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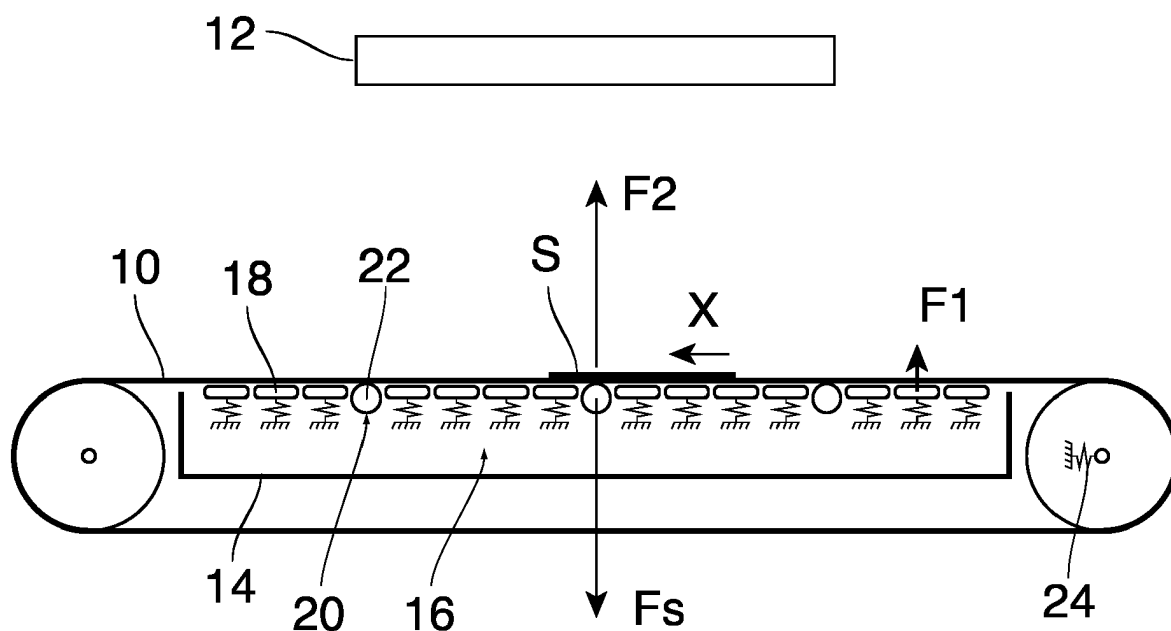
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(54) **APPARATUS FOR HEAT TREATMENT OF SHEETS**

(57) An apparatus for heat treatment of sheets (S) that are supported on a moving belt (10), wherein the sheets (S) are pressed against a support surface of the belt (10) and the belt is supported on a heat conductive stationary support structure (16), characterized in that

the heat conductive support structure (16) is elastically biased against the belt (10) with a biasing force (F1) and a compliance limiting mechanism (20) is arranged to support the belt (10) against a force (Fs) with which the sheets are pressed against the belt.

Fig. 1



Description

[0001] The invention relates to an apparatus for heat treatment of sheets that are supported on a moving belt, wherein the sheets are pressed against a support surface of the belt, and the belt is supported on a heat conductive stationary support structure.

[0002] More particularly, the invention relates to a dryer for printed media sheets in an ink jet printer.

[0003] In such a dryer, a radiation heater and/or a hot air blower is installed above the belt for heating the sheet to a temperature high enough for drying the ink that has been deposited on the sheet. The belt is perforated, and a suction box is installed underneath the belt, so that air is sucked-in through the perforations of the belt and the sheets are firmly attracted against the belt while moving past the heater.

[0004] In a high production printer, having a production of 600 sheets per minute, for example, the sheets have to be moved past the heater at a considerable speed, and the heater must be powerful enough to heat the sheets to a sufficiently high temperature in a time period that has a length of only a fraction of a second. Further, in view of the high speed, a high suction pressure is required for safely holding the sheets on the belt.

[0005] In general, the sheets on which an image has been printed with an ink jet print head have certain areas which have received a large amount of ink and are relatively wet, whereas other areas may have received only little or no ink. In view of the high power of the heater, there is a risk that the relatively dry areas on the sheet become overheated. For that reason, the heat conductive stationary support structure which is formed by a perforated top wall of the suction box has not only the function to support the belt but has also the function to equalize the temperature profile of the sheet by absorbing heat from the hotter areas of the sheet and transporting it to the cooler areas.

[0006] The high suction pressure with which the sheets are pressed against the belt has the consequence that the belt tends to sag and is pressed against the support structure with a force that is approximately equal to the force with which the sheet is pressed against the belt. On the one hand, this assures a good thermal contact between the belt and the heat conductive support structure. On the other hand, it leads also to high friction between the moving belt and the stationary support structure and, in view of the high speed of the belt, to increased energy consumption and accelerated wear of the belt.

[0007] It is an object of the invention to provide an apparatus of the type indicated above wherein the friction between the belt and the stationary support structure is reduced and the support structure is nevertheless capable of efficiently distributing the heat over the area of the sheet.

[0008] According to the invention, in order to achieve that object, the heat conductive support structure is elastically biased against the belt with a biasing force, and a

compliance limiting mechanism is arranged to support the belt against a force with which the sheets are pressed against the belt.

[0009] In order to assure a good thermal contact between the sheet and the support structure, via the belt intervening between them, the belt should be held in intimate full-face contact with the support structure. However, since the relation between the heat transfer at the interface between belt and support structure and the force with which the belt is pressed against the support structure is non-linear, it is sufficient that the belt and the support structure are gently biased against one another with a relatively small force. A reduced biasing force would however increase the compliance of the belt, i.e. the tendency of the belt to sag or to be deflected, because the pressing force exerted onto the sheet and the belt cannot be counterbalanced completely. For that reason, an additional compliance limiting mechanism is provided that is capable of supporting the belt with a higher force without causing too much friction. This assures that the elastic means that bias the support structure against the belt will not be compressed excessively, so that the biasing force and consequently also the friction are limited.

[0010] More specific optional features of the invention are indicated in the dependent claims.

[0011] The stationary support structure may be formed by a plurality of segments that are separated by gaps in which the compliance limiting mechanism, constituted for example by a set of rollers, can engage the belt. Preferably, the heat conductive segments extend in transverse direction of the belt, so that the support structure has a particularly high heat conductivity in the transverse direction. In the longitudinal direction of the belt, a temperature gradient in the heated sheet will be smoothened, anyway, because the sheet moves over the consecutive segments of the support structure.

[0012] The compliance of the belt can also be reduced by increasing the tension of the belt. In certain embodiments, it may even be possible to dispense with support rollers or other low-friction support elements, so that the compliance limiting mechanism will be formed only by a belt tensioning mechanism.

[0013] The segments of the support structure may be biased against the belt by means of coil springs, leaf springs, and the like.

[0014] In order to assure that the segments of the support structure are held in a common plane when the force pressing the belt against the support structure is low or absent, the range of movement of the segments in the direction normal to the plane of the belt may be limited by mechanical stops.

[0015] Embodiment examples will now be described in conjunction with the drawings, wherein:

Fig. 1 is a schematic side view of a heat treatment apparatus according to the invention;

Fig. 2 is a sectional view of a segment of a support

structure in the apparatus shown in Fig. 1,

Fig. 3 is a top plan view of a support structure supporting a conveyor belt; and

Fig. 4 is a diagram showing a relation between a heat conductivity of an interface between the belt and the support structure as a function of a force with which the belt is pressed against the support structure.

[0016] As an example of a heat treatment apparatus, Fig. 1 shows a dryer that forms part of an ink jet printer and serves for drying media sheets S on which an image has just been formed by means of an ink jet print head assembly that has not been shown. The sheets S are conveyed on an endless conveyor belt 10 and move in a direction indicated by an arrow X. A heater 12 is installed above the belt 10 and heats the sheets S, e.g. by irradiating them with infrared light, in order to dry the liquid ink that is deposited on the sheets.

[0017] A suction box 14 is installed underneath the upper strand of the belt 10 and has a top wall formed by an air-permeable support structure 16 that supports the belt 10 from below. The support structure 16 is constituted by a series of segments 18 that extend in transverse direction of the belt 10 and are elastically biased against the belt 10 with a force F1.

[0018] A suction pressure is applied to the interior of the suction box 14, so that air is drawn in through the air-permeable top wall and through perforations of the belt 10. As a consequence, the sheets S are firmly attracted against the top surface of the belt 10 with a force Fs. The suction force Fs is large enough to safely immobilize the sheets S on the belt 10 even when the belt moves at high speed.

[0019] A compliance limiting mechanism 20 is comprised by a set of rollers 22 that are arranged in some of the gaps between the segments 18 and are evenly distributed over the width and with a length of the belt 10 so as to rigidly support the belt from below with low friction. In addition, a belt tensioning mechanism 24 is provided for holding the belt 10 under relatively high tension in order to further reduce the compliance of the belt. The compliance limiting mechanism 20 exerts an upwardly directed force F2 on the belt 10. Together, the upwardly directed forces F1 and F2 counterbalance the suction force Fs, so that the belt 10 is substantially prevented from sagging.

[0020] Fig. 2 shows an individual segment 18 of the support structure 16. The segment is constituted by a profile member 26 that extends over the entire width of the belt 10 and has a cross-sectional shape of an inverted U with a flat top wall 28 and inwardly projecting flanges 30 at the bottom ends of the legs of the U. The flat top wall 28 is preferably provided with openings 28A which allow air to pass through the flat top wall 28. A biasing mechanism 32 which has only been shown schematically

in Fig. 2 biases the profile member 26 upwards so that, as long as no opposing force is exerted on the segment, the flanges 30 are held in engagement with stop members 34 which limit the upward movement of the profile member. The stop members 34 for all the segments 18 of the support structure are arranged such that the top walls 28 of the profile members 26 are flush with each other and constitute a horizontal plane on which the belt 10 is supported and which is slightly higher than the plane defined by the top vertices of the rollers 22.

[0021] When the suction pressure Fs acts upon the sheet S and the belt 10 is pressed downwards, the belt may yield to some extent, until the belt is supported on the rollers 22. In that condition, the segments 18 are pressed downwards and the springs of the biasing mechanisms 32 are compressed so that they exert the biasing force F1 onto the profile members 26. The springs of the biasing mechanisms 32 may be provided at opposite ends of the profile members 26. Optionally, additional springs may be distributed over the length of each profile member. Due to the rigidity of the profile members 26, the force F1 will be evenly distributed over the length of each segment. Further, the biasing mechanisms 32 allow the profile member 26 to tilt about a longitudinal axis (normal to the plane of the drawing in Fig. 2) so as to adapt to a possible deflection of the belt 10.

[0022] As is shown in Fig. 1, the suction force Fs which the sheet S exerts upon the belt 10 is counterbalanced mainly by the force F2 of the compliance limiting mechanism 20, and the force F2 varies in accordance with variations of the force Fs, whereas the biasing force F1 is limited and generally smaller than F2. This limits the friction between the moving belt 10 and the segments 18 of the support structure 16.

[0023] Fig. 3 shows a portion of the support structure 16 and the belt 10 in a top plan view. In this example, the biasing mechanism 32 is formed by forked leaf springs mounted on frame members 36 and supporting the opposite ends of each profile member 26. The stop members 34 are formed by pins that project from the frame members 36. Some of the rollers 22 have also been shown.

[0024] In this example, the sheet S has dark areas 38, 40 where a large amount of ink has been deposited on the sheet, and blank areas 42, 44 without ink. When the sheet S is uniformly irradiated by the heater 12, the temperature of the paper in the blank areas 42 and 44 will rise quicker and higher than in the dark areas 38 and 40. In order to prevent an over-heating of the paper in the blank areas, it is necessary that heat is quickly removed from these areas. Since the heat conductivity of the paper is poor, heat has to be transferred to the belt 10 and further to the support structure 16. Since the belt 10 has to be flexible, its thickness and heat capacity are limited, so that a major part of the heat must be transferred onto the profile members 26 of the support structure in which the top walls 28 have a large thickness and, accordingly, a high heat capacity. Further, the profile members 26 are

made of a material having a good heat conductivity, e.g. metal, so that heat will rapidly flow away in transverse direction of the belt 10 from the hot areas 42, 44 to the cooler areas 38, 40. As the belt 10 and the sheet S move in the direction x, the hot area 42, for example, will move over a segment that has been protected against excessive heat by the dark area 40 and will therefore also help to cool the hot area 42. In this way, heat is also distributed in longitudinal direction of the belt.

[0025] The limited force F1 with which the profile members 26 are biased against the belt 10 is just large enough to assure a good mechanical contact between the top walls 28 of the profile members and the belt 10, so that the heat can readily be transferred from the belt 10 to the profile members 26 while the friction between the support structure and the belt remains low.

[0026] Fig. 4 is a diagram showing the non-linear relation between the heat conductivity of the junction between the belt 10 and the support structure 16 and the force F with which the profile members 26 are biased against the belt. It can be seen that a relatively small force F1 is sufficient for assuring a substantial heat transfer.

Claims

1. An apparatus for heat treatment of sheets (S) that are supported on a moving belt (10), wherein the sheets (S) are pressed against a support surface of the belt (10) and the belt is supported on a heat conductive stationary support structure (16), **characterized in that** the heat conductive support structure (16) is elastically biased against the belt (10) with a biasing force (F1) and a compliance limiting mechanism (20) is arranged to support the belt (10) against a force (Fs) with which the sheets are pressed against the belt.
2. The apparatus according to claim 1, wherein the support structure (16) is divided into separate segments (18) which are biased against the belt (10) independently of one another.
3. The apparatus according to claim 2, wherein the segments (18) extend in transverse direction of the belt (10).
4. The apparatus according to claim 3, wherein a biasing mechanism (32) for the segments (18) is arranged to allow a rotation of each segment (18) about a longitudinal axis of the segment.
5. The apparatus according to any of the claim 2 to 4, wherein the compliance limiting mechanism (20) comprises rollers (22) that are arranged to engage the belt (10) in gaps between the segments (18).

6. The apparatus according to any of the claims 2 to 5, wherein a range of movement of the segments (18) in a direction towards the belt (10) is limited by stop members (34).
7. The apparatus according to any of the preceding claims, wherein the compliance limiting mechanism (20) comprises a tensioning mechanism (24) for tensioning the belt (10).

Fig. 1

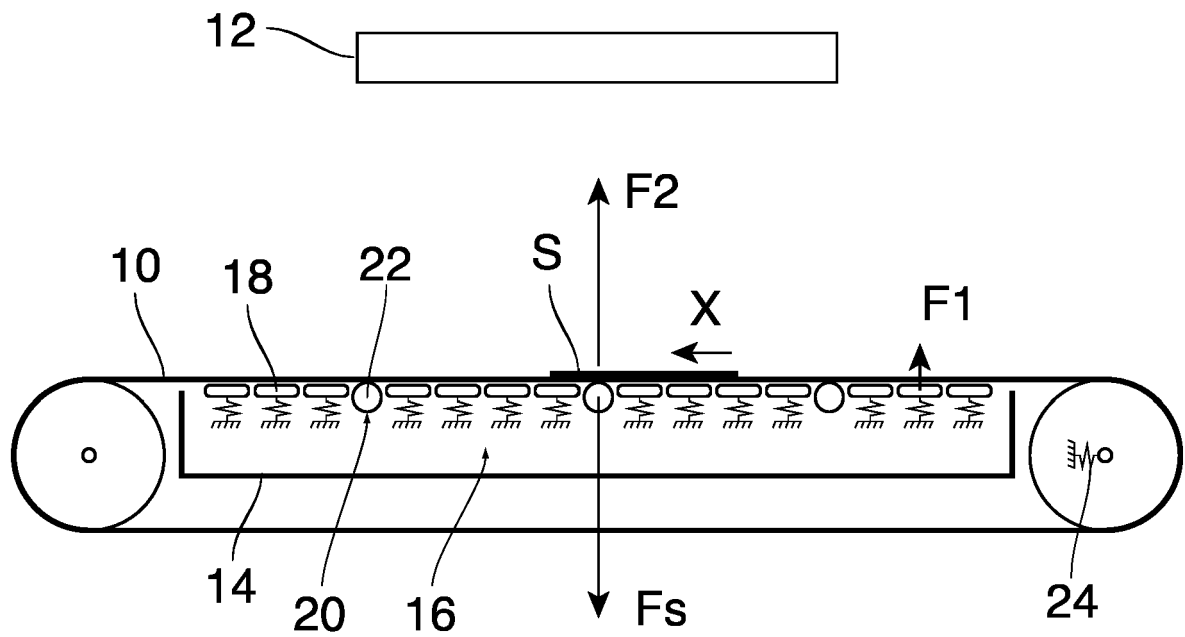


Fig. 2

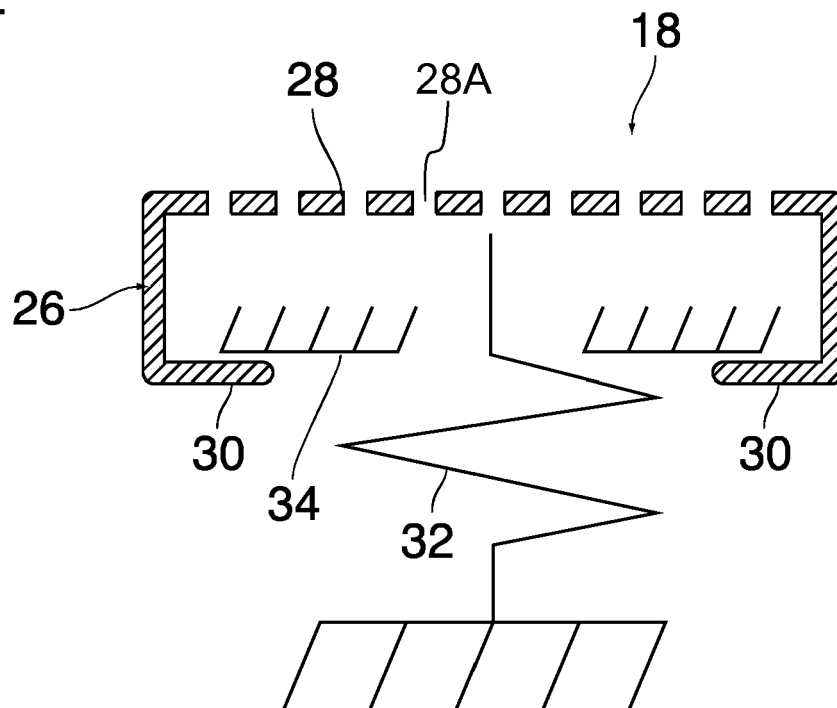


Fig. 3

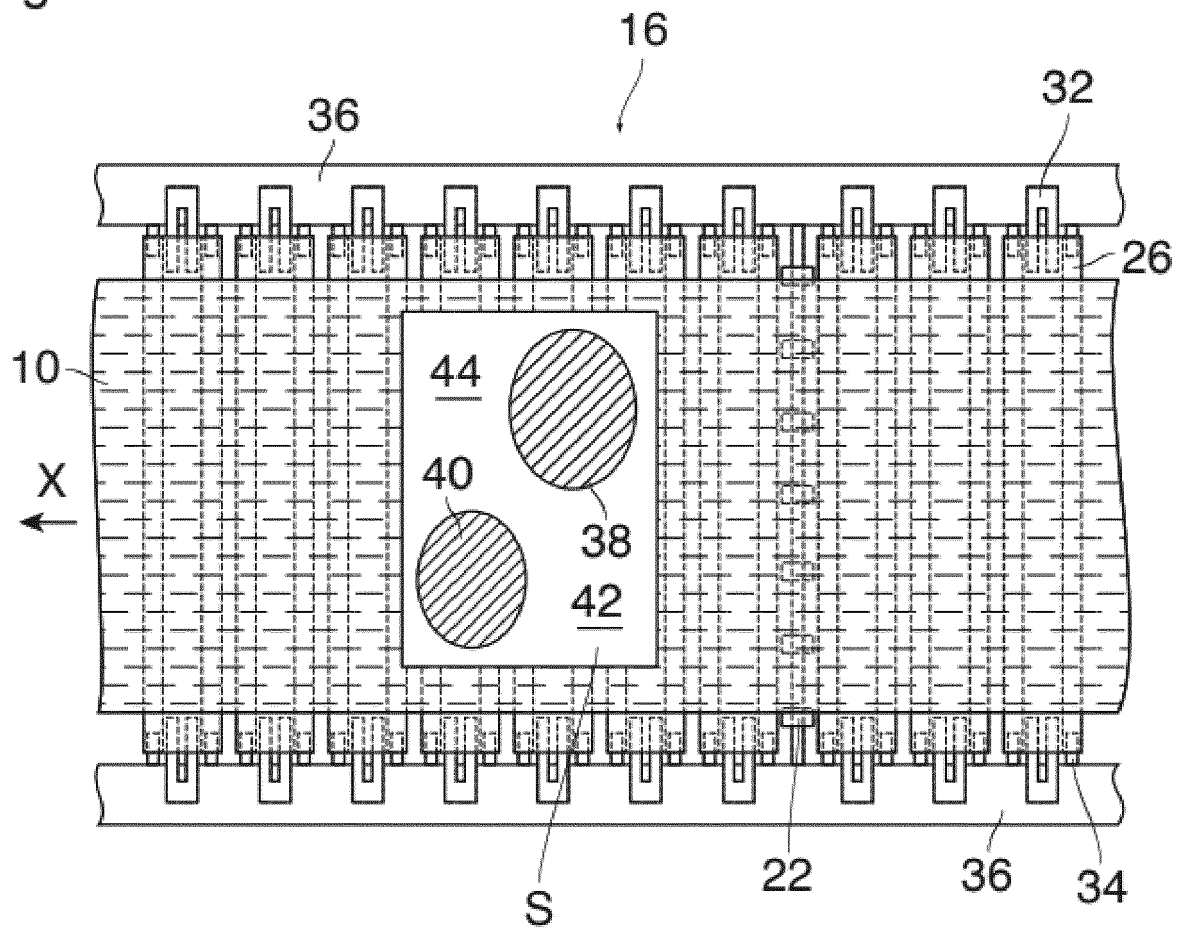
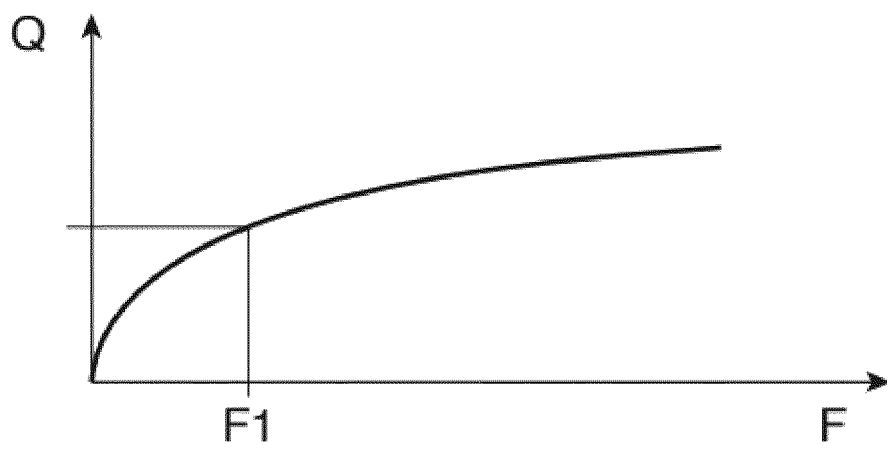


Fig. 4





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Application Number
EP 18 19 1939

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 21 February 2019	Examiner Munteh, Louis
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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