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(54) FOAM APPLICATION MACHINE FOR PRE-TREATMENT OF TEXTILE SUBSTRATES

(57) A machine (1) for pre-treatment of textile substrates, in particular for preparation for digital printing, finishing, functionalisation, etc., comprises a support structure (2) extending along a transverse axis (A) ; a series of guide rollers (7) to guide the substrate (T) through the machine (1) along a predefined path (P); a foam applicator device (8); a pair of dosing rollers (9) parallel to the axis (A) and located downstream of the foam applicator device (8) along the path (P) to dose the composition applied to the substrate (T); the foam applicator device (8) comprises at least one pair of carriages (11) movable along respective guides (15) parallel to the axis (A); containment members (17, 25, 26) are placed above each dosing roller (9) to delimit a foam accumulation zone defining an immersion bath through which the substrate (T) passes.

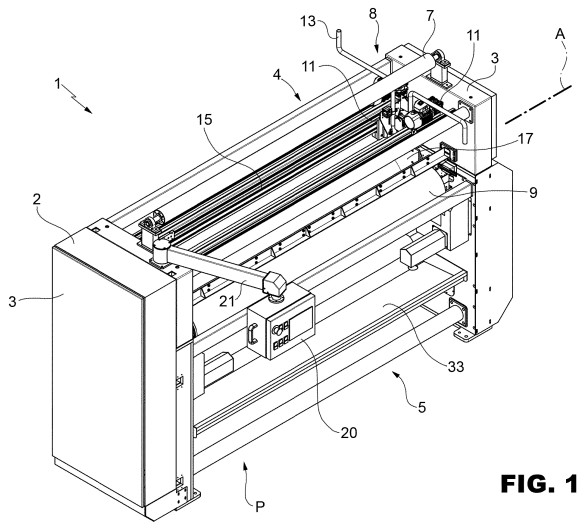

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority from Italian patent application no. 102019000024835 filed on 19/12/2019.

TECHNICAL FIELD

[0002] The present invention concerns a foaming machine for pre-treatment of textile substrates, in particular for preparation for digital printing, finishing, functionalisation, etc., in which the pre-treatment of the textile substrates, aimed for example at subsequent fixing of the digital printing inks or the application of functional substances or giving the textile substrates particular properties, is performed by application of a composition in the form of foam.

BACKGROUND ART

[0003] As known, in textile manufacturing production the printing process, which serves to transfer colours and designs onto a textile substrate, plays a fundamental role.

[0004] Alongside the more traditional printing techniques, essentially of screen-printing type, in more recent years ink jet digital printing techniques have become widespread; said techniques are decidedly more versatile than the previous ones since they do not require the preparation of printing screens.

[0005] In ink jet digital printing, small drops of ink are transferred onto the textile substrate, in sequence or simultaneously and according to a predefined pattern, thus mixing with one another at the various points of the substrate to reproduce the desired colours and form the required design.

[0006] Before undergoing ink jet digital printing, the textile substrates must be pre-treated.

[0007] In addition to the traditional pre-treatments (such as soda treatment, scouring, bleaching, drying, flattening, heatsetting, dyeing, etc.), prior to ink jet digital printing specific supplementary treatments are necessary, due to the particular characteristics of the digital printing inks.

[0008] Digital printing inks, unlike those used in other traditional printing techniques, are very fluid and are solubilised in large quantities of water, therefore posing significant problems of diffusion and migration into the textiles.

[0009] The textile substrates therefore have to be pre-treated with appropriate chemical reagents able to fix the inks.

[0010] Pre-treatment on continuous production lines is commonly carried out by: impregnation of the textiles in a bath containing the treatment agents in aqueous solution; roller squeezing (padding) to regulate the quantity of agents applied and eliminate any excess product applied; drying in oven/stenter/print dryer.

[0011] With this application system the textiles are totally immersed in the aqueous solutions and, on average, undergo a weight increase of 70-100%. This therefore entails a high consumption of water, chemicals and energy since the textiles then have to be dried before being printed.

[0012] Alternatively, as described in the patent IT1418789, a process is also known that substitutes the conventional pre-treatment of immersion in an aqueous solution with the application of a composition in the form of foam (foaming process).

[0013] In principle, the foaming process allows a significant reduction in the quantity of water absorbed by the textiles, with consequent high energy saving in the subsequent drying.

[0014] However, at the moment there is no machine that performs this process in a completely satisfactory manner.

[0015] Analogous problems are encountered in other types of treatments of textile substrates, in particular finishing and functionalisation, to give the textile substrates specific properties.

DISCLOSURE OF INVENTION

[0016] One object of the present invention is to provide a machine for pre-treatment of textile substrates, in particular for preparation for digital printing, finishing, functionalisation, etc., in which pre-treatment of the textile substrates is performed by the application of a composition in the form of foam, which is without the drawbacks of the known art highlighted here.

[0017] The present invention therefore concerns a machine as defined in essential terms in the attached claim 1 and, in its additional characteristics, in the dependent claims.

[0018] The machine in accordance with the invention allows effective application of the foam on the textile substrate.

[0019] In particular, the machine of the invention allows the foam, containing the treatment agents for the subsequent digital printing or other functional substances, to be deposited on one or both of the faces of the substrate.

[0020] Further advantages of the machine according to the invention are the following:

- the quantity of foam deposited on each face of the textile substrate is uniform along the entire working width of the textile substrate (i.e., for the entire width thereof);
- the machine has compact dimensions so that it can be included in existing lines and/or in any case so as to limit overall dimensions in the workshop;
- the machine has a high safety level and is very easy to manage, clean and service.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Further characteristics and advantages of the present invention will appear clear from the following description of a non-limiting embodiment thereof, with reference to the figures of the attached drawings, in which:

- figure 1 is a perspective view of a foaming machine for the pre-treatment of textile substrates in accordance with the invention;
- figure 2 is a plan view from above of the machine of figure 1;
- figure 3 is a section view according to the trace plane III-III of figure 2;
- figure 4 is a view on an enlarged scale and in section according to the trace plane IV-IV of figure 2 of a detail of the machine of the invention;
- figures 5-9 are sectioned schematic views, similar to the view of figure 2 but simplified and with parts removed for clarity, of further embodiments of the machine of the invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0022] In figure 1, the number 1 indicates overall a foaming machine 1 for pre-treatment, by application of a composition in the form of foam, of textile substrates intended for digital printing.

[0023] The machine 1 comprises a support structure 2, for example made of stainless steel, with vertical development and extending along a transversal axis A between a pair of lateral shoulders 3 which can house, for example, control members and electric components (known and not illustrated for simplicity).

[0024] With reference also to figures 2-4, the structure 2 has an upper inlet 4, from which a textile substrate T to be treated is fed to the machine 1, and a lower outlet 5, from which the treated substrate T is collected from the machine 1.

[0025] The machine 1 comprises: a set of guide rollers 7 to guide the textile substrate T through the machine 1 along a predefined path P; a foam applicator device 8 to supply a treatment composition in the form of foam onto the textile substrate T passing through the machine 1; a pair of dosing rollers 9 located downstream of the foam applicator device 8 along the path P to dose the composition applied on the textile substrate T.

[0026] In the non-limiting embodiment illustrated, the machine 1 comprises a first and a second guide roller 7, parallel to the axis A and located at respective opposite ends of the machine 1 defining the inlet 4 and the outlet 5; further guide rollers 7 can be variously located in the machine 1 to define the path P.

[0027] The foam applicator device 8 comprises at least a pair of carriages 11 provided with at least respective nozzles 12, connected by means of respective supply ducts 13 (optionally connected to one another) to a foam generating device 14 (schematically shown in figure 3) where the treatment composition to be applied is prepared (for example, with the procedures described in detail in the previously cited patent IT1418789) .

[0028] The carriages 11 are movable along respective guides 15 extending parallel to the axis A and formed on cross beams 16 which connect the shoulders 3. The carriages 11 are for example motorised, or driven by appropriate actuators to move along the respective guides 15.

[0029] Each carriage 11 is provided with at least one nozzle 12, which delivers the treatment composition in the form of foam, facing a face of the substrate T.

[0030] The carriages 11 are therefore provided with respective opposite nozzles 12 facing respective faces of the substrate T.

[0031] It is understood that the foam applicator device 8 can comprise several carriages 11 movable along each guide 15 and spaced from one another; it is also understood that each carriage 11 can have several nozzles 12 spaced from one another.

[0032] The dosing rollers 9 are located along the path P in an intermediate position between the inlet 4 and the outlet 5 and downstream of the foam applicator device 8 and are arranged side by side.

[0033] Preferably, the dosing rollers 9 are arranged parallel to the axis A (and therefore in particular horizontal), extending along respective longitudinal axes parallel to each other and to the axis A.

[0034] The dosing rollers 9 are arranged side by side and vertically aligned (namely, they are at the same height from the ground); the dosing rollers 9 are arranged so as to contact respective opposite faces of the substrate T which passes through the dosing rollers 9 and exert a predefined pressure on the substrate T; the dosing rollers 9 are counter-rotating so as to press the substrate T from top to bottom.

[0035] The textile substrate T enters the machine 1 from the inlet 4 and is guided along the path P by the guide rollers 7 to the outlet 5; along the path P, the substrate T receives the treatment composition in the form of foam delivered from the foam applicator device 8 and then passes between the dosing rollers 9 which have the function of dosing the foam and causing it to penetrate inside the substrate T.

[0036] The substrate T passes between the dosing rollers 9 essentially along a median plane P of the machine 1 and the dosing rollers 9 are arranged adjacent on opposite sides of the plane P.

[0037] According to requirements, the treatment composition (foam) can be applied on only one or on both faces of the substrate T, using the respective nozzles 12. The nozzles are oriented so as to supply the foam directly onto the substrate T, in particular onto one or both faces of the substrate T; the jet of foam coming out of the nozzles 12 therefore impacts the substrate T and the foam is then dragged by the substrate towards the dosing rollers 9.

[0038] The foam comes out of the nozzle 12 or the nozzles 12 and accumulates at the side of the substrate

T above the dosing rollers 9 (one only or both, depending on whether the composition is applied on one or both faces of the substrate T), where a foam accumulation zone is created defining an immersion bath through which the substrate T passes; the pressure between the dosing rollers 9 then eliminates the excess treatment composition from the substrate T and doses the penetration thereof into the substrate T.

[0039] In order to render the deposit of the treatment composition in the form of foam in the immersion bath uniform, the foam is delivered from the nozzles 12 moving the carriages 11 along the guides 15 so as to reach all the deposit zones.

[0040] This precaution compensates for the behaviour of the foam with respect to any liquid in adapting to the volume that contains it.

[0041] In any case, the subsequent passage of the substrate T between the dosing rollers 9 completes the uniform distribution of the foam.

[0042] In order to contain the foam only in the zone where it is required, the machine 1 comprises a pair of lateral walls, substantially perpendicular to the axis A and located at respective lateral ends of the machine 1 above the dosing rollers 9 and in contact with them.

[0043] Preferably, the position of the walls 17 (in particular the distance of the walls 17 from each other) can be adjusted to adapt to different dimensions of the substrate T to be treated. For example, the walls 17 are movable with respect to each other, driven by actuators, to translate parallel to the axis A one towards the other or vice versa.

[0044] The operation of the machine 1 is advantageously controlled by a control unit 20 provided with a suitable user interface, located for example on an articulated arm 21 that protrudes from the structure 2.

[0045] As illustrated in the schematic view of figure 5, the machine 1 comprises a foam regulation system 22, configured so as to manage and vary the quantity of foam which is dragged by the dosing rollers 9 to contact the substrate T.

[0046] In particular, the quantity of foam that generates the immersion bath is regulated by sensors 23, for example laser sensors, located at the inlet 4 of the machine 1 above the dosing rollers 9 and connected to the control unit 20.

[0047] The control unit 20 is configured so as to maintain the foam level in the immersion bath constant as the quantity of treatment composition consumed varies.

[0048] In particular, the control unit 20 regulates the quantity of foam delivered, and therefore the level of foam lying on the dosing rollers 9, so as to have a tangential foam distribution on the substrate T. Density and volume of the foam in the zone of contact with the substrate T are controlled so as to avoid excessive immersion of the substrate T in the immersion bath and guarantee a tangential impregnation. In other words, the quantity of foam delivered is such that the foam is brought into contact with the substrate T tangentially due to the dosing rollers 9.

[0049] The system 22 comprises doctor blades 25, 26 located above each dosing roller 9 to delimit the immersion bath.

[0050] In particular, each dosing roller 9 is associated with an internal doctor blade 25 and an external doctor blade 26, arranged side by side and extending parallel to the axis A; the doctor blades 25, 26 of each dosing roller 9 are spaced from each other and have respective end edges 27, 28 facing respective lateral surfaces 29 of the dosing rollers 9; the internal doctor blade 25 and the external doctor blade 26 are located respectively nearer to and farther from the median plane P (namely the substrate) of the machine.

[0051] The doctor blades 26, 26, together with the walls 17, constitute containment members delimiting the foam accumulation zone, namely the immersion bath, above the dosing rollers 9.

[0052] In the example illustrated (but not necessarily), the doctor blades 25, 26 are substantially parallel to the plane P.

[0053] The internal doctor blades 25 are advantageously movable with respect to the respective dosing rollers 9. In particular, each internal doctor blade 25 is movable (in the example illustrated vertically, namely parallel to the plane P) so as to be moved close to and spaced from the surface 29 of the respective dosing roller 9 and thus vary the distance of its end edge 27 from the surface 29 of the dosing roller 9.

[0054] For example, the doctor blades 25 translate parallel to the plane P driven by appropriate actuators.

[0055] The distance between the end edge 27 of each doctor blade 25 and the surface 29 of the respective dosing roller 9 defines a passage opening 30 for the foam through which the foam accumulated in the immersion bath comes into contact with the substrate T.

[0056] The external doctor blades 26 are for example fixed and in contact with the surfaces 29 of the respective dosing rollers 9 by means of the respective end edges 28. The external doctor blades 26 thus also have the function of cleaning the dosing rollers 9.

[0057] The movement of the internal doctor blades 25 to adjust the passage opening 30 and therefore the quantity of foam applied to the substrate T is controlled, for example, by the control unit 20 based on data detected and transmitted by a control sensor 31 located downstream of the dosing rollers 9; for example, the sensor 31 is a weight sensor that measures the weight of the substrate T at the outlet 5 of the machine 1; the control unit 20 then calculates the quantity of treatment composition applied as weight difference of the substrate T between inlet 4 and outlet 5 of the machine 1 and adjusts the position of the doctor blades 25 accordingly.

[0058] The machine 1 is advantageously inserted in a digital printing line (known per se and not illustrated); the synchronism of the machine 1 with the rest of the line can be guaranteed, for example, by a synchronism dancer roller, with the possibility of adjusting the textile tension

by means of pneumatic actuator.

[0059] Advantageously, the machine 1 is provided with conveying and collecting elements 33 (figures 1 and 3) located below the dosing rollers 9 and configured so as to intercept any losses and dripping of excess foam from the dosing rollers 9, preventing them from falling onto the treated substrate T.

[0060] Further optional aspects of the machine 1 are the following.

[0061] The dosing rollers 9 can be provided with an internal heating/cooling system, to heat/cool the surfaces 29 of the dosing rollers 9 and, therefore, the treatment composition applied to the substrate T.

[0062] As already highlighted, the machine 1 is designed to apply the foam on one side only of the substrate T or on both sides of the substrate T. For said purpose, the machine 1 is advantageously provided with a support system 35 which allows effective application of the treatment composition on one face only of the substrate.

[0063] As illustrated in the schematic view of figure 6, the support system 35 includes, for example, a central contact member 36, with the function of supporting the substrate T. The contact member 36 comprises in particular a bar extending parallel to the axis A and movable to be brought into contact with a face of the substrate T above a dosing roller 9 when the treatment composition is to be applied to the opposite face of the substrate T.

[0064] Alternatively or additionally, as shown in figure 7, the support system 35 includes auxiliary drawing cylinders 37 which divert the substrate T from the path P so as to keep it adequately supported on the side opposite the face on which the foam is applied.

[0065] As shown in the schematic view of figure 8, at the outlet 5 the machine 1 can be optionally provided with a group of squeezing cylinders 38, preferably integrated in the structure 2, to render uniform and cause the foam to penetrate further after the first collapse of the foaming agents in the dosing rollers 9.

[0066] As shown in the schematic view of figure 9, the machine 1 can optionally be provided with an automatic cleaning system 40, comprising a plurality of cleaning nozzles 41 distributed in the structure 2 and connected to a supply circuit (not illustrated) to spray a washing liquid (for example water) inside the machine 1, more precisely on the surfaces 29 of the dosing rollers 9, on the doctor blades 25, 26 and optionally on the squeezing cylinders 38 if present.

[0067] The washing liquid is then advantageously collected in a drain tank 42 located in the lower part of the machine 1 and provided with a discharge hole 43. Removable walls 44 are advantageously positioned around the machine 1 during the cleaning operations to contain the jets of washing liquid.

[0068] Lastly, it is understood that further modifications and variations can be made to the machine described and illustrated here that do not depart from the scope of the attached claims.

Claims

1. A machine (1) for pre-treatment of textile substrates, in particular for preparation for digital printing, finishing, functionalisation, etc., by application of a composition in the form of a foam, comprising a support structure (2) extending along a transverse axis (A); a series of guide rollers (7) to guide the substrate (T) through the machine (1) along a predefined path (P); a foam applicator device (8) to supply a treatment composition in the form of foam on the substrate (T) passing through the machine (1); a pair of dosing rollers (9) parallel to the axis (A) and located downstream of the foam applicator device (8) along the path (P) to dose the composition applied to the substrate (T); wherein the foam applicator device (8) comprises at least one pair of carriages (11) movable along respective guides (15), extending parallel to the axis (A), and equipped with at least respective nozzles (12), connected by respective supply ducts (13) to a foam generating device (14); and wherein containment members (17, 25, 26) are placed above each dosing roller (9) to delimit a foam accumulation zone defining an immersion bath through which the substrate (T) passes.

2. The machine according to claim 1, wherein the containment members comprise a pair of lateral walls (17), substantially perpendicular to the axis (A) and positioned at respective lateral ends of the machine (1) upon and in contact with the dosing rollers (9); and doctor blades (25, 26) substantially parallel to the axis (A) and positioned above each dosing roller (9) .

3. The machine according to claim 2, comprising at least a first pair of internal doctor blades (25), parallel to the axis (A) and placed above the respective dosing rollers (9) to delimit the immersion bath; each internal doctor blade (25) being movable with respect to the respective dosing roller (9) so as to be moved closer to and spaced apart from a lateral surface (29) of the dosing roller (9) and thus vary a passage opening (30) for the foam through which the foam accumulated in the immersion bath comes into contact with the substrate (T).

4. The machine according to claim 3, wherein the position of the internal doctor blades (25) is controlled by a control unit (20) on the basis of data collected and transmitted by a control sensor (31), for example a weight sensor, located downstream of the dosing rollers (9).

5. The machine according to claim 3 or 4, wherein each dosing roller (9) is associated with an internal doctor blade (25) and an external doctor blade (26), arranged side by side and extending parallel to the axis

(A) and spaced apart from each other.

6. The machine according to one of claims 2 to 5, wherein the walls (17) are movable with respect to each other, driven by actuators, to translate parallel to the axis (A) one towards the other or vice versa.

7. The machine according to one of the previous claims, comprising a foam regulation system (22), configured to control and adjust the quantity of foam that is dragged by the dosing rollers (9) to contact the substrate (T).

8. The machine according to one of the previous claims, wherein the quantity of foam that defines the immersion bath is regulated by sensors (23), for example laser sensors, located at an inlet (4) of the machine (1) above the dosing rollers (9) and connected to a control unit (20).

9. The machine according to one of the previous claims, wherein the carriages (11) are equipped with respective opposite nozzles (12) facing towards respective opposite faces of the substrate (T) .

10. The machine according to one of the previous claims, wherein the foam applicator device (8) comprises a plurality of carriages (11) movable along each guide (15) and spaced apart from one another; and/or each carriage (11) is provided with one or more nozzles (12) spaced apart from one another on the carriage (11).

11. The machine according to one of the previous claims, comprising a support system (35) allowing effective application of the treatment composition on one face of the substrate (T) only; the support system (35) comprising a central contact member (36), movable to be brought into contact with one face of the substrate (T) above one of the dosing rollers (9) when the treatment composition is to be applied onto the opposite face of the substrate (T); and/or auxiliary drawing cylinders (37) arranged so as to divert the substrate (T) from the path (P) and keep it adequately supported on the side opposite to the face on which the foam is applied.

12. The machine according to one of the previous claims, comprising a group of squeezing cylinders (38) located downstream of the dosing rollers (9).

13. The machine according to one of the previous claims, comprising an automatic cleaning system (40), comprising a plurality of cleaning nozzles (41) distributed in the structure (2) and connected to a supply circuit to spray a washing liquid into the machine (1); and a drain tank (42) located in a bottom part of the machine (1) to collect the used washing liquid.

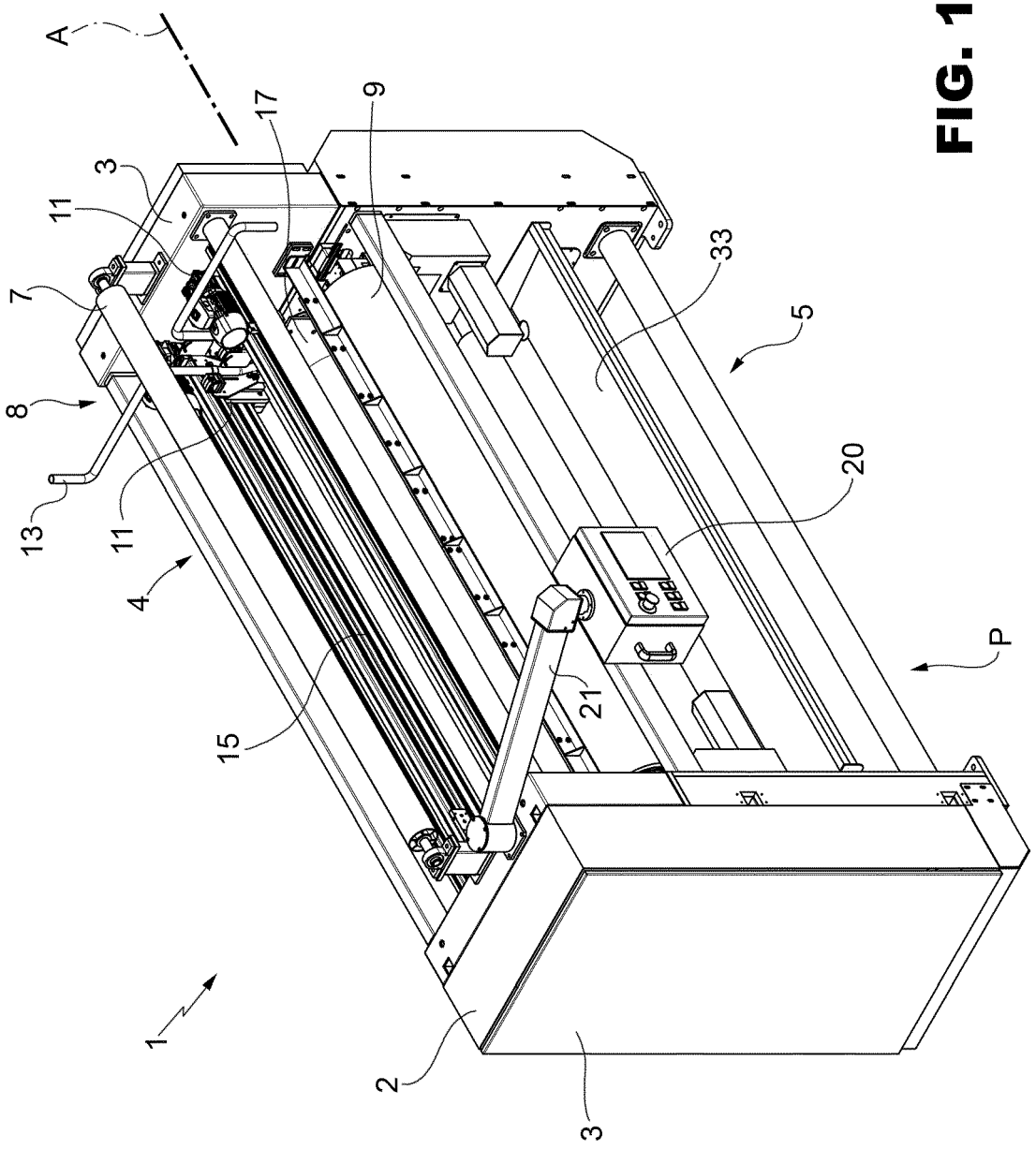

FIG. 1

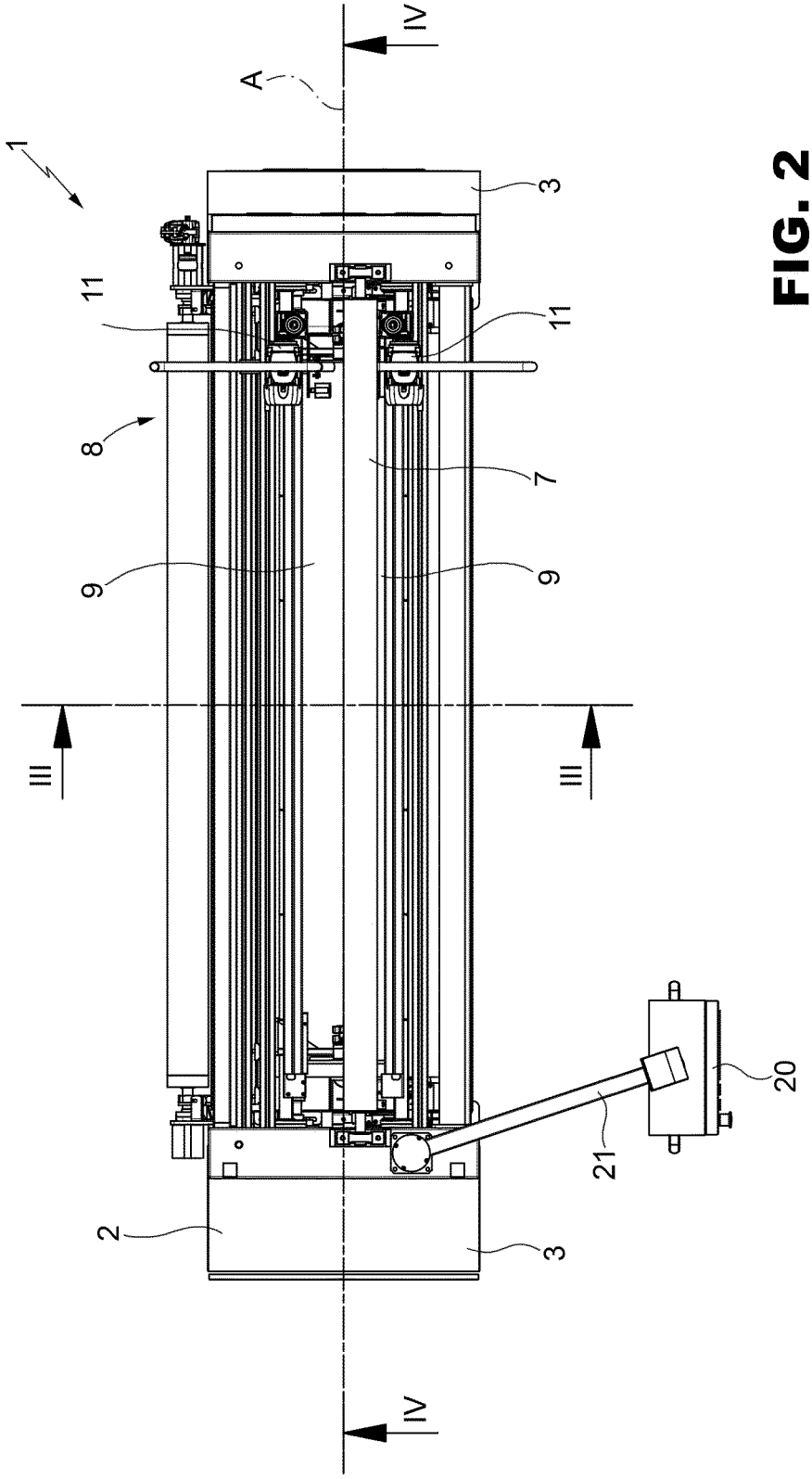

FIG. 2

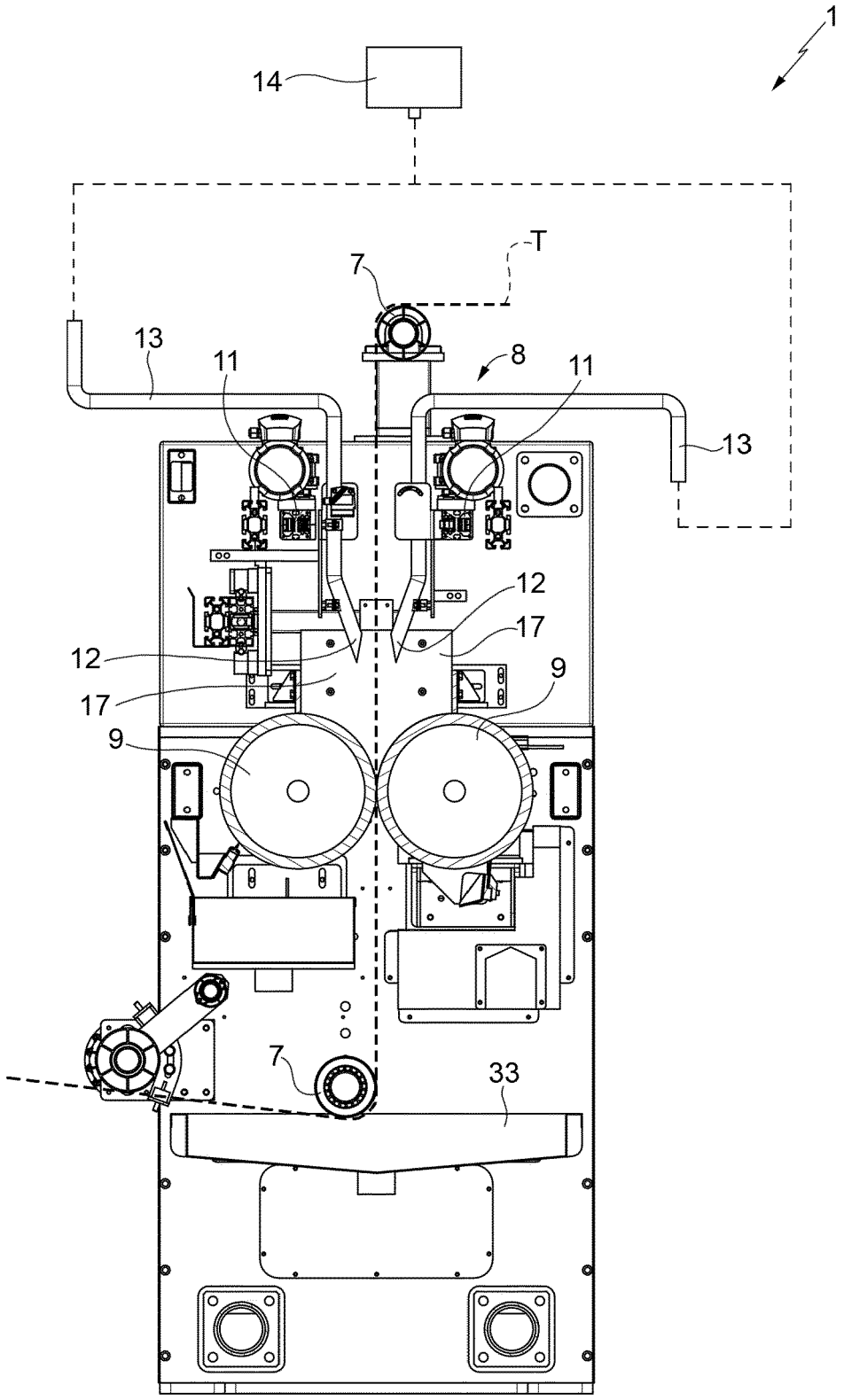

FIG. 3

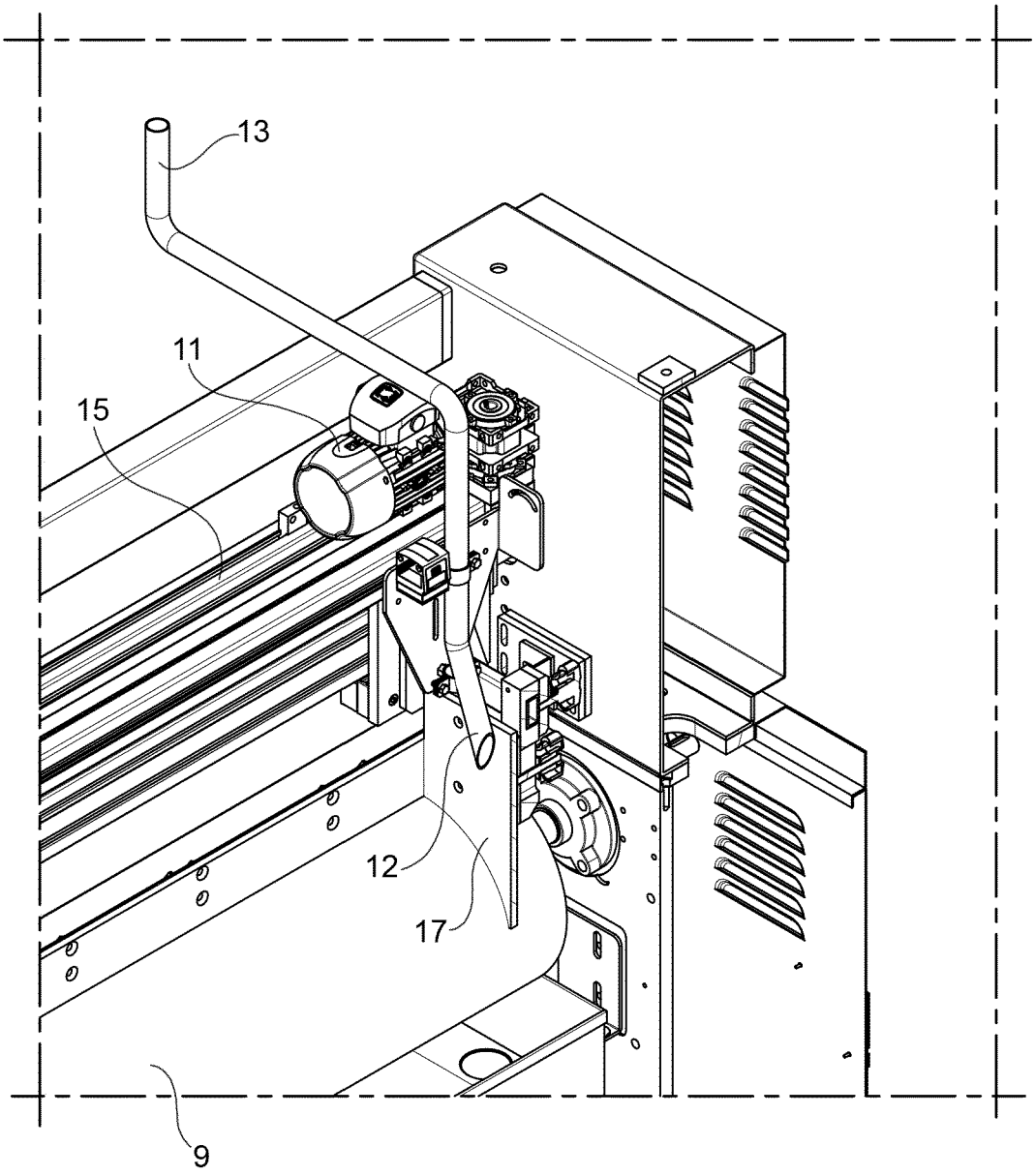

FIG. 4

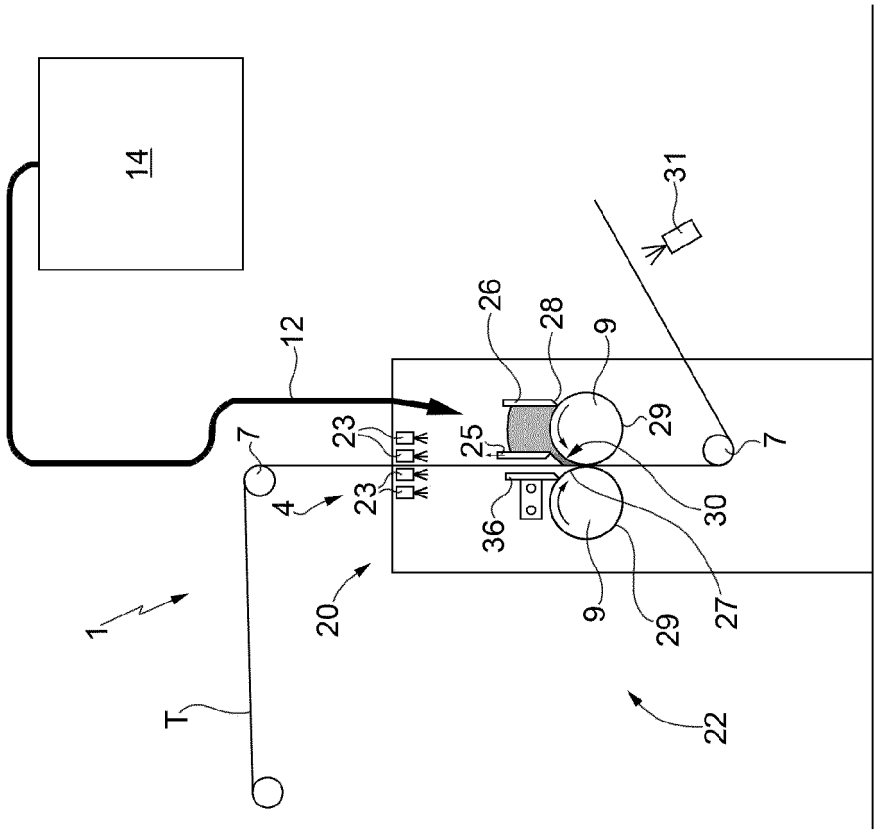
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FIG. 6

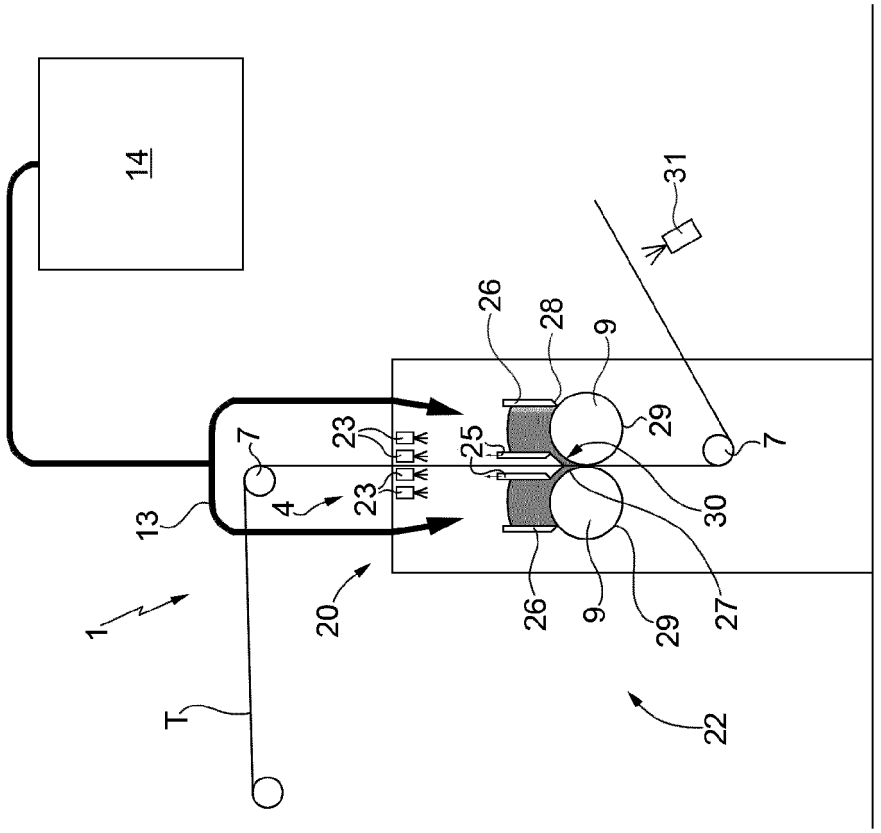
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FIG. 5

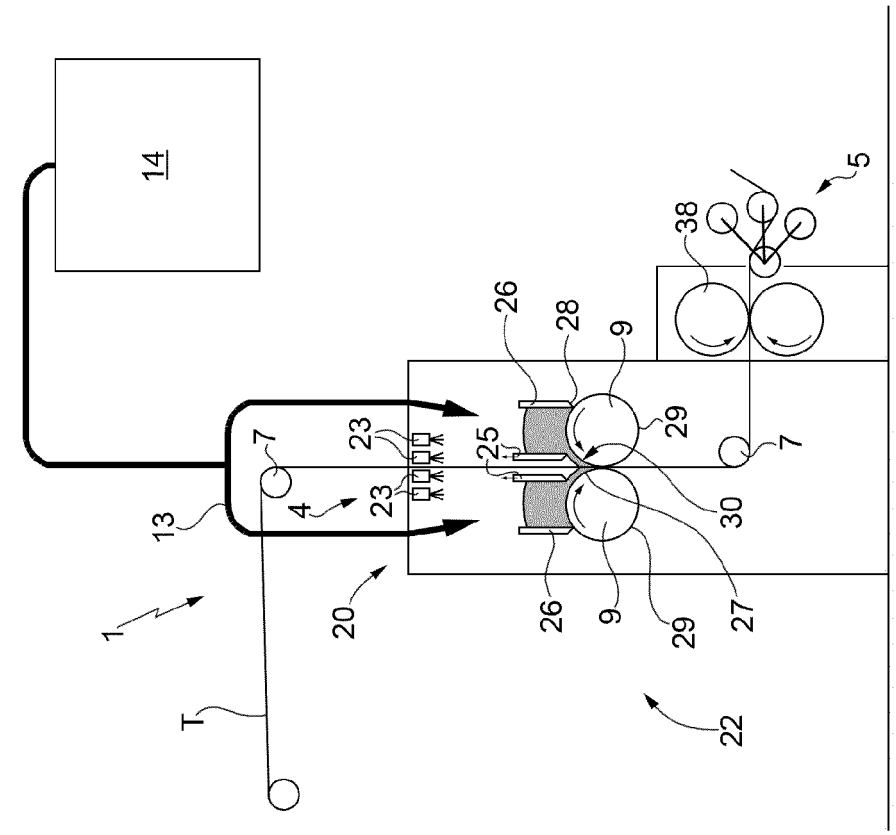
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FIG. 8

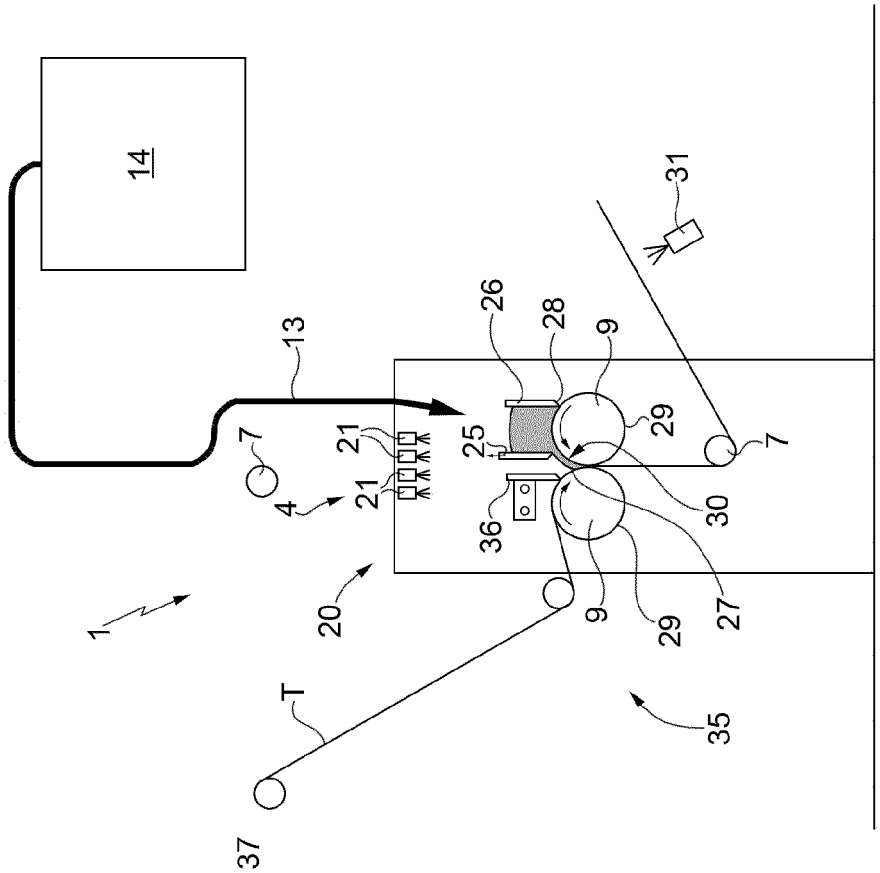
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FIG. 7

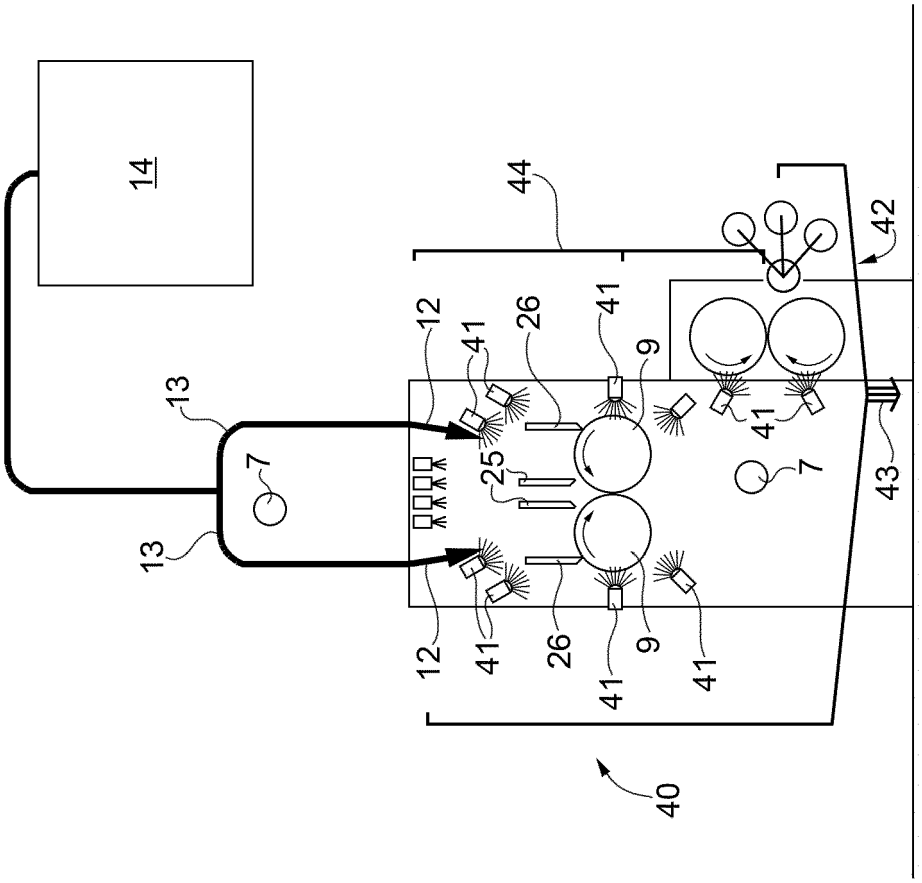

FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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- IT 1418789 **[0012] [0027]**