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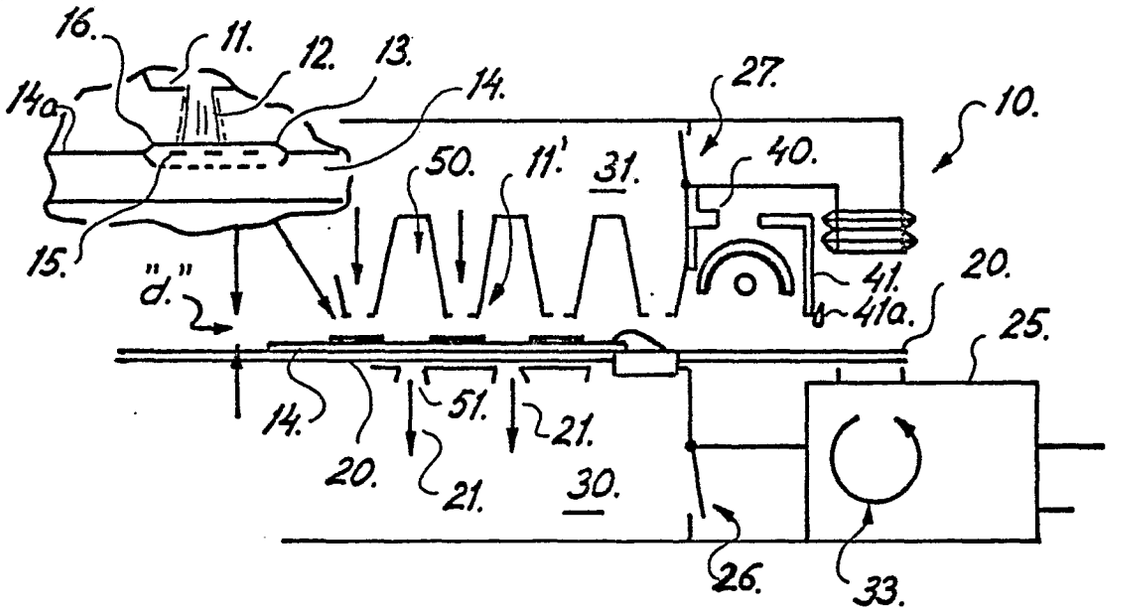
(54) A drying section equipped with blowing nozzles.

(57) The invention relates to a drying section (10) equipped with blowing nozzles (11, 11'), each of which is intended to direct an air stream (12) onto print material (14) carrying wet print (13). During a print drying process, respective nozzles (11) are located at a distance of less than 10 mm from the print (13), and the velocity of the air stream adjacent respective nozzles exceeds 100 m/sec, the time duration of the air streams being shorter than 10 sec, preferably between 1 and 5 sec for surface drying the wet print.



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A drying section equipped with blowing nozzles

TECHNICAL FIELD

The present invention relates to a drying section intended for drying wet print on print material, and more specifically to a drying section in which the print is dried with the aid of blowing nozzles, each of which is operative to direct a stream of air onto the wet print, so as to dry the water-based or solvent-based printing substance from which the print is formed.

The present drying section has been developed for the express purpose of surface-drying wet print on print material effectively and quickly, immediately prior to applying further print to said material in an adjacent, following silk screen printer. To this end, the drying section is connected between two mutually adjacent printing stations of a multi-colour silk screen printer.

BACKGROUND PRIOR ART

Drying sections equipped with blowing nozzles or like devices are known to the art, in several constructional configurations.

The drying sections are normally constructed specifically for the type of print to be dried. For instance, the drying section will be provided with blowers when the printing substances used are water-based or solvent-based inks or pastes, and with UV-lamps when the printing substances used are heat-curable or heat-hardenable substances. IR-lamps are also used to dry prints formed from these latter printing substances.

It is known to combine blowing nozzles UV-lamps in one and the same drying section, from instance from U.S. Patent Specification 4,551,925.

The present standpoint of techniques is based on the concept of thoroughly drying the wet paint on print material, before the material leaves the drying section. This concept, however, either requires the print material to be held in the drying section for a relatively long period of time, or requires a commensurately high energy input, in order to ensure that the wet print will be thoroughly dried or hardened throughout.

The known drying section also includes the possibility of moving the print material and/or the UV-lamps slowly through the drying section, during a print drying sequence, so that thorough drying or hardening of the print can be achieved at lower energy inputs.

In the case of print applied to a glass substrate, and in particular in the case of thick print, it is known from U.S. Patent Specification 4,538,358 to harden the print in two stages. In the first of these stages, a first print layer located contiguous with the upper surface of the glass substrate, is hardened with the aid of first devices positioned beneath the substrate, whereas in the second stage the top print layer is hardened with the aid of second devices positioned above the glass substrate. These devices are ultra-violet generators, in the form of UV-lamps.

SUMMARY OF THE INVENTION

TECHNICAL PROBLEMS

When studying the present state of the prior art discussed above, it will be seen that a technical problem resides in the provision of a drying section which can be placed advantageously between two printing stations of a multi-colour silk screen printer and which can be adapted to dry superficially water-based and solvent-based printing substances, primarily solely to an extent such that the surface layer of the wet print applied to print material will be sufficiently dry to enable a further wet print to be applied to said material without smudging the earlier print, inter alia with the intention of increasing the printing rate of the printer.

It will also be seen that a further technical problem resides in realizing that respective nozzles used in a drying section constructed to solve the aforesaid problem must be located very close to the print material during a print drying sequence, and that the air streams must exit from the nozzles at very high velocities, while still enabling the print material to be held in position against an underlying support surface, despite the regions of sub-pressure which are generated between the nozzle rows and which tend to lift the material from said supporting surface.

Another technical problem will be seen to exist in the ability to realize that the air streams should be of relatively short duration, particularly when surface drying, and therewith make available a longer time period in which the requisite pressure, or alternatively sub-pressure, can be built-up in a separate unit.

A further problem is one of realizing the advantage afforded when print material is held against a supporting surface with the aid of a partial vacuum or sub-pressure, and of realizing that this sub-pressure need only be active over the same length of time as the time duration of the air streams,

such that the sub-pressure will also be of short duration.

With respect to the intermittent process of generating air streams and concurrent sub-pressure periods as proposed here, it will be seen that a technical problem resides in the provision of conditions, with the aid of simple means, which will enable these short intermittent periods of air blowing and sub-pressure to be achieved with the aid of a circulating air volume, beneficially an attempered air volume.

Another technical problem is one of realizing the advantages that are afforded when the blowing nozzles are fixedly mounted on a raisable and lowerable frame structure, so as to enable the nozzles to be raised and lowered, and of realizing that edge surfaces on the frame structure be caused to coact with inlet and outlet sealing devices which are sealingly active when the frame is in its lower position and inactive when the frame is raised, during which time period the air streams and sub-pressures are generated.

It will also be seen that in the case of a drying section constructed in accordance with the aforegoing and capable of solving one or more of the aforesaid technical problems, a further technical problem exists in realizing that an increased air velocity will result in quicker drying, while still establishing that the air velocity should be less than 200 m/sec.

Finally, in the case of blowing nozzles of the aforesaid kind disposed in mutually parallel and mutually adjacent rows with an open channel facing the print and located between said nozzle rows, it will be seen that a further problem resides in realizing that the sub-pressure effect on the print material should be concentrated through openings located opposite said channel.

SUMMARY OF THE INVENTION

Accordingly, this invention is based on a drying section of the kind which is provided with blowing nozzles and in which each nozzle is intended to direct a stream of air at right angles onto print material bearing wet print. It is proposed in accordance with the invention that during a print drying sequence the distance of respective nozzles from the wet print is less than 10 mm and that the velocity of the air stream adjacent each nozzle is higher than 100 m/sec but lower than 200 m/sec.

Accordingly to advantageous embodiments of the invention, the air streams have a time duration of less than 10 sec, preferably between 1 and 5 secs, for surface drying water-based or solvent-based printing substances on an absorbent material.

It is also proposed that the nozzles are of "Pralldyse" construction, i.e. a nozzle construction with which part of the recycled air flow can be recovered.

It is also proposed that the print material is held firmly against a supporting surface with the aid of sub-pressure and that the period of sub-pressure activity has the same time duration as the air stream duration, preferably in coaction with gripping bars.

According to one advantageous embodiment, the over-pressure required to generate the air streams is created in a separate unit which also generates, at the same time, the requisite sub-pressure from a circulating air volume via simultaneous activation of two valves.

The blowing nozzles are preferably disposed in rows on a vertically movable frame structure, so that the nozzles can be raised and lowered. The frame may be configured to coact with inlet and outlet sealing devices. The extent of this nozzle movement is preferably from 50-100 mm, suitably from 50-75 mm.

According to another advantageous embodiment, the blowing nozzles are disposed in mutually adjacent rows and a channel which is open towards the print material is arranged between said rows, while sub-pressure openings are located opposite the open channel.

ADVANTAGES

The advantages primarily afforded by the present invention are associated with a drying section equipped with blowing nozzles, and reside in the provision of conditions which will enable wet print to be dried to varying degrees of dryness, from superficial to complete dryness throughout in the case of water-based and solvent-based printing substances. This will enable the drying section to be inserted between two mutually adjacent printing stations of a multi-colour silk screen printer in which surface drying of wet print is a prime desire. Complete drying of the wet print and partially dried prints present on print material in the last printing station in line can be effected subsequent to the print material leaving said station.

The invention also enables air streams of short time duration generated over short time intervals and acting on the upper surface of the print material to be accumulated via a circulating air volume and, at the same time, generate a region of high sub-pressure which acts on the undersurface of the print material.

The primary characteristic features of an inventive drying section are set forth in the characterizing clause of the following Claim 1.

BRIEF DESCRIPTION OF THE DRAWING

An exemplifying embodiment of a drying section equipped with blowing nozzles, where each said nozzle is intended to direct a stream of air onto wet-print carrying print material will now be described in more detail with reference to the accompanying drawing.

DESCRIPTION OF A PREFERRED EMBODIMENT

The present invention thus relates to a drying section 10 which incorporates a row of blowing nozzles, of which one has been referenced 11 in the drawing.

A plurality of such blowing nozzles 11 are disposed in close relationship and form a row. Parallel with this row are other blowing nozzles 11′ etc.

Each of the nozzles 11 is intended to direct a vertical air stream 12 onto print material 14 which carries a wet print 13, at right angles to said print material.

During the print drying process, respective nozzles 11 are located at a distance "d" from the print 13. This distance is less than 10 mm, preferably 5 mm, and the velocity of the air stream 12 adjacent the nozzle 11 is above 100 m/sec but beneath 200 m/sec. A suitable value in this respect is from 120 to 130 m/sec.

In accordance with the inventive concept, the air stream will be of relatively short time duration, normally a time duration of 10 secs, preferably a duration of between 1 and 5 secs, so as to surface dry wet print formed from water-based or solvent-based printing substances and applied to a print material of good absorbent properties.

When print 13 is applied to print material 14 in a silk screen printer, part of the print will diffuse into the print material 14, this diffusion area being referenced 15 in the single figure of the drawing, whereas the remainder of the print 13 will be located in the region of the upper surface 14a of the print material 14, in the form of a layer 16. This layer has been shown to lie above the upper surface 14a of the print material, in an exaggerated fashion for illustration purposes.

By surface drying in a multi-colour silk screen printer is meant that the layer 16 shall be dried in the drying section to a degree of dryness which will enable wet printing substance to be applied to the upper surface 14a of the print material 14 without smudging an earlier applied print against the stencil.

It should be noted that the wet layer 15 has a tendency to dissolve the layer 16, due to the high water content, or solvent content, of the layer 15, during the time taken to move the print material and its surface-dried print to the next printing station.

It is obvious that the time required to completely dry the print 15 is much longer than the time taken to dry the print superficially.

The nozzles 11 may advantageously be of the kind sold under the designation "Pralldysekonstruktion", i.e. a nozzle construction in which a given part of the recycled air flow can be recovered.

The print material is held firmly against a supporting surface 20, with the aid of a region of sub-pressure 21, and the supporting surface 20 is apertured to this end. The leading edge of the print material may also be held by a gripping bar.

It is proposed in accordance with the invention that the sub-pressure 21 is active over a period of time equal to the duration of the air stream 12.

It is also proposed that the overpressure from which the air streams 12 are generated is created in a unit 25 which is constructed so that it can also generate the requisite sub-pressure 21 at the same time, via simultaneous activation of a first valve 26 and a second valve 27.

The valve 26 separates a chamber 30 from the unit 25, whereas the valve 27 separates a chamber 31 from said unit 25.

The unit 25 is constructed to generate a circulating air volume 33, the temperature of which can be regulated in a known manner. Thus, there will prevail in the unit 25 an overpressure and a movement which can be caused suddenly to pass the valve 27 to form the air streams at the same time as the valve 26 opens and a requisite sub-pressure is generated in the chamber 30.

Upon completion of the active period, the valves 26 and 27 are closed, leaving sufficient time to again circulate the air volume 33.

In accordance with the present invention, the blowing nozzles 11 are stationarily mounted on a vertically movable frame 40, such as to enable the nozzles to be raised and lowered. The frame 40 coacts with inlet and outlet sealing devices 41, such that when the blowing nozzles occupy their lower position an edge 41a will abut the supporting surface 20.

The illustrated embodiment also includes the provision downstream of the blowing nozzles 11, 11′ of UV-radiating or IR-radiating devices, for use when hardenable printing substances or varnishes are used in the silk screen printer concerned.

The vertical distance moved by the blowing nozzles is from 50-100 mm, preferably 50-75 mm.

As will be seen from the drawing, the blowing nozzles 11, 11′ are positioned adjacent one another in parallel rows, and that an open channel 50 which faces the print 13 is located between pairs of

blowing nozzle rows, and that openings 51 operative in establishing a sub-pressure region are located opposite the open channel 50 and beneath the supporting surface.

The air streams 12 will generate turbulence or vortex flow in combination with coejection, and consequently there will be generated in the channel 50 a partial vacuum which tends to lift the print material, and therewith the print 13, from the supporting surface 20. This tendency is eliminated, by simultaneously applying sub-pressure 21 through the openings 51.

It will be understood that the invention is not restricted to the aforedescribed and illustrated exemplifying embodiment thereof, but that modifications can be made within the scope of the following claims.

Claims

1. A drying section equipped with blowing nozzles, each of which is intended to direct an air stream onto a print-carrying material, characterized in that during a print drying process the nozzles are located at a distance from the print material of less than 10 mm; and in that the velocity of the air stream adjacent respective nozzles is greater than 100 m/sec.

2. A drying section according to Claim 1, characterized in that the air streams have a time duration of less than 10 sec, preferably between 1 and 5 sec, for surface-drying wet print.

3. A drying section according to Claim 1 or 2, characterized in that the nozzles are of "Pralldysekonstruktion".

4. A drying section according to Claim 1, 2 or 3, characterized in that the print material is held against a supporting surface by means of a sub-pressure which is active throughout the time duration of respective air streams.

5. A drying section according to Claim 4, characterized in that the overpressure intended for generating the air streams is created from a unit which also generates the requisite sub-pressure at the same time from a circulating air volume, by the simultaneous activation of valves herefor.

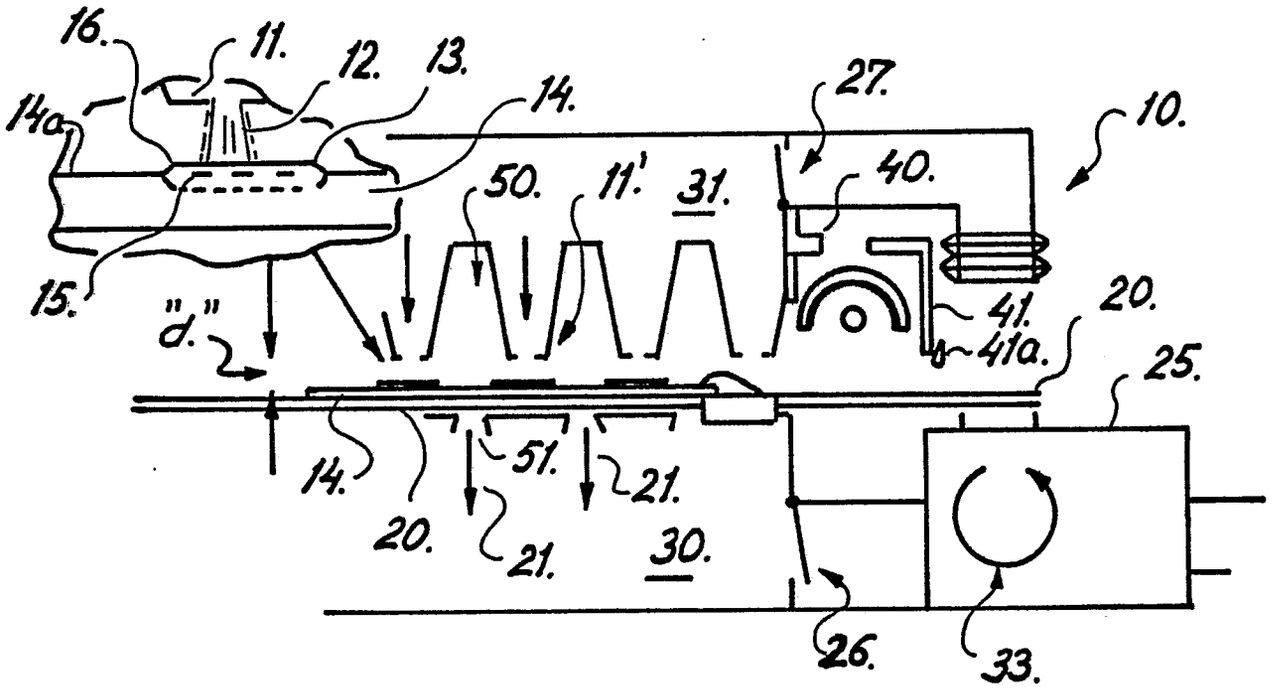
6. A drying section according to Claim 1, characterized in that the blowing nozzles are stationarily mounted on a vertically movable frame, such as to enable the nozzles to be raised and lowered.

7. A drying section according to Claim 6, characterized in that the frame is constructed to coact with inlet and outlet sealing devices.

8. A drying section according to Claim 7, characterized in that said movement is adapted to 50-100 mm.

9. A drying section according to Claim 1, characterized in that the air stream adjacent respective nozzles has a velocity below 200 m/sec.

10. A drying section according to Claim 1, characterized in that the blowing nozzles are positioned mutually adjacent one another in rows, with an open channel facing towards the print located between rows of blowing nozzles, and with sub-pressure openings located opposite said open channel.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