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(54) **AUTOMATIC EXHAUST AIR RECIRCULATION SYSTEM FOR A PRINTING MACHINE OF THE FLEXOGRAPHIC OR ROTARY TYPE, OR FOR A LAMINATING MACHINE**

AUTOMATISCHES ABLUFTRÜCKFÜHRUNGSSYSTEM FÜR EINE FLEXOGRAFISCHE ODER
ROTIERENDE DRUCKMASCHINE ODER EINE LAMINIERMASCHINE

SYSTÈME DE RECIRCULATION D'AIR D'ÉCHAPPEMENT AUTOMATIQUE DESTINÉ À UNE
MACHINE D'IMPRESSION DU TYPE FLEXOGRAPHIQUE OU ROTATIF OU À UNE MACHINE DE
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(73) Proprietor: **New Instruments and Research for
Analysis Srl**

20853 Biassono (MB) (IT)

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(72) Inventor: **Squicciarini, Stefano**

20853 Biassono (MB) (IT)

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Description

[0001] The present invention refers to an automatic exhaust air recirculation system for a printing machine of the flexographic or rotary type, or for a laminating machine, wherein said machine uses water-based inks or glues and/or flammable solvent-based inks or glues.

[0002] In particular the present invention refers to an automatic air recirculation system for a drying station for a machine choice between a printing machine of the flexographic or rotary type, a laminating machine wherein said machine using water-based inks or glues and/or flammable solvent-based inks or glues.

[0003] JPH0214772 A discloses a drying system for drying a coating liquid applied to a web.

[0004] All coating machines, laminating machines or printing machine (rotogravure or flexographic) are equipped with the drying ovens; the purpose of these drying ovens is to evaporate the solvent or water from the surfaces of the materials during their working processes.

[0005] The fresh air, taken outside or inside of the productive areas, is heated by suitable heating systems in order to obtain the desired drying temperature, which is subsequently pushed inside of the drying furnace and then be sucked and sent to evacuation.

[0006] During solvent-based applications, the presence of solvents is detected through an analytical sensor capable of detect the solvents concentration.

[0007] At high temperatures, solvents can create an explosion hazard, therefore the main objective of this analytical sensor is to monitor the solvent concentration for safety reasons.

[0008] A purpose of the present invention is to provide an automatic exhaust air recirculation system for a printing machine of the flexographic or rotary type, or for a laminating machine which allows to reduce the energy consumption and at the same time which allows a high degree of safety both for water-based inks or glues than for flammable solvents-based inks or glues.

[0009] Another purpose is to realize an automatic exhaust air recirculation system for a printing machine of the flexographic or rotary type, or for a laminating machine which allows to control and to reduce energy consumption and that the same time allows to use water-based inks or glues and also flammable solvent-based inks or glues.

[0010] Still another purpose is to have an automatic exhaust air recirculation system for a printing machine of the flexographic or rotary type, or for a laminating machine which allows to reduce the energy consumption by using water-based inks or glues and/or flammable solvent-based inks or glues.

[0011] A further purpose is to have an automatic exhaust air recirculation system for a printing machine of the flexographic or rotary type, or for a laminating machine which is economically advantageous.

[0012] These purposes according to the present invention are achieved by realizing an automatic exhaust

air recirculation system for a printing machine of the flexographic or rotary type, or for a laminating machine as described in claim 1.

[0013] Additional features of the invention are highlighted by the following claims.

[0014] The features and advantages of an automatic exhaust air recirculation system for a printing machine of the flexographic or rotary type, or for a laminating machine according to the present invention will become more evident from the following exemplifying and not for limiting description, referred to the attached schematic drawings in which:

Figure 1 is a schematic view of an automatic air recirculation system according to the present invention;

Figure 2 is a schematic view of a detail of Fig. 1; Figure 3 is a schematic view of Fig. 1 that shows the temperatures within the ventilation system of the automatic air recirculation system.

[0015] With reference to the figures, according to the present invention, it is shown an automatic exhaust air recirculation system 10 for a drying station or oven 92 for a machine 90 which uses water-based inks or glues and/or flammable solvent-based inks or glues, or their similar, such as ethyl acetate, ethyl alcohol, isotropic alcohol, acetone, methyl ketone, hexane, toluene, methoxy propanol, ethoxy propanol, wherein in particular said machine 90 is selected from a printing machine of the flexographic or rotary type, a laminating machine, a coating machine.

[0016] In particular said automatic exhaust air recirculation system 10 is suitable for a drying oven for a machine 90, in particular of the type previously described, which use water-based inks and/or flammable solvent-based inks or glues, or their similar, which for example ethyl acetate, ethyl alcohol, isopropyl alcohol, acetone, methyl ketone, hexane, toluene, methoxy propanol, ethoxy propanol.

[0017] In particular said automatic exhaust air recirculation system 10 is suitable to be used for a drying station 92 for said machine 90, in particular for continuous production of products 94 preferably in the form of sheets or films of the type containing water-based glues or pigments or flammable solvent-based glues or pigments which become dried products 95 after being treated by said station or drying oven 92 Said automatic exhaust air recirculation system 10 comprises a plurality of air ducts for defining an air ventilation system 20 for said drying oven 92 for said machine 90.

[0018] According to the present invention, said exhaust air recirculation automatic system 10 comprises an electronic control and command unit 15 and at least one temperature sensor 13 and an humidity sensor 12, in particular a relative humidity sensor 12, in which said humidity sensor 12 and said temperature sensor 13 are associated with said plurality of air ducts, and in particular

to said air ventilation system 20, for detecting the temperature and the air humidity for determining the relative humidity and in particular the absolute humidity within said plurality of air ducts.

[0019] Also said electronic control and command unit 15 is connected to said humidity sensor 12 and to said temperature sensor 13 for recirculating at least partially the exhaust air within said plurality of air ducts, in particular for redirecting at least partially the exhaust air within an exhaust air recirculation duct 24, for reducing the energy consumption and for reducing the total cubic meters of air to be evacuated, advantageously reducing the total cubic meters of waste air to treated eventually prior to put the same within said external environment, and at the same time for avoiding the condensation of water vapor on a product 94, and then at the same time preferably for maintaining the same quality of a second product 94 obtainable without air circulation or with a fixed recirculation at minimum levels such as a recirculation of the 20%.

[0020] In particular said humidity sensor 12 is integrated with a temperature sensor 13 in just one humidity and temperature sensor (12,13) capable of simultaneously detecting the temperature and humidity of the air, which in particular is capable of detect the temperature and the relative humidity of the air, for allowing said electronic control and command unit 15 to determine the dew point, and also allows to determine the deviation of the air conditions present within said plurality of air ducts with respect to said dew point at which it would have the condensation of the steam present in the air, which in this case will condense on the product 94 to be dried, damaging the same from the qualitative point of view.

[0021] Advantageously this allows to compare said absolute humidity present in said plurality of ducts with an absolute humidity limit that determines the dew point, in order to avoid formation of condensation on the product to be dried compromising the quality of the same.

[0022] Advantageously, this allows to determine an absolute humidity of the air so as to know the grams of water per cubic meter of air.

[0023] Advantageously, this allows to calculate the dew point, hence the temperature of condensation of the vapor present in the air that is in said plurality of ducts, and this allows to know the maximum humidity limit at a determined temperature beyond which it will have condensation of water on the product 94 to be dried in order to avoid reaching this limit for avoiding to compromise the quality of the product 94 and at the same time for performing a variable recirculation of the exhaust air advantageously saving both in terms of energy than in economic terms as performing a variable recirculation makes it possible to maintain the same quality of the product by evacuating minor cubic meters of exhaust air thus allowing downsizing of some parts of the plants.

[0024] Said plurality of air ducts comprises an air inlet duct 21, an exhausted air evacuation duct 23 and a exhaust air recirculation duct 24, and in particular it

comprises an air heating duct 22, for the entry of air conditioning and preferably heated within said drying oven 92 for said machine 90.

[0025] Preferably said automatic exhaust air recirculation system 10 comprises air heating means 29, for said station or drying oven 92 or for said machine 90.

[0026] Also this advantageously allows to reduce at least 30% of the total cubic meters of exhaust air and also allows to avoid an oversizing of the ventilation means for moving the air inside said ventilation system.

[0027] In particular said humidity sensor 12 is associated with said exhaust air evacuation duct 23 or to said air inlet duct 21, in particular in proximity of an entrance for said air heating means 29 and preferably in proximity of an exhaust air recirculation duct 24, in particular in the case in which said machine 90 is capable of printing with water-based inks or glues and also with flammable solvent-based inks or glues, or their like.

[0028] In particular said humidity sensor 12 is associated with an exhaust air evacuation duct 23 in particular in the case in which said machine 90 is able to print only with water based inks or glues.

[0029] In particular said air inlet duct 21 comprises a first end for sucking air from a preferably internal environment and a second end connected to an input of said air heating means 29, also in particular said heating duct 22 includes in particular a first end associated with an output of said air heating means 29 and a second end for entering hot air within said drying oven 92 for said machine 90, and also said exhaust air recirculation duct 24 includes in particular a first end connected to said exhaust air evacuation duct 23 and a second end connected to said air inlet duct 21, in particular in proximity of said second end of the same, said exhaust air evacuation duct 23 includes in particular a first end for withdrawing exhaust air coming out from said drying oven 92 for said machine 90, and also said exhaust air evacuation duct 23 includes a second end for entering exhaust air within a second external environment.

[0030] Preferably, said air heating means 29 are electrical heating means or a heat pump, or gas or thermal oil heating means or their similar.

[0031] In particular said air heating means 29 are associated with an air inlet duct 21 of which said machine 90 is equipped, and also said air heating means 29 include an outlet duct connected to an inlet duct of said drying oven 92 for said machine.

[0032] Said automatic exhaust air recirculation system 10 comprises ventilation means (32,35) and also a plurality of dampers (31,33,34) with modulated opening, preferably of the pneumatic or electric type, which are inserted within said plurality of air ducts and also which are connected to said electronic control and command unit 15 for varying the air flow within said plurality of air ducts.

[0033] In particular said plurality of dampers (31,33,34) preferably motorized are of the pneumatic type, advantageously allowing more rapid flow variations internally to

a corresponding air duct and thus a greater security for maintaining the concentration level of the flammable solvents below predetermined values limit.

[0034] Said automatic exhaust air recirculation system 10 comprises air flow regulating means for varying the exhaust air flow within said exhaust air recirculation duct 24 and for regulating the flow within said inlet duct 21 and within said exhaust air evacuation duct 23.

[0035] Advantageously said flow regulating means then allow to perform a variable recirculation of said exhaust air within said plurality of air ducts and allow to reduce the time for reaching the operating condition of the machine 90 further reducing the energy consumption, in particular reaching up to 90% of the exhaust air recirculation.

[0036] Also carrying out a variable recirculation of said exhaust air is possible to maintain an operating condition having constant temperature and humidity avoiding advantageously the print misalignment problems related to expansion of a print media, such for example the paper. Said flow regulating means comprise at least a first damper 34, in particular of the type with counterweight or pneumatic or electric, which is housed within said exhaust air recirculation duct 24 for varying the opening of the same.

[0037] Said at least one first damper 34 is one of the counterweight-damper type advantageously for preventing a return flow of fresh air from said inlet duct 21 towards said exhausted air evacuation duct 23.

[0038] Said flow regulating means comprise at least a second damper 31 motorized, and preferably pneumatic or electrical or barometric, which is housed within said air inlet duct 21 for varying the opening of the same.

[0039] Said flow regulating means comprise at least a third damper 33 motorized, and preferably pneumatic or electric, which is housed within said exhaust air evacuation duct 23 for varying the opening of the same.

[0040] Preferably said flow regulating means comprise said ventilation means (32,35) in particular associated with said exhaust air evacuation duct 23 for evacuating the exhaust air and also said ventilation means (32,35) are also associated with said air heating duct 22 for entering hot air within said drying oven 92 for said machine 90.

[0041] Preferably said ventilation means comprise a first fan 32 for pushing hot air into said drying oven 92, and a second fan 35 connected to said exhaust air evacuation duct 23 for extracting exhausted air from said drying oven 92.

[0042] Also preferably said electronic control and command unit 15 is a PLC or a micro PLC or a card containing a computer of embedded type, that is an embedded PC card.

[0043] Said electronic control and command unit 15 is connected to said flow regulating means and it is connected to said first motorized damper 34, and to said second motorized damper 31, and to said third motorized damper 33.

[0044] Preferably said humidity sensor 12 is positioned externally to said plurality of air ducts, and in particular it is positioned externally to said exhaust air evacuation duct 23 or externally to said air inlet duct 21.

5 **[0045]** Preferably said automatic 10 of exhaust air recirculation system includes a concentration detecting device 40 for a flammable solvent, preferably of infrared (IR) type or a flame ionization type or catalytic, which is connected to said electronic control and command unit 15 for detecting a concentration of said flammable solvent and for obtaining a ration, preferably percentage, between a concentration of said flammable solvent to a predetermined time instant and a predetermined minimum critical concentration of said flammable solvent 15 which would lead to a risk of fire or explosion. ("LEL Lower Explosion Level").

[0046] Preferably said automatic 10 of exhaust air recirculation system includes air sampling means 50 which are associated with said plurality of air ducts for taking a sample of air from said plurality of air ducts and for detecting the humidity of the sampled air by said humidity sensor (12), and in particular for detecting the humidity and air temperature of the sampled air by said humidity sensor and temperature (12,13).

25 **[0047]** Preferably said automatic 10 of exhaust air recirculation system also includes exclusion means 60 for said sampling means 50 which are positioned between said plurality of air ducts and said sampling means 50 for avoiding a contact of said humidity sensor 12, and in particular of said humidity sensor and temperature (12,13), with any flammable solvents present in said air sample in particular during a process where are used flammable solvent-based pigments or glues, or their like.

30 **[0048]** In particular said sampling means 50 and said exclusion means 60 are both connected to said electronic control and command unit 15; in particular in the case of a detection of at least one solvent within said plurality of air ducts with a concentration higher respect to a predetermined minimum concentration, which for example equal to or less than 3% of the LEL that is the minimum critical concentration limit of the solvent that would lead to a risk of explosion or fire, said electronic control and command unit 15 enables an actuator of said exclusion means 60 for said sampling means 50 for isolating and separating said sampling means 50 from said plurality of air ducts, avoiding that said humidity sensor 12, and in particular that said humidity and temperature sensor (12,13), come into contact with air in which is present a solvent.

45 **[0049]** Also in the case of a detection of at least one solvent within said plurality of air ducts with a concentration less than said predetermined minimum concentration, which for example equal to or less than 3% of the LEL that is the minimum critical concentration limit of the solvent that would lead to a risk of explosion or fire, preferably said electronic control unit and control 15 disables said actuator of said exclusion means 60 for said sampling means 50, i.e. it disable said means of exclusion 60, for connecting said means of sampling 50

to said plurality of air ducts, for allowing the detection of the humidity of the air and, if necessary, the temperature in the case of a processing with water-based pigments or glues.

[0050] Preferably said sampling means 50 comprise a chamber 52 within which is partially inserted said humidity sensor 12 and in particular said humidity and temperature sensor (12,13), in particular said chamber 52 is connected to said exhaust air evacuation duct 23 or to said air inlet duct 21, in particular to sample the air in part coming from said exhaust air evacuation duct 23 or in particular coming from said exhausted air recirculation duct 24 and for preventing any direct contact between said humidity sensor 12 and solvents that may be present within that plurality of air ducts.

[0051] Preferably said sampling means 50 comprise a isokinetic probe 54 which is associated with said plurality of air ducts for said machine 90, and in particular said isokinetic probe 54 is partially inserted within said exhaust air evacuation duct 23 or within said air inlet duct 21, for picking up an homogeneous and uniform sample of air within said plurality of air ducts, moreover said chamber 52 which is preferably associated with said isokinetic probe 54 in particular through a duct, also said sampling means 50 comprise air suction means, in particular of Venturi type, for sucking said air from said plurality of air ducts.

[0052] Preferably said exclusion means 60 includes a non-return valve 62 to depression, which includes a first end and a second end, in particular said first end of said non-return valve is connected to said isokinetic probe 54, and said second end of said non-return valve is associated with, and in particular connected to, said chamber 52 preferably by means of a duct.

[0053] Preferably said air suction means comprise air compression means for creating a flow of compressed air, not shown, and also said air suction means comprise a Venturi tube 56 connected at a first end to said chamber 52 and at a second end to said air compression means, for determining a suction of air from said isokinetic probe 54 to said chamber 52 obtaining an homogeneous and uniform sample of air present within said plurality of air ducts.

[0054] Also preferably said air suction means comprise an electrovalve, not shown, which is positioned in a safe area which is external to the areas classified ATEX, which allows an interruption of said flow of compressed air into said Venturi tube 56, said electrovalve is also connected to said electronic control and command unit 15, and in particular a closing of said electrovalve determines a consequent automatic closing of said non-return valve 62.

[0055] In particular said electronic control and command unit 15 is positioned in a safe area which is external to the areas classified ATEX, for maintaining a high level of safety and for reducing the costs of said automatic system 10.

[0056] In particular said chamber 52 is connected to

said isokinetic probe 54 through said non-return valve 62 for avoiding that within said chamber 52 may enter an amount of solvent which would certainly irreversibly damage said humidity sensor 12 or said humidity and temperature sensor (12,13).

[0057] In particular said sampling means 50 are integrated with said exclusion means 60.

[0058] Preferably said humidity sensor 12, and in particular said humidity and temperature sensor (12,13), it is an ATEX type sensor that is explosion-proof for use in environments with risk of explosion, such for example ATEX zones type 1 and type 2.

[0059] Preferably said automatic exhaust air recirculation system 10 comprises a detecting device for a plurality of operating parameters of said machine 90, in particular for detecting, for example, the process speed that is the material advance speed (lamination speed, coating speed, printing speed), the operating temperature inside the drying ovens, the feed speed of the material to be printed or to be coupled or to be laminated, the width of said material, the air temperature within said drying oven.

[0060] Preferably said automatic exhaust air recirculation system 10 is at least partially integrated with said machine 90.

[0061] In particular said electronic control and command unit 15 is at least partially integrated with a second electronic control and command unit for said machine 90 or it is connected to the same through at least one data connection or through a communication interface.

[0062] Preferably said automatic exhaust air recirculation system 10 comprises a pressure sensor, not shown, for detecting the air depression within said exhaust air evacuation duct 23, which is connected to an electronic controller, and also said automatic exhaust air recirculation system 10 comprises an inverter, not shown, which is controlled by said electronic controller and connected to said ventilation means, in particular connected to said second fan 35, for keeping a predetermined depression level within said exhaust air evacuation duct 23, independently by the air flow in the evacuation, for avoiding a leakage of exhaust air in an internal area in proximity of said drying oven 92.

[0063] In particular said electronic control and command unit 15 comprises a static memory, not shown, for storing information associated with said humidity and temperature sensor (12,13) and also preferably associated with said pressure sensor and also in particular with additional sensors.

[0064] Furthermore preferably said static memory further comprises a plurality of parameters and information for the operation of said automatic exhaust air recirculation system 10.

[0065] Furthermore preferably said electronic control and command unit 15 comprises protection means for said static memory for preventing unauthorized access to the same and also for avoiding changes to said plurality of parameters and information for the working of said automatic exhaust air recirculation system 10.

[0066] In the case of use of solvents at high temperatures, they can create risks of explosion, then the main objective is to monitor the solvent concentration and to ensure that the maximum admissible solvent threshold is never exceeded.

[0067] If the solvent concentration is lower than the admissible solvent threshold, the hot air exhaust from the drying ovens of the machines can be reused and mixed with fresh air before being heated and supplied again into said drying oven 92.

[0068] This operation is used for decreasing the energy costs associated with air heating systems.

[0069] The recirculation system is carried out through the control of the said plurality of dampers (31,33,34) with adjustable opening.

[0070] Obviously, the lower will be the solvent concentration detected by the analytical system, the greater the percentage of exhaust air recirculation and the resulting energy savings.

[0071] For security reasons, even while water-based application, the solvent analysis system is always active.

[0072] In particular for not to expose the humidity sensor (12,13) to organic solvent vapor during solvent applications, there is an external sampling system 50 by which, through air suction means as for example an ejector (venturi tube 56), a gas sample (vapor) is aspirated in an homogeneous way through the said isokinetic probe 54 which is inserted in the sampling point.

[0073] The aspirated sample gas, fills said chamber 52 where inside is placed the humidity sensor (12,13).

[0074] During solvent-based application, the water-based analysis system is bypassed, in automatic or manual manner, while preserving the humidity sensor (12,13) from the solvent which certainly would damage said humidity sensor (12,13) compromising its functionality.

[0075] In particular for security reasons, in the case of machines that use both water-based inks or adhesives, both flammable solvent-based inks or glues, solvent analysis system is always active even during water-based application, so if during a water-based solvent application, the sensor detects a solvent concentration $\geq 3\%$ LEL, the automatic system 10 automatically swaps the analysis from water-based solvent to solvent-based, bypassing and automatically protecting the temperature and relative humidity sensor.

[0076] Both in solvent-based applications and in those water-based, the percentage of recirculation of exhaust air is a function of several process variables:

- opening (width) of the material;
- ratio between solvent and inks (wet and dry);
- material coverage (percentage between solvent and glues or pigments applied);
- process speed (lamination speed, coating speed or printing speed);
- operating temperatures in the drying ovens.

[0077] In the case of opening (width) of the material, the greater will be the width of the film and the greater the concentration inside the drying oven.

[0078] In the case of the ratio between solvent or water and glues or pigments (wet and dry), the greater the wet part (solvent or water) respect to the dry part (glues or pigments), and the greater the concentration inside the drying oven.

[0079] In the case of the material covering 94 (percentage of covering of materials applied on the product surface 94), the greater will be the surface on which the material will be applied and the greater the concentration inside the drying oven.

[0080] In the case of the process speed (lamination speed, coating or printing), the greater will be the process speed and the higher the concentration inside the drying oven.

[0081] In the case of the operating temperature inside the drying furnace, the greater will be the operation temperature of the drying ovens and the greater the concentration inside the drying oven.

[0082] During the typical solvent-based application, the operating temperatures of the drying ovens vary between 60 °C and 90 °C.

[0083] Energy saving is given by the quantity of recirculated hot air.

[0084] The smaller will be the difference between the supply air temperature and the required temperature (Δt) and the greater the energy savings associated with the air heating system.

[0085] An efficient exhaust air recirculation system allows to reduce energy costs by 30% to 40% of current energy consumption.

[0086] During the typical water-based applications, the operating temperatures of the drying ovens vary between 90 °C and 140 °C.

[0087] Even in this case, the energy saving is given as the amount of recirculated hot air: the smaller will be the difference between the supply air temperature and the required temperature (Δt) and the greater the energy savings associated with the air heating system.

[0088] It has also been experimentally verified that in most of the water-based applications it is possible to recycle up to 90% of the exhausted air.

[0089] An efficient exhaust air recirculation system allows to decrease the energy costs from the 30% to 40%, but in this case, using of much higher operating temperatures than the solvent-based applications, the energy saving has an impact very more significant.

[0090] It has thus been seen that an automatic exhaust air recirculation system for a printing machine of rotary or flexographic type, or for a laminating machine according to the present invention achieves the purposes highlighted previously.

[0091] The automatic exhaust air recirculation system for a printing machine of rotary or flexographic type, or for a laminating machine of the present invention thus conceived is susceptible of numerous modifications and

variations, all within the same inventive concept .

[0092] Moreover, in practice the materials used, as well as their dimensions and components, may be any according to technical requirements.

Claims

1. Automatic exhaust air recirculation system (10) for a drying oven (92) for a machine (90) that uses tare-based inks or glues and/or flammable solvent-based inks or glues, or their like, wherein said machine (90) is selected from a printing machine of the flexographic or rotary type, a laminating machine, a coating machine, said automatic exhausted air recirculation system (10) includes a plurality of air ducts for defining an air ventilation system (20) for said drying oven (92) for said machine (90), said plurality of air ducts comprises an air inlet duct (21), an exhausted air evacuation duct (23) and a exhaust air recirculation duct (24), wherein the automatic exhaust air recirculation system comprises an electronic control and command unit (15) and at least one temperature sensor (13) and an humidity sensor (12), in particular a relative humidity sensor (12), wherein said humidity sensor (12) and said temperature sensor (13) are associated with said plurality of air ducts for detecting the temperature and the air humidity and for determining the relative humidity and in particular the absolute humidity within said plurality of air ducts, also said electronic control and command unit (15) is connected to said humidity sensor (12) and connected to said temperature sensor (13) for recirculating at least partially the exhaust air within said plurality of air ducts, for reducing the energy consumption and for reducing the cubic meters of air to be evacuated, advantageously reducing the total cubic meters of exhaust air that may be treated prior to placing the same within an external environment, and at the same time for avoiding the condensation of water vapor on a product (94) and also at the same time preferably for maintaining the same quality of a second product (94) obtainable with no air circulation or with a fixed recirculation at minimum levels such as a recirculation of 20%, also said automatic exhaust air recirculation system (10) comprising ventilation means (32,35) and a plurality of dampers (31,33,34) with modulated opening which are inserted within said plurality of air ducts and also connected to said electronic control and command unit (15) for varying the air flow within said plurality of air ducts, said plurality of dampers comprising at least a first motorized damper (34) which is housed within said exhaust air recirculation duct (24) for varying the opening of the same, said plurality of dampers comprising at least a second motorized damper (31) which is housed within said air inlet duct (21) for varying the opening of the same, said plurality of dampers comprising at least a third motorized damper (33) which is housed within said exhaust air evacuation duct (23), and said electronic control and command unit (15) is connected to said first motorized damper (34), and to said second motorized damper (31), and to said third motorized damper (33), for varying the opening of the same.
2. Automatic exhaust air recirculation system (10) according to claim 1, **characterized in that** said humidity sensor (12) is positioned externally to said plurality of air ducts, and in particular it is positioned externally to an exhaust air evacuation duct (23) or externally to an air inlet duct (21).
3. Automatic exhaust air recirculation system (10) according to claim 1 or 2, **characterized in that** said plurality of air ducts comprises an air heating duct (22) for introducing conditioned air, preferably heated, into said drying oven (92) for said machine (90), in which said humidity sensor (12) is associated with said exhaust air evacuation duct (23), or to said air inlet duct (21).
4. Automatic exhaust air recirculation system (10) according to any of the claims from 1 to 3, **characterized in that** said humidity sensor (12) is integrated with a temperature sensor (13) in just one humidity and temperature sensor (12,13) which is able to detect at the same time the temperature and the humidity of the air, in particular which is able to detect the temperature and the relative humidity of the air.
5. Automatic exhaust air recirculation system (10) according to any of the claims from 1 to 4, **characterized by** comprising a concentration detecting device (40) for a flammable solvent, preferably of infrared (IR) type or a flame ionization type or catalytic, which is connected to said electronic control and command unit (15) for detecting a concentration of said flammable solvent and for obtaining a ration, preferably percentage, between a concentration of said flammable solvent to a predetermined time instant and a predetermined minimum critical concentration of said flammable solvent which would lead to a risk of fire or explosion.
6. Automatic exhaust air recirculation system according to any of the claims from 1 to 5, **characterized by** comprising air sampling means (50) which are associated with said plurality of air ducts for taking a sample of air from said plurality of air ducts and for detecting the humidity of the sampled air by said humidity sensor (12), and in particular for detecting the humidity and air temperature of the sampled air by said humidity sensor and temperature (12,13).
7. Automatic exhaust air recirculation system accord-

- ing to claim 6, **characterized by** comprising exclusion means (60) for said sampling means (50) which are positioned between said plurality of air ducts and said sampling means (50) for avoiding a contact of said humidity sensor (12), and in particular of said humidity sensor and temperature (12,13), with any flammable solvents present in said air sample in particular during a process where are used flammable solvent-based pigments or glues, or their like.
8. Automatic exhaust air recirculation system according to claim 6, **characterized in that** said sampling means (50) and said exclusion means (60) are both connected to said electronic control and command unit (15); in particular in the case of a detection of at least one solvent within said plurality of air ducts with a concentration higher respect to a predetermined minimum concentration, which for example equal to or less than 3% of the LEL that is the minimum critical concentration limit of the solvent that would lead to a risk of explosion or fire, said electronic control and command unit (15) enables an actuator of said exclusion means (60) for said sampling means (50) for isolating and separating said sampling means (50) from said plurality of air ducts, avoiding that said humidity sensor (12), and in particular that said humidity and temperature sensor (12,13), come into contact with air in which is present a solvent.
 9. Automatic exhaust air recirculation system according to any of the claims from 6 to 8, **characterized in that** said sampling means (50) comprise a chamber (52) within which is partially inserted said humidity sensor (12) and in particular said humidity and temperature sensor (12,13), in particular said chamber (52) is connected to said exhaust air evacuation duct (23) or to said air inlet duct (21).
 10. Automatic exhaust air recirculation system according to any of the claims from 6 to 9, **characterized in that** said sampling means (50) comprise a isokinetic probe (54) which is associated with said plurality of air ducts for said machine (90), and in particular said isokinetic probe (54) is partially inserted within said exhaust air evacuation duct (23) or within said air inlet duct (21) for picking up an homogeneous and uniform sample of air within said plurality of air ducts, moreover said chamber (52) which is preferably associated with said isokinetic probe (54) in particular through a duct, also said sampling means (50) comprise air suction means, in particular of Venturi type, for sucking said air from said plurality of air ducts.
 11. Automatic exhaust air recirculation system according to any of the claims from 7 to 10, **characterized in that** said exclusion means (60) includes a non-return valve (62) to depression, which includes a first end and a second end, in particular said first end of said non-return valve is connected to said isokinetic probe (54) and said second end of said non-return valve is associated with, and in particular connected to, said chamber (52) preferably by means of a duct.
 12. Automatic exhaust air recirculation system according to any of the claims from 10 to 11, **characterized in that** said air suction means comprise air compression means for creating a flow of compressed air, and also said air suction means comprise a Venturi tube (56) connected at a first end to said chamber (52) and at a second end to said air compression means, also preferably said air suction means comprise an electrovalve which is positioned in a safe area which is external to the areas classified ATEX, which allows an interruption of said flow of compressed air into said Venturi tube (56), said electrovalve is also connected to said electronic control and command unit (15), and in particular a closing of said electrovalve determines a consequent automatic closing of said non-return valve (62).
 13. Automatic exhaust air recirculation system according to any of the claims from 10 to 11, **characterized in that** said chamber (52) is connected to said isokinetic probe (54) through said non-return valve (62) for avoiding that within said chamber (52) may enter an amount of solvent which would certainly irreversibly damage said humidity sensor (12) or said humidity and temperature sensor (12,13).
 14. Automatic exhaust air recirculation system according to any of the claims from 1 to 13, **characterized in that** said humidity sensor (12), and in particular said humidity and temperature sensor (12,13), it is an ATEX type sensor that is explosion-proof for use in environments with risk of explosion.
 15. Automatic exhaust air recirculation system according to any of the claims from 1 to 14, **characterized in that** said flammable solvents are selected from ethyl acetate, ethyl alcohol, isotropic alcohol, acetone, methyl ketone, hexane, toluene, methoxy propanol, ethoxy propanol, or their similar.
 16. Automatic exhaust air recirculation system according to any of the claims from 1 to 15, **characterized by** comprising a detecting device for a plurality of operating parameters of said machine (90), in particular for detecting, for example, the process speed that is the material advance speed, the operating temperature inside the drying ovens, the feed speed of the material to be printed or to be coupled or to be laminated, the width of said material, the air temperature within said drying oven.

Patentansprüche

1. Automatisches Abluft-Umluftsystem (10) für einen Trocknungssofen (92) einer Maschine (90), die was-
serbasierte Farben oder Klebstoffe und/oder brenn-
bare lösungsmittelbasierte Farben oder Klebstoffe
oder dergleichen verwendet, wobei die Maschine
(90) aus einer Flexodruck- oder Rotationsdruckma-
schine, einer Laminiermaschine oder einer Be-
schichtungsmaschine ausgewählt ist, wobei das au-
tomatische Abluft-Umluftsystem (10) eine Mehrzahl
von Luftleitungen umfasst, die ein Luftbelüftungs-
system (20) für den Trocknungssofen (92) der Ma-
schine (90) bilden, wobei die Mehrzahl von Luftlei-
tungen eine Lufteinlassleitung (21), eine Abluftlei-
tung (23) und eine Umluftleitung (24) umfasst, wobei
das automatische Abluft-Umluftsystem eine elektro-
nische Steuer- und Regeleinheit (15) sowie mindes-
tens einen Temperatursensor (13) und einen Feuch-
tigkeitssensor (12), insbesondere einen Sensor für
relative Feuchtigkeit (12), umfasst, wobei der Feuch-
tigkeitssensor (12) und der Temperatursensor (13)
der Mehrzahl von Luftleitungen zugeordnet sind, um
die Temperatur und die Luftfeuchtigkeit zu erfassen
und die relative Feuchtigkeit und insbesondere die
absolute Feuchtigkeit innerhalb der Mehrzahl von
Luftleitungen zu bestimmen, wobei die elektronische
Steuer- und Regeleinheit (15) mit dem Feuch-
tigkeitssensor (12) und dem Temperatursensor (13)
verbunden ist, um die Abluft zumindest teilweise
innerhalb der Mehrzahl von Luftleitungen umzuwäl-
zen, um den Energieverbrauch zu reduzieren und
die auszuleitenden Kubikmeter Luft zu verringern,
wodurch vorteilhaft das Gesamtvolumen der Abluft
reduziert wird, das vor der Einleitung in die Außen-
umgebung behandelt werden muss, und gleichzeitig
eine Kondensation von Wasserdampf auf einem
Produkt (94) vermieden wird und gleichzeitig vor-
zugsweise die gleiche Qualität eines zweiten Pro-
dukts (94) beibehalten wird, das ohne Luftumwäl-
zung oder mit einer festen Mindestumwälzung, bei-
spielsweise einer Umwälzung von 20 %, erzielbar
wäre, wobei das automatische Abluft-Umluftsystem
(10) ferner Lüftungsmittel (32, 35) und eine Mehrzahl
von Klappen (31, 33, 34) mit modulierbarer Öffnung
umfasst, die in die Mehrzahl von Luftleitungen ein-
gesetzt und mit der elektronischen Steuer- und Re-
geleinheit (15) verbunden sind, um den Luftstrom
innerhalb der Mehrzahl von Luftleitungen zu variie-
ren, wobei die Mehrzahl von Klappen mindestens
eine erste motorisierte Klappe (34) umfasst, die in
der Umluftleitung (24) angeordnet ist, um deren
Öffnung zu variieren, mindestens eine zweite motor-
isierte Klappe (31), die in der Lufteinlassleitung (21)
angeordnet ist, um deren Öffnung zu variieren, und
mindestens eine dritte motorisierte Klappe (33), die
in der Abluftleitung (23) angeordnet ist, und wobei
die elektronische Steuer- und Regeleinheit (15) mit
den Durchflussregelmitteln sowie mit der ers-
ten motorisierten Klappe (34), der zweiten motor-
isierten Klappe (31) und der dritten motorisierten
Klappe (33) verbunden ist, um deren Öffnung zu
variieren.
2. Automatisches Abluft-Umluftsystem (10) nach An-
spruch 1, **dadurch gekennzeichnet, dass** der
Feuchtigkeitssensor (12) außerhalb der Mehrzahl
von Luftleitungen angeordnet ist, insbesondere au-
ßerhalb der Abluftleitung (23) oder außerhalb der
Lufteinlassleitung (21).
3. Automatisches Abluft-Umluftsystem (10) nach An-
spruch 1 oder 2, **dadurch gekennzeichnet, dass**
die Mehrzahl von Luftleitungen eine Luftheizleitung
(22) umfasst, um konditionierte, vorzugsweise er-
wärmte Luft in den Trocknungssofen (92) der Maschi-
ne (90) einzuleiten, wobei der Feuchtigkeitssensor
(12) der Abluftleitung (23) oder der Lufteinlasslei-
tung (21) zugeordnet ist.
4. Automatisches Abluft-Umluftsystem (10) nach ei-
nem der Ansprüche 1 bis 3, **dadurch gekennzeich-
net, dass** der Feuchtigkeitssensor (12) mit einem
Temperatursensor (13) in einem einzigen Feuchtig-
keits- und Temperatursensor (12, 13) integriert ist,
der gleichzeitig die Temperatur und die Feuchtigkeit
der Luft, insbesondere die relative Feuchtigkeit der
Luft, erfassen kann.
5. Automatisches Abluft-Umluftsystem (10) nach ei-
nem der Ansprüche 1 bis 4, **dadurch gekennzeich-
net, dass** es eine Konzentrationsdetektionsvorrich-
tung (40) für ein brennbares Lösungsmittel umfasst,
vorzugsweise vom Infrarot-Typ (IR), Flammenioni-
sationstyp oder katalytischen Typs, die mit der elekt-
ronischen Steuer- und Regeleinheit (15) verbunden
ist, um eine Konzentration des brennbaren Lösungs-
mittels zu erfassen und ein Verhältnis, vorzugsweise
einen Prozentsatz, zwischen einer Konzentration
des brennbaren Lösungsmittels zu einem bestimm-
ten Zeitpunkt und einer vorbestimmten minimalen
kritischen Konzentration des Lösungsmittels zu er-
halten, die zu einem Brand- oder Explosionsrisiko
führen würde.
6. Automatisches Abluft-Umluftsystem nach einem der
Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass**
es Probenahmemittel (50) umfasst, die der Mehrzahl
von Luftleitungen zugeordnet sind, um eine Luftpro-
be aus der Mehrzahl von Luftleitungen zu entneh-
men und die Feuchtigkeit der entnommenen Luft-
probe mittels des Feuchtigkeitssensors (12) und
insbesondere die Feuchtigkeit und die Lufttempera-
tur der entnommenen Luftprobe mittels des Feuch-
tigkeits- und Temperatursensors (12, 13) zu erfassen.

7. Automatisches Abluft-Umluftsystem nach Anspruch 6, **dadurch gekennzeichnet, dass** es Ausschlussmittel (60) für die Probenahmemittel (50) umfasst, die zwischen der Mehrzahl von Luftleitungen und den Probenahmemitteln (50) angeordnet sind, um einen Kontakt des Feuchtigkeitssensors (12), insbesondere des Feuchtigkeits- und Temperatursensors (12, 13), mit in der Luftprobe vorhandenen brennbaren Lösungsmitteln zu vermeiden, insbesondere während eines Verfahrens, bei dem lösungsmittelbasierte Pigmente oder Klebstoffe oder dergleichen verwendet werden. 5 10
8. Automatisches Abluft-Umluftsystem nach Anspruch 6, **dadurch gekennzeichnet, dass** die Probenahmemittel (50) und die Ausschlussmittel (60) beide mit der elektronischen Steuer- und Regeleinheit (15) verbunden sind; insbesondere aktiviert die elektronische Steuer- und Regeleinheit (15) im Falle einer Detektion mindestens eines Lösungsmittels innerhalb der Mehrzahl von Luftleitungen mit einer Konzentration oberhalb einer vorbestimmten minimalen Konzentration, beispielsweise gleich oder kleiner als 3 % der UEG, das heißt der unteren Explosionsgrenze des Lösungsmittels, die zu einem Explosions- oder Brandrisiko führen würde, einen Aktuator der Ausschlussmittel (60), um die Probenahmemittel (50) von der Mehrzahl von Luftleitungen zu isolieren und zu trennen, wodurch verhindert wird, dass der Feuchtigkeitssensor (12), insbesondere der Feuchtigkeits- und Temperatursensor (12, 13), mit Luft in Kontakt kommt, die ein Lösungsmittel enthält. 15 20 25 30
9. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 6 bis 8, **dadurch gekennzeichnet, dass** die Probenahmemittel (50) eine Kammer (52) umfassen, in die der Feuchtigkeitssensor (12) und insbesondere der Feuchtigkeits- und Temperatursensor (12, 13) teilweise eingeführt ist, wobei die Kammer (52) mit der Abluftleitung (23) oder der Lufteinlassleitung (21) verbunden ist. 35 40
10. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 6 bis 9, **dadurch gekennzeichnet, dass** die Probenahmemittel (50) eine isokinetische Sonde (54) umfassen, die der Mehrzahl von Luftleitungen der Maschine (90) zugeordnet ist und teilweise in die Abluftleitung (23) oder die Lufteinlassleitung (21) eingeführt ist, um eine homogene und gleichmäßige Luftprobe aus der Mehrzahl von Luftleitungen zu entnehmen, wobei die Kammer (52) vorzugsweise über eine Leitung mit der isokinetischen Sonde (54) verbunden ist, und wobei die Probenahmemittel (50) ferner Luftansaugmittel, insbesondere vom Venturi-Typ, umfassen, um Luft aus der Mehrzahl von Luftleitungen anzusaugen. 45 50
11. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 7 bis 10, **dadurch gekennzeichnet, dass** die Ausschlussmittel (60) ein Unterdruck-Rückschlagventil (62) umfassen, das ein erstes Ende und ein zweites Ende aufweist, wobei das erste Ende des Rückschlagventils mit der isokinetischen Sonde (54) verbunden ist und das zweite Ende mit der Kammer (52) verbunden ist, vorzugsweise über eine Leitung. 55
12. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 10 bis 11, **dadurch gekennzeichnet, dass** die Luftansaugmittel Luftkompressionsmittel umfassen, um einen Druckluftstrom zu erzeugen, und dass die Luftansaugmittel ein Venturi-Rohr (56) umfassen, das mit einem ersten Ende mit der Kammer (52) und mit einem zweiten Ende mit den Luftkompressionsmitteln verbunden ist, wobei die Luftansaugmittel vorzugsweise ein Magnetventil umfassen, das in einem sicheren Bereich außerhalb der ATEX-klassifizierten Bereiche angeordnet ist und eine Unterbrechung des Druckluftstroms in das Venturi-Rohr (56) ermöglicht, wobei das Magnetventil ebenfalls mit der elektronischen Steuer- und Regeleinheit (15) verbunden ist und insbesondere ein Schließen des Magnetventils ein automatisches Schließen des Rückschlagventils (62) bewirkt. 5
13. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 10 bis 11, **dadurch gekennzeichnet, dass** die Kammer (52) über das Rückschlagventil (62) mit der isokinetischen Sonde (54) verbunden ist, um zu verhindern, dass eine Menge Lösungsmittel, die den Feuchtigkeitssensor (12) oder den Feuchtigkeits- und Temperatursensor (12, 13) irreversibel beschädigen würde, in die Kammer (52) eindringt. 10 15 20 25 30 35 40 45 50 55
14. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 1 bis 13, **dadurch gekennzeichnet, dass** der Feuchtigkeitssensor (12), insbesondere der Feuchtigkeits- und Temperatursensor (12, 13), ein explosionsgeschützter ATEX-Sensor für den Einsatz in explosionsgefährdeten Bereichen ist. 5
15. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 1 bis 14, **dadurch gekennzeichnet, dass** die brennbaren Lösungsmittel aus Ethylacetat, Ethylalkohol, Isopropylalkohol, Aceton, Methyl-Ethyl-Keton, Hexan, Toluol, Methoxypropanol, Ethoxypropanol oder dergleichen ausgewählt sind. 5
16. Automatisches Abluft-Umluftsystem nach einem der Ansprüche 1 bis 15, **dadurch gekennzeichnet, dass** es eine Vorrichtung zur Detektion einer Vielzahl von Betriebsparametern der Maschine (90) umfasst, insbesondere zur Detektion beispielsweise der Prozessgeschwindigkeit, das heißt der Vor-

schubgeschwindigkeit des Materials, der Betriebstemperatur innerhalb der Trocknungsöfen, der Zuführgeschwindigkeit des zu druckenden, zu kopelnden oder zu laminierenden Materials, der Breite des Materials und der Lufttemperatur innerhalb des Trocknungssofens.

Revendications

1. Système automatique de recirculation de l'air d'évacuation (10) pour un four de séchage (92) pour une machine (90) utilisant des encres ou colles à base aqueuse et/ou des encres ou colles à base de solvants inflammables, ou similaires, ladite machine (90) étant sélectionnée parmi une machine d'impression de type flexographique ou rotatif, une machine de laminage, une machine d'enduction, ledite système automatique de recirculation de l'air d'évacuation (10) comprend une pluralité de conduits d'air définissant un système de ventilation d'air (20) pour ledit four de séchage (92) pour ladite machine (90), ladite pluralité de conduits d'air comprenant un conduit d'entrée d'air (21), un conduit d'évacuation de l'air d'extraction (23) et un conduit de recirculation de l'air d'extraction (24), ledite système automatique de recirculation de l'air d'évacuation comprend une unité électronique de commande et de contrôle (15) et au moins un capteur de température (13) et un capteur d'humidité (12), en particulier un capteur d'humidité relative (12), ledit capteur d'humidité (12) et ledit capteur de température (13) sont associés à ladite pluralité de conduits d'air pour détecter la température et l'humidité de l'air et pour déterminer l'humidité relative et en particulier l'humidité absolue à l'intérieur de ladite pluralité de conduits d'air, ladite unité électronique de commande et de contrôle (15) est connectée audit capteur d'humidité (12) et audit capteur de température (13) pour recirculer au moins partiellement l'air d'extraction dans ladite pluralité de conduits d'air, afin de réduire la consommation d'énergie et de réduire les mètres cubes d'air à évacuer, réduisant avantageusement le volume total d'air d'extraction à traiter avant son rejet dans l'environnement extérieur, tout en évitant la condensation de vapeur d'eau sur un produit (94) et en maintenant de préférence la même qualité d'un second produit (94) obtainable sans recirculation d'air ou avec une recirculation fixe à des niveaux minimaux tels qu'une recirculation de 20 %, ledit système automatique de recirculation de l'air d'évacuation (10) comprend également des moyens de ventilation (32, 35) et une pluralité de registres (31, 33, 34) à ouverture modulée, insérés dans ladite pluralité de conduits d'air et connectés à ladite unité électronique de commande et de contrôle (15) pour faire varier le débit d'air dans ladite pluralité de conduits d'air, ladite pluralité de registres comprend

au moins un premier registre motorisé (34) logé dans ledit conduit de recirculation de l'air d'extraction (24) pour en faire varier l'ouverture, au moins un second registre motorisé (31) logé dans ledit conduit d'entrée d'air (21) pour en faire varier l'ouverture, et au moins un troisième registre motorisé (33) logé dans ledit conduit d'évacuation de l'air d'extraction (23), ladite unité électronique de commande et de contrôle (15) est connectée auxdits moyens de régulation du débit et audit premier registre motorisé (34), audit second registre motorisé (31) et audit troisième registre motorisé (33), pour en faire varier leur ouvertures.

2. Système automatique de recirculation de l'air d'évacuation (10) selon la revendication 1, **caractérisé en ce que** ledit capteur d'humidité (12) est positionné à l'extérieur de ladite pluralité de conduits d'air, et en particulier à l'extérieur d'un conduit d'évacuation de l'air d'extraction (23) ou à l'extérieur d'un conduit d'entrée d'air (21).
3. Système automatique de recirculation de l'air d'évacuation (10) selon la revendication 1 ou 2, **caractérisé en ce que** ladite pluralité de conduits d'air comprend un conduit de chauffage de l'air (22) pour introduire de l'air conditionné, de préférence chauffé, dans ledit four de séchage (92) de ladite machine (90), ledit capteur d'humidité (12) étant associé audit conduit d'évacuation de l'air d'extraction (23) ou audit conduit d'entrée d'air (21).
4. Système automatique de recirculation de l'air d'évacuation (10) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** ledit capteur d'humidité (12) est intégré avec un capteur de température (13) dans un seul capteur d'humidité et de température (12, 13) apte à détecter simultanément la température et l'humidité de l'air, en particulier apte à détecter la température et l'humidité relative de l'air.
5. Système automatique de recirculation de l'air d'évacuation (10) selon l'une quelconque des revendications 1 à 4, **caractérisé en ce qu'il** comprend un dispositif de détection de concentration (40) d'un solvant inflammable, de préférence de type infrarouge (IR), ionisation de flamme ou catalytique, connecté à ladite unité électronique de commande et de contrôle (15) pour détecter une concentration dudit solvant inflammable et pour obtenir un rapport, de préférence un pourcentage, entre une concentration dudit solvant inflammable à un instant prédéterminé et une concentration critique minimale prédéterminée dudit solvant inflammable susceptible d'entraîner un risque d'incendie ou d'explosion.
6. Système automatique de recirculation de l'air d'éva-

- cuation selon l'une quelconque des revendications 1 à 5, **caractérisé en ce qu'il** comprend des moyens d'échantillonnage d'air (50) associés à ladite pluralité de conduits d'air pour prélever un échantillon d'air de ladite pluralité de conduits d'air et pour détecter l'humidité de l'air échantillonné au moyen dudit capteur d'humidité (12), et en particulier pour détecter l'humidité et la température de l'air échantillonné au moyen dudit capteur d'humidité et de température (12, 13).
7. Système automatique de recirculation de l'air d'évacuation selon la revendication 6, **caractérisé en ce qu'il** comprend des moyens d'exclusion (60) pour lesdits moyens d'échantillonnage (50), positionnés entre ladite pluralité de conduits d'air et lesdits moyens d'échantillonnage (50), pour éviter un contact dudit capteur d'humidité (12), et en particulier dudit capteur d'humidité et de température (12, 13), avec tout solvant inflammable présent dans ledit échantillon d'air, en particulier lors d'un procédé utilisant des pigments ou colles à base de solvants inflammables ou similaires.
8. Système automatique de recirculation de l'air d'évacuation selon la revendication 6, **caractérisé en ce que** lesdits moyens d'échantillonnage (50) et lesdits moyens d'exclusion (60) sont tous deux connectés à ladite unité électronique de commande et de contrôle (15), en particulier, dans le cas d'une détection d'au moins un solvant dans ladite pluralité de conduits d'air avec une concentration supérieure à une concentration minimale prédéterminée, par exemple égale ou inférieure à 3 % du LIE, c'est-à-dire la limite inférieure d'explosivité du solvant susceptible d'entraîner un risque d'explosion ou d'incendie, ladite unité électronique de commande et de contrôle (15) active un actionneur desdits moyens d'exclusion (60) pour isoler et séparer lesdits moyens d'échantillonnage (50) de ladite pluralité de conduits d'air, évitant que ledit capteur d'humidité (12), et en particulier ledit capteur d'humidité et de température (12, 13), n'entre en contact avec de l'air contenant un solvant.
9. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 6 à 8, **caractérisé en ce que** lesdits moyens d'échantillonnage (50) comprennent une chambre (52) dans laquelle est partiellement inséré ledit capteur d'humidité (12) et en particulier ledit capteur d'humidité et de température (12, 13), ladite chambre (52) étant connectée audit conduit d'évacuation de l'air d'extraction (23) ou audit conduit d'entrée d'air (21).
10. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 6 à 9, **caractérisé en ce que** lesdits moyens d'échantillonnage (50) comprennent une sonde isocinétique (54) associée à ladite pluralité de conduits d'air de ladite machine (90), ladite sonde isocinétique (54) étant partiellement insérée dans ledit conduit d'évacuation de l'air d'extraction (23) ou dans ledit conduit d'entrée d'air (21) pour prélever un échantillon homogène et uniforme d'air dans ladite pluralité de conduits d'air, ladite chambre (52) est de préférence associée à ladite sonde isocinétique (54), en particulier par l'intermédiaire d'un conduit, lesdits moyens d'échantillonnage (50) comprennent également des moyens d'aspiration d'air, en particulier de type Venturi, pour aspirer ledit air de ladite pluralité de conduits d'air.
11. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 7 à 10, **caractérisé en ce que** lesdits moyens d'exclusion (60) comprennent un clapet anti-retour (62) à dépression, comprenant une première extrémité et une seconde extrémité, ladite première extrémité dudit clapet anti-retour étant connectée à ladite sonde isocinétique (54) et ladite seconde extrémité étant associée, et en particulier connectée, à ladite chambre (52), de préférence au moyen d'un conduit.
12. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 10 à 11, **caractérisé en ce que** lesdits moyens d'aspiration d'air comprennent des moyens de compression d'air pour créer un flux d'air comprimé, et **en ce que** lesdits moyens d'aspiration d'air comprennent un tube Venturi (56) connecté à une première extrémité à ladite chambre (52) et à une seconde extrémité auxdits moyens de compression d'air. De préférence, lesdits moyens d'aspiration d'air comprennent une électrovanne positionnée dans une zone sûre, extérieure aux zones classées ATEX, permettant l'interruption dudit flux d'air comprimé dans ledit tube Venturi (56), ladite électrovanne étant également connectée à ladite unité électronique de commande et de contrôle (15), la fermeture de ladite électrovanne détermine en particulier la fermeture automatique dudit clapet anti-retour (62).
13. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 10 à 11, **caractérisé en ce que** ladite chambre (52) est connectée à ladite sonde isocinétique (54) par l'intermédiaire dudit clapet anti-retour (62) pour éviter qu'une quantité de solvant susceptible d'endommager irréversiblement ledit capteur d'humidité (12) ou ledit capteur d'humidité et de température (12, 13) ne pénètre dans ladite chambre (52).
14. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 1

à 13, **caractérisé en ce que** ledit capteur d'humidité (12), et en particulier ledit capteur d'humidité et de température (12, 13), est un capteur de type ATEX antidéflagrant pour une utilisation dans des environnements présentant un risque d'explosion.

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15. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 1 à 14, **caractérisé en ce que** lesdits solvants inflammables sont sélectionnés parmi l'acétate d'éthyle, l'alcool éthylique, l'alcool isopropylique, l'acétone, la méthyléthylcétone, l'hexane, le toluène, le méthoxypropanol, l'éthoxypropanol ou similaires.
- 10
16. Système automatique de recirculation de l'air d'évacuation selon l'une quelconque des revendications 1 à 15, **caractérisé en ce qu'il** comprend un dispositif de détection d'une pluralité de paramètres de fonctionnement de ladite machine (90), en particulier pour détecter, par exemple, la vitesse du procédé, c'est-à-dire la vitesse d'avancement du matériau, la température de fonctionnement à l'intérieur des fours de séchage, la vitesse d'alimentation du matériau à imprimer, à coupler ou à laminer, la largeur dudit matériau, la température de l'air à l'intérieur dudit four de séchage.
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FIG. 1

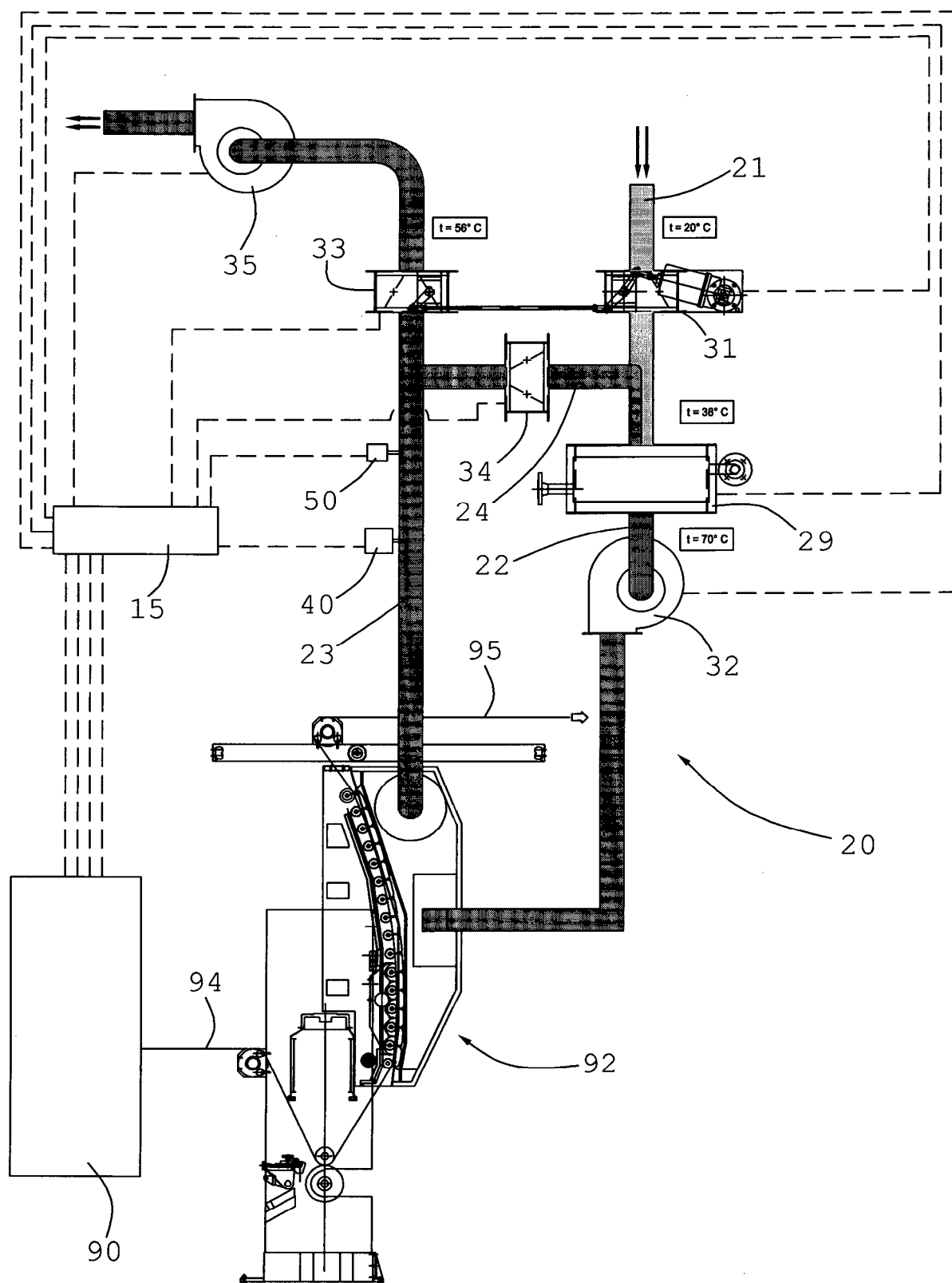


FIG. 2

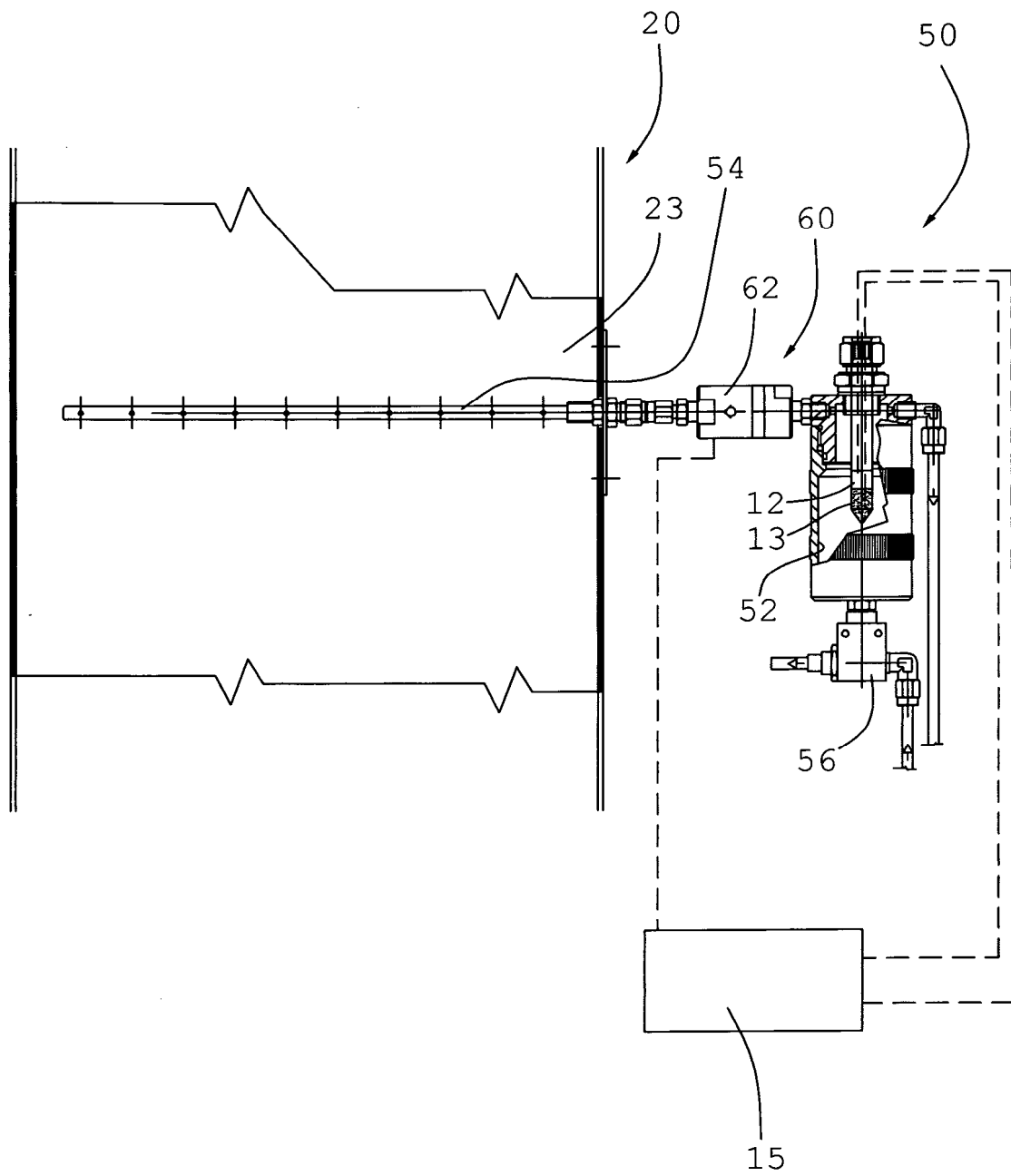
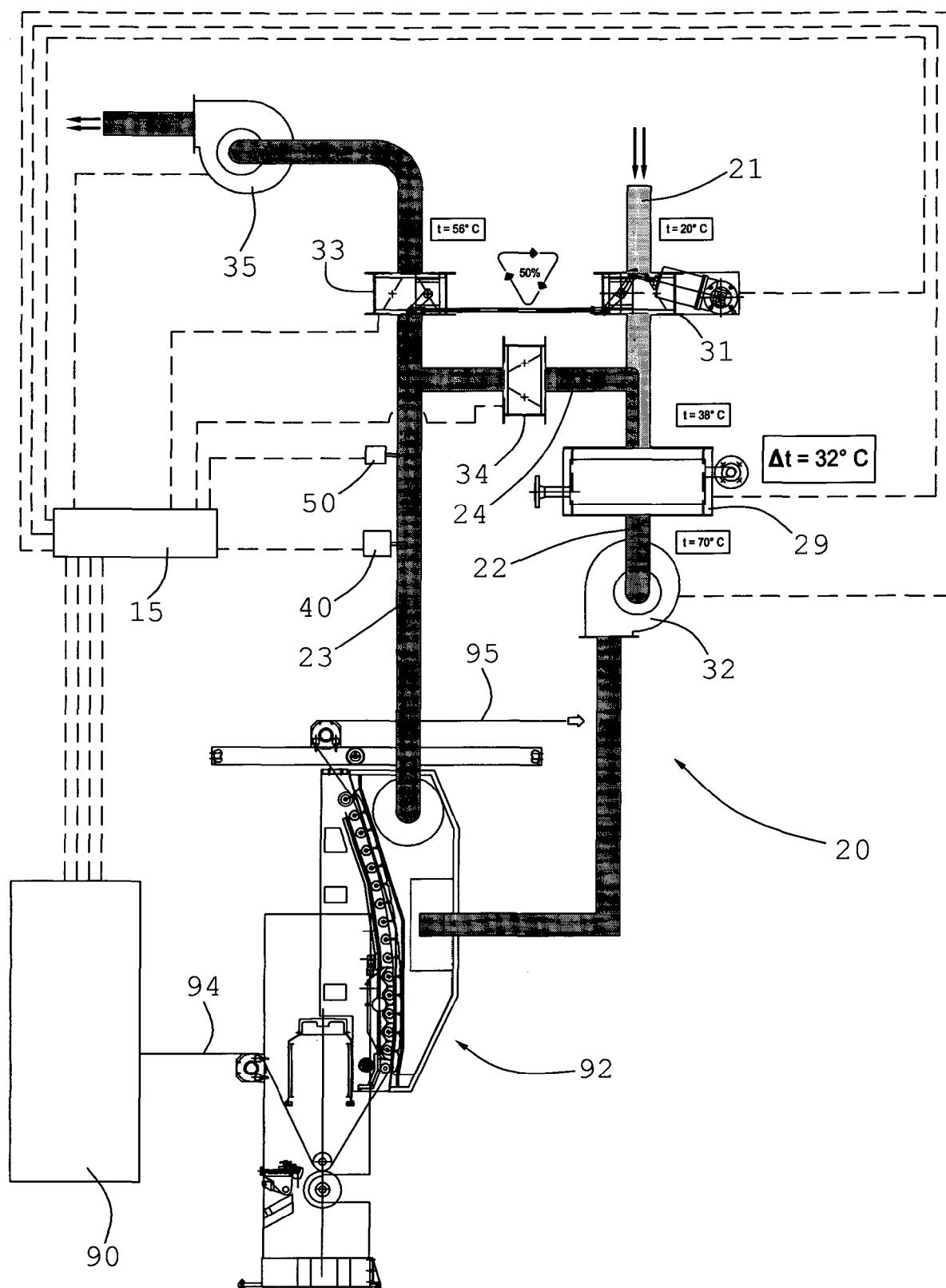


FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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