internal space (12) of the protecting cover (11), which space (12) forms a single chamber in which the spraying equipment (8) is located, is open towards the first moving surface (3) so that a machine-wide, first wall element (13; 53) of the protecting cover (11) is located upstream said application zone, as seen in relation to the direction of movement of the first moving surface (3) onto which the treatment medium is applied, and defines a machine-wide, first gap (24; 40) between itself and the first moving surface (3), and a machine-wide, second wall element (14; 54) of the protecting cover (11) defines a machine-wide, second gap (25; 26; 41) between itself and the first moving surface (3) or a

second moving surface (27), characterized by the following steps:

– sealing the protecting cover (11) while using a sealing arrangement in connection with said gaps (24, 25; 26; 40, 41) in order to at least substantially restrict passage of air and contaminations through the gaps (24, 25; 26; 40, 41) in a controlled manner;

– supplying capture air in a controlled manner in order to capture contaminations occurring within the space (12); and

– continuous and controlled evacuating of the capture air with contaminations from the said single chamber through which the capture air is flowing.

27. The method according to claim 26, characterized in that the capture air is diverted towards the evacuating system without any possibility of reaching the application zone.

28. The method according to claim 26 or 27, characterized in that the protecting cover (11) is arranged so that the first moving surface (3) is brought to pass and define also the second gap (25), said second gap (25) being sealed in order to be set to the smallest possible size without coining into contact with the first moving surface (3) so that the quantity of air and thereby the quantity of contaminations, which possibly might flow out through the second gap (25), are reduced to a corresponding degree.

29. The method according to claim 26 or 27, characterized in that the protecting cover (11) is arranged so that the first moving surface (3) is brought to pass and define only the first gap (24) and so that the second moving

surface (27) is brought to pass and define the second gap (26) , said second moving surface (27) running into said space (12) for being redirected in order to encounter the first moving surface (3) after this has passed the application zone, and that the second gap (26) is sealed by means of said sealing arrangement.

30. The method according to any one of claims 26 to 29, characterized in that a mechanical sealing device (28, 29) is used for each gap (24, 25; 26) as a sealing arrangement which is adjusted in order to give the gap a desired size and achieve said restriction of passage of air and contaminations, at least said sealing device for the first gap (24) allowing introduction of the required capture air.

31. The method according to any one of claims 26 to 29, characterized in that a fluid sealing device is used for each gap (40, 41) as a sealing arrangement which has at least one fluid jet (42, 43) creating a barrier which is impenetrable or almost impenetrable for air and contaminations.

32. The method according to claim 31, characterized in that a gas, is used as a fluid, at least a proportion of said air jets being diverted into the protecting cover (11) in order to form said capture air.

33. The method according to claim 32, characterized in that the gas is air.

34. The method according to claim 31, characterized in that a liquid is used as a fluid, said required capture

air being supplied to the space (12) from a separate, external source of compressed air.

35. The method according to any one of claims 26 to 34, characterized in that the paper or board machine is operated at a speed of at least 1200 m/min.

Fig. 1 (PRIOR ART)

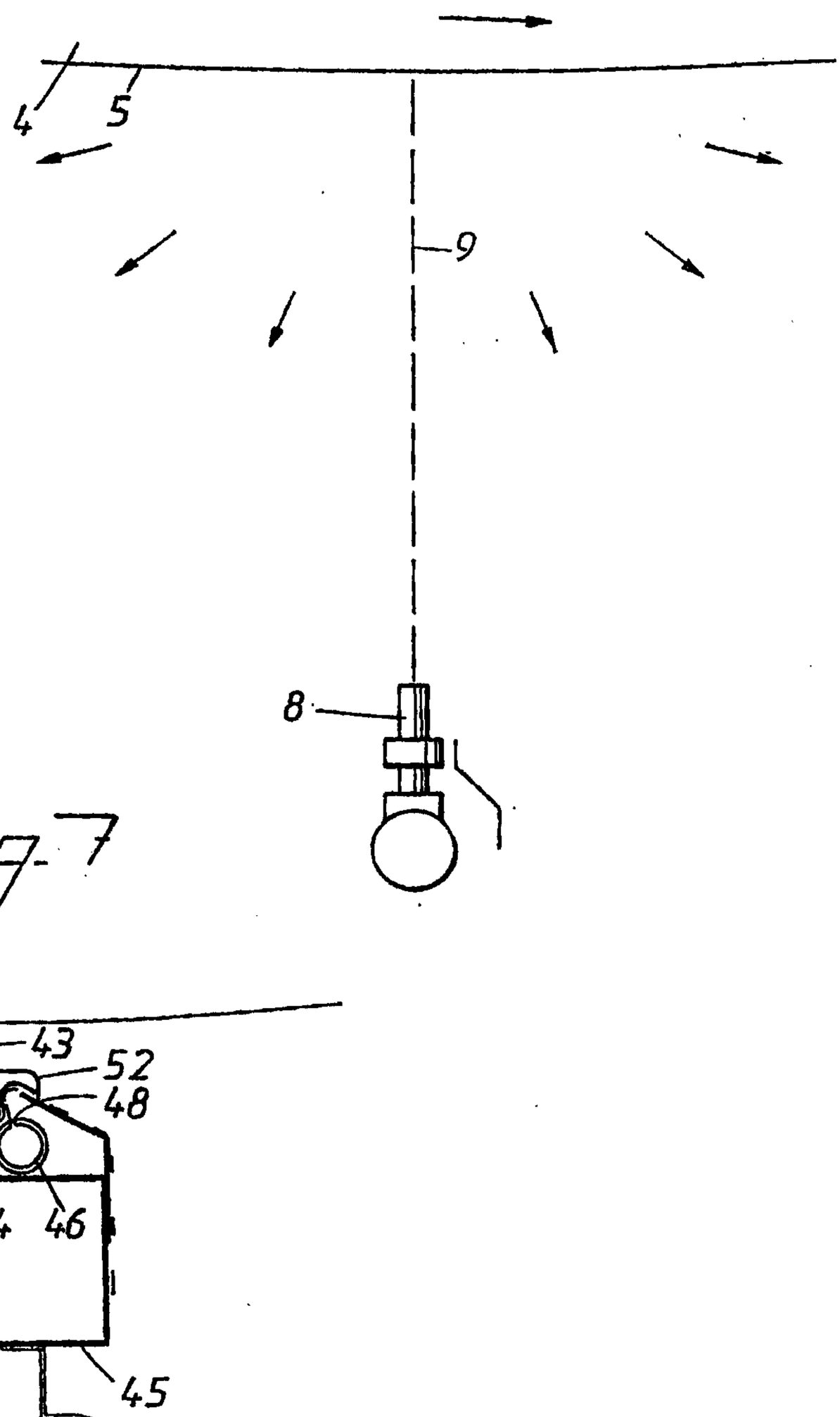

Fig. 7

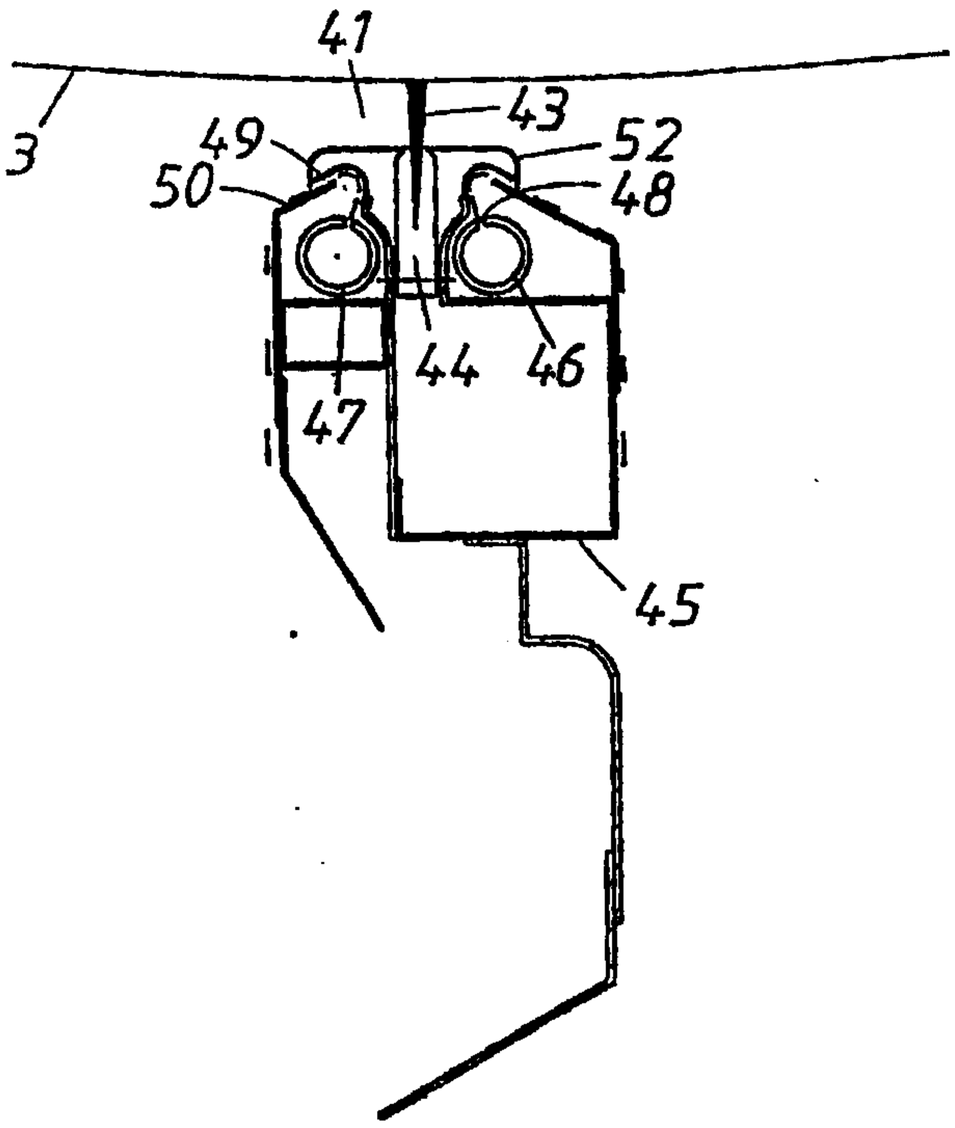

Fig. 2

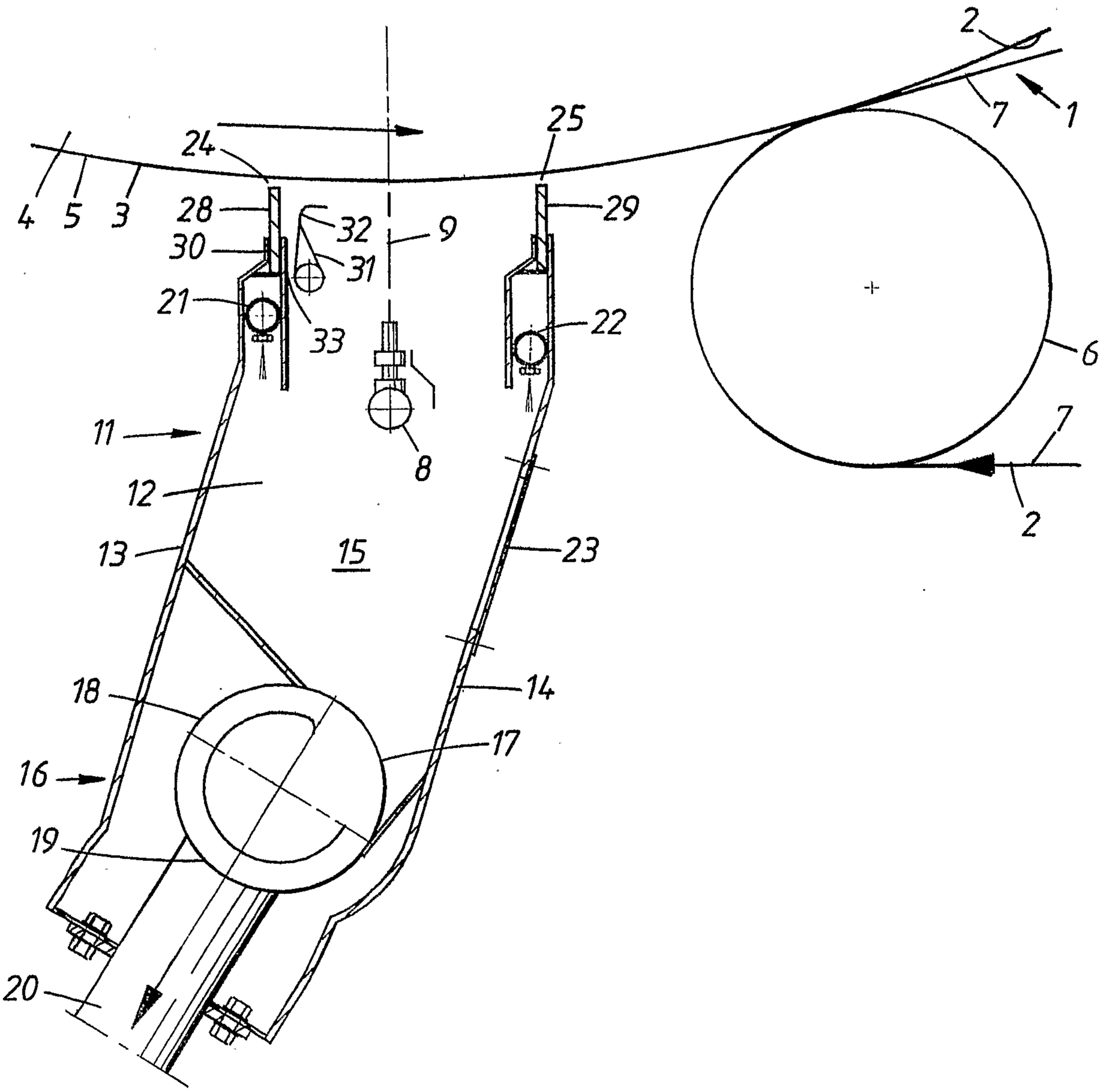
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Fig. 3

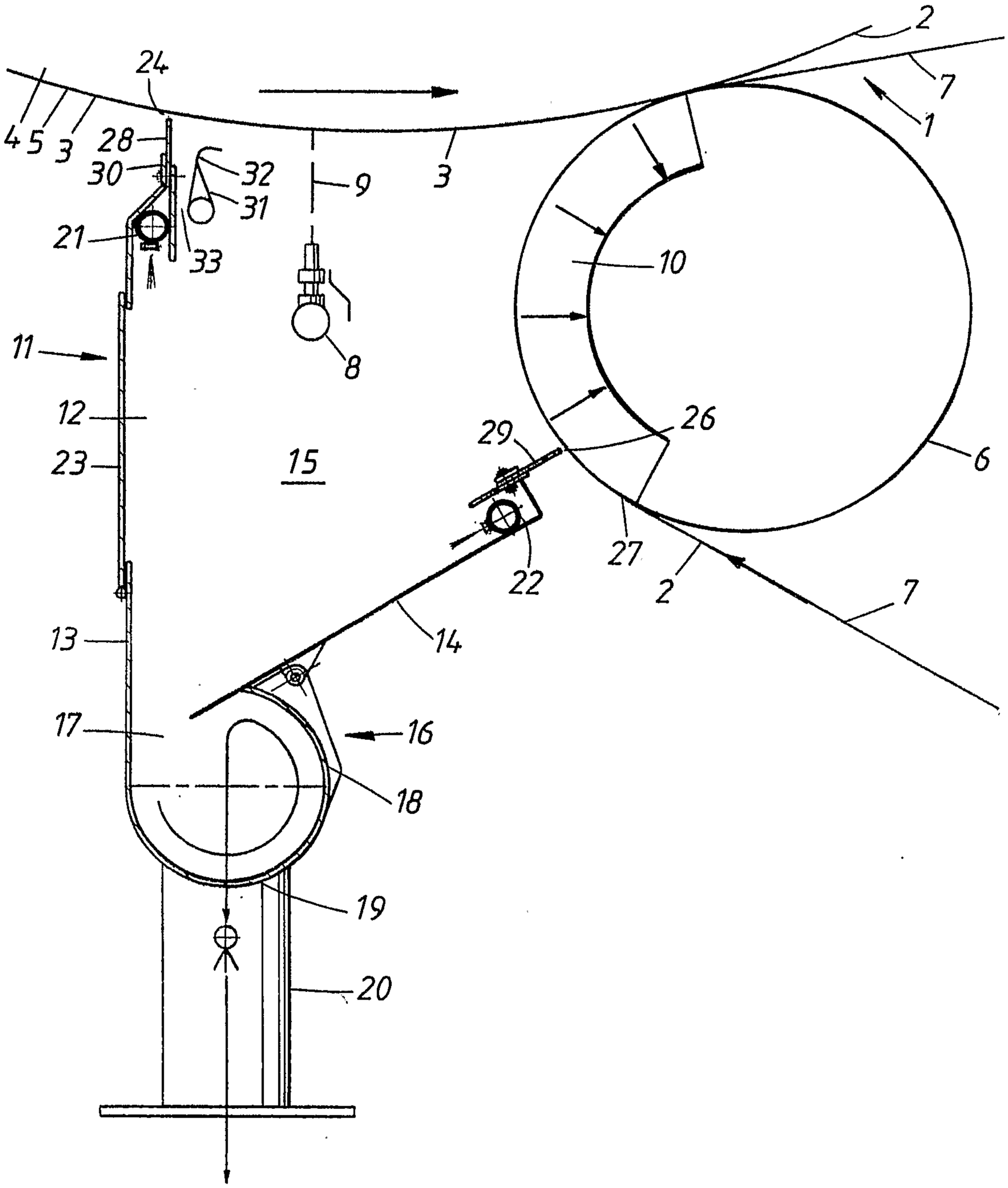
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Fig. 4

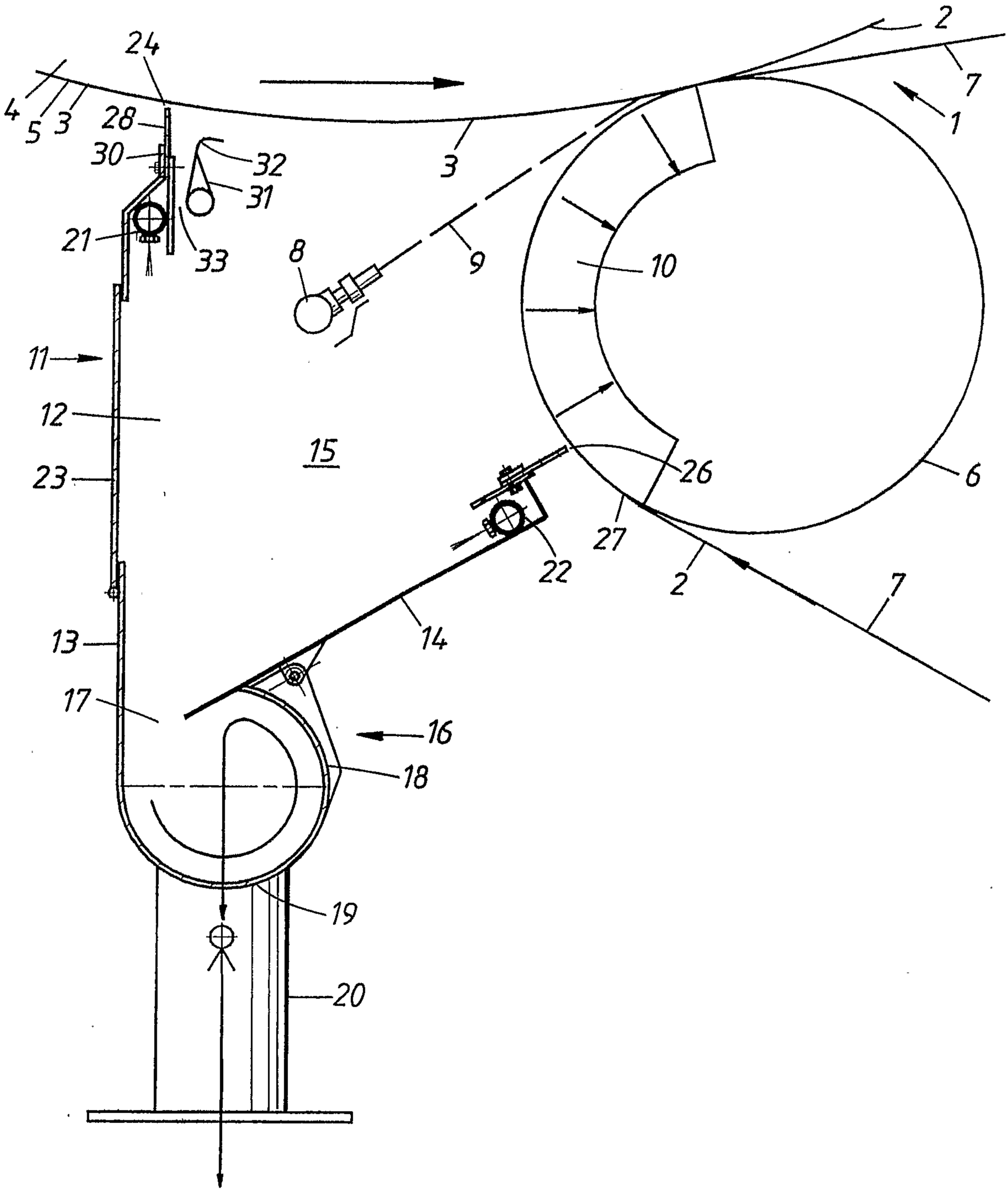
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Fig. 5

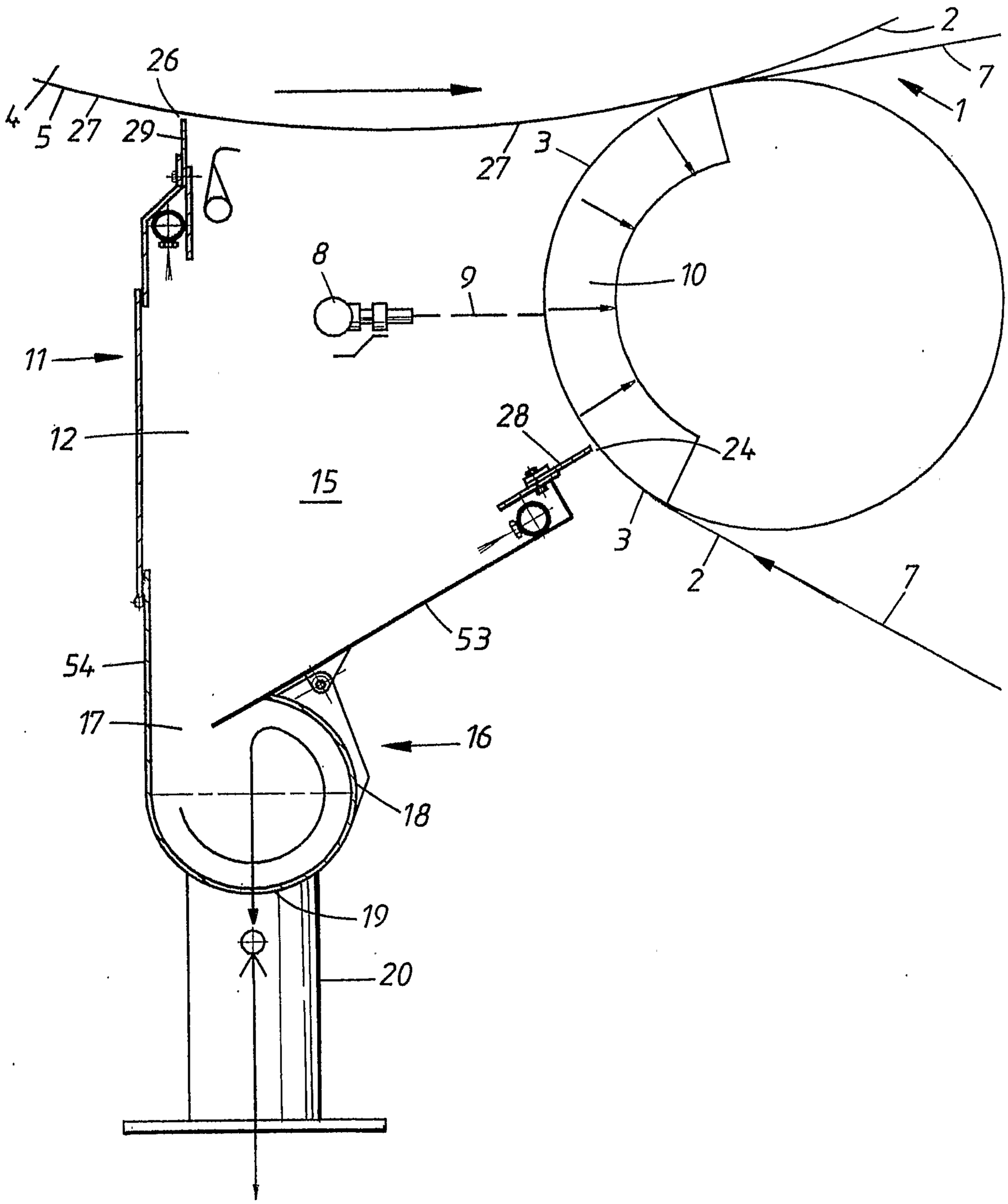
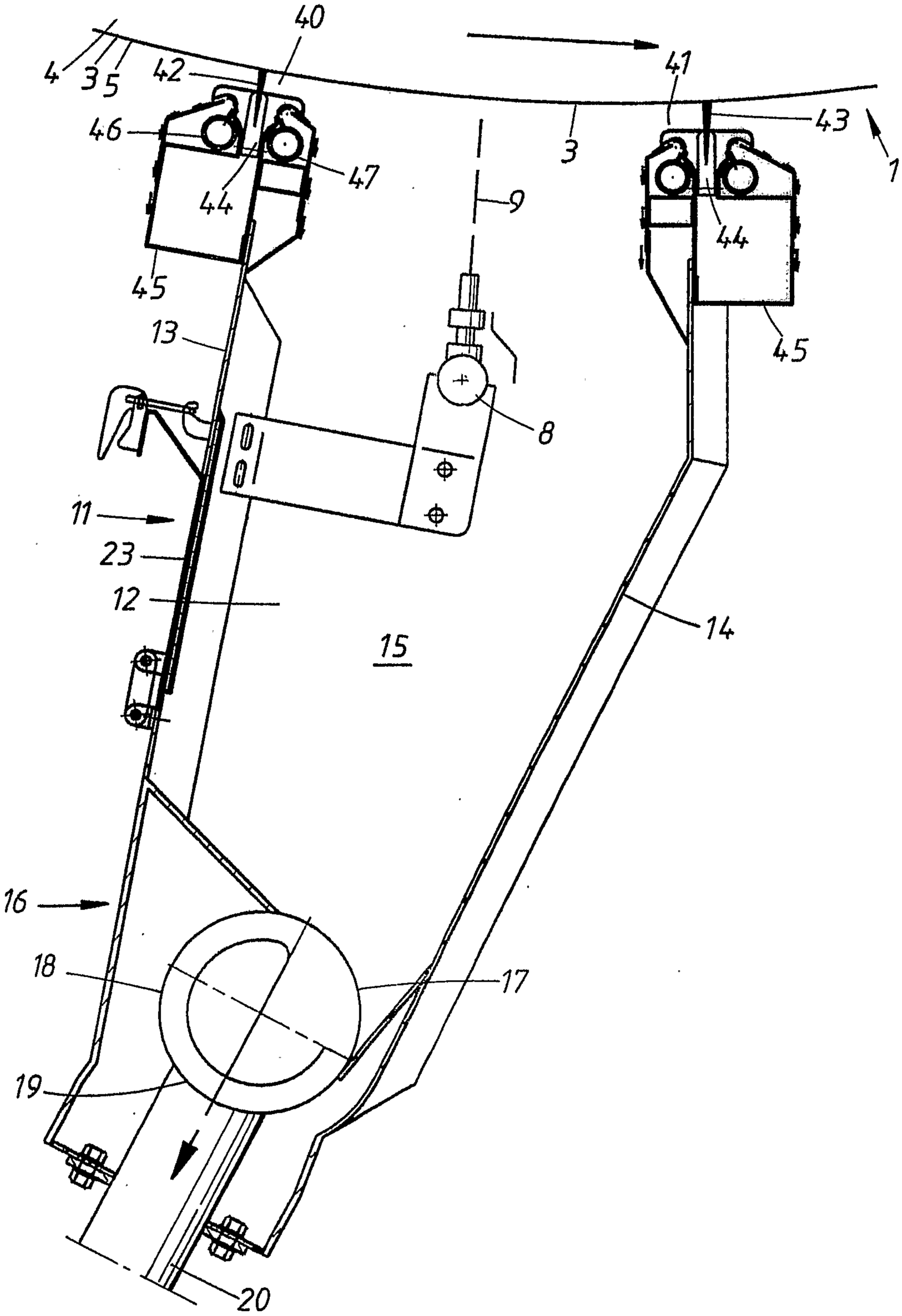
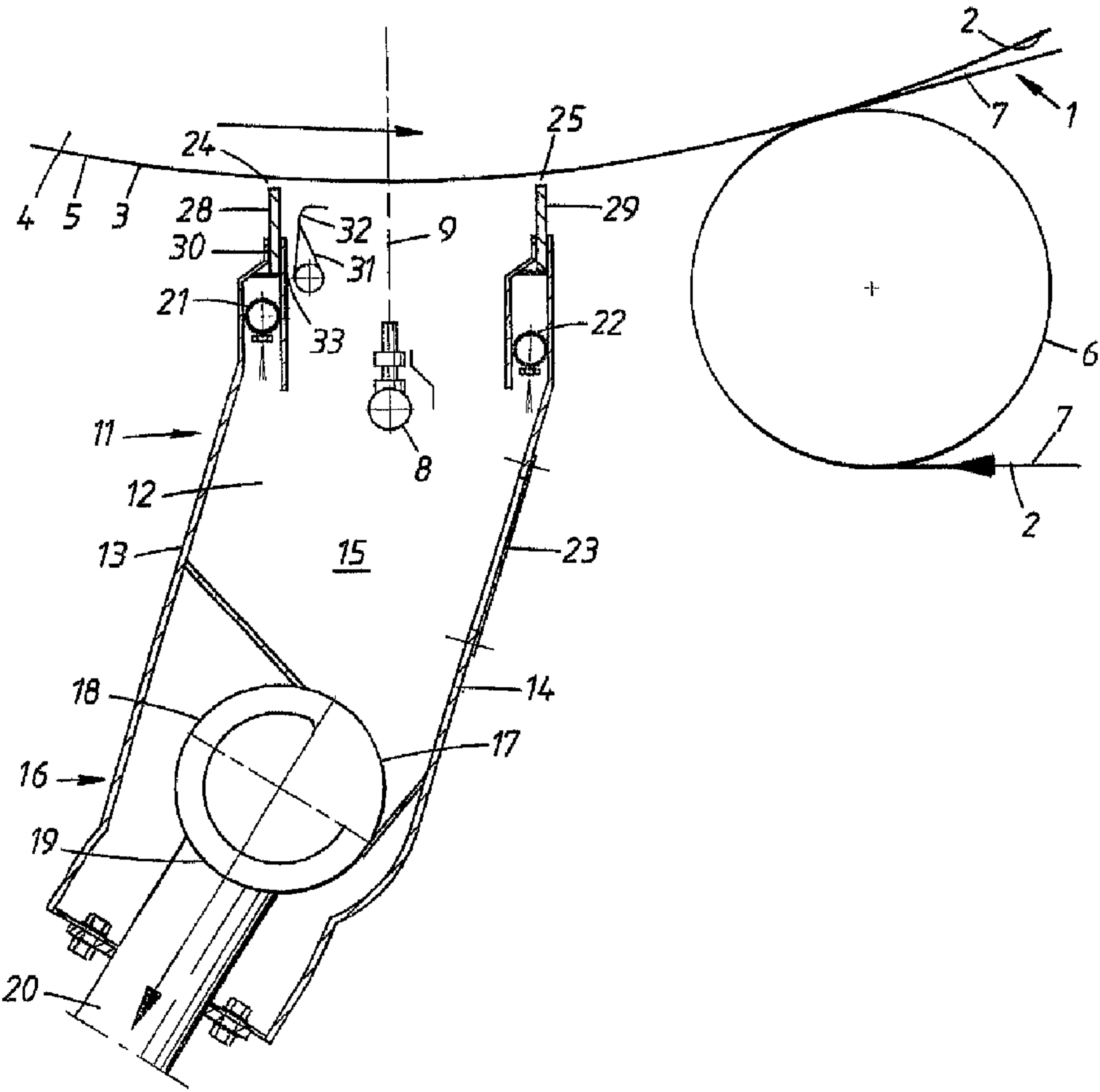


Fig 6

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