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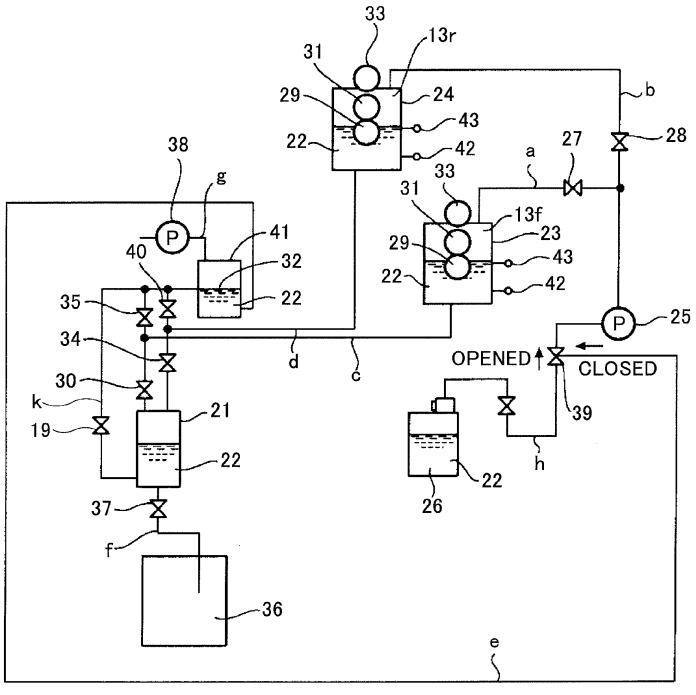
(54) Treatment liquid application apparatus and image forming system including the same

(57) A treatment liquid application apparatus includes a front-side application supply pan (23); a back-side application supply pan (24); a supply line (h,a,b) for supplying a treatment liquid to the supply pans; a reserve tank (21); a filter chamber (41) including a filter (32); a front-side application removing and circulating line (c); a back-side application removing and circulating line (d); a returning line (e) for returning the treatment liquid from which the foreign matter has been removed by the filter to the supply pans; a liquid flow creation part (25) that creates flows of the treatment liquid in the respective lines; valves; and a control part (44) for controlling the liquid flow creation part and the valves for supplying the treatment liquid to the application removing and circulating lines in a process of supplying the treatment liquid to the supply pans at a time of power supply being turned on.

FIG.3



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Description

[0001] The present invention relates to a treatment liquid application apparatus for an ink-jet printer and an image forming system including the same.

[0002] The treatment liquid application apparatus applies a treatment liquid to a to-be-recorded-on medium prior to image formation such as a bleeding prevention agent for preventing image bleeding in the ink-jet printer that forms an image on the to-be-recorded-on medium such as a web by discharging ink droplets thereto.

[0003] An ink-jet printer in a liquid discharge recording type using a recording head that discharges ink droplets is known as an image forming apparatus such as a printer, a facsimile machine, a copier, a plotter or a multifunction peripheral having the respective functions thereof in its housing.

[0004] In such an ink-jet printer, a recording head discharges ink droplets onto a to-be-recorded-on medium that is being conveyed, and thus, the ink-jet printer forms an image on the to-be-recorded-on medium. Such ink-jet printers include those of serial type forming images on to-be-recorded-on media by discharging ink droplets thereto by recording heads moving in main scan directions and those of line type forming images on to-be-recorded-on media by discharging ink droplets thereto by recording heads not moving.

[0005] Such ink-jet printers are advantageous because of low noise and low running cost, and also, because it is easier to provide those carrying out color printing. Therefore, recently such ink-jet printers have rapidly become widespread. However, such an ink-jet printer may have a quality problem, i.e., image bleeding, degradation in image density or tones, an offset of an image, and/or the like, that may occur when an image is formed on a to-be-recorded-on medium other than ink-jet paper. Furthermore, as another problem, an ink-jet printer may have a problem concerning toughness in an image formed such as a problem concerning water-resistant property, weather-resistant property or the like.

[0006] In order to solve these problems, various methods have been proposed to improve image quality by applying a treatment liquid having a function of causing ink agglomeration to a to-be-recorded-on medium before forming an image thereto.

[0007] For example, Japanese Laid-Open Patent Application No. 2007-50315 proposes a treatment liquid application apparatus in which, for preventing a proper circulation from being obstructed by a treatment liquid that may otherwise be thickened inside a tube or the like through which the treatment liquid flows, a time is measured since a circulation of the treatment liquid was finished at the last time, and a treatment liquid circulation method is changed depending on the time. Further, the treatment liquid is circulated during supply of the treatment liquid.

[0008] However, in the treatment liquid application apparatus in the related art, only one filter is provided in a treatment liquid circulation line, and also, only the single treatment liquid circulation line is provided. Further, a flow of the treatment liquid is not switched between a treatment liquid circulation operation and a supply operation. Therefore, in a treatment liquid application apparatus using different lines for supplying and removing the treatment liquid, and removing the treatment liquid from a supply pan using a water head difference, a very long time may be required for removing the treatment liquid. Furthermore, as a result of the treatment liquid being continuously exposed to air during such a very long time, degradation in the treatment liquid may be accelerated.

[0009] According to one embodiment of the present invention, a treatment liquid application apparatus includes a front-side application supply pan that stores a treatment liquid to be applied to a front side of a to-be-recorded-on medium; a back-side application supply pan that stores the treatment liquid to be applied to a back side of the to-be-recorded-on medium; a treatment liquid cartridge that stores the treatment liquid; a supply line that supplies the treatment liquid stored in the treatment liquid cartridge to the front-side application supply pan and the back-side application supply pan, respectively; a reserve tank that has higher airtightness than the front-side application supply pan and the back-side application supply pan; a filter chamber that includes a filter for removing foreign matter contained in the treatment liquid through a circulation during an application of the treatment liquid to the to-be-recorded-on medium; a front-side application removing and circulating line that connects the front-side application supply pan with the reserve tank and the filter chamber; a back-side application removing and circulating line that connects the back-side application supply pan with the reserve tank and the filter chamber; a returning line that is connected from the filter chamber to the supply line in-line and returns the treatment liquid from which the foreign matter has been removed by the filter to the front-side application supply pan and the back-side application supply pan; a liquid flow creation part that creates flows of the treatment liquid in the supply line, the front-side application removing and circulating line, the back-side application removing and circulating line and the returning line; a plurality of valves installed on the supply line, the front-side application removing and circulating line, the back-side application removing and circulating line and the returning line for switching thereamong a line through which the treatment liquid flows; and a control part that controls the liquid flow creation part and the values for supplying the treatment liquid to at least one of the front-side application removing and circulating line and the back-side application removing and circulating line in a process of supplying the treatment liquid to the front-side application supply pan and the back-side application supply pan at a time of power supply being turned on in the treatment liquid application apparatus.

[0010] Other objects, features and advantages of the present invention will become more apparent from the

following detailed description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a general configuration diagram showing a flow of operations in an image forming system according to embodiments;
FIG. 2 shows a general configuration diagram for a treatment liquid application apparatus used in the image forming system;
FIG. 3 is a schematic diagram showing lines for removing, circulating and supplying a treatment liquid according to a first embodiment;
FIG. 4 is a block diagram showing connections between a control part and respective members associated therewith in the treatment liquid application apparatus according to the first embodiment;
FIG. 5 is a control flowchart showing an operation sequence according to the first embodiment;
FIGs. 6A and 6B illustrate flows of the treatment liquid in a process of supplying the treatment liquid to the removing lines;
FIG. 7 is a schematic diagram showing lines for removing, circulating and supplying a treatment liquid according to a second embodiment;
FIG. 8 is a control flowchart showing an operation sequence according to the second embodiment;
FIG. 9 is a schematic diagram showing lines for removing, circulating and supplying a treatment liquid according to a related art case for comparison; and
FIG. 10 is a control flowchart showing an operation sequence according to the related art case for comparison.

[0011] For the sake of convenience, the related art for comparison will be described first.

[0012] FIG. 9 is a schematic diagram showing lines for removing, circulating and supplying a treatment liquid 22 according to the related art case for comparison that the inventor and so forth have devised in the past.

[0013] The system shown in FIG. 9 includes a front-side application supply pan 23, a back-side application supply pan 24, a treatment liquid cartridge 26 for supplying the treatment liquid 22 to the supply pans 23 and 24, a pump 25 for feeding the treatment liquid 22 to the supply pans 23 and 24, a supply line "h" extending from the cartridge 26 to the pump 25, a front-side application supply line "a" extending from the pump 25 to the front-side application supply pan 23, a back-side application supply line "b" extending from the pump 25 to the back-side application supply pan 24, an electromagnetic valve 27 for opening and closing the supply line "a" and an electromagnetic valve 28 for opening and closing the supply line "b".

[0014] The system further includes a reserve tank 21 for temporarily storing the treatment liquid 22, a filter chamber 41 including a filter 32 inside for removing foreign matter contained in the treatment liquid 22, a front-side application removing and circulating line "c" connected from the front-side application supply pan 23 to the reserve tank 21 and the filter chamber 41, an electromagnetic valve 30 for opening and closing a removing line at the side of the reserve tank 21 on the front-side application removing and circulating line "c", an electromagnetic valve 35 for opening and closing a removing and circulating line at the side of the filter chamber 41 on the front-side application removing and circulating line "c", a back-side application removing and circulating line "d" connected from the back-side application supply pan 24 to the reserve tank 21 and the filter chamber 41, an electromagnetic valve 34 for opening and closing a removing line at the side of the reserve tank 21 on the back-side application removing and circulating line "d", an electromagnetic valve 40 for opening and closing a removing and circulating line at the side of the filter chamber 41 on the back-side application removing and circulating line "d", and a returning line "e" connected from the filter chamber 41 to the supply line "h" in-line.

[0015] An electromagnetic valve 39 that is a three-way valve is installed at a point at which the supply line "h" and the returning line "e" are connected. As a result of the electromagnetic valve 39 being opened, the supply line "h" connecting the pump 25 and the cartridge 26 is opened. As a result of the electromagnetic valve 39 being closed, the returning line "e" connecting the pump 25 and the filter chamber 41 is opened.

[0016] The system further includes a waste liquid tank 36 for disposing of the treatment liquid 22, a waste liquid line "f" extending from the reserve tank 21 to the waste liquid tank 36, and an electromagnetic valve 37 for opening and closing the waste liquid line "f".

[0017] Squeezing rollers 29 supply the treatment liquid 22 stored in the supply pans 23 and 24 to application rollers 31, which application rollers 31 are placed inside the supply pans 23 and 24, respectively. Top parts of the supply pans 23 and 24 are formed to cover the application rollers 31, respectively, and have such shapes as to reduce evaporation of the treatment liquid 22 inside the supply pans 23 and 24, and degradation in the treatment liquid 22 due to being exposed to air. However, it is necessary to provide openings at positions (nip areas) at which the application rollers 31 and pressurization rollers 33 are pressed to each other, respectively, and thus, the supply pans 23 and 24 do not have completely sealed structures, respectively.

[0018] Note that, a treatment liquid application operation is carried out as follows. As shown in FIG. 2 (that will be described later), a web W (to-be-recorded-on medium) is made to pass through the nip area between the application roller 31 and the pressurization roller 33 (included in a front-side application part 13f, described later) in the front-side application supply pan 23, and then, is made to pass through the nip area between the application roller 31 and the pressurization roller 33 (included in a back-side application part 13r, described later) in the back-side application supply pan 24. Thus, the treatment liquid 22 stored in the respective supply pans 23 and 24

is applied to respective sides of the web W, as will be described later using FIG. 2.

[0019] Therefore, the reserve tank 21 is provided which has higher airtightness than the supply pans 23 and 24. Then, by opening the electromagnetic valves 30 and 34 on the removing and circulating lines "c" and "d" that connect the supply pans 23 and 24 with the reserve tank 21, respectively, it is possible to remove the treatment liquid 22 inside the supply pans 23 and 24 to the reserve tank 21 using the respective water head differences between the supply pans 23 and 24 and the reserve tank 21.

[0020] Note that a time to carry out the treatment liquid removing operation of thus removing the treatment liquid 22 inside the supply pans 23 and 24 to the reserve tank 21 is determined as follows. That is, the treatment liquid removing operation is carried out when the power supply has been turned off in the treatment liquid application apparatus. Alternatively, the treatment liquid removing operation is carried out during a time during which, even during the power being supplied in the treatment liquid application apparatus, a treatment liquid application operation is stopped for a longer time than a regular time interval between jobs such as a time of replacing the web W, a time of changing the printing pattern, or the like. Thus, the treatment liquid removing operation is prevented during a time interval between jobs so as to avoid, to the utmost, a waiting time for supplying the treatment liquid 22 to the supply pans 23 and 24 at a time of starting a job after carrying out the treatment liquid removing operation.

[0021] The above-mentioned lines "a", "b", "c", "d", "e" and "f" are implemented by tubes. At a time to turn on the power supply in the treatment liquid application apparatus, the tubes of the removing and circulating lines "c" and "d" are in a state of the treatment liquid 22 having been removed therefrom and air existing instead. Therefore, the treatment liquid 22 is supplied to the respective supply pans 23 and 24. Then, after the liquid levels of the treatment liquid 22 in the supply pans 23 and 24 have become greater than or equal to predetermined levels, a treatment liquid application start signal is received from a host apparatus (not shown).

[0022] Based on the treatment liquid application start signal, the treatment liquid application apparatus starts a treatment liquid application operation to apply the treatment liquid 22 to the web W. Then, during the treatment liquid application operation, at certain time intervals, the electromagnetic valves 35 and 40 on the removing and circulating lines "c" and "d" are opened and, the electromagnetic valve 39 is closed, whereby the retuning line "e" is opened that connects the pump 25 with the filter chamber 41. Then, the pump 25 is driven for a certain time period, and thereby, a circulation operation is carried out. In the circulation operation, the pump 25 forcibly supplies the treatment liquid 22 from the supply pans 23 and 24 to the tubes of the removing and circulating lines "c" and "d". After that, foreign matter is removed from the treatment liquid 22 as a result of the treatment liquid 22 passing through the filter 32 in the filter chamber 41. Then, the treatment liquid 22 is returned to the supply pans 23 and 24 through the returning line "e" and the supply lines "a" and "b".

[0023] During the circulation operation thus carried out after the power supply has been turned on in the treatment liquid application apparatus, the treatment liquid 22 is supplied to the removing and circulating lines "c" and "d" as a result of the pump 25 being driven. Thus, the tubes of the removing and circulating lines "c" and "d" have entered a state of being filled with the treatment liquid 22.

[0024] However, in the system of circulating the treatment liquid 22 described above using FIG. 9, the tubes of the removing and circulating lines "c" and "d" are in a state of containing air until the circulation operation is carried out since the power supply was turned on. Therefore, a problematic situation may occur in some cases. That is, a case is assumed where, in a state of the power supply having been turned on in the treatment liquid application apparatus and then the respective supply pans 23 and 24 having been filled with the treatment liquid 22, the power supply is turned off without carrying out a treatment liquid application operation. Also another case is assumed where, in a state of the respective supply pans 23 and 24 having been filled with the treatment liquid 22, a long period of time has elapsed during which no treatment liquid application operation has been carried out. In these cases, in order to remove the treatment liquid 22 from the respective supply pans 23 and 24 to the reserve tank 21, a very long period of time may be required due to air present in the tubes of the removing and circulating lines "c" and "d". That is, when the electromagnetic valves 30 and 34 are opened to remove the treatment liquid 22 from the respective supply pans 23 and 24 to the reserve tank 21 using the water head differences between the respective supply pans 23 and 24 and the reserve tank 21, the potential energy of the water head differences for causing the treatment liquid 22 to flow down to the reserve tank 21 is absorbed by the air present in the tubes of the removing and circulating lines "c" and "d". During such a very long period of time, the treatment liquid 22 is continuously exposed to air, and thus, degradation in the treatment liquid 22 may be accelerated.

[0025] FIG. 10 is a control flowchart showing an operation sequence of the treatment liquid application apparatus described above using FIG. 9.

[0026] As shown in FIG. 10, in step S21, it is determined whether the supply pans 23 and 24 are to be filled with the treatment liquid 22. The operation of filling the supply pans 23 and 24 with the treatment liquid 22 is carried out at a time of the power supply having been turned on in the treatment liquid application apparatus, or at a time of starting a treatment liquid application operation after removing the treatment liquid 22 that the supply pans 23 and 24 have been filled with to the reserve tank 21.

[0027] When the supply pans 23 and 24 are to be filled

with the treatment liquid 22, the front-side application supply pan 23 and the back-side application supply pan 24 are filled with the treatment liquid 22 supplied from the reserve tank 21 or the cartridge 26, in step S22. That is, the treatment liquid 22 in the reserve tank 21 is used to fill the supply pans 23 and 24 in a case where the treatment liquid 22 is present in the reserve tank 21. However, in a case where the treatment liquid 22 is not present in the reserve tank 21, the treatment liquid 22 in the cartridge 26 is used to fill the supply pans 23 and 24.

[0028] After step S22, according to printing information input from the host apparatus, it is determined whether a treatment liquid application operation of applying the treatment liquid 22 to the web W is to be carried out, in step S23.

[0029] When the determination result in step S23 is YES, the process proceeds to step S24.

[0030] In step S24, a treatment liquid application operation of applying the treatment liquid 22 to the web W is carried out through the front-side application part 13f and the back-side application part 13r as mentioned above. The treatment liquid application apparatus reads the output values of low-level liquid level sensors installed inside the front-side application supply pan 23 and the back-side application supply pan 24. Then, in a case where it has been determined based on the thus read output values of the low-level liquid level sensors that it is necessary to supply the treatment liquid 22 to the supply pans 23 and 24, the treatment liquid 22 is supplied to the supply pans 23 and 24 from the reserve tank 21 or the cartridge 26. After the treatment liquid application operation has been thus finished, the process returns to step S23.

[0031] When the determination result in step S23 is NO, the process proceeds to step S25.

[0032] In step S25, it is determined whether the treatment liquid 22 in the supply pans 23 and 24 is to be removed to the reserve tank 21. Normally, the treatment liquid removing operation is carried out in a case where a period of time on the order of one selected from a range between 30 minutes and 2 hours has elapsed continuously without carrying out a treatment liquid application operation.

[0033] When the determination result in step S25 is YES, the process proceeds to step S26.

[0034] When the determination result in step S25 is NO, the process returns to step S23.

[0035] In step S26, the electromagnetic valves 30 and 34 are opened, and the treatment liquid 22 is removed from the front-side application supply pan 23 and the back-side application supply pan 24 to the reserve tank 21 through the electromagnetic valves 30 and 34.

[0036] Next, embodiments will be described.

[0037] The embodiments have the following features:

(a) At a time when the power supply in a treatment liquid application apparatus has been turned on, a treatment liquid filling operation of supplying a treatment liquid to supply pans is carried out. During the treatment liquid filling operation, the treatment liquid is supplied to a tube of a removing line that is not used in the treatment liquid filling operation.

(b) A liquid detection sensor is provided in the removing line. Then, at a time when the power supply in the treatment liquid application apparatus has been turned on, first the output value of the liquid detection sensor provided in the removing line is read. Then, the treatment liquid is supplied to the tube of the removing line during the treatment liquid filling operation of supplying the treatment liquid to the supply pans only when the thus read output value indicates that there is no treatment liquid in the removing line.

(c) Before a treatment liquid application operation of applying the treatment liquid to a to-be-recorded-on medium, application mode information indicating whether the treatment liquid is to be applied to a front side, a back side or both sides of the to-be-recorded-on medium is transmitted from an ink-jet printer, a host apparatus or the like to the treatment liquid application apparatus.

Then, in the above-mentioned process (a), when the application mode information indicates a mode of applying the treatment liquid only to the front side of the to-be-recorded-on medium, only the removing line for the front-side application supply pan is filled with the treatment liquid. When the application mode information indicates a mode of applying the treatment liquid only to the back side of the to-be-recorded-on medium, only the removing line for the back-side application supply pan is filled with the treatment liquid. When the application mode information indicates a mode of applying the treatment liquid to both sides of the to-be-recorded-on medium, the removing lines for both the front-side application supply pan and the back-side application supply pan are filled with the treatment liquid.

(d) The period of time of supplying the treatment liquid to the tube(s) of the removing line(s) is the period of time required for filling the tube(s) of the removing line(s) with the treatment liquid.

[0038] Next, the embodiments will be described using the drawings. FIG. 1 is a general configuration diagram showing a flow of operation in an image forming system according to the embodiments.

[0039] As shown in FIG. 1, a web W that is a long continuous sheet of paper (to-be-recorded-on medium) paid out from a paper supply apparatus 100 is first supplied to a treatment liquid application apparatus 101, in which a treatment liquid 22 is applied to both sides of the web W, and thus, a pretreatment is carried out.

[0040] Next, the web W thus processed is supplied to a first ink-jet printer 102a, in which a desired image is formed on the front side of the web W as a result of ink droplets being discharged onto the front side of the web

W. Thereafter, the web W is turned upside down by an inverting apparatus 103, and then, the web W is supplied to a second ink-jet printer 102b, in which a desired image is formed on the back side of the web W as a result of ink droplets being discharged onto the back side of the web W.

[0041] After printing has been thus carried out on both sides of the web W, the web W is supplied to a subsequent-treatment apparatus (not shown), in which a predetermined subsequent treatment is carried out on the web W.

[0042] FIG. 2 shows a general configuration diagram of the treatment liquid application apparatus 101 used in the image forming system shown in FIG. 1, and shows a state of applying the treatment liquid 22 to the web W.

[0043] As shown in FIG. 2, in the treatment liquid application apparatus 101, a plurality of guide rollers 1 that have bearings (not shown) at both their ends and are freely rotatable are provided, and thereby, a path through which the web W is conveyed is provided.

[0044] Further, a Feed-In (FI) roller 2 is provided which is rotated by a driving source such as a motor (not shown), and the pulling force of a spring (not show) causes a FI nip roller 4 to be pressed onto the FI roller 2.

[0045] The web W is elastically sandwiched by the FI roller 2 and the FI nip roller 4, and, as a result of the FI roller 2 being rotated by the driving source, the treatment liquid application apparatus 101 can pull the web W inside from the paper supply apparatus 100.

[0046] Further, the web W thus supplied by the FI roller 2 and the FI nip roller 4 to the inside of the treatment liquid application apparatus 101 is somewhat slackened, and thus, as shown in FIG. 2, an air loop AL is formed by the thus slackened part of the web W.

[0047] The web W that has passed through the air loop AL then passes through between two passing shafts 5 and between two edge guides 6. The two passing shafts 5 are placed to extend in a direction perpendicular to the drawing of FIG. 2. The web W passes through between the passing shafts 5 in sequence to follow an "S"-shaped path. The pair of edge guides 6 having plate-like shapes are supported by the passing shafts 5. The distance between the edge guides 6 is set to be the same as the width of the web W.

[0048] Therefore, by the functions of the passing shafts 5 and the edge guides 6, the running position of the web W in the width direction is controlled, and thus, the web W can be made to run stably. Note that the edge guides 6 are attached to the passing shafts by attaching devices such as screws, for example, and the positions of the edge guides 6 are adjustable according to the width of the web W actually used.

[0049] Tension is exerted on the web W that has passed through between the passing shafts 5 and edge guides 6, by a tension shaft 7 that is fixed, for the purpose of achieving stable running of the web W.

[0050] The web W that has been thus pressed by the tension shaft 7 then passes through between an in-feed roller 8 driven and rotated by a driving source such as a motor (not shown) and a feed-nip roller 9. Although not shown, a plurality of the feed-nip rollers 9 is placed along the axial direction of the in-feed roller 8, and the respective feed-nip rollers 9 are pressed to the in-feed roller 8 by springs (not shown).

[0051] The web W that has passed through between the in-feed roller 8 and the feed-nip rollers 9 is led to a first dancing unit 17. The first dancing unit 17 includes a rotatable dancing roller 11 and a first movable frame 12. The first dancing unit 17 is suspended by the web W, as shown in FIG. 2.

[0052] The first dancing unit 17 is movable along the gravity direction A. Further, a first dancing unit detection part is provided (not shown) that detects the position of the first dancing unit 17. The driving source of the in-feed roller 8 is controlled according to the output of the first dancing unit detection part, and thus, the position of the first dancing 17 unit can be adjusted.

[0053] The web W that has passed through the first dancing unit 17 passes through the above-mentioned front-side application part 13f for applying the treatment liquid 22 on the front side of the web W and the above-mentioned back-side application part 13r for applying the treatment liquid 22 on the back side of the web W, in sequence. Thus, the treatment liquid 22 is applied to both sides of the web W.

[0054] The web W that has passed through the back-side application part 13r passes through between an out-feed roller 14 driven and rotated by a driving source such as a motor (not shown) and another feed-nip roller 9. Although not shown, a plurality of the feed-nip rollers 9 is placed along the axial direction of the out-feed roller 14, and the respective feed-nip rollers 9 are pressed to the out-feed roller 14 by springs (not shown).

[0055] The web W that has passed through the out-feed roller 14 and the feed-nip rollers 9 is then wound on rotatable second dancing rollers 15a and 15b and a guide roller 1 placed between the second dancing rollers 15a and 15b so that the web W follows a path shaped like "W" as shown in FIG. 2.

[0056] The two dancing rollers 15a and 15b are rotatably mounted on a second movable frame 16 by bearings (not shown) at both ends of the rollers 15a and 15b, and are included in a second dancing unit 18 together with the second movable frame 16. Also the second dancing unit 18 is suspended by the web W, as shown in FIG. 2.

[0057] Also the second dancing unit 18 is movable along the gravity direction A. A second dancing unit detection part is provided (not shown) that detects the position of the second dancing unit 18. The driving source of the out-feed roller 14 is controlled according to the output of the second dancing unit detection part, and thus, the position of the second dancing unit 18 can be adjusted.

[0058] As the treatment liquid 22, a liquid obtained from dissolving or dispersing a water-soluble agglomerating agent that has a function of agglomerating or insolubiliz-

ing a water-soluble color material in water or an organic solvent is used.

[0059] FIG. 3 is a schematic diagram showing lines for removing, circulating and supplying the treatment liquid 22.

[0060] The circulation system shown in FIG. 3 includes, as shown, a front-side application supply pan 23, a back-side application supply pan 24, a treatment liquid cartridge 26 for supplying the treatment liquid 22 to the supply pans 23 and 24, a pump 25 for feeding the treatment liquid 22 to the supply pans 23 and 24, a supply line "h" extending from the cartridge 26 to the pump 25, a front-side application supply line "a" extending from the pump 25 to the front-side application supply pan 23, a back-side application supply line "b" extending from the pump 25 to the back-side application supply pan 24, an electromagnetic valve 27 for opening and closing the supply line "a" and an electromagnetic valve 28 for opening and closing the supply line "b".

[0061] This system further includes a reserve tank 21 for temporarily storing the treatment liquid 22, a filter chamber 41 including a filter 32 inside for removing foreign matter contained in the treatment liquid 22, a front-side application removing and circulating line "c" connected from the front-side application supply pan 23 to the reserve tank 21 and the filter chamber 41, an electromagnetic valve 30 for opening and closing a removing line at the side of the reserve tank 21 on the front-side application removing and circulating line "c", an electromagnetic valve 35 for opening and closing a circulating line at the side of the filter chamber 41 on the front-side application removing and circulating line "c", a back-side application removing and circulating line "d" connected from the back-side application supply pan 24 to the reserve tank 21 and the filter chamber 41, an electromagnetic valve 34 for opening and closing a removing line at the side of the reserve tank 21 on the back-side application removing and circulating line "d", an electromagnetic valve 40 for opening and closing a circulating line at the side of the filter chamber 41 on the back-side application removing and circulating line "d", and a returning line "e" connected from the filter chamber 41 to the supply line "h" in-line.

[0062] An electromagnetic valve 39 that is a three-way valve is installed at a point at which the supply line "h" and the returning line "e" are connected. As a result of the electromagnetic valve 39 being opened, the supply line "h" connecting the pump 25 and the cartridge 26 is opened. As a result of the electromagnetic valve 39 being closed, the returning line "e" connecting the pump 25 and the filter chamber 41 is opened.

[0063] This system further includes a waste liquid tank 36 for disposing of the treatment liquid 22, a waste liquid line "f" extending from the reserve tank 21 to the waste liquid tank 36, and an electromagnetic valve 37 for opening and closing the waste liquid line "f".

[0064] Squeezing rollers 29 for supplying the treatment liquid 22 stored in the supply pans 23 and 24 to application rollers 31, and the application rollers 31 are placed inside the supply pans 23 and 24, respectively. Top parts of the supply pans 23 and 24 are formed to cover the application rollers 31, respectively, and have shapes such as to reduce evaporation of the treatment liquid 22 inside the supply pans 23 and 24 and degradation in the treatment liquid 22 due to being exposed to air. However, it is necessary to provide openings at positions (nip areas) at which the application rollers 31 and pressurization rollers 33 are pressed to each other, and thus, the supply pans 23 and 24 do not have completely sealed structures, respectively.

[0065] Note that a treatment liquid application operation is carried out as follows. As shown in FIG. 2 (described above), the web W (to-be-recorded-on medium) is made to pass through the nip area between the application roller 31 and the pressurization roller 33 (included in the front-side application part 13f, described above) in the front-side application supply pan 23, and then, is made to pass through the nip area between the application roller 31 and the pressurization roller 33 (included in the back-side application part 13r, described above) in the back-side application supply pan 24. Thus, the treatment liquid 22 stored in the respective supply pans 23 and 24 is applied to respective sides of the web W, as mentioned above using FIG. 2.

[0066] Therefore, the reserve tank 21 is provided which has higher airtightness than the supply pans 23 and 24. Then, by opening the electromagnetic valves 30 and 34 on the removing and circulating lines "c" and "d" that connect the supply pans 23 and 24 with the reserve tank 21, respectively, it is possible to remove the treatment liquid 22 inside the supply pans 23 and 24 to the reserve tank 21 using the respective water head differences between the supply pans 23 and 24 and the reserve tank 21.

[0067] Note that a time to carry out the treatment liquid removing operation of thus moving the treatment liquid 22 inside the supply pans 23 and 24 to the reserve tank 21 is determined as follows. That is, the treatment liquid removing operation is carried out when the power supply has been turned off in the treatment liquid application apparatus. Alternatively, the treatment liquid removing operation is carried out during a time in which, even when the power is being supplied in the treatment liquid application apparatus, a treatment liquid application operation is stopped for a longer time than a regular time interval between jobs such as a time of replacing the web W, a time of changing the printing pattern, or the like. Thus, the treatment liquid removing operation is prevented during a time interval between jobs so as to avoid, to the utmost, a waiting time for supplying the treatment liquid 22 to the supply pans 23 and 24 at a time of starting a job after carrying out the treatment liquid removing operation.

[0068] The above-mentioned lines "a", "b", "c", "d", "e" and "f" are implemented by tubes. At a time to turn on the power supply in the treatment liquid application apparatus, the tubes of the removing and circulating lines

"c" and "d" are in a state of the treatment liquid 22 having been removed therefrom and air existing instead. Therefore, the treatment liquid 22 is supplied to the respective supply pans 23 and 24. Then, after the liquid levels of the treatment liquid 22 in the supply pans 23 and 24 have become greater than or equal to predetermined levels, a treatment liquid application start signal is received from a host apparatus (not shown).

[0069] As shown in FIG. 3, low-level liquid level sensors 42 and high-level liquid level sensors 43 for detecting the liquid levels of the treatment liquid 22 are installed on side surfaces of the supply pans 23 and 24, respectively. The low-level liquid level sensors 42 are sensors to be used to determine whether to carry out supplying the treatment liquid 22 to the supply pans 23 and 24 in a case where the treatment liquid 22 has been reduced in the supply pans 23 and 24 during a treatment liquid application operation. The high-level sensors 43 are sensors to be used to determine whether to terminate supplying the treatment liquid 22 to the supply pans 23 and 24.

[0070] In response to the application start signal, a treatment liquid application operation of applying the treatment liquid 22 to the web W by the front-side application part 13f and the back-side application part 13r are started. Then, during the treatment liquid application operation, at certain time intervals, the electromagnetic valves 35 and 40 on the removing and circulating lines "c" and "d" are opened and, the electromagnetic valve 39 is closed, whereby the retuning line "e" is opened which connects the pump 25 with the filter 32. Then, the pump 25 is driven for a certain time period, and thereby, a circulation operation is carried out. In the circulation operation, the pump 25 forcibly supplies the treatment liquid 22 from the supply pans 23 and 24 to the tubes of the removing and circulating lines "c" and "d". After that, foreign matter is removed from the treatment liquid 22 as a result of the treatment liquid 22 passing through the filter 32. Then, the treatment liquid 22 is returned to the supply pans 23 and 24 through the returning line "e" and the supply lines "a" and "b".

[0071] A pump 38 is installed on a liquid supply line "g" connected with the filter chamber 41, in the system of FIG. 3. The pump 38 is used to forcibly supply the treatment liquid 22 to raise the liquid level of the treatment liquid 22 in the filter chamber 41 to a prescribed value in a case where the liquid level of the treatment liquid 22 in the filter chamber 41 has lowered to a level lower than the prescribed value. When the liquid level of the treatment liquid 22 in the filter chamber 41 is lower than the prescribed value, it is not possible to smoothly pull the treatment liquid 22 from the supply pans 23 and 24 to the filter chamber 41, and thus, the circulation operation of the treatment liquid 22 cannot be smoothly carried out.

[0072] FIG. 4 is a block diagram showing connections between a control part 44 and respective members associated therewith in the treatment liquid application apparatus according to the first embodiment.

[0073] As shown in FIG. 4, the control part 44 includes a memory 45 that stores information such as filling finish information described later, a timer 46 to be used to measure a period of time T1 and a period of time T2 (described later), and so forth.

[0074] The detection signals from the low-level liquid level sensors 42, the high-level liquid level sensors 43, (liquid detection sensors 47 according to the second embodiment described later) and so forth, the application mode information 48 and the printing information 49 are input to the control part 44.

[0075] Further, control signals are output from the control part 44 to the pump 25 and the electromagnetic valves 27, 28, 30, 34, 35, 39, 40 and 19, respectively.

[0076] FIG. 5 is a control flowchart showing an operation sequence of the treatment liquid application apparatus according to the first embodiment.

[0077] As shown in FIG. 5, in step S1, it is determined whether to supply the treatment liquid 22 to the supply pans 23 and 24. The operation of supplying the treatment liquid 22 is carried out at a time of the power supply having been turned on in the treatment liquid application apparatus, or at a time of starting a treatment liquid application operation after removing the treatment liquid 22 that the supply pans 23 and 24 have been filled with to the reserve tank 21.

[0078] When the determination result of step S1 is YES, the process proceeds to step S2.

[0079] When the determination result of step S1 is NO, the process returns to step S1.

[0080] Then, in step S2, supplying the treatment liquid 22 from the reserve tank 21 or the cartridge 26 to the front-side application supply pan 23 and the back-side application supply pan 24 is started. That is, the treatment liquid 22 in the reserve tank 21 is used to supply the supply pans 23 and 24 in a case where the treatment liquid 22 is present in the reserve tank 21. However, in a case where the treatment liquid 22 is not present in the reserve tank 21, the treatment liquid 22 in the cartridge 26 is used to supply the supply pans 23 and 24 (see FIG. 6A).

[0081] Then, in step S3, it is determined whether the removing and circulating lines "c" and "d" have been filled with the treatment liquid 22. That is, it is determined, from the information stored in the memory 45 (see FIG. 4), whether filling the removing and circulating lines "c" and "d" with the treatment liquid 22 has been carried out. When no information has been stored in the memory 45 indicating that filling the removing and circulating lines "c" and "d" with the treatment liquid 22 has been carried out (step S3 NO), the process proceeds to step S4. When information has been stored in the memory 45 indicating that filling the removing and circulating lines "c" and "d" with the treatment liquid 22 has been carried out (step S3 YES), the process proceeds to step S6.

[0082] In step S4, it is determined whether a time to supply the treatment liquid 22 to the removing and circulating lines "c" and "d" has come. The time to supply the

treatment liquid 22 to the removing and circulating lines "c" and "d" is a time when a period of time T1 has elapsed since supplying the treatment liquid 22 to the supply pans 23 and 24 was started in step S2. The period of time T1 is preferably a period of time during which such an amount of the treatment liquid 22 as to fill the removing and circulating lines "c" and "d" has been supplied to the front-side application supply pan 23 and the back-side application supply pan 24.

[0083] Note that, at a time when the power supply has been turned on in the treatment liquid application apparatus, supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" can be started immediately without waiting for the elapse of the period of time T1, in a case where the liquid levels of the treatment liquid 22 in the front-side application supply pan 23 and the back-side application supply pan 24 are higher than or equal to the positions of the low-level liquid level sensors 42 (see FIG. 3), respectively.

[0084] When the determination result in step S4 is YES, the process proceeds to step S5.

[0085] When the determination result in step S4 is NO, the process returns to step S2.

[0086] In step S5, supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" is carried out. Flows of the treatment liquid 22 during the process of supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" will be described later using FIGs. 6A and 6B.

[0087] After step S5, the process returns to step S2.

[0088] In step S6, it is determined whether filling the front-side application supply pan 23 and the back-side application supply pan 24 with the treatment liquid 22 has been finished. This determination is carried out based on the signals from the high-level liquid level sensors 43 (see FIG. 3).

[0089] When the determination result of step S6 is YES, the process proceeds to step S7.

[0090] When the determination result of step S6 is NO, the process returns to step S2.

[0091] In step S7, according to the printing information 49 (see FIG. 4) sent from the host apparatus, it is determined whether a treatment liquid application operation of applying the treatment liquid 22 to the web W is to be carried out.

[0092] When the determination result of step S7 is YES, the process proceeds to step S8.

[0093] When the determination result of step S7 is NO, the process proceeds to step S9.

[0094] In step S8, a treatment liquid application operation of applying the treatment liquid 22 to the web W (see FIG. 2) is carried out through the front-side application part 13f and the back-side application part 13r as mentioned above. The treatment liquid application apparatus reads the output values of low-level liquid level sensors 42 installed to the front-side application supply pan 23 and the back-side application supply pan 24. Then, based on the read output values of low-level liquid level sensors 42, in a case where it has been determined that it is necessary to supply the treatment liquid 22 to the supply pans 23 and 24, the treatment liquid 22 is supplied to the supply pans 23 and 24 from the reserve tank 21 or the cartridge 26.

[0095] After the application of the treatment liquid 22 to the web W has been finished, the process returns to step S7.

[0096] In step S9, it is determined whether the treatment liquid 22 in the supply pans 23 and 24 is to be moved to the reserve tank 21. Normally, this treatment liquid removing operation is carried out in a case where a period of time on the order of one selected from a range between 30 minutes and 2 hours has elapsed continuously without carrying out a treatment liquid application operation.

[0097] When the determination result in step S9 is YES, the process proceeds to step S10.

[0098] When the determination result in step S9 is NO, the process returns to step S7.

[0099] In step S10, the electromagnetic valves 30 and 34 are opened, and thereby, the treatment liquid 22 is moved from the front-side application supply pan 23 and the back-side application supply pan 24 to the reserve tank 21.

[0100] FIGs. 6A and 6B illustrate flows of the treatment liquid 22 in a process of filling the removing and circulating lines "c" and "d". FIG. 6A shows a state of supplying the treatment liquid 22 to the supply pans 23 and 24 (step S2). FIG. 6B shows a state of removing and circulating the treatment liquid 22.

[0101] As shown in FIG. 6A, for example, during the operation of supplying the treatment liquid 22 to the supply pans 23 and 24 from the cartridge 26 (step S2), the electromagnetic valves 35, 40, 30 and 34 are closed, and the electromagnetic valve 39 that is the three-way valve is opened. Thereby, the supply line "h" connecting the pump 25 and the cartridge 26 is opened. Further, the pump 25 is driven. As a result, the treatment liquid 22 is supplied from the cartridge 26 to the supply pans 23 and 24 through the supply line "h" and the supply lines "a" and "b".

[0102] On the other hand, in a case of supplying the treatment liquid 22 from the reserve tank 21 to the supply pans 23 and 24, the electromagnetic valve 39 is closed to open the returning line "e" connecting the reserve tank 21 and the pump 25. Also, an electromagnetic valve 19 is opened to open a supply line "k" connecting the reserve tank 21 to the filter chamber 41, and the pump 25 is driven. As a result, the treatment liquid 22 is supplied from the reserve tank 21 to the supply pans 23 and 24 through the supply line "k", the filter chamber 41, the returning line "e", and the supply lines "a" and "b".

[0103] The process of filling the removing and circulating lines "c" and "d" (step S5) is carried out as follows. That is, as shown in FIG. 6B, the electromagnetic valves 35 and 40 on the removing and circulating lines "c" and "d" are opened, and the electromagnetic valve 39 that is the three-way valve is closed. Thereby, the retuning line

"e" connecting the pump 25 and the filter chamber 41 is opened. Further, the pump 25 is driven for the certain time T2.

[0104] In this suction operation of the pump 25, air in the returning line "e" and the filter chamber 41 is suctioned, and the filter chamber 41 thus has a negative pressure. As a result, as shown in FIG. 6B, the suction force of pulling the treatment liquid 22 to the filter chamber 41 is exerted, and thereby, the treatment liquid 22 in the front-side application supply pan 23 and the back-side application supply pan 24 is forcibly supplied into the removing and circulating lines "c" and "d", which are thus filled with the treatment liquid 22. Then, the treatment liquid 22 is further supplied to the filter chamber 41 in which the filter 32 is installed.

[0105] The above-mentioned driving time T2 of thus driving the pump 25 may be one required to fill the removing and circulating lines "c" and "d" with the treatment liquid 22 as a result of the pump 25 being driven.

[0106] In the image forming system shown in FIG. 1, an operator can select a side of the web W to which the treatment liquid 22 is applied depending on a job. The information indicating the operator's selection is transmitted, as the application mode information 48, to the treatment liquid application apparatus from the host apparatus or the ink-jet printer. In a mode of applying the treatment liquid 22 only to the front side of the web W according to the application mode information 48, only the electromagnetic valve 35 is opened, and thus, only the tube of the removing and circulating line "c" connected to the front-side application supply pan 23 is filled with the treatment liquid 22. On the other hand, in a mode of applying the treatment liquid 22 only to the back side of the web W according to the application mode information 48, only the electromagnetic valve 40 is opened, and thus, only the tube of the removing and circulating line "d" connected to the back-side application supply pan 24 is filled with the treatment liquid 22.

[0107] Thereby, what is required is to fill only one of the removing and circulating lines "c" and "d". As a result, the flow rate of the treatment liquid 22 that flows through only one of the removing and circulating lines "c" and "d" as a result of the pump 25 being driven is doubled. Thus, it is possible to halve the driving time T2 of the pump 25, and thus, it is possible to reduce the treatment liquid supplying time.

[0108] When this process of filling the removing and circulating line(s) with the treatment liquid 22 has been finished, the filling finish information indicating that filing the removing and circulating line(s) has been finished is stored in the memory 45.

[0109] Note that switching from the state shown in FIG. 6A to the state shown in FIG. 6B is carried out when the low-level liquid level sensors 42 in the supply pans 23 and 24 have output the detection signals, or at a time when the above-mentioned time T1 has elapsed since the process of supplying the treatment liquid 22 to the supply pans 23 and 24 was started. Switching from the state shown in FIG. 6B to the state shown in FIG. 6A is carried out when the above-mentioned time T2 has elapsed since the process of supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" was started.

[0110] According to the first embodiment described above, the process of filling the removing and circulating lines "c" and "d" is carried out in step S5 or step S5 is skipped when the removing and circulating lines "c" and "d" have been already filled with the treatment liquid 22 (step S3 YES). Therefore, during the process of filling the removing and circulating lines "c" and "d", the removing and circulating lines "c" and "d" are filled with the treatment liquid 22. In other words, no air is present in the removing and circulating lines "c" and "d". As a result, when the treatment liquid removing operation is carried out in step S10, the treatment liquid in the supply pans 23 and 24 smoothly flow down to the reserve tank 21 by the function of the water head differences. Thus, it is possible to carry out the treatment liquid removing operation rapidly.

[0111] FIG. 7 is a schematic diagram showing lines for removing, circulating and supplying the treatment liquid 22 according to the second embodiment.

[0112] The circulation system shown in FIG. 7 is different from the circulation system according to the first embodiment shown in FIG. 3 in that the above-mentioned liquid detection sensors 47 are provided inside the removing and circulating lines "c" and "d", respectively, in the second embodiment. According to the second embodiment, at a time of the power supply having been turned on in the treatment liquid application apparatus, first, the output values of the liquid detection sensors 47 are read. Then, only in a case where, based on the read output values of the liquid detection sensors 47, it has been detected that there is no treatment liquid 22 in the removing and circulating lines "c" and "d", supplying the treatment liquid 22 to the removing and circulating line(s) "c" and/or "d" is carried out.

[0113] Each of the liquid detection sensors 47 is such that two electrode pins are inserted into the tube, electric conduction between the electrode pins is detected when the tube has been filled with the treatment liquid 22, and thus, it is detected that there is the treatment liquid 22 in the tube.

[0114] According to the second embodiment, also the detection signals from the liquid detection sensors 47 (enclosed by a broken line in FIG. 4) are input to the control part 44 in the treatment liquid application apparatus, as mentioned above.

[0115] FIG. 8 is a control flowchart showing an operation sequence of the treatment liquid application apparatus according to the second embodiment.

[0116] As shown in FIG. 8, in step S11, it is determined whether the treatment liquid 22 is to be supplied to the supply pans 23 and 24. The operation of supplying the treatment liquid 22 to the treatment liquid 22 is carried out at a time of the power supply having been turned on

in the treatment liquid application apparatus, or at a time of starting a treatment liquid application operation after moving the treatment liquid 22 that the supply pans 23 and 24 have been filled with to the reserve tank 21.

[0117] When the determination result of step S11 is YES, the process proceeds to step S12.

[0118] When the determination result of step S11 is NO, the process returns to step S11.

[0119] In step S12, supplying the treatment liquid 22 to the front-side application supply pan 23 and the back-side application supply pan 24 is started from the reserve tank 21 or the cartridge 26. That is, the treatment liquid 22 in the reserve tank 21 is used to supply the supply pans 23 and 24 in a case where the treatment liquid 22 is present in the reserve tank 21. However, in a case where the treatment liquid 22 is not present in the reserve tank 21, the treatment liquid 22 in the cartridge 26 is used to supply the supply pans 23 and 24.

[0120] Then, in step S13, the output values of the liquid detection sensors 47 installed in the removing and circulating lines "c" and "d" are read, and it is determined whether to supply the treatment liquid 22 to the removing and circulating lines "c" and "d". Supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" is carried out only in a case where the output values of both the liquid detection sensors 47 indicate that there is no treatment liquid 22. Thereby, it is not necessary to repeat supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" each time when the power supply has been turned on in the treatment liquid application apparatus. Supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" is carried out only when it is actually required. Thus, it is possible to avoid an unnecessary increase in the supplying period of time of supplying the treatment liquid 22 to the supply pans 23 and 24.

[0121] When the determination result in step S13 is YES, the process proceeds to step S16.

[0122] When the determination result in step S13 is NO, the process proceeds to step S14.

[0123] In step S14, it is determined whether a time to supply the treatment liquid 22 to the removing and circulating lines "c" and "d" has come. The time to supply the treatment liquid 22 to the removing and circulating lines "c" and "d" is a time when a period of time T1 has elapsed since supplying the treatment liquid 22 to the supply pans 23 and 24 was started in step S12. The period of time T1 is preferably a period of time during which such an amount of the treatment liquid 22 as to fill the removing and circulating lines "c" and "d" has been supplied to the front-side application supply pan 23 and the back-side application supply pan 24.

[0124] Note that, at a time when the power supply has been turned on in the treatment liquid application apparatus, supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" can be started immediately without waiting for the elapse of the period of time T1, in a case where the liquid levels of the treatment liquid 22 in the front-side application supply pan 23 and the back-side application supply pan 24 are higher than or equal to the positions of the low-level liquid level sensors 42, respectively.

[0125] When the determination result in step S14 is YES, the process proceeds to step S15.

[0126] When the determination result in step S14 is NO, the process returns to step S12.

[0127] Thus, in step S15, supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" is carried out. Flows of the treatment liquid 22 during the process of supplying the treatment liquid 22 to the removing and circulating lines "c" and "d" are the same as those described above using FIGs. 6A and 6B.

[0128] After step S15, the process returns to step S12.

[0129] In step S16, it is determined whether filling the front-side application supply pan 23 and the back-side application supply pan 24 with the treatment liquid 22 has been finished. This determination is carried out based on the signals from the high-level liquid level sensors 43.

[0130] When the determination result of step S16 is YES, the process proceeds to step S17.

[0131] When the determination result of step S16 is NO, the process returns to step S12.

[0132] In step S17, according to the printing information 49 sent from the host apparatus, it is determined whether a treatment liquid application operation of applying the treatment liquid 22 to the web W is to be carried out.

[0133] When the determination result of step S17 is YES, the process proceeds to step S18.

[0134] When the determination result of step S17 is NO, the process proceeds to step S19.

[0135] In step S18, a treatment liquid application operation of applying the treatment liquid 22 to the web W is carried out through the front-side application part 13f and the back-side application part 13r as mentioned above. The treatment liquid application apparatus reads the output values of low-level liquid level sensors 42 installed to the front-side application supply pan 23 and the back-side application supply pan 24. Then, based on the read output values of low-level liquid level sensors 42, in a case where it has been determined that it is necessary to supply the treatment liquid 22 to the supply pans 23 and 24, the treatment liquid 22 is supplied to the supply pans 23 and 24 from the reserve tank 21 or the cartridge 26.

[0136] After the application of the treatment liquid 22 to the web W has been finished, the process returns to step S17.

[0137] In step S19, it is determined whether the treatment liquid 22 in the supply pans 23 and 24 is to be removed to the reserve tank 21. Normally, this treatment liquid removing operation is carried out in a case where a period of time on the order of one selected from a range between 30 minutes and 2 hours has elapsed continuously without carrying out a treatment liquid application

operation.

[0138] When the determination result in step S19 is YES, the process proceeds to step S20.

[0139] When the determination result in step S19 is NO, the process returns to step S17.

[0140] In step S20, the electromagnetic valves 30 and 34 are opened, and thereby, the treatment liquid 22 is removed from the front-side application supply pan 23 and the back-side application supply pan 24 to the reserve tank 21.

[0141] Also according to the second embodiment described above, the process of filling the removing and circulating lines "c" and "d" is carried out in step S15 or step S15 is skipped when the removing and circulating lines "c" and "d" have been already filled with the treatment liquid 22 (step S13 YES). Therefore, the removing and circulating lines "c" and "d" are filled with the treatment liquid 22. In other words, no air is present in the removing and circulating lines "c" and "d". As a result, when the treatment liquid removing operation is carried out in step S20, the treatment liquid in the supply pans 23 and 24 smoothly flows down to the reserve tank 21 by the function of the water head differences. Thus, it is possible to carry out the treatment liquid removing operation rapidly.

[0142] Thus, according to the embodiments described above, it is possible to provide a treatment liquid application apparatus by which a time required for carrying out a treatment liquid removing operation of moving a treatment liquid to a reserve tank can be reduced, and degradation in the treatment liquid can be avoided to the utmost.

[0143] Although the treatment liquid application apparatus and the image forming apparatus including the same have been described by the embodiments, the present invention is not limited, and further variations and modifications may be made without departing from the scope of the present invention.

[0144] The present patent application is based on and claims the benefit of priority of Japanese Priority Application No. 2012-252416 filed on November 16, 2012, the entire contents of which are hereby incorporated herein by reference.

Claims

1. A treatment liquid application apparatus comprising:

a front-side application supply pan that stores a treatment liquid to be applied to a front side of a to-be-recorded-on medium;
a back-side application supply pan that stores the treatment liquid to be applied to a back side of the to-be-recorded-on medium;
a treatment liquid cartridge that stores the treatment liquid;
a supply line that supplies the treatment liquid stored in the treatment liquid cartridge to the front-side application supply pan and the back-side application supply pan, respectively;
a reserve tank that has higher airtightness than the front-side application supply pan and the back-side application supply pan;
a filter chamber that includes a filter for removing foreign matter contained in the treatment liquid through a circulation during an application of the treatment liquid to the to-be-recorded-on medium;
a front-side application removing and circulating line that connects the front-side application supply pan with the reserve tank and the filter chamber;
a back-side application removing and circulating line that connects the back-side application supply pan with the reserve tank and the filter chamber;
a returning line that is connected from the filter chamber to the supply line in-line and returns the treatment liquid from which the foreign matter has been removed by the filter to the front-side application supply pan and the back-side application supply pan;
a liquid flow creation part that creates flows of the treatment liquid in the supply line, the front-side application removing and circulating line, the back-side application removing and circulating line and the returning line;
a plurality of valves installed on the supply line, the front-side application removing and circulating line, the back-side application removing and circulating line and the returning line for switching thereamong a line through which the treatment liquid flows; and
a control part that controls the liquid flow creation part and the values for supplying the treatment liquid to at least either of the front-side application removing and circulating line and the back-side application removing and circulating line in a process of supplying the treatment liquid to the front-side application supply pan and the back-side application supply pan at a time of power supply being turned on in the treatment liquid application apparatus.

2. The treatment liquid application apparatus as claimed in claim 1, further comprising:

respective liquid detection sensors provided in the front-side application removing and circulating line and the back-side application removing and circulating line for detecting whether there is the treatment liquid therein, wherein
the treatment liquid is supplied to the front-side application removing and circulating line when the liquid detection sensor has detected that

there is no treatment liquid in the front-side application removing and circulating line, and
the treatment liquid is supplied to the back-side application removing and circulating line when the liquid detection sensor has detected that there is no treatment liquid in the back-side application removing and circulating line.

3. The treatment liquid application apparatus as claimed in claim 1, wherein
according to application mode information that is input to the control part, the treatment liquid is supplied to only one of the front-side application removing and circulating line and the back-side application removing and circulating line which is to be used to apply the treatment liquid.

4. The treatment liquid application apparatus as claimed in claim 1, wherein
a fact that an amount of the treatment liquid greater than or equal to a capacity of the front-side application removing and circulating line has been stored in the front-side application supply pan triggers an operation of the control part to supply the treatment liquid to the front-side application removing and circulating line, and
a fact that an amount of the treatment liquid greater than or equal to a capacity of the back-side application removing and circulating line has been stored in the back-side application supply pan triggers an operation of the control part to supply the treatment liquid to the back-side application removing and circulating line.

5. The treatment liquid application apparatus as claimed in claim 1, wherein
an elapse of a period of time required for finishing filling the front-side application removing and circulating line with the treatment liquid by the liquid flow creation part triggers an operation of the control part to terminate an operation of supplying the treatment liquid to the front-side application removing and circulating line, and
an elapse of a period of time required for finishing filling the back-side application removing and circulating line with the treatment liquid by the liquid flow creation part triggers an operation of the control part to terminate an operation of supplying the treatment liquid to the back-side application removing and circulating line.

6. An image forming system comprising:

an ink-jet printer; and
the treatment liquid application apparatus claimed in any one of claims 1-5 provided on an upstream side of the ink-jet printer in a direction in which the to-be-recorded-on medium is conveyed.

FIG.1

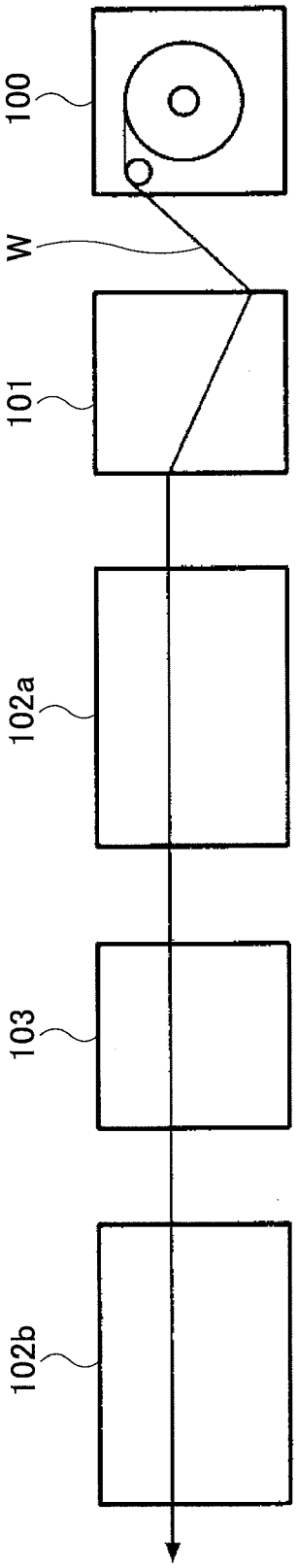
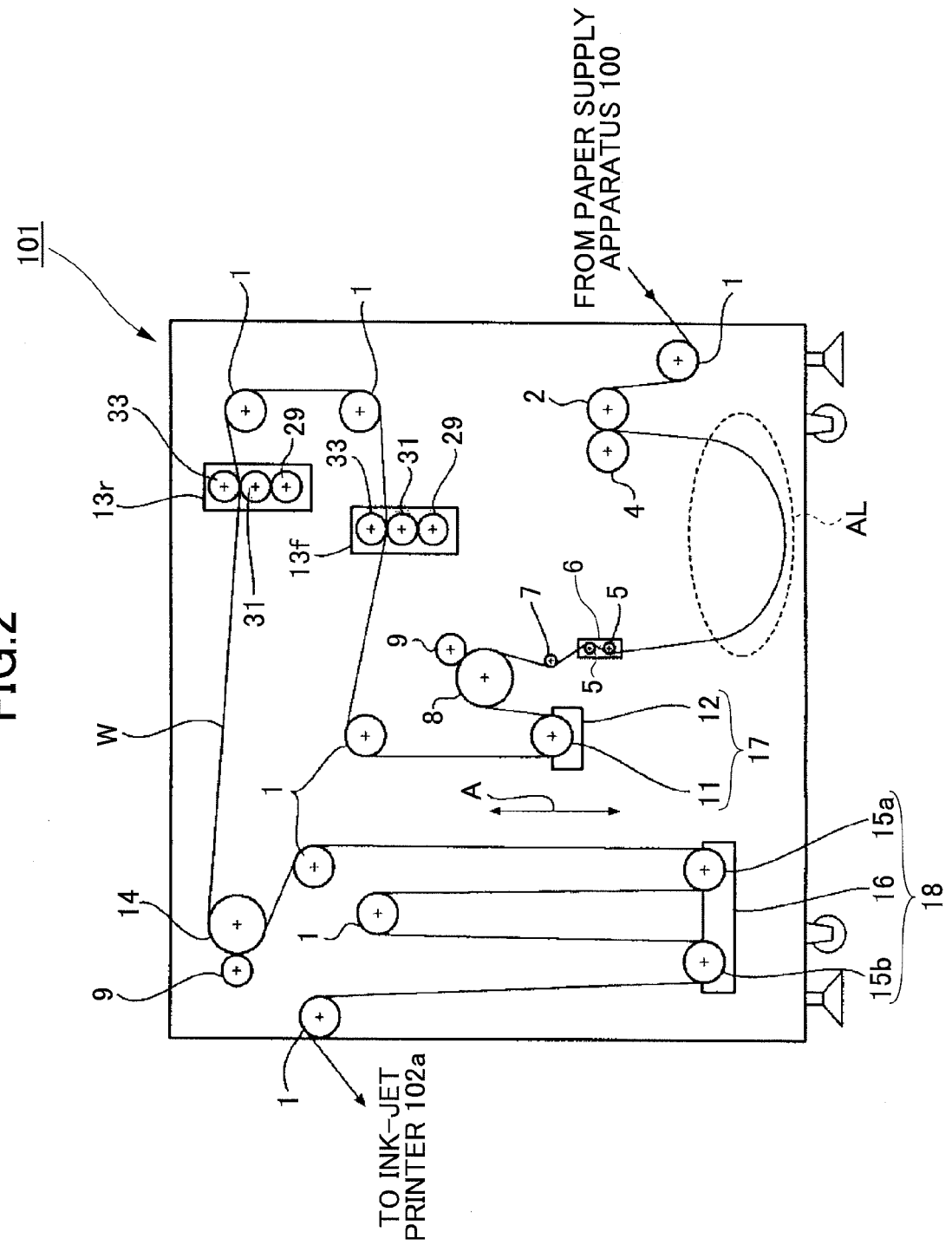


FIG.2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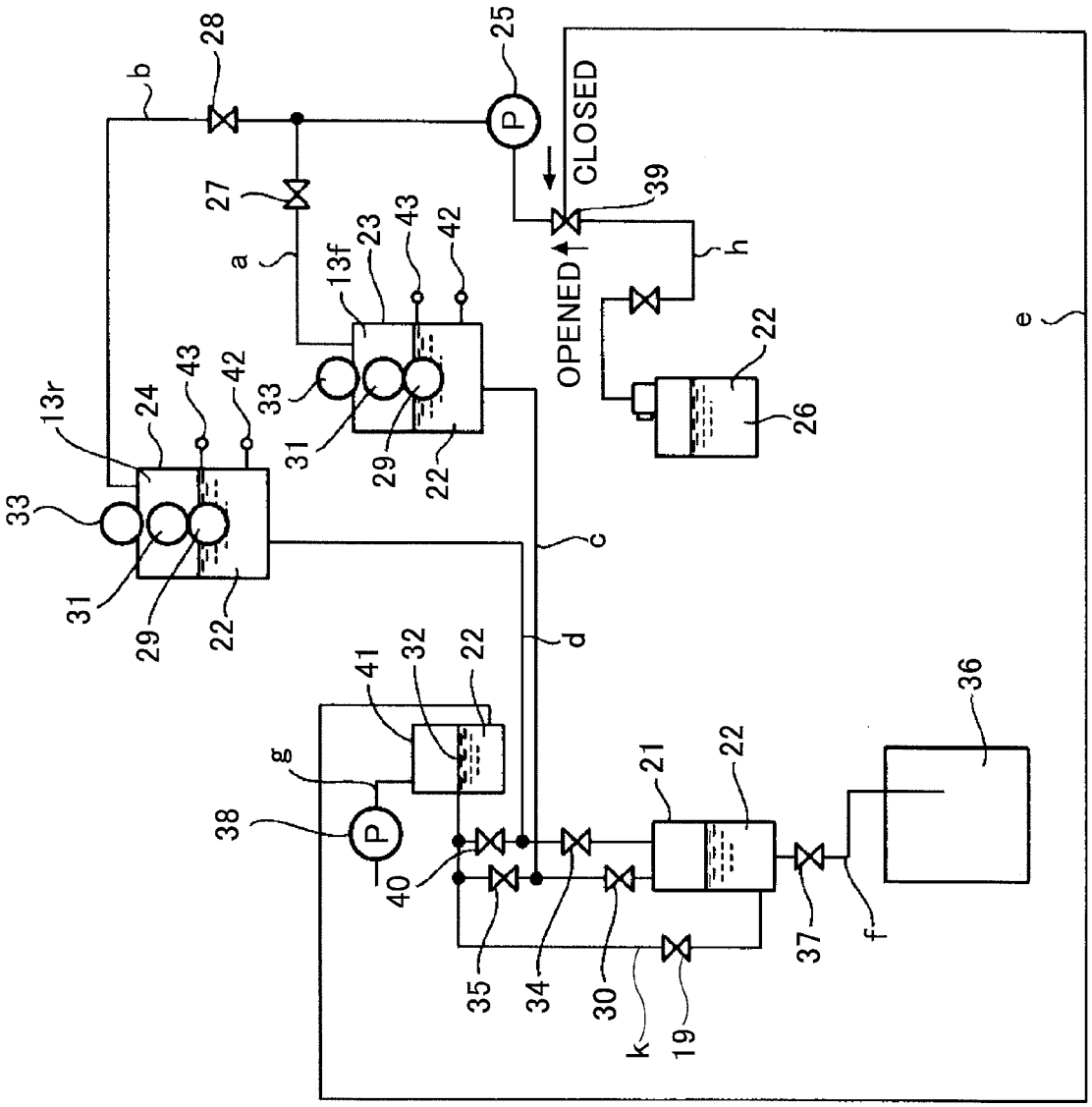
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c
d
41
32
22
g
38
P
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34
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k
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FIG.3

FIG.4

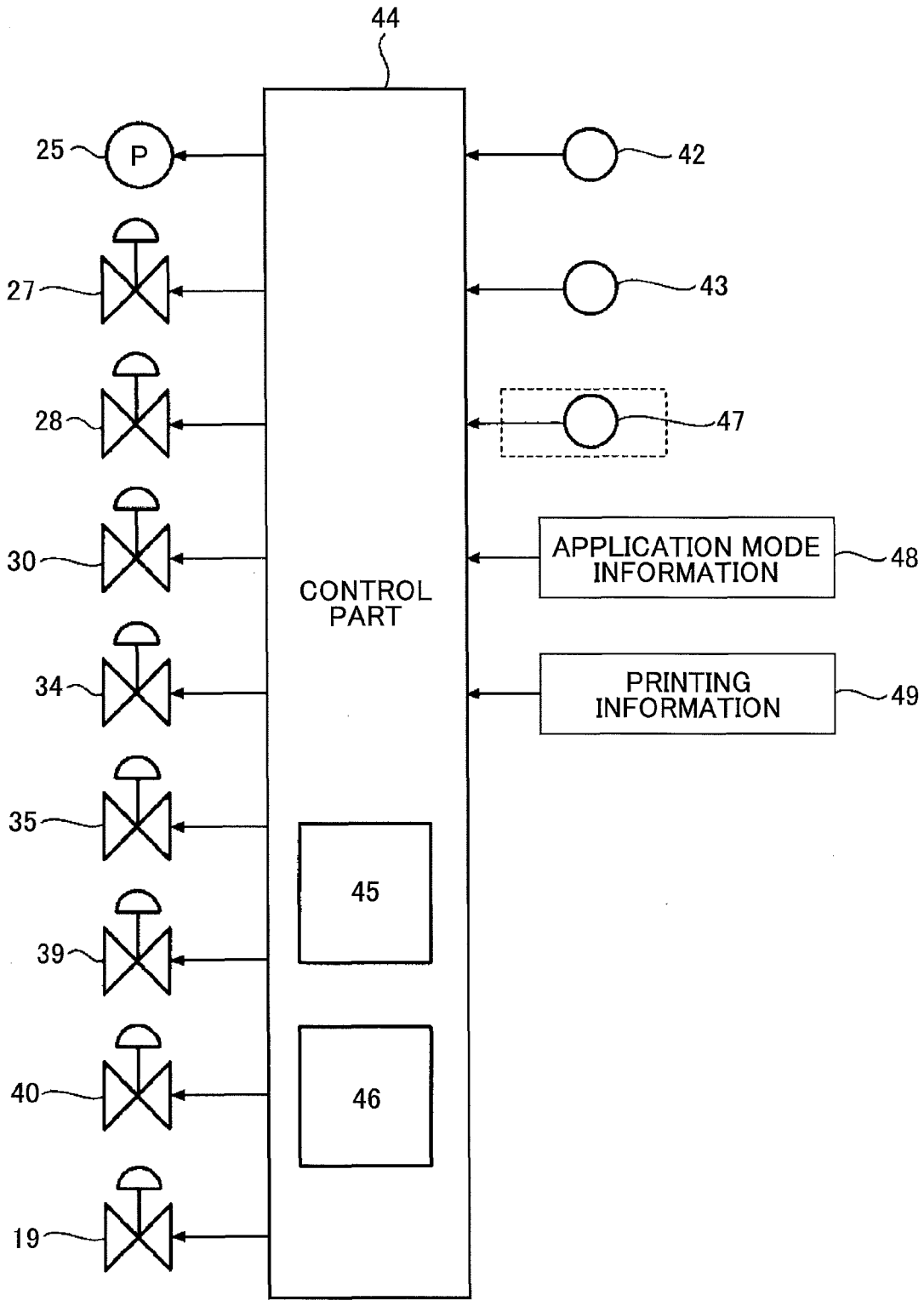

44
25
P
42
27
43
28
47
30
APPLICATION MODE INFORMATION
48
CONTROL PART
34
PRINTING INFORMATION
49
35
45
39
40
46
19

FIG.5

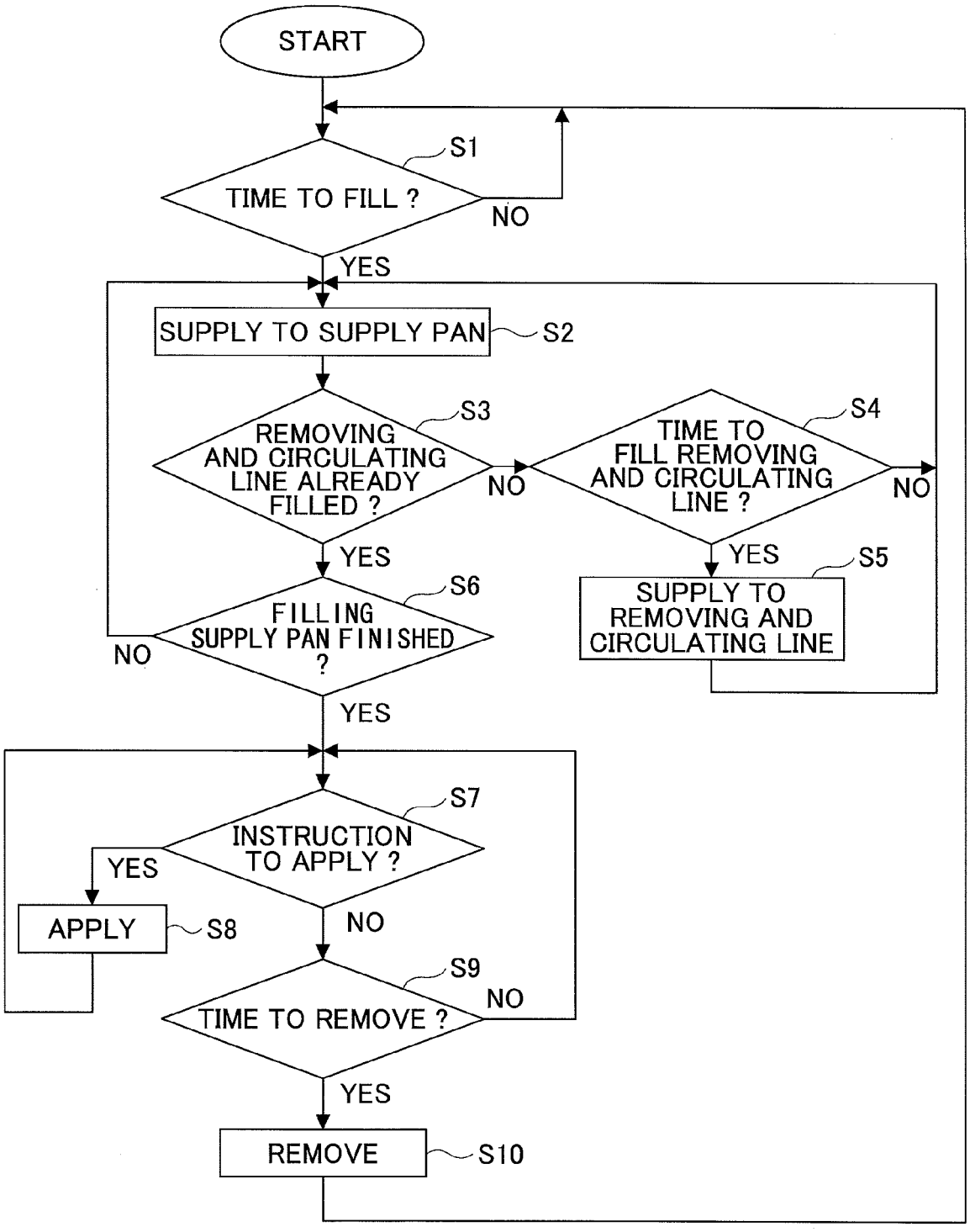

START
S1
TIME TO FILL ?
NO
YES
SUPPLY TO SUPPLY PAN
S2
S3
REMOVING AND CIRCULATING LINE ALREADY FILLED ?
NO
S4
TIME TO FILL REMOVING AND CIRCULATING LINE ?
NO
YES
YES
S5
SUPPLY TO REMOVING AND CIRCULATING LINE
S6
FILLING SUPPLY PAN FINISHED ?
NO
YES
S7
INSTRUCTION TO APPLY ?
YES
APPLY
S8
NO
S9
TIME TO REMOVE ?
NO
YES
REMOVE
S10

FIG.6A

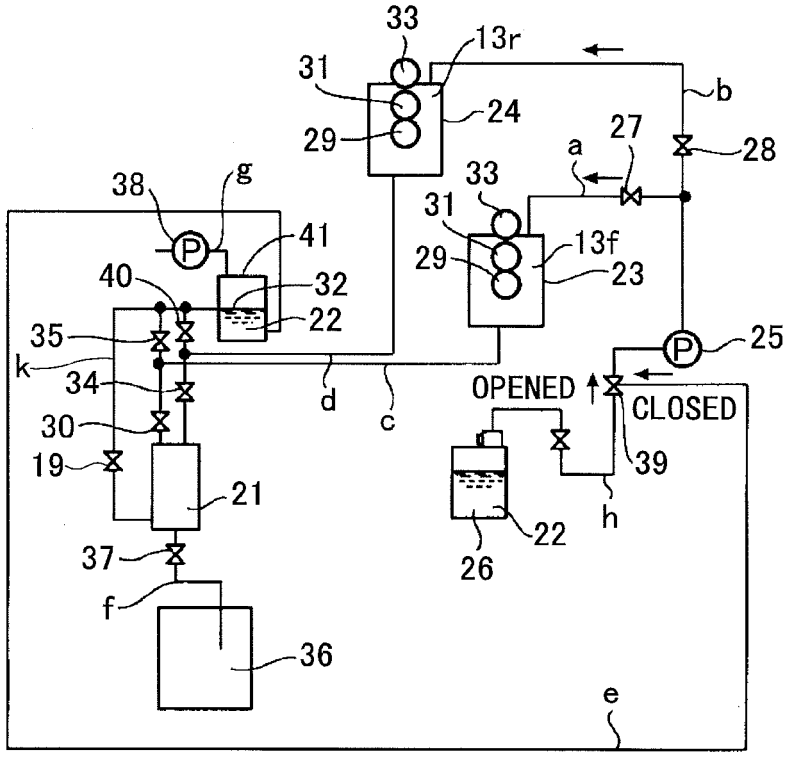

33
13r
31
24
29
b
27
28
a
38
g
33
31
41
13f
29
23
40
32
22
35
25
k
34
d
c
OPENED
CLOSED
30
39
19
21
h
22
37
26
f
36
e

FIG.6B

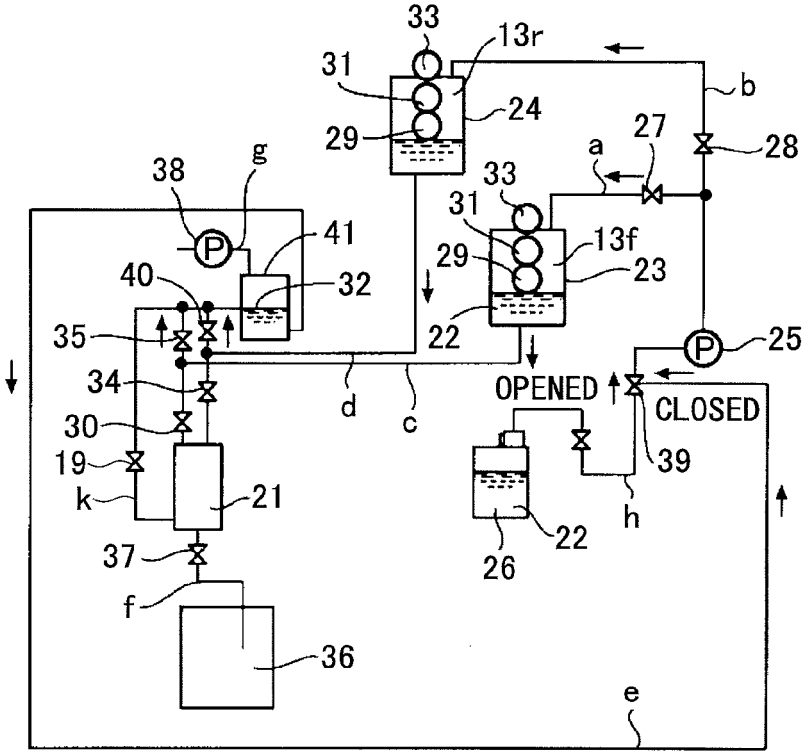

33
13r
31
24
29
b
27
28
a
38
g
33
31
41
13f
29
23
40
32
22
35
25
34
d
c
OPENED
CLOSED
30
39
19
k
21
h
22
37
26
f
36
e

FIG.7

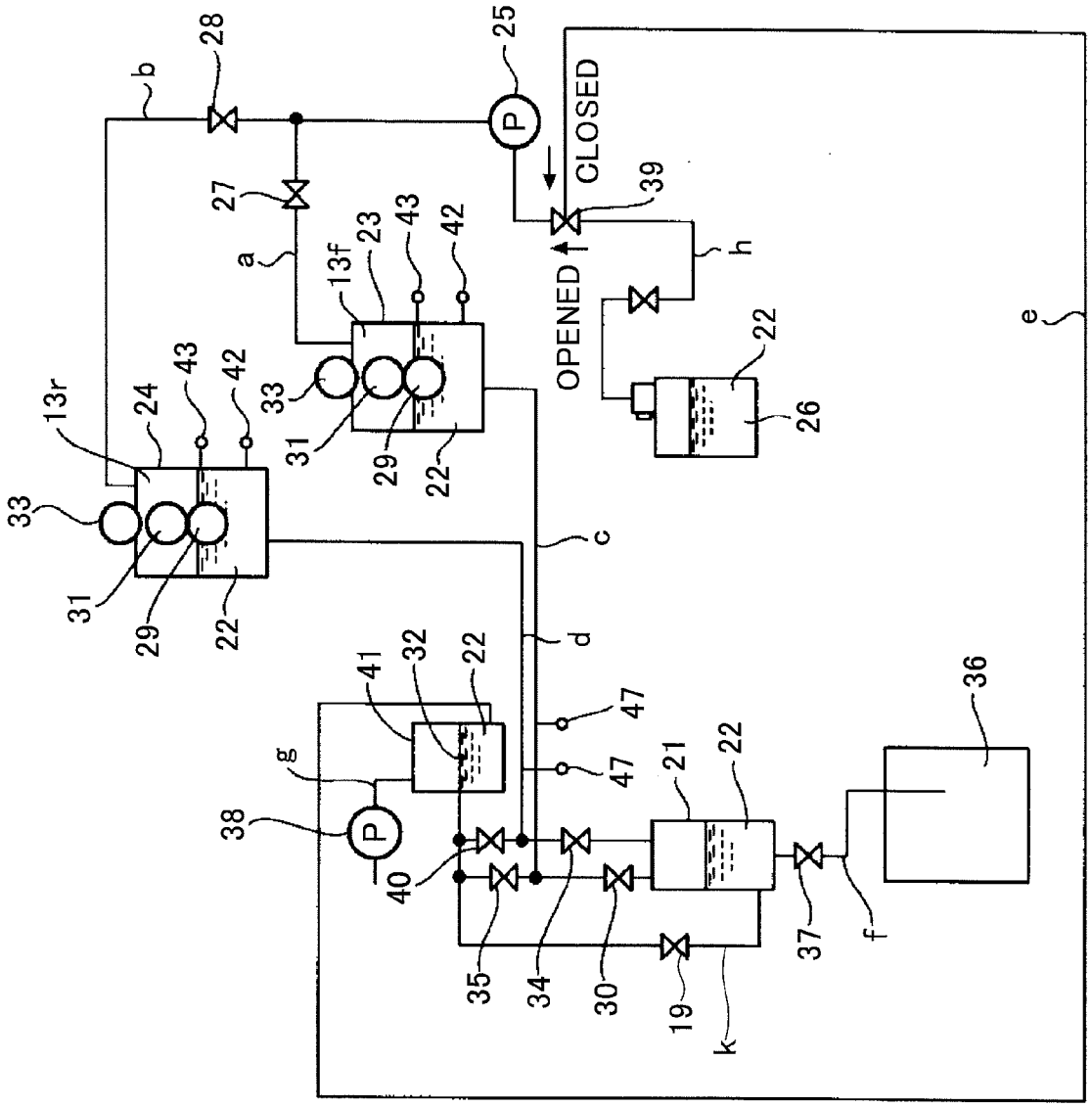

b
28
25
P
CLOSED
OPENED
39
27
a
13f
23
43
42
h
22
26
e
33
31
29
22
c
d
41
32
22
47
47
g
38
P
40
21
22
36
37
f
35
34
30
19
k

FIG.8

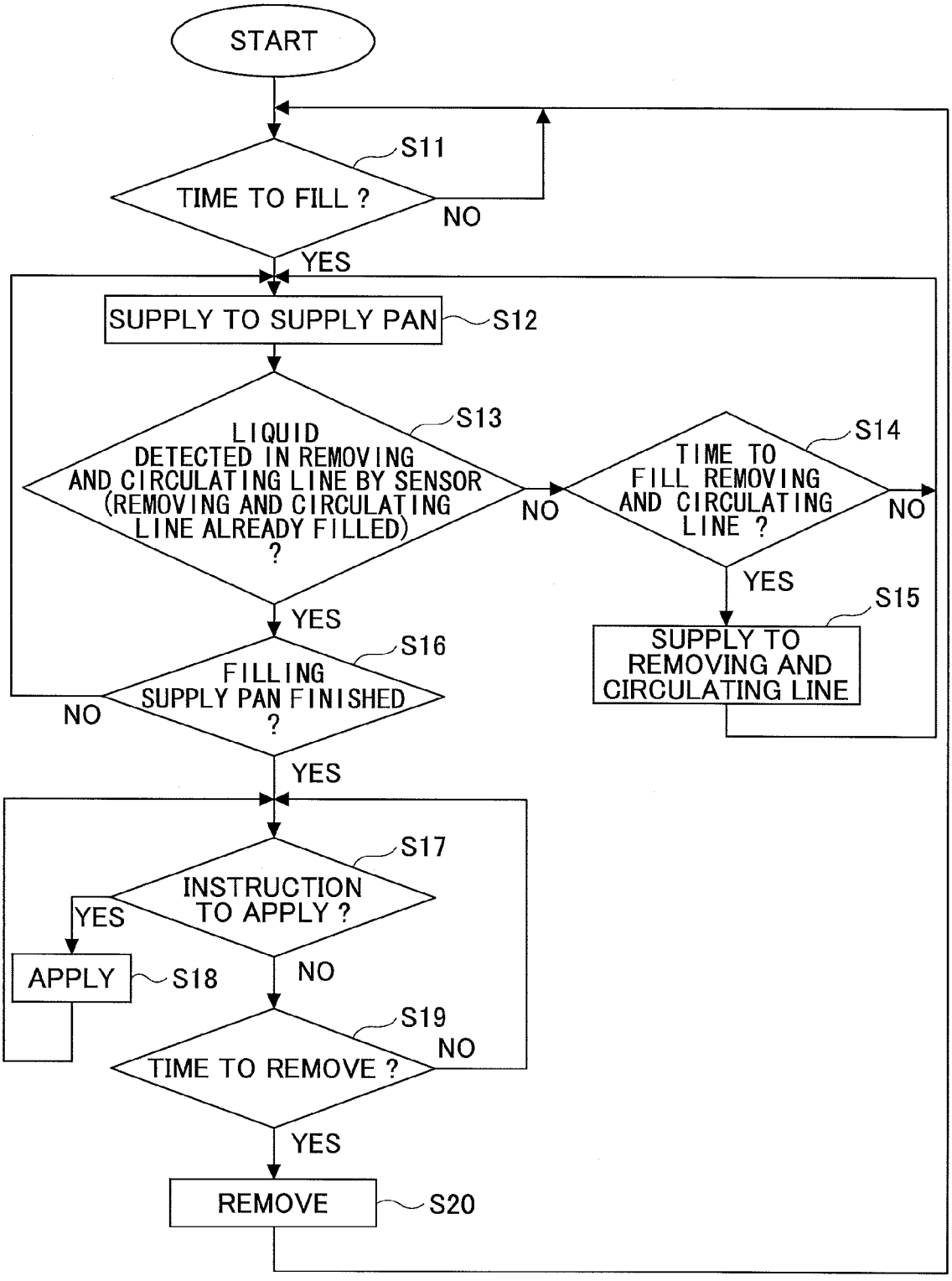

START
S11
TIME TO FILL ?
NO
YES
SUPPLY TO SUPPLY PAN
S12
LIQUID DETECTED IN REMOVING AND CIRCULATING LINE BY SENSOR (REMOVING AND CIRCULATING LINE ALREADY FILLED) ?
S13
NO
TIME TO FILL REMOVING AND CIRCULATING LINE ?
S14
NO
YES
S15
SUPPLY TO REMOVING AND CIRCULATING LINE
YES
FILLING SUPPLY PAN FINISHED ?
S16
NO
YES
INSTRUCTION TO APPLY ?
S17
YES
APPLY
S18
NO
TIME TO REMOVE ?
S19
NO
YES
REMOVE
S20

FIG.9

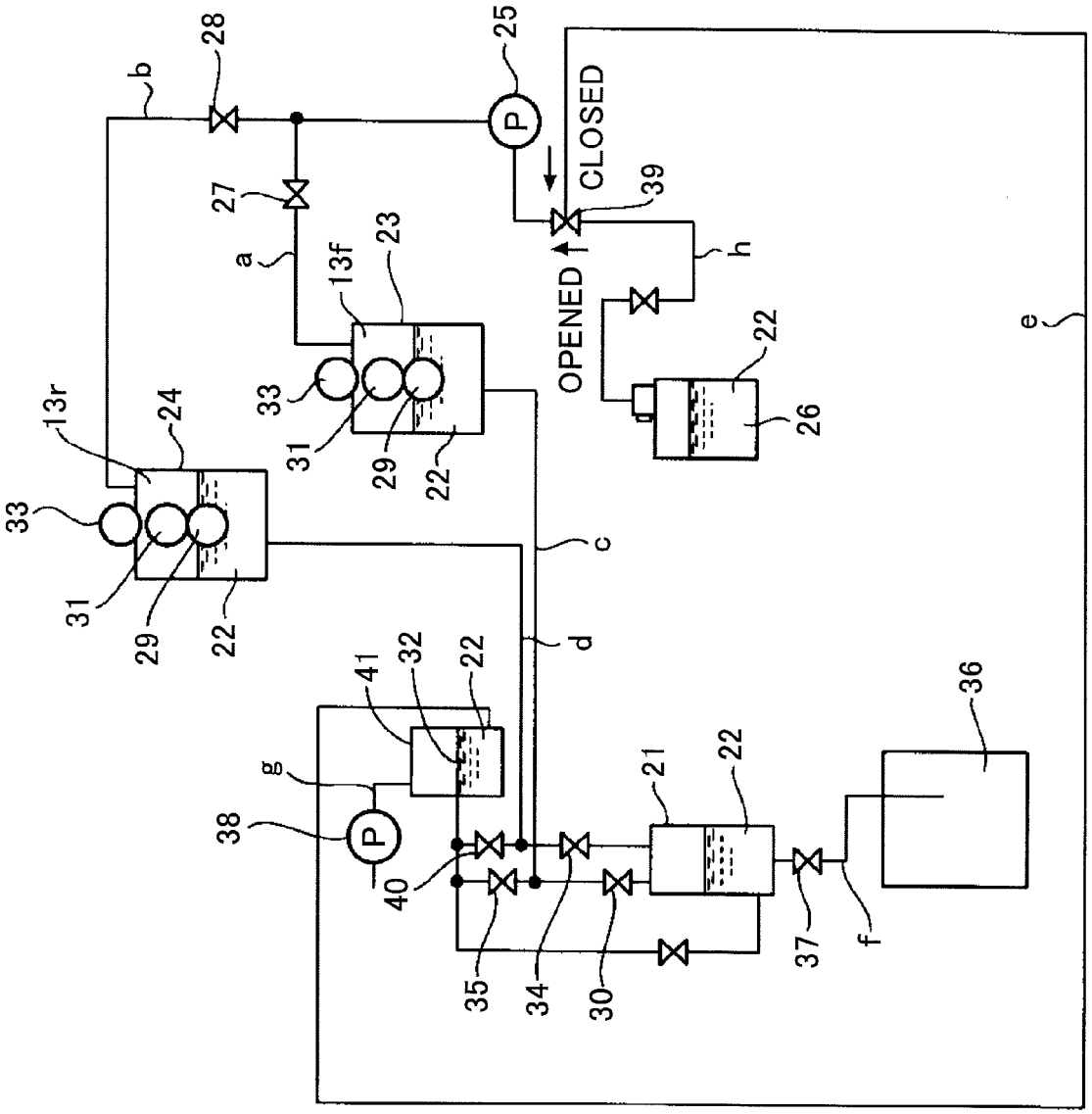
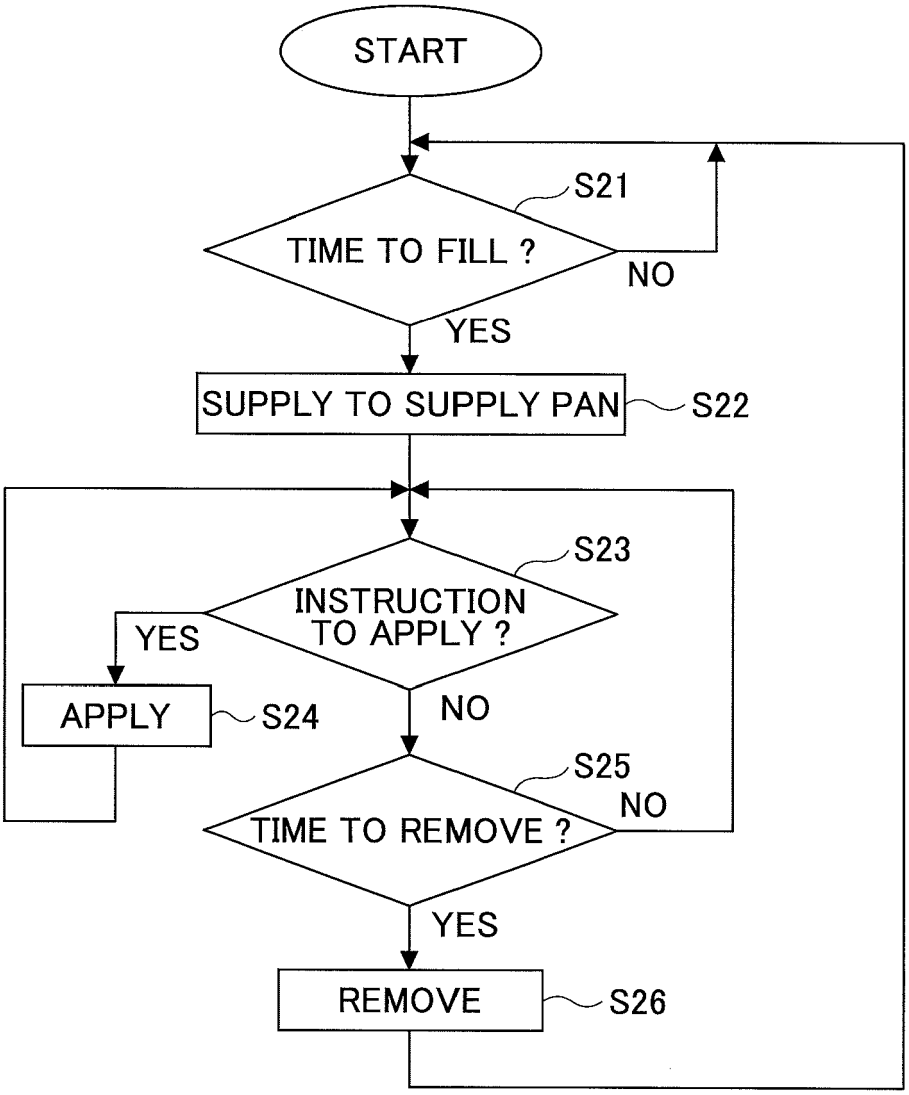

b
28
25
P
CLOSED
27
39
a
13f
23
OPENED
h
22
26
e
33
31
29
22
13r
24
c
d
41
32
22
g
38
P
40
21
22
36
35
34
30
37
f

FIG.10


START
S21
TIME TO FILL ?
NO
YES
SUPPLY TO SUPPLY PAN
S22
S23
INSTRUCTION TO APPLY ?
YES
APPLY
S24
NO
S25
TIME TO REMOVE ?
NO
YES
REMOVE
S26

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 8360

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 075 128 A (GNUECHTEL HERMAN C [US] ET AL) 24 December 1991 (1991-12-24) * column 2, line 32 - column 4, line 2; figures 1,2 *	1	INV. B41J11/00 B05C1/08
A	US 2011/310185 A1 (KOMABA HIROYOSHI [JP] ET AL) 22 December 2011 (2011-12-22) * paragraph [0041] - paragraph [0049] *	1,6	
A	US 2012/262519 A1 (HOSHINO SEIJI [JP] ET AL) 18 October 2012 (2012-10-18) * paragraph [0041] *	1,6	
A	US 6 379 463 B1 (KELLEY JOHN [US] ET AL) 30 April 2002 (2002-04-30) * column 3, line 26 - line 35; figures 1,2 *	1	

TECHNICAL FIELDS SEARCHED (IPC)
B41J
B05C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 February 2014	Diaz-Maroto, V

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12-02-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5075128 A	24-12-1991	NONE	
US 2011310185 A1	22-12-2011	JP 2012000821 A	05-01-2012
		US 2011310185 A1	22-12-2011
US 2012262519 A1	18-10-2012	JP 2012218374 A	12-11-2012
		US 2012262519 A1	18-10-2012
US 6379463 B1	30-04-2002	AU 2143200 A	15-05-2000
		US 6379463 B1	30-04-2002
		WO 0024525 A2	04-05-2000

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Patent documents cited in the description

- JP 2007050315 A **[0007]**
- JP 2012252416 A **[0144]**