(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 162 518 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.12.2001 Bulletin 2001/50

(51) Int Cl.[7]: **G03G 21/00**

(21) Application number: **01114018.3**

(22) Date of filing: **08.06.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **09.06.2000 JP 2000173577**

(71) Applicant: **MINOLTA CO., LTD.**
Chuo-Ku, Osaka-Shi, Osaka 541-8556 (JP)

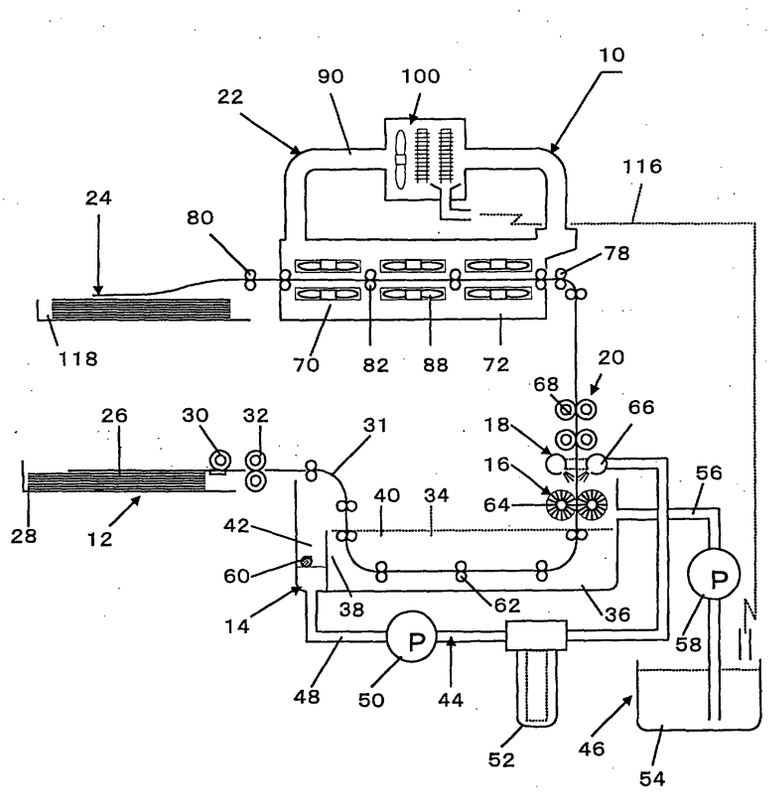
(72) Inventor: **Yamamoto, Masashi,**
c/o Minolta Co., Ltd.
Chuo-ku, Osaka-shi, Osaka 541-8556 (JP)

(74) Representative: **Glawe, Delfs, Moll & Partner**
Patentanwälte
Postfach 26 01 62
80058 München (DE)

(54) Sheet regenerating apparatus

(57) A sheet regenerating device 10 has a dip station 14 that applies a liquid 34 to a sheet 26 with a printing material, a remove station 16 that removes the printing material to which the liquid has been applied by the dip station, and a dehumidified air supply station 100 that supplies a dehumidified air to the sheet before the application of the liquid and/or after the removal of the printing material.

Fig. 1



EP 1 162 518 A2

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a sheet regenerating apparatus. In particular, the present invention relates to a sheet regenerating apparatus in which a printed or copied sheet of paper or plastic film is deprived of a printing material such as ink and toner fixed thereon and thereby regenerated so that it can be reused for printing or copying. Further, the present invention relates to a sheet regenerating apparatus that uses a certain liquid for removing the printing material from the sheet.

BACKGROUND OF THE INVENTION

[0002] Conventionally, there have been proposed a variety of regenerating devices that use a certain liquid for removing the printing material from the sheet. In general, the regenerating device of this type includes a feed station for feeding sheets each bearing printing material, e.g., papers or films copied or printed with toner; a wet station for applying a liquid to wet the sheets fed from the sheet feeding station; a printing material remove station for removing the printing material from the wetted sheet; a dry station (post-dry station) for drying the wetted sheet from which the printing material has been removed; and a receiving station for receiving the dried sheets.

[0003] In the meantime, there has been proposed a sheet capable of being deprived of printing material therefrom if it has been pre-dried before being fed into the wet station. For this reason, another sheet regenerating device in which an additional dry station (pre-dry station) is mounted before the wet station for pre-drying the sheet prior to its wetting. Each of the pre-drying and post-dry stations in the conventional sheet regenerating device has a roller or plate with a built-in heater for removing water or moisture included in the sheet.

[0004] However, the heating of the sheet by the use of the roller or plate with the built-in heater causes following several drawbacks:

(a) Water vapor existing in the vicinity of the dried-sheet surfaces prevents and delays the complete drying of the sheet.
(b) In the regeneration of the sheet having a base layer of pulp fibers and a waterproofing layer coated on the base layer, high temperature (e.g., about 160°C) applied by the heated member or roller causes the water in the sheet to boil, which results in disadvantageous small bubbles in the waterproofing layer.
(c) Synthetic or transparent sheets made of resin, when they are heated, tend to deform (e.g., curl) and lose their flatness, which decreases a recycling possibility of the regenerated sheet.
(d) In general the roller is heated up to about 150°C, which requires the dry station to be insulated. Otherwise, the high temperature air with a great amount of moisture flows out and then deteriorates the atmosphere.

SUMMARY OF THE INVENTION

[0005] Accordingly, a sheet regenerating apparatus of the present invention has a dip station that applies a liquid to a sheet with a printing material; a remove station that removes the printing material to which the liquid has been applied by the dip station; and a dehumidified air supply station that supplies a dehumidified air to the sheet before the application of the liquid and/or after the removal of the printing material.

[0006] In another aspect of the present invention, the sheet regenerating apparatus has a dry station that dries the sheet while the sheet is transported, wherein the dehumidified air supply station supplies the dehumidified air to the dry station.

[0007] In another aspect of the present invention, the dry station has a device that blows the dehumidified air against the sheet.

[0008] In another aspect of the present invention, the dehumidified air supply station has a dehumidifying device that collects water from the air.

[0009] In another aspect of the present invention, the water collected from the air by the dehumidifying device is returned to the liquid.

[0010] In another aspect of the present invention, the regenerating apparatus has a supplemental reservoir for a supplement of the liquid, wherein the liquid collected by the dehumidifying device is retained in the supplemental reservoir.

[0011] In another aspect of the present invention, the regenerating apparatus has a first transporting member that transports the air dehumidified by the dehumidifying device from the dehumidified air supply station to the dry station, and a second transporting member that transports the air with a vapor generated from a water contained in the sheet from the supply station to the dry station to the dehumidified air supply station.

[0012] In another aspect of the present invention, the sheet to which the dehumidified air is supplied is a sheet from which the printing material has been removed therefrom.

[0013] In another aspect of the present invention, the sheet to which the dehumidified air is supplied is a sheet on which the printing material is supported thereon.

[0014] In another aspect of the present invention, the regenerating apparatus has a first receiver that receives the sheet on which the printing material is supported thereon, and a first dehumidified air supplier that supplies the dehumidified air from the dehumidified air supply station to the sheet received in the receiver

[0015] In another aspect of the present invention, the first receiver is covered by a cover so that an interior of the receiver is isolated from an exterior thereof.

[0016] In another aspect of the present invention, the regenerating apparatus has a second receiver for receiving the sheet on which the printing material has been removed therefrom, and a second dehumidified air supply station that supplies the dehumidified air from the dehumidified supply station to the sheet received in the second receiver.

[0017] In another aspect of the present invention, the second receiver is covered by a cover so that an interior of the second receiver is isolated from an exterior thereof.

[0018] In another aspect of the present invention, the regenerating apparatus has a sheet transporting pass to which the dehumidified air is supplied from the dehumidified air supply station, wherein the sheet with the printing material to which the liquid will be applied and the sheet from which the printing material has been removed are transported in the sheet transporting pass.

[0019] In another aspect of the present invention, the sheet transporting pass has a device that blows the dehumidified air against the sheet.

[0020] In another aspect of the present invention, the dehumidified air has a humidity of less than about 20%.

[0021] In another aspect of the present invention, the printing material is a toner and the dehumidified air has a temperature of about less than 55°C.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is a cross sectional view of a regenerating device according to the first embodiment of the present invention;
Fig. 2 is a cross sectional view of the dry station of the regenerating device shown in Fig. 1;
Fig. 3 is a dehumidifier provided in the dry station shown in Figs. 1 and 2;
Fig. 4 is a cross sectional view of the regenerating device according to the second embodiment of the present invention;
Fig. 5 is a cross sectional view of the sheet regenerating device according to the third embodiment of the present invention; and
Fig. 6 is a cross sectional view of the regenerating device according to the fourth embodiment of the present invention.

PREFERRED EMBODIMENTS OF THE INVENTION

[0023] With reference to the drawings, several embodiments of the present invention will be described hereinafter. In the several drawings, like reference numerals indicate like parts throughout the embodiments.

I. First Embodiment

1. Outline of regenerating device

[0024] Fig. 1 shows a sheet regenerating device 10 according to the first embodiment of the present invention for regenerating a sheet of paper and plastic film, for example, by removing a printing material such as toner from the sheet.

[0025] Generally, the regenerating device 10 includes a feed station 12 for receiving one or more sheets to be regenerated by the device 10 and then feeding the same; a wet station 14 for applying a liquid and thereby wetting the sheet fed from the supply station 12; a remove station 16 for removing the printing material from the wetted sheet; a rinse station 18 for spraying a liquid onto the sheet from which the printing material has been removed and thereby rinsing out of the printing material that may still exist on the sheet; a water remove station 20 or squeezing station for removing water remaining on the sheet from which the printing material has been removed; a dry station 22 for drying the sheet so that the sheet can be reused for printing; and a discharge station 24 for discharging the dried sheet and then receiving the discharged sheet.

2. Sheet supply station

[0026] The sheet supply station 12 has a supply tray 28 for receiving a stack of sheets 26. Preferably, the sheet stacked on the tray 28 is a special sheet that is suitably designed to be regenerated by the likes of this regenerating device 10. The sheet supply station 12 also has a sheet separating mechanism 30 for separating the topmost sheet from other sheets and then feeding the same into the next station, and a sheet transporting mechanism 32 for transporting the sheet separated from others by the sheet separating mechanism 30, along a sheet transporting pass 31.

[0027] Advantageously, the separating mechanism 30 has a pickup roller and a separation pad that makes a contact with a periphery surface of the pickup roller. In operation of the mechanism, the pickup roller brings into contact with the topmost sheet in the stack of sheets and then feed the sheet toward the sheet transporting mechanism 31 by the rotation thereof. The topmost sheet is then separated from another sheet underneath the topmost sheet by the separation pad. Although this type of separating mechanism is preferably used, it may be replaced by another separating mechanism.

[0028] Also preferably, the sheet transporting mechanism 32 may be a conventional roller transporting mechanism available for a sheet transporting device in the copying and printing devices. The typical roller transporting mechanism includes a pair of parallel shafts, one of which being connected with a drive source such as motor. Each shaft carries a plurality of rollers made of rubber, for example, each spaced a certain distance along a longitudinal axis of the shaft away from the other. The two shafts are positioned so that each roller on one shaft makes a peripheral contact with another roller on the other shaft, allowing the opposing rollers to nip and transport the sheet.

3. Dip station

[0029] The dip station 14 has a container 36 for receiving a cleaning liquid 34. The cleaning liquid 34 may be a water without any additives. In order to facilitate the removal of the printing material from the sheet 26, a surface active agent of about 0.01% (=weight of agent / weight of water) may be added to the liquid. Also, in order to prevent the decomposition of the water, a suitable preservative may be added to the water.

[0030] An interior of the container 36 is divided by a partition 38 or overflow gate into two chambers; a primary chamber or dipping chamber 40 in which the sheet is dipped in the cleaning liquid 34 and an additional chamber 42 for receiving the cleaning liquid 34 that has overflowed from the dipping chamber 40. Also, the container 36 is provided with a circulation unit 44 for returning the cleaning liquid 34 in the additional chamber 42 to the dipping chamber 40 and also collecting impurities including the printing material contained in the cleaning liquid while the cleaning liquid is transported from the additional chamber to the dipping chamber. Further, the container 36 is also equipped with a supplemental unit 46 for the supplement of the cleaning liquid 34 for the dipping chamber 40.

[0031] In the embodiment, the liquid circulation unit 44 has a circulation passage 48. One end of the passage 48 is connected to a bottom of the additional chamber 42 and the other end thereof is positioned above the dipping chamber 40. This allows the cleaning liquid 34 in the additional chamber 42 to be transported through the passage 48 and then supplied from above and to the dipping chamber 40. Also, the circulation passage 48 has a pump 50 for circulating the cleaning liquid 34 along the passage and a filter 52 for collecting and removing the impurities from the cleaning liquid 34.

[0032] The supplemental unit 46 has a supplemental container or reservoir 54 for receiving the supplemental cleaning liquid 34, a liquid passage 56 having one end positioned in the cleaning liquid 34 in the reservoir 54 and the other end positioned above the cleaning liquid 34 in the dipping chamber 40, and a pump 58 for transporting the supplemental cleaning liquid 34 from the reservoir 54 to the dipping chamber 40 through the passage 56. The operation of the pump 56 of the supplemental unit 46 is controlled in response to a signal transmitted from a water gauge 60 for detecting a level of the liquid contained in the additional chamber 42, so that the liquid level in the additional chamber 42 is kept constant. Although the water gauge 60 may be any one of conventional level detectors, a combination of a float and a switch is preferably used.

[0033] The dipping chamber 40 of the container 36 houses a plurality of sheet transporting mechanisms 62 for transporting the sheet 26 through the cleaning liquid 34 in the dipping chamber 40, and a guide mechanism (not shown) for guiding the sheet 26 between the neighboring sheet transporting mechanisms 62. The sheet transporting mechanism may be the above-described roller transporting mechanism. The guide mechanism may be made of a pair of spaced guide panels defining a sheet pass therebetween. Preferably, each of the guide panels has openings, allowing the cleaning liquid 34 to move in and out of the sheet pass through the openings. The guide mechanism may be made of a plurality of wires each extending along the sheet transporting direction and spaced a certain distance apart from another in the transverse direction perpendicular to the sheet transporting direction.

4. Remove station

[0034] The remove station 16 has a pair of brush rollers 64 opposed to each other through the sheet transporting pass. Each brush roller 64 has a shaft mounted for rotation and connected to a drive unit or motor not shown. Mounted around a periphery of the shaft is a base member or cloth in which a number of fibers of nylon for example are planted. This causes, by the driving of the motor connected to the shaft, the fibers of the brush rollers repeatedly bring into contact with opposite surfaces of the sheet 26 transported along the sheet transporting pass 31 to remove the printing material from the sheet.

[0035] Preferably, a peripheral of the brush roller 64 runs several to several-tens times faster than the sheet 26 being transported in the dip station.

[0036] Also preferably, the drive motor of the brush rollers 64 are controlled so that, when a leading edge of the sheet enters the opposing region of the brush rollers 64, the fibers apply a forward frictional force to the sheet and, on the other hand, when a tailing edge of the sheet leaves the opposing region, the fibers apply a backward frictional force to the sheet.

[0037] Although the brush rollers 64 are used for contacting and thereby removing the printing material from the sheet 26, another type of roller with a flexible member such as sponge or cloth mounted around the shaft may be used instead.

5. Rinse station

[0038] The rinse station 18 has a pair of spray nozzles 66. The nozzles 66 are positioned on opposite sides of the sheet transporting pass 31 and above the brush roller 64 so that the nozzles 66 spray the cleaning liquid 34 against the opposite sides of the sheet 26 that is moving or has moved past between the pair of brush rollers 64. For this purpose, the spray nozzles 66 are connected to the liquid circulating passage 48 so that the cleaning liquid 34 purified in its transportation through the circulating passage 48 is supplied.

[0039] Preferably, the spray nozzles 66 are formed by a single tube or conduit with a number of small openings defined therein at regular intervals in its longitudinal direction. This tube is turned around in the form of U and the two opposing straight portions are positioned on opposite sides of the sheet transporting pass.

6. Water remove station

[0040] The water remove station 20 has a pair of squeeze rollers 68 positioned on opposite sides of the sheet transporting pass 31 with outer peripheries thereof contacted with each other on the pass 31. One of the pair of squeeze rollers 68 is connected to a motor not shown so that by the driving of the motor the pair of contacting squeeze rollers 68 rotate to transport the sheet in the sheet transporting direction as they squeeze the water out of the sheet. Although in this embodiment two pairs of squeeze rollers are provided along the sheet transporting pass 31, one of which may be eliminated.

7. Dry station

[0041] The dry station has a housing 72 defining a dry chamber 70 including a part of the sheet transporting pass 31. As best shown in Fig. 2, the housing 72 has an inlet 74 or inlet opening defined therein for introducing the wet sheet 26 into the dry chamber 70 and an outlet 76 or outlet opening also defined therein for discharging the dried sheet 26 from the dry chamber 70. As shown in Fig. 1, a sheet transporting mechanism 78 is provided adjacent and outside the inlet 74 for guiding the sheet 26 fed from the water remove station 20 toward the inlet 74. Likewise, another sheet transporting mechanism 80 is provided adjacent and outside the outlet 76 for guiding the sheet 26 discharged from the outlet 76 toward the discharge station 24.

[0042] Referring again to Fig. 2, a plurality of sheet transporting mechanisms 82 are positioned at certain intervals along the sheet transporting pass 31 between the inlet 74 and the outlet 76 in the dry chamber 70. The above-described roller transporting mechanism provided in the dip station 14 is preferably used for the sheet transporting mechanisms 82. A sheet guide not shown is provided between the neighboring sheet transporting mechanisms 82 for guiding the sheet 26 transported along the sheet transporting pass 31. Preferably, the sheet guide is formed by a pair of guide plates each with a number of openings defined therein for causing fresh air to make contact with the drying sheet. Alternatively, the sheet guide is formed by a plurality of wires each extending in the sheet transporting direction and spaced a certain distance from another in the transverse direction.

[0043] Preferably, the inlet 74 and the outlet 76 are provided with seal mechanisms for airtightly sealing the inlet and outlet openings, respectively. For example, the seal mechanism has a transporting mechanism 82 with a pair of opposing rollers provided adjacent opening 74 (76). Also, the seal has two flexible members 84 (86) made from rubber

sheet or plastic sheet and supported at one end thereof on upper and lower edges of the opening so that the other ends of the flexible members make contact with peripheries of the associated rollers, respectively.

[0044] Between the neighboring sheet transporting mechanisms 82, a drying means in the form of blower or fan 88 is provided above and below the upper and lower guide members, respectively, so that air is fed from the fans 88 through the openings defined in the upper and lower guide members onto the opposite sides of the sheet 26 as it is guided by the guide members. A heater may be provided adjacent the guide members or fans 88 along the guide members so that air heated by the heater is impinged onto the sheet.

[0045] Preferably, a region in which air is impinged onto the sheet being transported from the inlet 74 to the outlet 76 is about 60cm where the sheet is transported at about 10 to 20 mm/sec. Also preferably, a distance between the fan 88 and the sheet transporting pass 31 is about 1 to 2cm and a flow rate of air blown out from the fan 88 is about 5m/sec. Further, a distance between the upper and lower sheet guides is determined as small as possible, preferably about 4mm.

[0046] A heated air supply or transport means in the form of air circulation pass 90 is connected at its opposite ends to the dry chamber 70 for collecting wet air or moisture from the dry chamber and then supplying dried air into the dry chamber. Preferably, one end or outlet 92 of the circulation pass 90 is provided near the outlet 76 of the chamber and the other end or inlet 94 is provided near the inlet 74 of the chamber. Alternatively, the outlet 92 and inlet 94 may be provided near the inlet 74 and outlet 76, respectively. Also preferably, a heater 96 made of electric heater is provided in the outlet 92 and a circulation fan 98 is provided in the inlet 94. The heater 96 and fan 98 are electrically connected to a power source through a controller (both not shown).

[0047] A dehumidified air supply station or dehumidifier 100 is positioned between the inlet 92 and outlet 94 for dehumidifying air transported in the circulation pass 90 from the inlet 94 toward the outlet 92. For example, as best shown in Fig. 3, the dehumidifier 100 has a passage or tube 102 for circulating a suitable heat transporting substance or coolant. For this purpose, the tube 12 is equipped with a compressor 104 for compressing the coolant to generate a condensed high pressure and high temperature substance; a first heat exchanger 106 for exchanging heat between the high temperature condensed substance and the low temperature air; a decompression valve 108 for decompressing the condensed substance heat-exchanged at the first heat exchanger to generate low temperature condensed substance; and a second heat exchanger 110 for exchanging heat between the low temperature condensed substance and high temperature air, the low temperature and low pressure gaseous substance being returned to the compressor after the second heat exchange.

[0048] The first and second heat exchangers 106 and 110 are located in the air circulation pass 90 so that the first heat exchanger 106 takes a downward position adjacent the outlet 92 and the second heat exchanger 110 takes a upstream position adjacent the inlet 94. Preferably, each of the first and second heat exchangers 106 and 110 has a tube for transporting the substance, and a number of fins made of metal with an elevated heat transfer characteristic and supported on the outer periphery of the tube.

[0049] Further, a fan or rotary fan 112 is provided between the first heat exchanger 106 and the outlet 92. A receiver 114 is provided below the second heat exchanger 110 for collecting water droplets of cleaning liquid formed on the outer periphery of the second heat exchanger 110. The receiver 114 is fluidly connected to a collecting tube or passage 116 for transporting the cleaning liquid 34 collected by the receiver 114 into the supplemental reservoir 54 (see Fig. 1).

8. Discharge station

[0050] Referring back to Fig. 1, the discharge station 24 has a discharge tray 118 in which the sheet 26 dried at the dry station and then discharged from the dry station is stacked.

9. Sheet regenerating operation

[0051] Operations of the regenerating device 10 so constructed will be described hereinafter. The sheet or sheets 26 to be regenerated are stacked on the supply tray 28. Once the regenerating device 10 is driven, the topmost sheet in the stack is separated from others by the separating mechanism 30 and then fed out of the supply tray 28. Then, the sheet 26 is transported by the sheet transport mechanism 32 toward the dip station 14.

[0052] In the dip station 14, the sheet 26 is guided by the guide members and transported by the sheet transport mechanism as it is dipped in the cleaning liquid 34 in the dipping chamber 40 for a predetermined time. This changes the printing material on the sheet 26 into a condition in which it can be removed with a slight physical contact applied thereto. The sheet 26 picked up from the cleaning liquid 34 in the dipping chamber 40 is transported between the pair of brush rollers 64. The brush rollers 64 make frictional contacts with the opposite surfaces of the sheet 26, so that the printing material on the sheet 26 is removed therefrom. The spray nozzle 66 sprays the cleaning liquid 34 onto the surface portion of the sheet 26 that has moved past the opposing region of the brush rollers 64, rinsing away the residual printing material from the sheet. Simultaneously, the printing material transferred onto the brush rollers 64 are

also rinsed off by the spray.

[0053] The printing material rinsed down into the dipping chamber 40 and also separated from the sheet in the dipping chamber dipping chamber is flowed with the cleaning liquid 34 beyond the partition 38 into the additional chamber 42. The printing material is transported together with the cleaning liquid in the circulation pass 48 by the pump 50 into the filter 52 where it is separated from the cleaning liquid 34. The cleaning liquid 34 from which the printing material has been removed is then sprayed from the nozzle 66 onto the opposites sides of the sheet 26 and also to the brush rollers 64. During the operation, the water gauge 60 detects the water level in the additional chamber 42 and, if the water level becomes to be lower than the predetermined level, the pump 58 is energized so that the supplemental cleaning liquid 34 is fed from the supplemental reservoir 54 into the dipping chamber 40.

[0054] The sheet 26 from which the printing material has been removed is then squeezed by the pair of squeeze rollers 68 in the water remove station 20, which removes the most of the water on the sheet and also a part of water in the sheet therefrom. Then the sheet is transported into the dry station 22 where the dried air is impinged onto the opposite sides of the of the sheet. Subsequently, the dried sheet is discharged onto the discharge tray 118 of the discharge station 24.

10. Dry operation

[0055] A dry operation in the dry station 22 will be described in detail hereinafter. As shown in Fig. 2, air in the dry chamber 70 and the circulation pass 90 is transported by the circulation fan 98 and the rotary fan 112 from the inlet 94 to the outlet 92 in the circulation pass 90 and from the outlet 92 toward the inlet 94 in the dry chamber 70. Specifically, air (i.e., high temperature and high humidity air) entered the circulation pass 90 from the inlet 94 is changed to low temperature and low humidity air by the contact with the low temperature second heat exchanger 110 in the dehumidifier 100. Water droplets of cleaning liquid 34 generated by the contact of air with the second heat exchanger 110 is collected by the receiver 114 and then fed through the collecting passage 116 into the supplemental tank 54.

[0056] The low temperature and low humidity air is brought into contact with the high temperature first heat exchanger 106 and thereby changed into the low temperature and low humidity air. The low temperature and low humidity air is then transported by the rotary fan 112 into the outlet 92 of the circulation pass 90 where it is heated again by the heater 96 and, afterwards, fed into the dry chamber 70 near the outlet 76.

[0057] The high temperature and low humidity air (e.g., temperature of about 35 to 60°C and humidity of about 5 to 20%) supplied into the dry chamber 70 is applied to the top and bottom surfaces of the sheet 26 being transported by the sheet transporting mechanism 82 in the sheet transporting pass 31. As a result, a major part of the water remaining not only on the surface of the sheet but also in its interior is removed therefrom.

[0058] The water removed from the sheet 26, now in the form of high temperature and high humidity vapor, is transported by the discharge fan 98 into the air circulation pass 90 together with air flowing from the inlet 92 toward the outlet 94. The high temperature and high humidity vapor is changed by the dehumidifier 100 again into high temperature and low humidity air and then returned to the dry chamber 70.

[0059] Preferably, in order to control a condition in the dry chamber 70, including temperature and humidity, electric thermometer and hygrometer are provided at suitable positions in the dry chamber 70. In this instance, based on outputs from the thermometer and hygrometer, the discharge fan 98, rotary fan 112, and compressor 104 are controlled to adjust the temperature and humidity in the dry chamber 70. As is known in the art, the temperature has a specific relationship with the humidity. This means that, simply by controlling the fans and the compressor according to the output from the thermometer, not only the temperature but also the humidity can be controlled.

[0060] As can be seen from above, the regenerating device with the dry station 22 causes the high temperature and low humidity air (e.g., air with the temperature of about 35 to 60°C and the humidity of about 5 to 20%) to be impinged onto the sheet 26. This allows the sheet 26 to be effectively dried to a necessary degree even if the sheet 26 has a base layer of pulp fibers and a spongy coating layer coated on the base layer, for example. Also, the high humidity vapor generated from the water removed out of the sheet is changed into the low humidity air by the dehumidifier. This prevents the high humidity air from being discharged into the atmosphere, which would otherwise cause a deterioration of the atmosphere. Further, the water collected at the dehumidification is reused as the cleaning liquid, which minimizes a loss of the cleaning liquid and thereby reduces the number of supplements of the cleaning liquid.

II. Experiments

[0061] Experiments were conducted to evaluate an ability of regeneration for the regenerating device. In experiments, prepared were two types of A-4 size sheets A and B, which will be described afterwards. A water content of each sheet was measured immediately before and after the dry chamber. Also, a surface electrical resistance of each dried sheet was measured. Further, an image was reproduced on the regenerated sheets and a quality of each image was evaluated through a visual test.

[0062] For printing, an electrophtographic copying machine commercially available from Minolta Co., Ltd. under the tradenade of EP1082 was used. For the measurement of the surface electrical resistance, a digital insulator in the tradename of DSM-8103 and an electrode for flat panel in the tradename of DSM-8103 both commercially available from Toa Denpa Kogyo Kabushiki Kaisha were used. The water content was determined using following two differences W1-W0 and W2-W0, wherein W0 being a weight of sheet measured after it was maintained at 70°C in an electric furnace for 15 minutes; W1 being a weigh of sheet before it was dried; and W2 being a weight of sheet after it was dried.

[0063] The sheet A had three layers; base, middle, and top layers. A paper commercially available from Minolta Co., Ltd. in the tradenamde of CF paper was used. For the middle layer, a mixture of 100g of water dispersant urethane solution (HUX-232, Asahi Denka Kogyo Kabushiki Kaisha), 5g of melamine formaldehyde (Sumilase 613, Sumitomo Chemical Co., Ltd., and 0.1g of polyoxiethylenenonylphenylether was mixed for 5 minutes to result in a specific solution for the middle layer which was then coated by a bar coater on one surface of the base layer. The coating layer was dried at 120°C for 5 minutes and then exposed to a corona discharge, resulting in the middle layer having a thickness of five microns.

[0064] For the top layer, a solution was prepared by dissolving 16 grams of anion denatured polyvinylalcohol (KL-318, Kurare Co., Ltd.) in water of 184 grams. Then the solution was added with 3.2 grams of epoxy cross-linker (Deconar EX-313, Nagase Kasei Co., Ltd.) and 0.4 grams of polyoxiethylenenonylphenylether, which was then mixed for 15 minutes. The resultant was coated by a bar coater on the middle layer and then heated at 120°C for two hours, resulting in the top layer having a thickness of 9 microns.

[0065] The sheet B also had three layers; base, middle, and top layers. A sheet made of polyethyleneterephthalate (PET), having a thickness of 100 microns, was used for the base layer.

[0066] For the middle layer, prepared was a mixture of 14 grams of polycarbonate and 86 grams of 1,4-dioxanthan. The mixture was added with 1 gram of melamine-formaldehyde (Sumilase resin 613, Sumitomo Chemical Co., Ltd.), which was then coated on the base layer. The coated base layer was heated at 80°C for 5 minutes and then exposed to a corona discharge, resulting in the middle layer of 3 microns.

[0067] For the top layer, prepared was a mixture of 16 grams of polyvinylalcohol (CM-318, Kurare Co., Ltd.) as water based resin and 184 grams of water. The mixture was added with 0.5 grams of melamine-formaldehyde (Sumilase resin 613, Sumitomo Chemical Co., Ltd.), 0.6 grams of aluminum chloride, 0.2 grams of polyoxiethylenenonylphenylether as surface-active agent, and 1 gram of small particles of silica (Cylicia 450, Fuji Cylicia). The mixture was stirred for 15 minutes. The resultant liquid was coated on the middle layer with a bar coater and then heated at 120°C for two hours, resulting in the top layer of having a thickness of 6 microns.

[0068] Test conditions and results are shown as follows:

Test 1

[0069]

T1 (Temperature in the dry chamber)	40°C
H1 (Humidity in the dry chamber)	10%RH
L (Drying distance in the dry chamber)	600mm
V (Sheet transporting velocity)	20mm/sec

Table 1

Sheet	Before dried	After dried		
	WC (mg/cm^2)	WC (mg/cm^2)	SR (GΩ/□)	IQ
A	3.7	0.7	2	Almost Good
B	0.7	0.3	00	Good

Wc: Water content
SR: Surface electrical resistance
IQ: Quality of resultant image

Test 2

[0070]

T1	40°C
H1	10%RH
L	600mm
V	10mm/sec

Table 2

Sheet	Before dried	After dried		
	WC (mg/cm^2)	WC (mg/cm^2)	SR (GΩ/□)	IQ
A	3.7	0.5	45	Good
B	0.7	0.15	1.2	Good

Test 3

[0071]

T1	50°C
H1	5%RH
L	600mm
V	20mm/sec
Note that an additional heater was used.	

Table 3

Sheet	Before dried	After dried		
	WC (mg/cm^2)	WC (mg/cm^2)	SR (GΩ/□)	IQ
A	3.7	0.5	25	Good
B	0.7	0.2	800	Good

Test 4

[0072]

T1	50°C
H1	6%RH
L	600mm
V	10mm/sec
Note that an additional heater was used.	

Table 4

Sheet	Before dried	After dried		
	WC (mg/cm^2)	WC (mg/cm^2)	SR (GΩ/□)	IQ
A	3.7	0.45	110	Good

Table 4 (continued)

Sheet	Before dried	After dried		
	WC (mg/cm^2)	WC (mg/cm^2)	SR (GΩ/□)	IQ
B	0.7	0.15	1,500	Good

Test 5

[0073] The test 5, in which the dehumidifier was de-energized, was conducted under the following condition.

T1	25°C
H1	45%RH
L	600mm
V	20mm/sec
Note that the dehumidifier was de-energized.	

Table 5

Sheet	Before dried	After dried		
	WC (mg/cm^2)	WC (mg/cm^2)	SR (GΩ/□)	IQ
A	3.7	1.4	0.2	Transfer defects detected (No image was transferred)
B	0.7	0.5	2,000	Transfer defects detected

Test 6 (Comparative test)

[0074]

T1	25°C
H1	45%RH
L	600mm
V	10mm/sec
Note that the dehumidifier was de-energized.	

Table 6

Sheet	Before dried	After dried		
	WC (mg/cm^2)	WC (mg/cm^2)	SR (GΩ/□)	IQ
A	3.7	1.2	200	Transfer defects detected (No image was transferred)
B	0.7	0.4	5,000	Transfer defects detected

[0075] In addition, it was found that, under the condition in which the dehumidifier was de-energized, the humidity was increased considerably (i.e., the humidity being 85% after ten sheets have been dried) and the drying feature was decreased considerably.

III. Other embodiments

(1) Second embodiment

[0076] Fig. 4 shows a second embodiment of the regenerating device 10A. In the regenerating device 10A, the discharge station 24 has a cover 120 that covers an interior 124 of the discharge tray 118 and thereby isolates the

sheets 26 received on the discharge tray 118 from the atmospherer. Preferably, the cover 120 is hinged at a hinge 122 mounted on the housing 72 of the dry station 22 so that it can be opened for the removal of the dried sheets 26, as necessary. Also, the interior 124 defined by the cover 120 and the discharge tray 118 is connected with the drying chamber 70 so that it has the same condition as that in the drying chamber 70. Further, in order to prevent the high temperature and low humidity air from being discharged from the drying chamber 70 through the interior 124 into the atmosphere when the cover 120 is opened, the cover 120 is provided with a shutter 126 that moves with the cover 120 to close the outlet 76 of the drying chamber 70 and thereby disconnect between the drying chamber 70 and the interior 124.

[0077] With this embodiment, the sheet 26 dried at the dry station 22 is held in the same condition as in the drying chamber 70. This ensures that a high quality image is printed or copied on the sheet 26.

(2) Third embodiment

[0078] Fig. 5 shows a third embodiment of the regenerating device 10B. In the regenerating device 10B, the supply station 12 has a cover 130 that covers an interior 132 of the supply tray 118 and thereby isolates the sheets 26 received on the discharge tray 118 from the atmosphere. Also, the interior 132 is connected with the drying chamber 70 through a passage or duct 133 so that it has the same condition as in the dry chamber 70. With the regenerating device 10B of the third embodiment, the sheet in the sheet supply station 12 is dehumidified before dipping. This causes that, once the sheet 26 is dipped in the cleaning liquid 34 in the dipping chamber 40, it absorbs the cleaning liquid 34 so quickly than the sheet that has not been dehumidified in advance, which ensures the printing material to be removed effectively from the sheet in the subsequent printing material remove station.

(3) Fourth embodiment

[0079] Fig. 6 shows a fourth embodiment of the regenerating device 10C in which the housing 72 of the dry station 22 has a pre-dry station 140 defined therein for dehumidifying the sheet 26 fed from the sheet supply station 12 before it is dipped at the dip station. For this purpose, the pre-dry station 140 has one or more fans 142 on either side of the sheet transporting pass 31 between the sheet supply station 12 and the dip station 14. This causes the low temperature air in the drying chamber 70 is blown onto the opposite sides of the sheet 26, so that the sheet is dried to a certain extent before it is dipped.

[0080] It should be noted that an excessively high temperature in the drying chamber 70 may cause a melting of the printing material such as toner supported on the sheet 26. Therefore, the temperature of the air in the drying chamber 70 and, in particular, air to be blown onto the sheet 26 in the pre-dry station 140 is maintained below a glass dislocation point of the printing material in order to prevent the melting of the printing material. For example, where the printing material is a toner, the temperature of air to be blown against the sheet 26 in the pre-dry station 140 is maintained less than about 55°C.

[0081] With the regenerating device 10C, the sheet 26 is dehumidified to a suitable condition before its dipping. If the sheet is dehumidified by the use of roller with a heater incorporated therein, it might be difficult to dehumidify the sheet to a required degree in the condition where the temperature of the roller is maintained less than the glass dislocation point. However, according to this embodiment, since the low humidity and high temperature air, but the temperature being less than the glass dislocation point, is blown onto the sheet 26, the sheet is well dehumidified without any occurrence of the melting of the printing material.

[0082] Although the present invention has been fully described in connection with various embodiments in which the sheet designed exclusively for its regeneration is dipped in the cleaning liquid and then, by the contact with brush rollers, it is deprived of printing material, it is not limited thereto and can also be applied to another regenerating device shown in JP 7-84395 A, in which a normal paper is dipped in the cleaning liquid and then deprived of printing material by a separation member.

[0083] As can be seen from above, according to the regenerating device of the present invention, the sheet from which the printing material has been removed therefrom is dried by the low humidity air fed from the dry station. This eliminates the vapor layer from the sheet, improving the drying of the sheet. Also, the sheet can be dried at a temperature lower than that applied from the heat roller, which prevents the occurrence of small air bubbles in the waterproof layer or of deformation (e.g., curl) of the sheet. Further, no insulator is needed for insulating the dry station.

Claims

1. A sheet regenerating apparatus, comprising:

a dip station that applies a liquid to a sheet with a printing material;
a remove station that removes the printing material to which the liquid has been applied by the dip station; and
a dehumidified air supply station that supplies a dehumidified air to the sheet before the application of the liquid and/or after the removal of the printing material.

2. The sheet regenerating apparatus in accordance with claim 1, further comprising:
a dry station that dries the sheet while the sheet is transported,
wherein the dehumidified air supply station supplies the dehumidified air to the dry station.

3. The sheet regenerating apparatus in accordance with claim 2, wherein the dry station has a device that blows the dehumidified air against the sheet.

4. The sheet regenerating apparatus in accordance with claim 1, wherein the dehumidified air supply station has a dehumidifying device that collects water from the air.

5. The sheet regenerating apparatus in accordance with claim 4, wherein the water collected from the air by the dehumidifying device is returned to the liquid.

6. The sheet regenerating apparatus in accordance with claim 5, further comprising:
a supplemental reservoir for a supplement of the liquid,
wherein the liquid collected by the dehumidifying device is retained in the supplemental reservoir.

7. The sheet regenerating apparatus in accordance with claim 4, further comprising:

a first transporting member that transports the air dehumidified by the dehumidifying device from the dehumidified air supply station to the dry station; and
a second transporting member that transports the air with a vapor generated from a water contained in the sheet from the supply station to the dry station to the dehumidified air supply station.

8. The sheet regenerating apparatus in accordance with claim 1, wherein the sheet to which the dehumidified air is supplied is a sheet from which the printing material has been removed therefrom.

9. The sheet regenerating apparatus in accordance with claim 1, wherein the sheet to which the dehumidified air is supplied is a sheet on which the printing material is supported thereon.

10. The sheet regenerating apparatus in accordance with claim 1, further comprising:

a first receiver that receives the sheet on which the printing material is supported thereon; and
a first dehumidified air supplier that supplies the dehumidified. air from the dehumidified air supply station to the sheet received in the receiver

11. The sheet regenerating apparatus in accordance with claim 10, wherein the first receiver is covered by a cover so that an interior of the receiver is isolated from an exterior thereof.

12. The sheet regenerating apparatus in accordance with claim 1, further comprising:

a second receiver for receiving the sheet on which the printing material has been removed therefrom; and
a second dehumidified air supply station that supplies the dehumidified air from the dehumidified supply station to the sheet received in the second receiver.

13. The sheet regenerating apparatus in accordance with claim 12, wherein the second receiver is covered by a cover so that an interior of the second receiver is isolated from an exterior thereof.

14. The sheet regenerating apparatus in accordance with claim 1, further comprising:
a sheet transporting pass to which the dehumidified air is supplied from the dehumidified air supply station,
wherein the sheet with the printing material to which the liquid will be applied and the sheet from which the printing material has been removed are transported in the sheet transporting pass.

15. The sheet regenerating apparatus in accordance with claim 14, wherein the sheet transporting pass has a device that blows the dehumidified air against the sheet.

16. The sheet regenerating apparatus in accordance with claim 1, wherein the dehumidified air has a humidity of less than about 20%.

17. The sheet regenerating apparatus in accordance with claim 1, wherein the printing material is a toner and the dehumidified air has a temperature of about less than 55°C.

Fig. 1

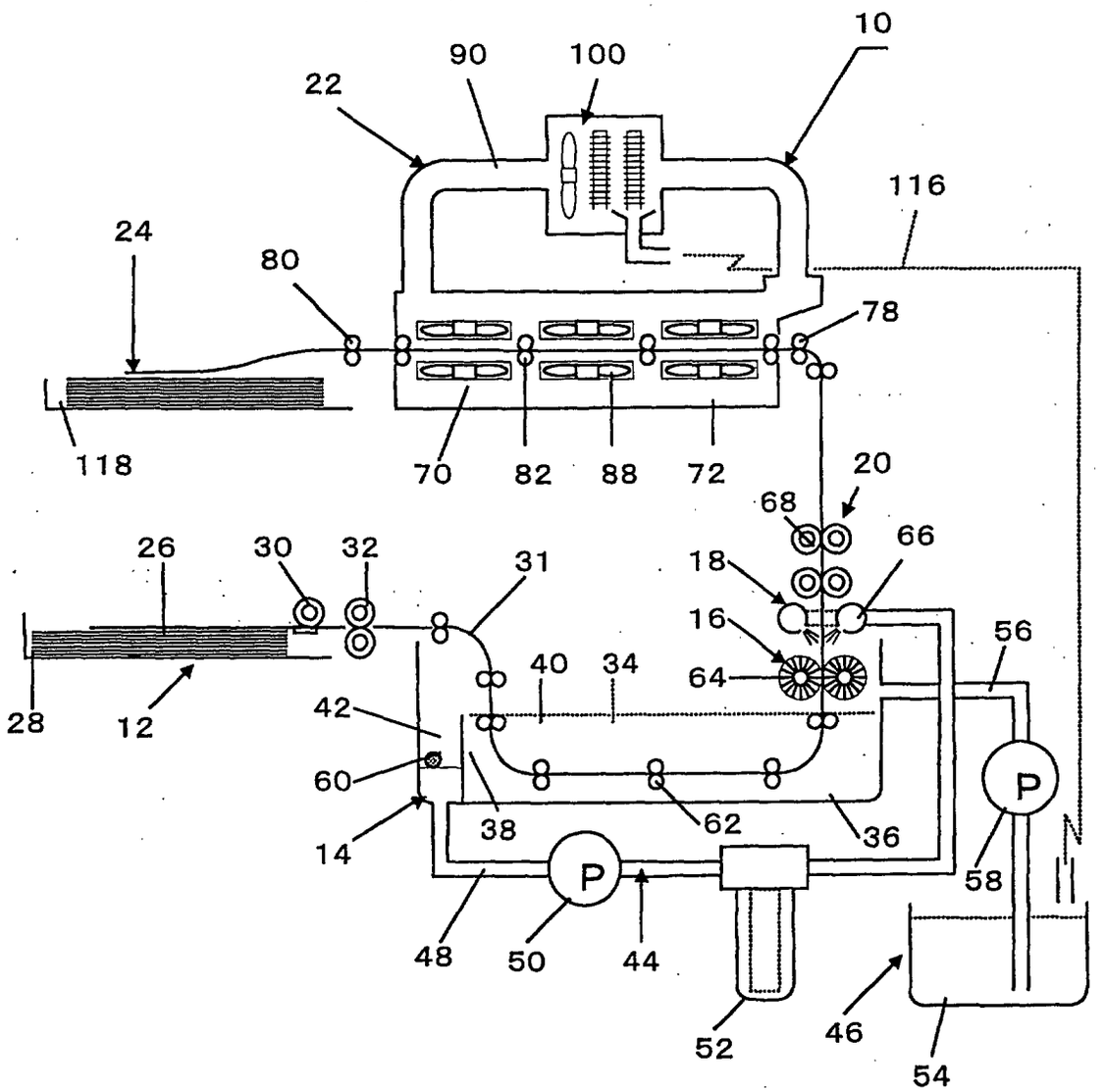

10
90
100
22
116
24
80
78
118
70
82
88
72
20
68
66
26
30
32
31
18
16
56
40
34
64
28
12
42
60
38
62
36
14
P
58
48
50
44
52
46
54

Fig. 2

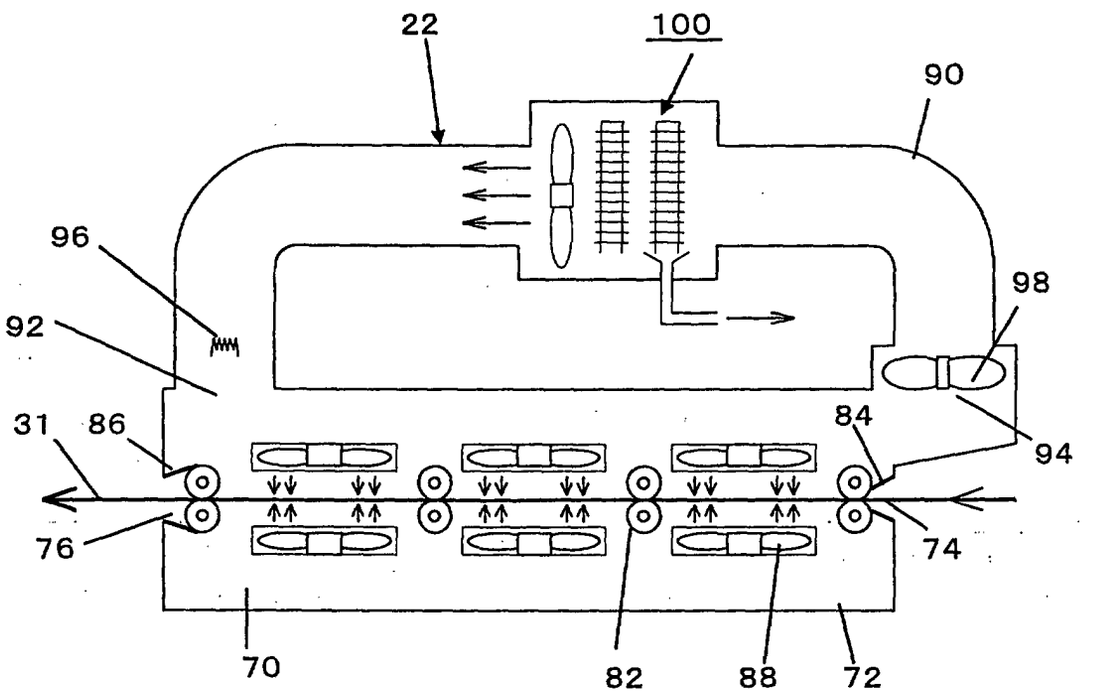


Fig. 3

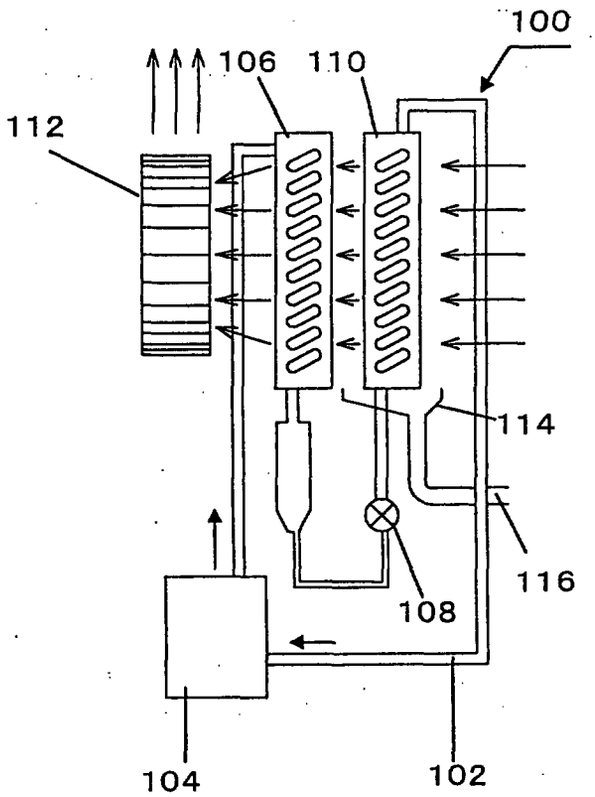


Fig. 4

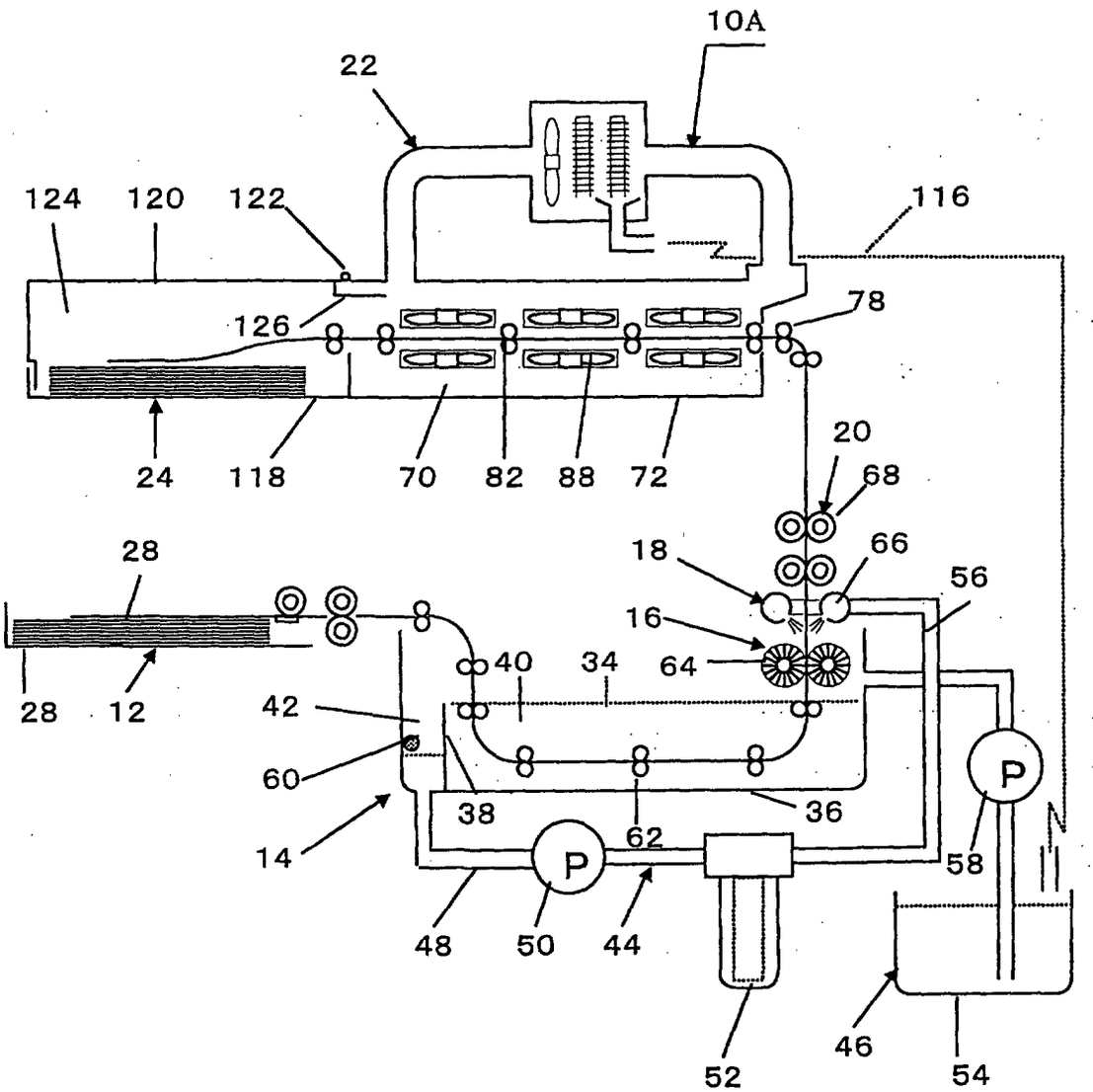

10A
22
124
120
122
116
126
78
24
118
70
82
88
72
20
68
28
18
66
56
16
64
40
34
42
28
12
60
38
36
62
14
P
58
48
50
44
46
52
54

Fig. 5

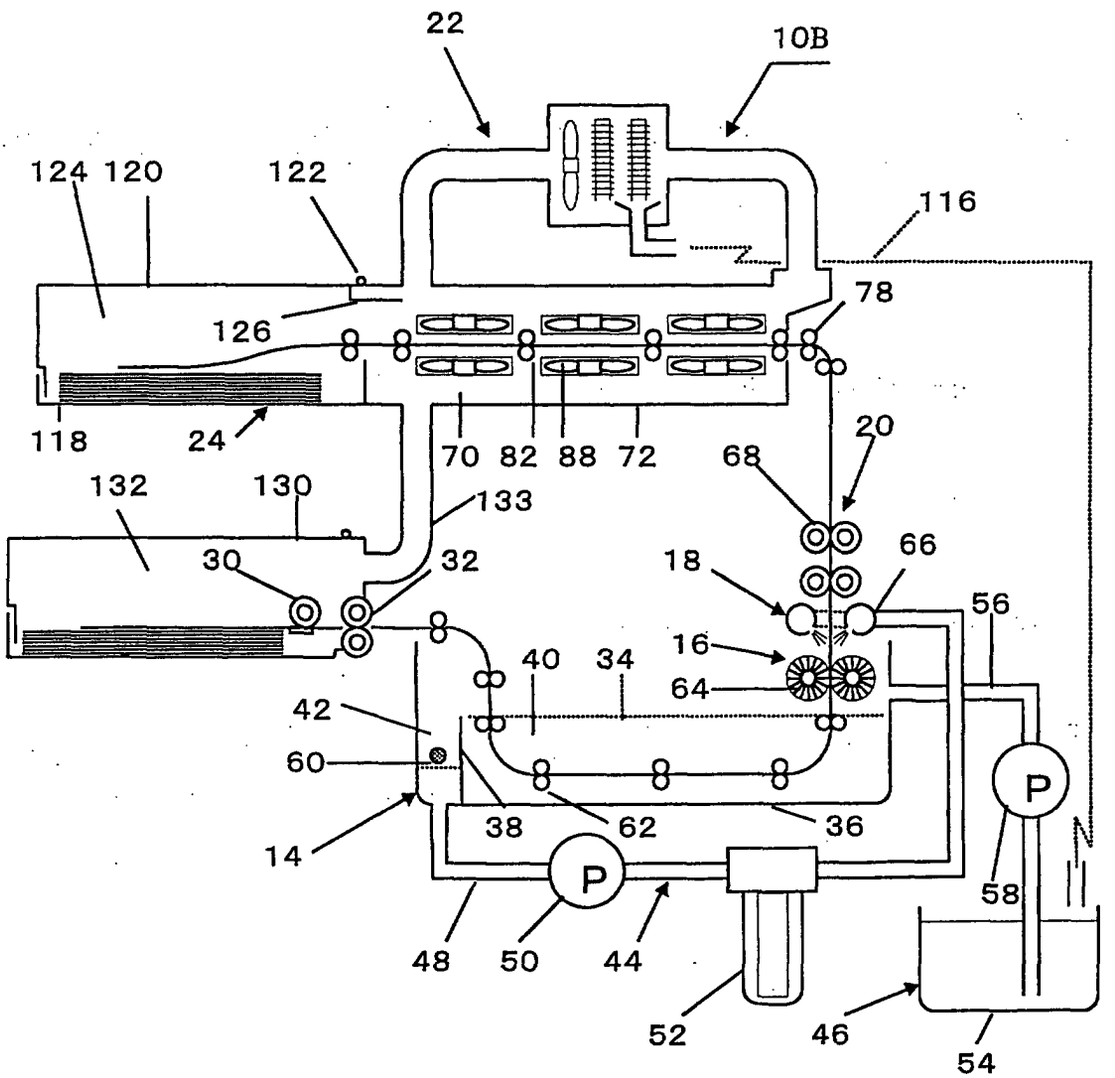
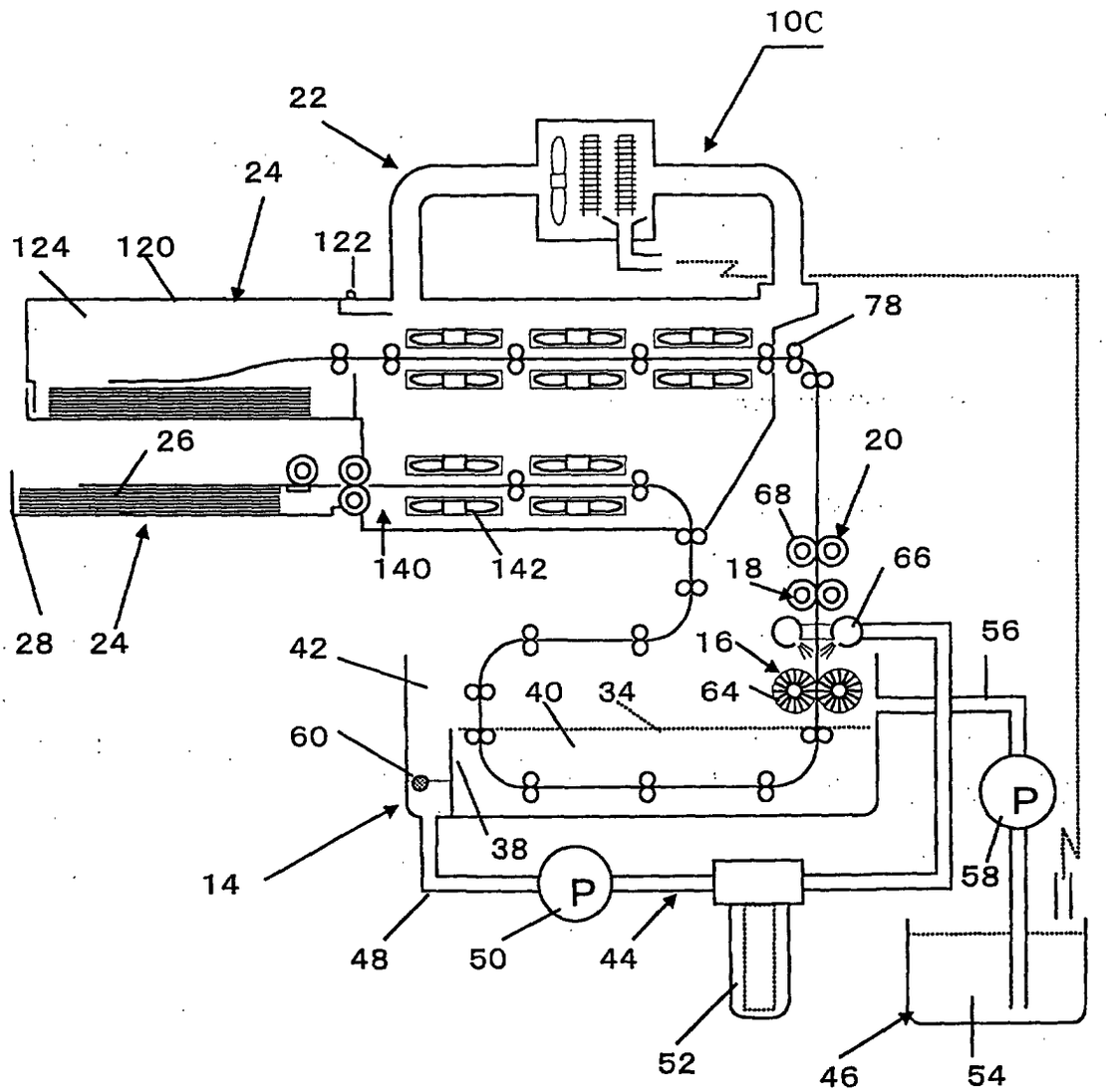

22
10B
124
120
122
116
126
78
118
24
70
82
88
72
68
20
132
130
133
30
32
18
66
56
16
40
34
64
42
60
38
62
36
14
P
58
48
50
44
52
46
54

Fig. 6


10C
22
24
124
120
122
78
26
20
68
66
18
140
142
28
24
42
16
56
40
34
64
60
38
14
58
48
50
44
52
46
54
P
P