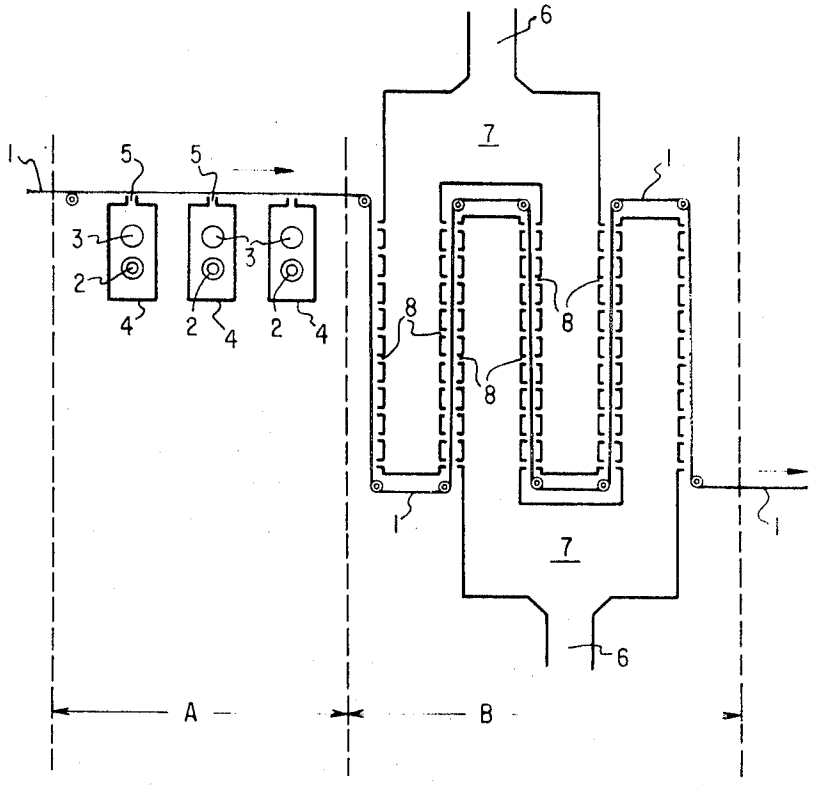
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HUMIDITY CONTROL OF PHOTOGRAPHIC PRINTING PAPER

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# HUMIDITY CONTROL OF PHOTOGRAPHIC PRINTING PAPER

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## ABSTRACT OF THE DISCLOSURE

Controlling the humidity of photographic printing paper by blowing a steam and inert gas mixture onto the support side only and thereafter blowing air of optimum relative humidity against the coating layer surface or both surfaces.

The production of photographic printing papers has been carried out by applying coating solutions prepared from silver halide emulsion, gelatin and other chemicals onto a support such as baryta paper to be superposed, in order, according to the number of layers desired, and thereafter, cooling, drying and humidifying the same.

Since the humidity contained in the photographic printing paper so produced has a great influence upon the physical and photographic qualities thereof, the production must be carried out under air conditioning or controlled humidity so that the most suitable humidity is retained by the photographic printing paper to maintain the quality thereof. The paper is packaged to keep the humidity constant until it is used.

The humidity contained in a photographic printing paper can substantially be expressed as a function of relative humidity, rather than as a function of absolute humidity in the ambient air. The influence of dry-bulb temperature upon the humidity equilibrium can nearly be neglected. Thus the humidity contained in the photographic printing paper may be considered as converted into an equilibrium relative humidity. When the humidity expressed by a relative humidity in equilibrium with the photographic printing paper fluctuates, the photographic and physical qualities of most photographic printing papers are affected. In many cases, deterioration of the photographic qualities with the passage of time may be considered as a function of the equilibrium relative humidity thereof. Mainly, the sensitivity, gamma and fog are affected by change of the equilibrium relative humidity.

Physical qualities, such as shrinkage, curl and fragility are affected by low relative humidity, and friction, spot and ferrotype effected by a high relative humidity. For storage and use of various photographic printing papers a relative humidity in the range of 40% to 65% R.H. is generally suitable. Production of a photographic printing paper in the prior art is generally carried out in which the humidity is controlled by exposing the photographic printing paper, after drying, to an air stream having a relative humidity of 40% to 65% which is the most suitable range for photographic printing papers,



thereby equating the humidity contained therein with the relative humidity. This humidity is referred to as the "optimum humidity."

Such humidity control method is disadvantageous due to the loss of space economy and producibility, because a humidity control time of at least 10 minutes is necessary to equilibrate a photographic printing paper with a predetermined optimum relative humidity. The photographic printing paper involved in the humidity controlling is of a length of several hundred meters where production speed increases.

It has been customary in the paper making industry, printing industry, etc., to humidify paper in a short time by various methods such as by spraying water or blowing steam directly thereon, or passing the paper through a chamber filled with steam including a high temperature, high humidity chamber and a low temperature chamber alternately to condense the water. These methods have, however, been unsatisfactory to maintain a precise and uniform humidity within a photographic printing paper. These methods have further disadvantages. There are often formed spoils or spots on the surface of a photographic printing paper by water drops, which is caused by uneven distribution of humidity, and the paper ripples and crimps. Accordingly, they are all unsuitable as a humidity controlling method for photographic printing papers.

It is the principal object of the invention to provide a rapid and precise method of obtaining optimum humidity with a uniform distribution and without forming spoils, paper ripples and crimps in photographic printing papers, particularly black-and-white printing paper and color printing paper on an installation scale having a space economy with high production speed.

In accordance with the present invention, there is provided a method of controlling the humidity of a photographic printing paper which involves drying excessively the photographic printing paper to a humidity less than a predetermined optimum humidity. A mixture of steam and air or inert gas, is blown against only the support side of the photographic printing paper to humidify to a humidity corresponding to 70–120% of said optimum humidity. Immediately thereafter, an air adjusted to a relative humidity suitable for the photographic printing paper is forcedly blown against the coating layer side or both sides of the photographic printing paper along a parallel flow path to incorporate the optimum humidity therein.

Further objects and features of the invention will become apparent while reading the following description in connection with the drawing in which:

The single drawing figure is a schematic view of the apparatus employing one embodiment of the invention.

Referring to the drawing, the humidity controlling system is partitioned into section A referred to as "front humidity controlling section" wherein humidifying is carried out by blowing a mixed gas, and section B referred to as "back humidity controlling section" wherein humidity controlling is carried out by blowing an air adjusted to a relative humidity suitable for a photographic printing paper, such as photographic printing paper 1, in web form. Steam feed pipe 2 and air or inert gas feed pipe 3 open into each mixing chamber 4. Chamber 4 mixes

steam and air or inert gas and carries nozzle 5 for blowing the mixed gas onto web 1. Duct 6 feeds an air adjusted to a relative humidity suitable for the photographic printing paper into chamber 7. Nozzles 8 blow the humidity controlling air onto web 1.

In operation of the humidity controlling system, photographic printing paper 1, dried excessively to a humidity less than a predetermined optimum humidity according to the kind of paper is moving in the direction of arrow in such a manner that the coating layer side is uppermost and the reverse side, i.e., the support side is lowermost. Paper 1 enters humidity controlling section A wherein steam from steam feed pipe 2 is mixed with air or inert gas from air or inert gas feed pipe 3 in mixing chamber 4 and immediately, blown against only the reverse side, i.e., support side of paper 1 through nozzle 5.

The photographic printing paper 1 is humidified to a humidity corresponding to 70–120% of the optimum humidity thereof by the mixture of steam and air or inert gas from nozzle 5 in humidity controlling section A. Directly after the humidifying step, web 1 enters rear humidity controlling section B. In rear humidity controlling section B, air adjusted to a relative humidity suitable for photographic printing paper 1 and fed to humidity controlling air blowing chamber 7 via blast duct 6. Air temperature and humidity controlling means (not shown) heat the air which is blown against the coating layer surface or both surfaces of photographic printing paper 1 by humidity controlling air blow-off nozzles 8, to thereby move the humidity of photographic printing paper 1 to the optimum level. It is required that the gas blown against photographic printing paper 1 in the front humidity controlling section A be a mixture of steam and air or inert gas. In the case where only steam is used as in the known rapid humidifying method, there occur spots due to water drops, and the paper ripples, crimps, etc., resulting in deterioration of the quality of the photographic printing paper. In the case of using a mixture of steam and air or inert gas, after the passage of some time, satisfactory humidifying results cannot be given. The ratio of steam to air or inert gas is preferably in the range of 0.5 part to 10 parts of air or inert gas to 1 part of steam, by volume.

In discharging a mixed gas from blow-off nozzle 5, it is preferred in order to obtain good humidification to use a number of nozzles of narrow width rather than a single nozzle of wide width.

The surface of the photographic printing paper to be exposed to a mixed gas in front humidity controlling section A, is preferably limited to the reverse side or support side thereof, to carrying out humidifying without deteriorating the quality of the coating layer. A vertical flow of mixed gas to the reverse side is desired for effective humidifying.

In rear humidity controlling section B, the surface to be exposed to a humidity controlling air is not particularly limited, the both sides desirable in many cases. The direction of blowing the humidity controlling air against the photographic printing paper is at right angles to rather than parallel with the coating layer surface and reverse surface to provide effective humidification with the same amount of flow. A good humidifying effect is achieved by the use of a number of nozzles of narrow width, as in front humidity controlling section A. The flow rate of humidity controlling air from blow-off nozzle 8 is preferably more than 10 m./sec., and a flow rate of more than 30 m./sec. is to be avoided from economical point of view.

In this case, the temperature and humidity conditions of the humidity controlling air supplied from an air temperature and humidity controlling blast means, being suitable for a photographic printing paper, are determined according to the kind of paper, and, in many cases, within an air dry-bulb temperature of 15 to 30° C. and air relative humidity of 40 to 65%.



It is apparent from the foregoing illustration that this invention shortens markedly the humidity controlling time without deterioration in the quality of a photographic printing paper by blowing a mixture of steam and air or inert gas against the coating layer surface thereof and humidifying rapidly, and immediately thereafter a rapid humidifying air having a relative humidity suitable for a photographic printing paper is blown against the coating layer surface or both surfaces thereof to thereby incorporate an optimum humidity in the photographic printing paper rapidly and precisely. Consequently, in accordance with the invention, humidity control of a photographic printing paper can be carried out without the occurrence of spots, paper ripples, and crimps on an installation characterized by space economy and high production speed.

The following examples are given in order to illustrate the invention without limiting the same.

## EXAMPLE 1

In making a conventional black-and-white printing paper, a photographic printing paper, dried excessively to a humidity in equilibrium with dry air and having a relative humidity of 15% was processed by using the humidity controlling apparatus as shown in the single drawing figure. First, in front humidity controlling section A thereof, a mixed gas of 1 part of steam and 3 parts of air was blown against only the reverse side of the photographic printing paper and then, in back humidity controlling section B, a humidity controlling air adjusted to a relative humidity of 60%, suitable for the photographic printing paper, was blown against the coating layer surface and the reverse surface at a flow rate of 15 m./sec. It was made clear by examination of the photographic printing paper after completion of humidity control, that the humidity control was favorably accomplished. The humidity contained therein was within the standard of quality management and there was present no spots due to water drops, paper ripples or crimps.

## EXAMPLE 2

In making a color printing paper, a photographic printing paper dried excessively to a humidity in equilibrium with dry air having a relative humidity of 20% was processed using the humidity controlling apparatus as shown in the single drawing figure. First, in front humidity controlling section thereof A, a mixture of 1 part of steam and 3.5 parts of air was blown against only the reverse surface, i.e., support surface of the photographic printing paper, and then, in back humidity controlling section B, a humidity controlling air adjusted to a relative humidity of 55% was blown against the coating layer surface and reverse surface at a velocity of 17.5 m./sec.

It was made clear by examinations of the photographic printing paper after completion of the humidity control that the humidity controlling step was favorably accomplished. The humidity contained therein was within the standards for quality management and there were found no change in the photographic characteristics nor spots due to water drops, paper ripples or crimps.

What is claimed is:

1. A method of controlling the humidity of a photographic printing paper comprising the steps of:

drying the paper excessively to a humidity less than the optimum humidity of the particular paper used,

blowing a mixture of steam of another gas against only the support surface of the photographic printing paper to humidify the same to a humidity corresponding to 70 to 120% of said paper optimum humidity and

immediately blowing air adjusted to a relative humidity suitable for said printing paper against at least said coating layer surface to adjust said paper humidity to its optimum level.

2. The method of claim 1 wherein gas mixture blown against said support surface only comprises steam and air.

3. The method of claim 1 wherein said gas mixture blown against said support surface only comprises steam and an inert gas.

4. The method of claim 1 wherein said gas mixture blown against said support surface only comprises 1 part steam and 0.5 to 10 parts of the other gas.

5. The method of claim 1 wherein said air is blown against at least said coating layer surface at right angles thereto and at a velocity of between 10 m./sec. and 30 m./sec.



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