APPARATUS FOR TREATMENT OF MATERIALS, PARTICULARLY THE HEAT TREATMENT OF WEBS

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ABSTRACT
Apparatus for the heat treatment of webs of materials, particularly textiles, and especially tension-sensitive textiles, e.g., knitwear, which comprises the arrangement of a plurality of nozzle bodies forming together a large surface, either below the path of the travelling web, or both below and above that path, each body having outlet openings for the admission of a treatment medium to impinge the web, said apparatus further comprising narrow ducts for the discharge of the treatment medium, all ducts emptying into a larger collecting duct, arranged laterally so as not to interfere with the web on its way out of the apparatus. The advantage of the apparatus according to the invention is that it provides flutter free and substantially pressure- and tension-free movement of loosely guided webs, which are exposed to the current of a gaseous medium.

5 Claims, 3 Drawing Figures
APPARATUS FOR TREATMENT OF MATERIALS, PARTICULARLY THE HEAT TREATMENT OF WEBS

The present invention relates to an apparatus for heat treatment of materials, for instance, the drying or dry-heat treatment of webs, e.g., textile webs, with gaseous media; more particularly, the invention relates to such treatment when the webs are guided in tensioning chains of wide stretching machines.

Many types of treatment devices are known for the continuous heat treatment of webs of materials, in which the treatment medium is admitted to the webs through nozzles of circular or angular cross sections or slot-shaped nozzles. In practice, all these treatment devices having ventilating systems which are so designed that the escaping treatment medium is carried off from the web, either contrary to, or in the direction of the moving web over discharge ducts which are arranged transversely to the direction of the web movement; in another arrangement, the gaseous medium is returned to a circulating blower. Within the area of the discharge or waste gas ducts, unstable current conditions nearly always prevail, which lead to disturbing fluttering or buffeting of the web under treatment, sometimes causing the web to be sucked into the waste gas ducts. This happens especially when the web is very loosely guided by some guide means. There are also occasional but recurring contacts between the web at the edges of the nozzle bodies and the boundary surfaces of the discharge areas which cause disturbances. Unfavorable dynamic tensioning or pressure loads have been found to be caused by these waste gas current components of the treatment medium in either direction of the web in the treatment of load-sensitive textile webs, particularly knitted wear. When the webs are guided by leading type tensioning chains, such webs are loosely held with smaller or larger transverse folds.

It is therefore an object of the present invention to provide a treatment device for loosely guided webs which is free of the disadvantages of the known devices.

More particularly, it is an object of the invention to provide a device which guarantees a flutter-free and substantially pressure- and tension-free movement of loosely guided webs when they are exposed to the current of a gaseous medium.

According to the invention, these objects are accomplished by arranging below the web to be treated, or both below and above the web, nozzle systems which consist of nozzle bodies disposed parallel to the path of the web to form a large, almost uninterrupted surface. The small gaps of the large surfaces are provided with comparatively narrow, vertical discharge ducts for the treatment medium. In a particularly advantageous embodiment of the device according to the invention, the discharge ducts are disposed only, or almost only, in the direction of the web movement. Viewed in the vertical discharge direction, they appear as comparatively short, vertical slots. Their cross sections should preferably be at least three times and at the most, five times the sum of the nozzle outlet openings in the associated nozzle bodies.

In a further advantageous embodiment, the vertical discharge or exhaust ducts are connected to collecting ducts of larger size which are arranged transversely to the direction of travel of the web and outside of the intermediate range of that path. In this manner, the discharge of the treatment medium in the larger ducts remains transversely to the sense of travel of the web, which is desirable, because the heating units and the circulating blowers for the treatment medium are thereby disposed laterally from the web transport, so that their undesirable effect hitherto exerted on the web is eliminated.

At the transition of the vertical discharge ducts to the larger transversely disposed collecting ducts for the treatment medium, the cross sections for the streaming media should be at least 30-50 per cent of the cross sections of the ducts facing the web. It has been proven advisable to provide widened cross sections when using longer vertical discharge ducts.

The large surfaces of the nozzle bodies preferably interrupted only by the narrow vertical discharge ducts, act by means of the treatment medium as a cushion or buffer, capable of load carrying, and supporting the web depending on the intensity of the gas stream escaping from the nozzles. By adjusting higher or lower current intensities and the weight of the web under treatment, an equilibrium position can be assumed in a freely floating position between the two nozzle systems. To obtain a better adjustment of the intensity of the gas current, particularly for obtaining a stable cushioning effect for the web, or for different operational conditions, such as variations in permeability of the web, or differences in weight, it is desirable to provide known means for throttling the treatment gas, especially at the larger discharge ducts, in order to generate additional static pressures in the treatment space.

The nozzle bodies may be provided with circular or slit-shaped openings. For the nozzle system below the path of the web, a large number of outlet openings with small diameters of 3-5 mm, evenly distributed over the surface, have proved advantageous for the treatment of the present invention. They provide an excellent supporting cushion at a distance of about 10-15 mm from the web to be carried and treated. The nozzles above the web should have larger outlet openings because of the heat transfer to be brought about. Care should, however, be taken to avoid an arrangement with larger spacings when nozzles with larger outlet openings are used, especially with webs guided with formation of folds, because they, in turn, cause discharge effects transverse to the folds. The outlet openings of the nozzles should then be arranged in rows. In that case, it has proved advantageous to arrange the rows somewhat obliquely with respect to the direction of travel of the web in order to avoid stripes of imprints of the nozzles from forming on the web. For the same reasons, it is advisable to arrange slit-shaped nozzles transversely or slightly obliquely to the web travel. In each individual case, the systems of nozzle outlet openings have to be adjusted carefully in accordance with the waste gas discharge systems. This is comparatively simple when a cushioning system is provided with a plurality of small nozzle outlet openings.

In order to prevent the goods from being sucked into the remaining slits present between nozzle bodies, arranged in series in the direction of the travel of the web, the width of the slits should preferably be below 5 mm.

A special application of the treatment device according to the invention, with the described ventilation and gas impingement systems, is used for knitted webs and
webs of textured synthetic fibers. These are particularly sensitive to tensioning and to fluttering when guided in wide leading type tensioning chains and subjected to heat treatment to bring about high shrinkage. The web is, in that case, exposed to the dynamic load of the nozzle ventilation with marked transverse fold formation caused by the lead in the tensioning chains. While up to now, the discharge of the treatment gas occurring transversely to the folds led to higher dynamic loads of pull and pressure, and the waste gas currents passing through in the direction of the transverse folds led to additional fluttering, and to the danger of sagging folds being sucked in, a similar danger is practically eliminated by the comparatively minimal discharge surface of the discharge slits when compared with the entire nozzle body surface, and particularly, with the discharge occurring preferably transversely to the surfaces. The folds of the textile web are capable of being almost entirely supported by an air cushion formed below the path of the web. This provides ideal conditions for bringing about shrinkage without a fluttering or tensioning phenomena.

Instead of providing nozzle systems with individual nozzle bodies above and below the path of the web as described, the apparatus may be designed with limitation of the principle of the air cushioning of forming formation below the path of the web, whereas the upper nozzle system may be provided, e.g., with single nozzle members forming a high efficiency nozzle system of a known design.

In order to insure the formation of stable pressure zones in the last mentioned system, perforated nozzles are arranged to both sides of the nozzle member, with small spacings between the perforations, arranged in rows. Slit nozzles can also be disposed transversely with respect to the travel direction of the web. Between neighboring nozzles members, baffle plates or throttling means are provided for blocking the vertical drainage of the treatment medium.

Other objects and features of the present invention will become apparent from the following detailed discussion considered in connection with the accompanying drawings which disclose the embodiments of the invention. It is to be understood, however, that the drawings are designed for the purpose of illustration only and not as a definition of the limits of the invention.

In the drawings, wherein similar reference characters denote similar elements throughout the several views:

FIG. 1 is a partial section through one embodiment of an apparatus according to the invention;
FIG. 2 is a plan view seen from above of the nozzle bodies with the different nozzle systems; and
FIG. 3 is a partial section through a different embodiment of the apparatus.

Referring now to FIG. 1, a web 10 is shown moving in folds as indicated by arrows A,A in the direction from left to right.

Below and above the path of the web, nozzle bodies 11 and 11a are shown in parallel arrangement for the admission of the treatment or drying medium from supply ducts 11c. In a preferred embodiment, the nozzle bodies are arranged only below the path of the web. Each nozzle body has a plurality of outlet openings, whose diameter may be from about 3-5 mm, evenly distributed over the surface of the nozzle body.

As shown in FIG. 2, a series of nozzle bodies 12 is arranged adjacent to nozzle bodies 11, and this series is followed by nozzle bodies 13.

Referring again to FIG. 1, narrow vertical discharge or exhaust ducts 16 for the escaping treatment medium are illustrated, which generally are parallel to the direction of the path of the web and which, as may be seen from FIG. 2, are disposed between nozzle bodies 11 and 12, and 12 and 13, respectively. These ducts are capable of removing the treatment gases, after their impingement onto the web and lateral outflow therefrom without dynamic instability or suction effect on the moving web. The sum of the cross sections of the vertical ducts 16 should be at least about three times, and at the most, about five times the sum of the associated nozzle outlet surfaces in bodies 11-13. In that case there is no danger of unfavorable effects in the current of the waste gases in the range of the discharge ducts.

In addition to narrow discharge ducts 16, collecting discharge ducts 17 are provided (FIG. 1), usually disposed transversely to the travel of the web, and as shown in the drawing, practically closed with respect to the web. The small slits 18 between adjacent nozzle bodies 11 and 11a could also be closed. Where the discharge ducts 16 empty into collecting ducts 17, at 19, their diameters have to be enlarged in order to avoid unfavorable flow conditions at those points.

In FIG. 2, nozzle body 12 is shown to have slit-shaped openings 22a which may be exactly in the direction of the travelling web, or 22b at a slight angle thereto. The width of the slits can be between 5-10 mm. In a modified embodiment, it would be possible to provide more slits having a width of 1.5-2.5 mm.

The nozzles and the nozzle bodies, arranged above the path of the web, may be of various designs. They may be, as illustrated in FIG. 1, of the same type as bodies 12 and 13 shown in FIG. 2.

However, they may be of a different type as shown in FIG. 3. In that FIG., nozzle bodies 31 below the web 10 correspond to bodies 11 illustrated in FIG. 1. Duct 37 is a collecting duct corresponding to duct 17 of FIG. 1. However, the upper nozzle bodies 41 are square shaped and arranged at a greater distance from the path of the web. Vertical discharge ducts 42 are disposed between nozzle bodies 41.

An arrangement of this type is desirable, especially when tensioning chains 9 guiding the web, require a larger spacing of the web from the nozzle outlets, or when heavier webs are to be treated. The web will then adjust itself during travel in an equilibrium position near the lower horizontal nozzle body surfaces. This prevents the upper open discharge ducts from damaging the material due to their proximity to the web.

In order to provide an additional stabilization of the pressure zones in that area, there may be baffle plates 43 or throttles arranged in the discharge ducts 42. Moreover, blocking nozzles 40 can be used at the lateral boundaries of the nozzle members 41, which may either be spaced apart rows of circular nozzle openings or slit-shaped nozzles.

While only a few embodiments of the present invention have been shown and described, it is to be understood that other changes and modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:
1. An apparatus for gaseous treatment drying of webs of material traveling in a path comprising:
   a first plurality of nozzle bodies in planar array and each flaring to a discharge end positioned on one side of the web and disposed one after another along the path of the traveling material;
   a second plurality of nozzle bodies in planar array and each flaring to a discharge end positioned on the other side of the web and disposed one after another along the path of traveling material and wherein each of said first and second plurality of nozzle bodies includes a plurality of approximately evenly disposed circular apertures for directing the gaseous medium towards the web, the walls of adjacent nozzle bodies defining collection ducts therebetween;
   a plurality of narrow apertures defining slits formed between said nozzle bodies in each of said first and second plurality of supply ducts and communicating with the collecting ducts; and
   a plurality of exhaust apertures extending longitudinally in the direction of web movement and disposed within each of said nozzle bodies so as to be evenly spaced among the circular apertures of said nozzle bodies for providing an uninterrupted pressure cushion without sharp pressure discontinuities, and exhaust apertures including exhaust ducts communicating through the flarings into the collecting ducts so that the spent gas can escape through said exhaust ducts and slits.

2. The apparatus as recited in claim 1, wherein the total area of said plurality of exhaust apertures is three to five times greater than the total area of the plurality of circular apertures in said first and second plurality of nozzle bodies which direct and supply the gaseous medium towards the web.

3. The apparatus as recited in claim 1 further comprising tensioning chains for guiding the web at a distance of from 10 to 30 mm from the outlet openings defined by each of said first and second plurality of nozzle bodies, and wherein the circular apertures in each of said first and second plurality of nozzle bodies are approximately 3 to 5 mm in diameter.

4. An apparatus for gaseous treatment and drying of webs of material traveling in a path comprising:
   a first plurality of nozzle bodies positioned on one side of the web and placed one after another along the path of traveling material, said first plurality of nozzle bodies being substantially square-shaped;
   a second plurality of nozzle bodies positioned on the other side of the web and disposed one after another along the path of traveling material and each flaring to a discharge end, said first and second plurality of nozzle bodies containing a plurality of circular apertures evenly disposed therethrough for directing the gaseous medium towards the web;
   a plurality of exhaust apertures substantially rectangular and extending longitudinally in the direction of web movement and disposed longitudinally between adjacent sides of each of said first and second plurality of nozzle bodies and disposed so as to be substantially evenly spaced among the circular apertures of said first and second plurality of nozzle bodies for providing an uninterrupted pressure cushion devoid of sharp pressure discontinuity.

5. The apparatus as in claim 4 wherein disposed between adjacent sides of said first plurality of nozzle bodies is a baffle for regulating the amount of gaseous medium exiting through said exhaust apertures of said first plurality of nozzle bodies.

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