United States Patent [19]

Geyken et al.

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[54] **WEB DRIER**

[75] Inventors: **Erwin Geyken; Peter Dawidowitsch,** both of Munich, Germany

[73] Assignee: **Agfa-Gevaert Aktiengesellschaft,** Leverkusen, Germany

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**.....**F26b 13/00**

[58] **Field of Search**.....34/155, 162, 151, 34/160

[56] **References Cited**

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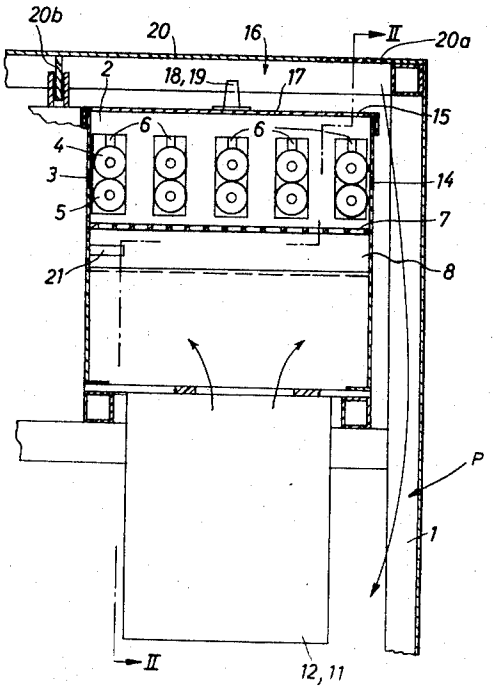
Primary Examiner—Carroll B. Dority, Jr.

Attorney—Michael S. Striker

[57] **ABSTRACT**

A drier for sheet-shaped photographic web materials has a housing in which first and second transport rollers are located for engaging the web at opposite major surfaces thereof to advance it in a predetermined path. One or more blowers with associated heating devices are provided for blowing warm air towards one of the major surfaces of the web. Perforated sheet metal walls establish adjacent this one surface intermediate the same and the blowers a pressure chamber which extends at least substantially over the cross-sectional area of the housing and which in the direction of flow of the airstream or airstreams has a dimension substantially smaller than its dimensions transversely to this direction. Thus, warm air enters the chamber from the blower or blowers and leaves it in direction towards the major surface of the web substantially evenly distributed over substantially the entire cross-sectional area of the housing.

6 Claims, 2 Drawing Figures



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SHEET 1 OF 2

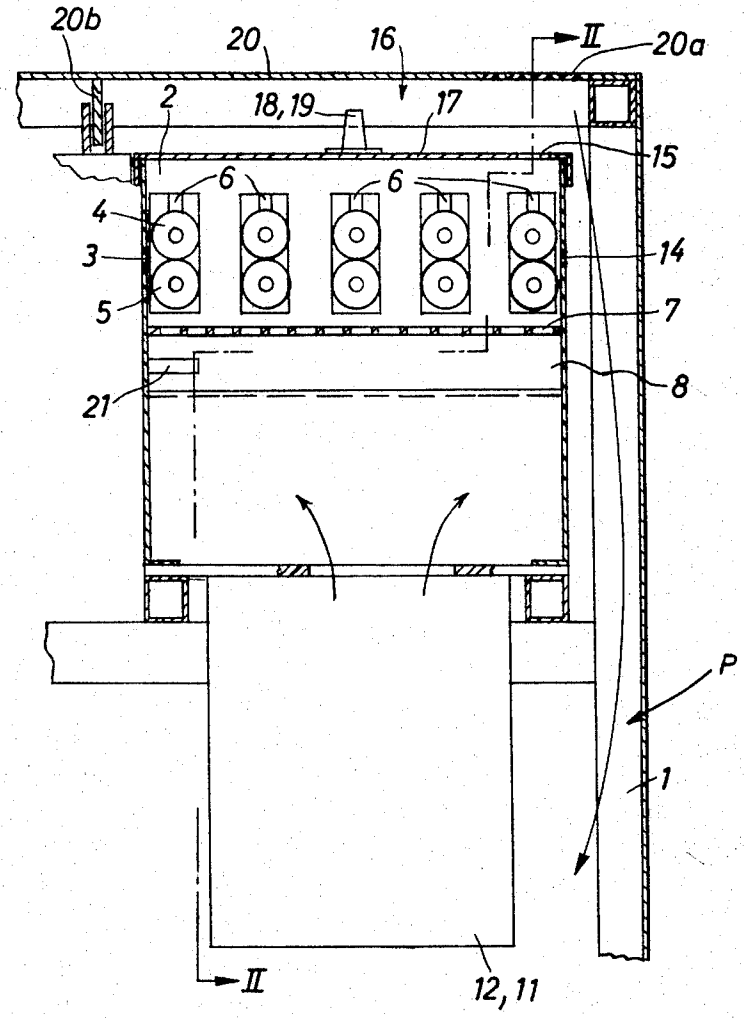

Fig. 1

INVENTOR
ERWIN GEYKEN
PETER DAWIDOWITSCH

BY

Atty.

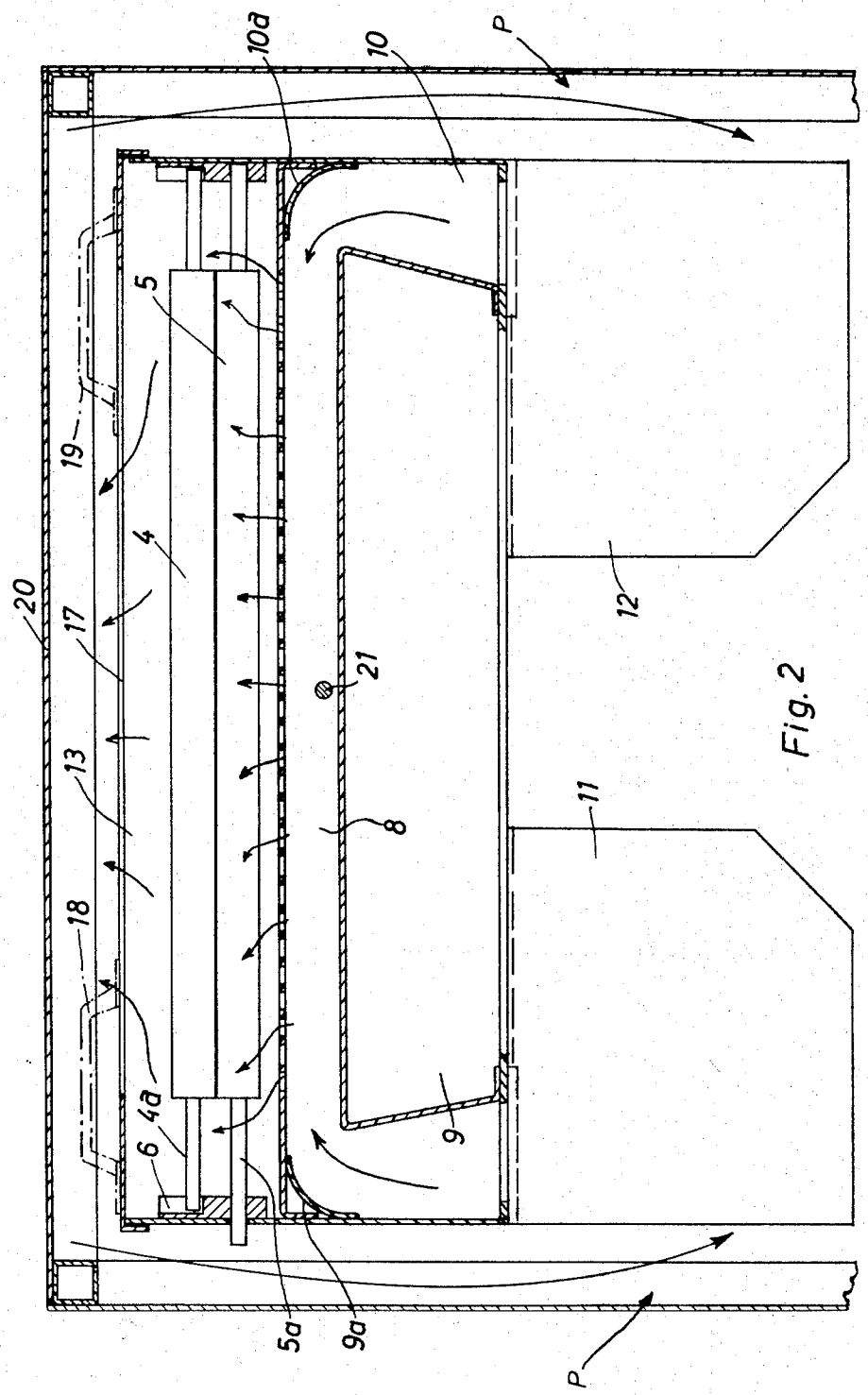

Fig. 2

INVENTOR
ERWIN GEYKEN
PETER DAWIDOWITSCH

BY
Michael J. Striker
Attorney

WEB DRIER

BACKGROUND OF THE INVENTION

The present invention relates generally to a drier, and particularly to a web drier. Still more specifically the invention relates to a drier for photographic materials, especially sheet-shaped photographic materials.

It is already known to provide driers of the general type under discussion in which the photographic materials to be dried are passed between engaging rollers which transport them in a predetermined path, and in which streams of warm air are blown against the material to be dried. They are particularly well suited for use in conjunction with a developer device in which the materials pass through the developer apparatus in a straight usually at least substantially horizontal path, and in which their major upper and lower surfaces are treated with developer fluid. Subsequently the developed photographic material then passes through the associated web drier in which conventionally tubes or conduits have been provided which are arranged symmetrically with reference to the layer of the web to be dried and provided with slots through which warm air is blown at the web.

Experience has shown, however, that this type of drier is not entirely satisfactory for a variety of reasons. On the one hand, the effectiveness of the blowing arrangements and the through-put of air volume were relatively limited because of the necessary rather significant number of deflections in the flow path of the air, and also because of the relatively great back pressure resulting from the narrow slots through which the air had to escape. On the other hand, the concentrated blowing of air against the web to be dried in relatively limited areas of the latter, caused uneven drying or difficulties in traversal of the web in its predetermined path because of the deflection exerted upon the web by the relatively high pressure of the escaping air.

For these reasons it is desirable to improve such web driers, and industry has felt this need for some time. However, heretofore no improved solution to this problem has been forthcoming.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to overcome the aforementioned disadvantages.

More particularly it is an object of the present invention to provide an improved web drier described here under discussion.

Still more specifically it is an object of the present invention to provide an improved web drier for photographic materials, particularly for sheet-shaped photographic material, in which quick drying results can be obtained with minimal technological measures.

A concomitant object of the invention is to provide such an improved web drier which, because of its simplicity, is highly reliable in its operation.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides in a web drier which, briefly stated, comprises a housing and first and second transport rollers mounted in the housing for engaging a web at opposite major surfaces thereof to thereby advance it in a predetermined path. Supply means supply at least one stream of warm air which is directed towards one of the major surfaces of the web. Perforate wall means defines

intermediate the supply means and the one major surface, proximal to the latter, a chamber extending at least substantially over the cross-sectional area of the housing and having in direction of flow of the stream of warm air a dimension which is substantially smaller than its dimensions transversely to this direction, so that the warm air leaves the chamber substantially evenly distributed over substantially the entire cross-sectional area of the housing.

By resorting to this construction the warm air reaches the web to be dried without any flow-resistance differential developing anywhere over the cross-section of the housing. Thus, a large quantity of warm air can be blown at and past the web to be dried with a small pressure differential. This results in a rapid and very even drying of the web, as experience and tests have shown.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical somewhat diagrammatic section through an apparatus according to the present invention; and

FIG. 2 is a section taken on line II—II of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now FIGS. 1 and 2 in detail, it will be seen that reference numeral 1 in FIG. 1 identifies a frame for the apparatus according to the present invention, which may for instance be composed of a plurality of square cross-section tubes or the like. In any case, the various structural units of an automatically operating sheet-film developing device with horizontal film feed are mounted in this frame 1. The device comprises a web drier 2 having an inlet opening 3. By the time the film or web to be treated has reached the inlet opening 3 of the apparatus 2, it has already passed through a developing station, a fixing station and watering station. These various stations may be of any construction known from the art, for instance they may be constructed according to the teaching of German Pat. No. 1,293,586. In themselves they do not form part of the present invention and have been mentioned here only to provide background information on the treatment which the web will have undergone before it reaches the inventive web drying apparatus 2 according to the present invention.

It will be appreciated that it is the purpose of the web-drying apparatus according to the present invention to completely dry the web—here sheet films—in the quickest possible time, with the lowest energy expenditure and in the shortest path, keeping in mind the established through-put speed selected for the films. Because the length of the path in such web driers, in which the path is horizontal or at least substantially horizontal, must be added to the length of the path traversed by the web in the preceding treating stations,

it is particularly important that in the drier the length of the path be kept as short as possible because it, added to the length of the path which the web traverses in the preceding stations, determines the overall horizontal length of the total apparatus; evidently, the shorter the total apparatus can be kept in horizontal direction, the better it will be because the apparatus will require less floor space which is frequently at a premium.

As shown, the web drier according to the present invention comprises five pairs of transport rollers, each pair having an upper transport roller **4** and a lower transport roller **5**. At least one roller of each pair—that is either the roller **4** or the roller **5**—is driven by means of a suitable drive, for instance a worm drive or the like. The rollers are mounted in mounting elements **6** which at the same time constitute the lateral walls of the drying chamber **13** defined by the overall housing of the device **2**. The rollers themselves may be made of various different materials, for instance of hard paper, and contact one another only under the weight of the uppermost roller **4** of each pair. The web to be dried advances between the rollers **4** and **5** of each pair in a path which in the illustrated embodiment is horizontal, but which could also be somewhat different, that is be only substantially horizontal.

Below the lower rollers **5**, spaced therefrom by approximately the roller diameter, is a perforated sheet material wall **7** which extends over the entire cross-sectional area of the housing. It is advantageously constituted by a commercially available perforated sheet-metal member provided with quadratic openings arranged in an even pattern, with the combined cross-sectional area of the openings being not in excess of half of the total cross-sectional area of the member **7**. Below this member **7** is a chamber **8** whose height is approximately equal to the diameter of the rollers **4** or **5**. It, also, extends over the entire cross-sectional area of the housing, that is of the chamber **13**.

As FIG. **2** shows particularly clearly, those edge regions of the chamber **8** which are lateral with respect to the direction of advancement of the web, that is which are located at opposite sides of the path traversed by the web, the chamber **8** is connected via slightly divergent channels **9** and **10**, and curved guide baffles **9***a* and **10***a*, with the discharge openings of respective blowers **11** and **12**. The channels **9** and **10** have relatively large cross-sectional areas and therefore the blowers **11** and **12** are capable of turning over large quantities of air into the chamber **8**, at relatively low energy requirements and against low back pressure. From the chamber **8** the air is very evenly distributed over the entire cross-sectional area of the member **7** and therefore of the chamber **13**, and rises from the apertures of the member **7** at relatively low speeds and in substantially normal direction with reference to the plane of the web, to impinge upon the downwardly directed major surface thereof. The impingement is almost vertical and as a consequence the impinging air is deflected laterally to the edges of the web in the presence of a web; of course, if a web is momentarily not present the air will simply pass upwardly between the rollers. In the edge regions of the web outside the transverse width of the widest web to be processed in the drier, the diameter of the rollers **4** and **5** is reduced to the configuration identified at **4***a* and **5***a* which is just sufficient for withstanding the mechanical forces acting upon the rollers, so that a sufficiently large flow space exists for flowing of the air from the underside to the upperside and to the upwardly directed major surface of the web. The width of this space corresponds to at least one roller diameter. When the thus deflected warm air reaches the upper side of the web, it now flows in the axial direction of the rollers normal to the transportation of the web along the upper side of the latter, until the two streams of air coming from opposite lateral edges of the web meet in the middle and are deflected upwardly.

Outlet means is provided, in the illustrated embodiment in form of an outlet slot **15** which is located above the discharge opening **14** for the web, and the upwardly deflected air moves in concomitant movement with the web until it reaches the slot **15** which is provided in the other cover **17** of the chamber **13**. From the slot **15** the air moves into a distributing chamber **16** which is separated by the cover **17** from the chamber **13**, handles **18** and **19** being provided for facilitating removal of the cover **17** for inspection and cleaning purposes. A similarly removable cover **20** is provided which closes the distributor chamber **16** and can be withdrawn for inspection, cleaning and the like. The cover **20** is provided with apertures **20***a* which communicate with the ambient atmosphere so that some of the air emitted through the slot **15** can escape to the exterior of the device.

The largest portion of the moist air leaving the chamber **13** through the slot **15** will flow along the lateral walls bounding the chamber **16** and from there downwardly through the passages P in the direction indicated by the arrows (see FIGS. **1** and **2**) until it reaches the inlet of the blowers **11** and **12**. Heating devices are provided upstream of the blowers **11** and **12** which are controlled by a temperature sensor **21** located in the chamber **8**, so that the temperature of the air supplied by the blowers **11** and **12** is automatically maintained at the desired value which can of course be adjusted as required.

The arrangement of the heating devices upstream of the blowers **11** and **12** has the advantage that even if the air is unevenly heated in the heating device, it becomes thoroughly admixed in the blowers **11** and **12** before it is supplied to the chamber **8** so that uneven heating is compensated. The air aspirated by the blowers **11** and **12** is a mixture of fresh air aspirated from the exterior of the device, and of the air which has entered the chamber **16** through the slot **15** from the chamber **13**. Thus, after a short start-up period of the apparatus a constant value of air humidity develops for the air entering into the chamber **13**, as well as for the air emitted from the chamber **13**. The advantage of drying with air which is moister than the ambient air outside the apparatus, is that the drying obtained in this manner is very even and is conformed to the throughput speed of the web, if a sufficiently large quantity of such air can be passed along the upper surface of the web to be dried, as is the case in the apparatus according to the present invention.

It is also pointed out that the rollers **4** and **5** have an influence upon the drying effect, inasmuch as their surfaces pick up droplets adhering to the major surfaces of the web and inasmuch as the thus picked up liquid is

quickly returned into the airstream due to the higher temperature of the roller surfaces. On the other hand, contact of the surfaces of the rollers at elevated temperature with the web, facilitates heating and drying of the web.

It will be appreciated that the invention is not limited to the embodiment which has been illustrated herein for purposes of explanation. It is possible, for instance, to make the chamber **13** substantially lower so that the cover **17** would be located only a very small distance above the upper rollers **4**. Should this be the case, then the outlet slot **15** would have to be located in the middle of the device, that is in the middle of the path which is being traversed by the web, so that the warm air would move along the upper surface of the web in axial direction of the rollers to the middle of the path, and would be emitted from there. It will also be possible to provide on the cover **20** a portion **20*b*** which cooperates with projections on the frame **1** to constitute a labyrinth seal preventing an overflowing of the moist warm air into the wet treating station of the overall device, with such wet-treating station not being a part of the present invention.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a web drier, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. A web drier, particularly for sheet-shaped photographic materials, comprising a housing having an inlet and a discharge opening for webs to be dried; first and second transport rollers in said housing for engaging a web at opposite major surfaces thereof to thereby advance the web in a predetermined path from said inlet to said discharge opening; supply means for supplying at least one stream of warm air directed towards one of said major surfaces; perforate wall means defining intermediate said supply means and said one major surface, proximal to the latter, a chamber extending at least substantially over the cross-sectional area of said housing and having in direction of flow of said stream of warm air a dimension which is substantially smaller than its dimension transversely to said direction, so that the warm air leaves said chamber substantially evenly distributed over substantially the entire cross-sectional area of said housing; and air outlet means in form of at least one slot located above said discharge opening.

2. A web drier as defined in claim **1**, said perforate wall means comprising sheet-metal walls provided with evenly distributed perforations.

3. A web drier as defined in claim **2**, wherein the combined cross-sectional area of the perforations in the respective sheet-metal wall is at most equal to one-half the total cross-sectional area of the wall.

4. A web drier as defined in claim **1**, said rollers being positioned for advancing said web in a substantially horizontal path, and wherein said chamber is located downwardly of and below said path.

5. A web drier as defined in claim **1**; further comprising side wall means bounding lateral sides of said chamber; and wherein said supply means comprises a pair of blowers each supplying a stream of warm air to said chamber, and conduit means extending from the respective blower to said side wall means so as to discharge the stream of warm air against the latter for deflection through substantially 90° into said chamber.

6. A web drier as defined in claim **1**; further comprising a distributor chamber outside said housing and communicating with said air outlet means, and apertures in said distributor chamber communicating with the ambient atmosphere.

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