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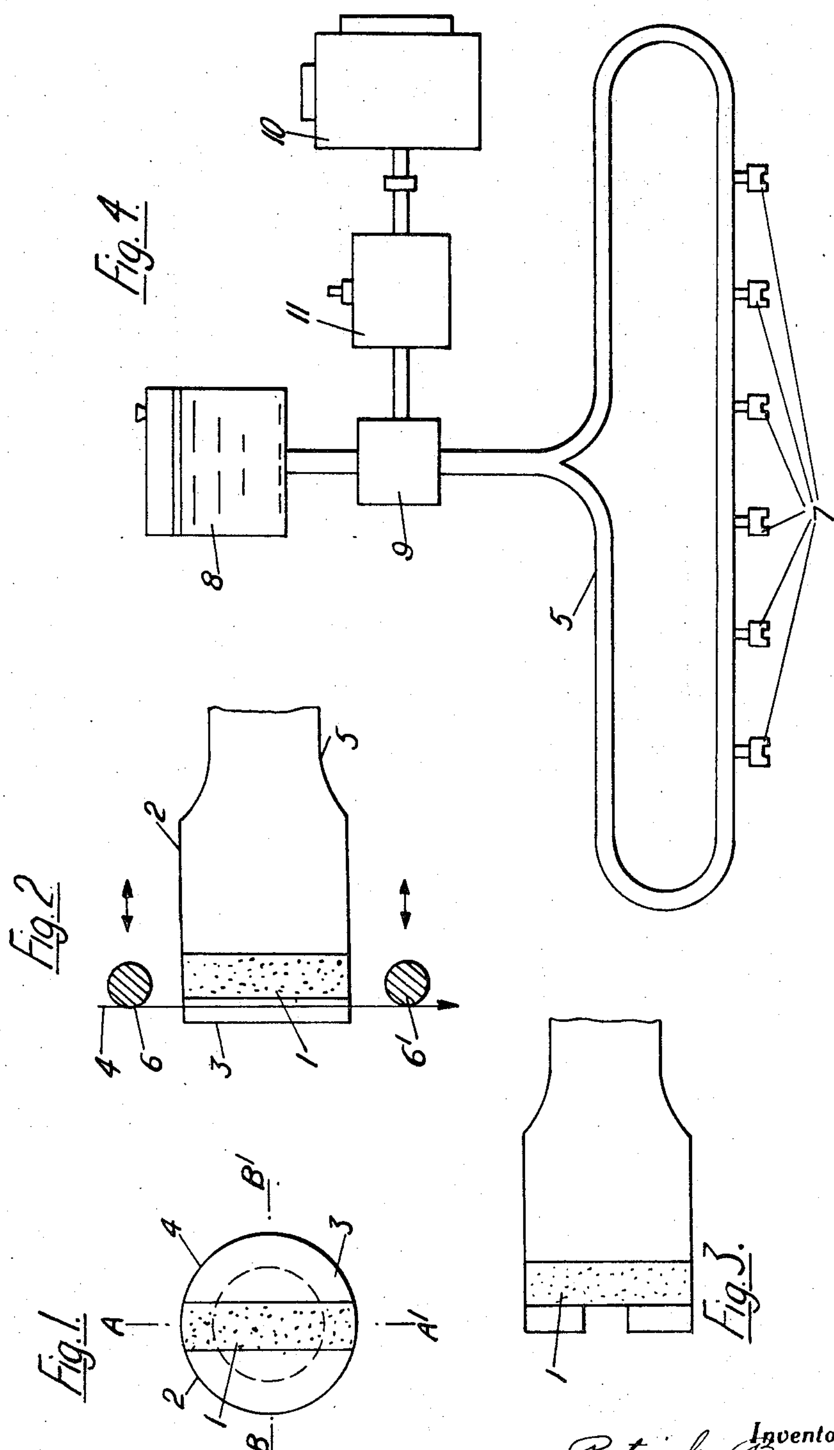

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PROCESS FOR TREATING MOVING YARNS OR STRIPS WITH A LIQUID

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ABSTRACT OF THE DISCLOSURE

In order to treat a yarn or strip with a liquid such as an oiling or sizing composition, the liquid is passed through a porous partition so as to form a stable film on an essentially plane external surface of the partition and the yarn or strip is moved in continuous contact with the film but does not directly contact the partition.

This invention relates to a process for treating moving materials in the form of yarns or strips with a liquid, and to a device for carrying out this process.

In this specification, the term "yarn" is to be understood as any thread-like material whether in the form of continuous filaments or spun from discontinuous fibres, and "strip" is to be understood as a continuous flat element of great length, such as for example a yarn web, a fabric, a nonwoven web, a ribbon, a foil or a film.

It is usual in the textile industry to have to treat yarns or combinations of yarns continuously with a lubricant, an antistatic agent, a sizing agent or some other finishing agent in order to make the material suitable for subsequent working.

Many devices for oiling or sizing moving filamentary materials used industrially are not entirely satisfactory. Amongst the most usual devices are rotating rollers which by capillary action carry the treating liquid from a tray, and by a wiping action deposit it on the yarn, however the wiping of the yarn over the roller creates large differences in the tension of the yarn in front of and behind the roller; furthermore the liquid is not deposited uniformly, and such apparatus is bulky. Devices based on an inclined channel in which the moving yarn is treated by means of a drop of liquid formed continuously by simple pressure drop give good results, but experience has shown that if several channels are fed by a single pump, each channel does not receive the same amount of liquid because of variations in the pressure drop from one channel to the next, and this produces differences which interfere with the good subsequent behaviour of the yarn. It is thus necessary to provide one pump for each device, and this complicates the overall apparatus and increases its cost.

An apparatus for treating a moving yarn by means of a liquid which has been known for a long time comprises two opposing surfaces of an absorbent material fed with liquid, and means for holding the two surfaces against one another whilst still permitting the yarn to pass between them. Here again the friction of the yarn against the surfaces and the bulk of the device prevent its industrial use, particularly at high yarn speeds.

Recently a spinning apparatus has been proposed which comprises, below the spinning chamber, a guide for the convergence of the filaments, to which this guide also transfers a treatment liquid which is fed in under pressure. The liquid comes into an internal reservoir in the guide, passes through a filter layer, and then passes across orifices pierced in the partition of the guide and ending

at the base of grooves cut in the external surface of the latter. The filaments, combined into bundles, pass under the orifices which end in the grooves and are thus continuously treated with a drop of liquid. Here again there is friction between the yarn and the device; furthermore such an apparatus does not allow the use of a liquid having a volatile component, such as certain sizing compositions.

The present invention provides a process for treating a moving material in the form of a yarn or a strip by means of a liquid, which comprises forming a stable liquid film on an essentially plane external surface of a porous partition by the passage of liquid through the said partition, and in bringing the material into continuous contact with the said film without direct contact with the partition.

The invention comprises also a device for treating a moving material in the form of a yarn or a strip by means of a liquid, which comprises a porous partition having an essentially plane exposed surface, means for passing the treatment liquid through the porous partition, and guide means adapted to control the path of travel of a moving yarn or strip so that it passes close to but out of contact with the said exposed surface.

The production of a stable liquid film on the essentially plane surface of a porous partition depends on several factors.

An important first factor is the viscosity of the treatment liquid. In practice such a liquid can be of very varied forms, ranging from homogeneous solutions through oils to very thick glues, or heterogeneous liquids such as dispersion and emulsions. (The particular case of waxes is made equivalent to that of oils by heating the wax supply tube to render the wax more fluid.) The viscosity of the treatment liquid determines the choice of the diameter of the pores and hence of the "grain" of the porous partition, which, other things being equal, must be finer, the less viscous the liquid. In the case of dispersions the mean diameter of the pores of the partition must be chosen so as to be greater than the mean size of the dispersed liquid or solid particles. The choice of the grain determines the pressure which the liquid has to exert on the porous partition, and this pressure has to be sufficient for the penetration of the liquid into the partition to allow the formation of a stable liquid film.

Furthermore the thickness of this film has to be carefully adjusted, for example by adjusting the feed pressure, in order that the material may receive the amount of treatment liquid required to coat it partially or completely as may be desired while it remains out of contact with the porous partition. In the case of the tretment of yarns or yarn webs, the thickness is preferably chosen so that the coating shall be complete. Continuous foils, on the other hand, can be passed tangentially to the surface of the liquid film so as to treat only one of the two faces.

The stability of the liquid film can be further favoured by reducing the surface tension of the liquid on the porous partition, for example by adding wetting agents or by making the ends of this partition of a suitable shape.

The rate of feed of the treatment liquid through the porous partition must be the greater, the faster the material passes in front of the porous partition and the greater the amount of liquid which is to be applied to the material. This amount is not limited. It varies with the nature of the liquid, with that of the material to be treated, with the dimensions of this material and with the operations to which the said material is to be subsequently subjected.

The adjustment of the various parameters referred to above is a simple matter for the expert.

Since there is no contact of the material to be treated with any solid body (other than the necessary guides), there is no limit to the speed of the material. Thus this process makes it possible to treat moving materials at the very high speeds which are necessary for industrial production.

The treatment liquids which can be used are of very diverse natures. In the textile industry for example oiling agents and/or antistatic agents may be applied in the form of homogeneous oily products or emulsions, and sizing agents in the form of glues as such dissolved in a volatile solvent, the glue thereafter being fixed on to the yarn through evaporation of the solvent. Other possible treatment agents that may be mentioned include dyestuffs and finishing agents.

The treatment of the moving material may be carried out with any desired orientation of the surface of the porous partition, since the stability of the liquid film does not significantly depend on the position of this partition. This property is particularly valuable, in that it makes it possible to carry out a treatment under the most difficult of position and space conditions.

The device of the invention first of all comprises a porous partition having an essentially plane exposed surface. The grain of this partition may lie within wide limits, but is preferably between several microns, say 3–5 microns, and a hundred microns. The dimensions of the operating surface are, for a yarn, generally chosen according to its bulk, and for a strip according to its thickness and surface area. In this latter case the surface of the porous partition is preferably delimited by a shield, a window or other suitable means which permits part only of the moving material to be treated or the stability of the liquid film to be improved. The thickness of the partition may vary; in particular, it depends on the nature of the substance of which the partition consists, and this nature results in particular manufacturing conditions. The porous materials constituting the partition may for example be sintered materials based on metals or alloys such as steels or bronzes, or on porcelain, alumina, glass or synthetic polymers, especially polyamides, polytetrafluorethylene and polyolefines.

The device also comprises means for causing the treatment liquid to pass through the porous partition under pressure. This liquid may for example be kept under pressure by means of a reservoir which is under load or under pressure, or by means of a pump. A pump which provides a constant flow rate, and preferably a volumetric pump of a type which is in itself known (rotating pump, or alternating pump), may be used. A single pump can advantageously feed several treatment devices. The pressure drops resulting from the pipelines do not in this case interfere as they do in an arrangement comprising an assembly of oiling channels, since pressure losses due to the liquid supply pipelines are in effect very low compared to those due to the porous partition and as a result are negligible.

The position of the material to be treated relative to the porous partition can be adjusted by guide means which are in themselves known, before and beyond the treatment device, with the latter being placed over the trajectory of the material to be treated.

The process and device of the invention offer a combination of numerous advantages compared to known processes and devices. The device is of greatly reduced bulk, is very economical and can be used in any desired position and hence at any desired point of an industrial installation.

This latter property can advantageously be used to produce combinations of the porous partitions, and these combinations also form part of the invention. For example, two devices can be grouped in line or side by side with the porous surfaces in the same plane. With such an apparatus it is possible to treat a yarn or strip successively with one and the same liquid or with two different liquids fed from two separate circuits.

Another interesting combination consists of arranging two porous partitions face to face at a small distance from one another, so that the yarn or strip passes between them and is treated over its entire surface. The degree of spacing of the surfaces depends on the bulk of the yarn or the thickness of the strip and must in all circumstances be at least equal to the sum of the respective thicknesses of the two liquid films. With such an apparatus it is possible to treat a yarn or strip of greater thickness than with a single device and to run it at an increased speed since there are two sources of the treatment liquid. In the case of a continuous strip or foil each of the partitions can be fed with a different liquid, so that the two faces can be given distinct treatments.

The invention includes also assemblies of porous partitions fed by one or more liquids and arranged along the sides of a polygon which is preferably regular, the operating surfaces facing inwards or outwards. With apparatus of the first type it is possible to treat thread-shaped elements of large diameter, such for example as bristles or tyre cord. The assemblies with the porous partitions turned outwards may be mounted on a drum-type, device allowing the successive and advantageously periodic treatment of a yarn with various agents such as for example dyestuffs.

One most important advantage of the process of the invention is that, since the yarn or strip has no direct contact with the porous partition, it does not undergo any substantial degree of friction, and hence there is no difference in tension before and after treatment; this makes it possible to deposit liquid particularly uniformly, and also to treat material which is being unwound at high speeds.

The invention is illustrated schematically in the accompanying drawing, in which

FIG. 1 is a face view of a device according to the invention,

FIG. 2 is a section along the line AA′ in FIG. 1,

FIG. 3 is a section along the line BB′ in FIG. 1, and

FIG. 4 is a top view of a complete industrial installation.

Referring now to the drawing the device comprises a porous partition **1** arranged in a tube **2** over its cross-section and quite close to the end of the tube. In front of the operating surface of the porous partition, which is delimited by a cover **3**, a yarn **4** passes vertically in a downward direction at high speed. The path of the yarn near the porous partition is regulated by means of two guide rollers **6** and **6′**. The porous partition **1** is fed with the treatment liquid by means of the pipeline **5**. The liquid forms a stable liquid film, which treats the yarn, on the exposed surface of the partition.

Referring now to FIG. 4, the installation comprises six treatment positions **7** fed with liquid from a reservoir **8**, through a pipeline **5**, by means of a pump **9** actuated by a motor **10** through a reduction gear **11**.

The following examples illustrate the invention.

EXAMPLE 1

A 77.8 decitex (70 den.)/17 filament polyhexamethylene adipamide yarn unwinding at a speed of 567 m./min. is continuously stretched at a ratio of 4.47 at a stretching position with zero torsion. On issuing from the stretching unit the yarn is given a heat relaxation treatment on a hotplate at 230° C., and then passes 0.2 mm. away from a porous partition of diameter 10 mm. and thickness 3 mm., made of sintered stainless steel (having a very low carbon content and containing molybdenum) of grain size 75 microns. This partition is fed, by means of a gear pump delivering 0.3 $cm.^3$ per revolution, with an aqueous solution of a sizing agent essentially consisting of polyacrylic acid containing, as the plasticiser, a mineral oil to which sodium lauryl phosphate has been added. The speed of the pump is regulated to apply to the yarn 0.15% by weight of the size. The tension in the yarn before and beyond the device is the same, and equal to 0.09 g./decitex (0.1 g./den.).

EXAMPLE 2

The operation is carried out as in Example 1 but with a yarn speed of 312 m./min. and a 40% by weight aqueous solution of the same sizing agent, the viscosity of the solution being 2300 cp. at 25° C. The distance of the yarn from the porous partition is 0.4 mm. The speed of the pump is varied in order to leave different amounts of the size on the yarn as follows:

Pump speed in r.p.m.	Amount of size in percent by weight relative to the yarn
12	0.03
20	0.07
40	0.45
66	0.61

EXAMPLE 3

The operation is carried out as in Example 2, replacing the treating agent solution by a 33% solution of the same product in dimethylformamide. The experiment gives the following results.

Pump speed in r.p.m.	Amount of sizing agent on the yarn in percent by weight relative to the yarn
12	0.11
40	0.34
66	0.78

EXAMPLE 4

Polyhexamethylene adipamide yarns of 44.5 decitex (40 den.)/13 filaments are stretched in five positions, at a ratio of 3.45 and a speed of 506 m./min. Each yarn thereafter undergoes a heat relaxation treatment on a metal plate heated to 120° C. The yarn is then treated with an oily composition containing 60% of ethylhexyl stearate, 30% of a nonionic emulsifier and 10% of potassium lauryl phosphate (antistatic agent). This oil has a viscosity of 40 cp. at 25° C. The variation in the amount of oil on the yarn as a function of the grain size of the porous partition is studied. All the porous partitions used in this example are made of sintered stainless steel; their thickness is 3 mm. and their diameter 10 mm. in each case. The results obtained are given in the following table.

Diameter of grains in microns	Amount of oil in percent by weight relative to the yarn
3	0.75
8	1.25
14	1.55
20	2.45
28	5.03

EXAMPLE 5

The amount of oil on the yarn at the outside of each coil and on the yarn close to the support or base of the coil is measured on three coils of yarn which has been oiled under the conditions of Example 4 but with differing amounts of oil. The results of these measurements are given in the following table (the amounts of oil are expressed as percentages by weight relative to the yarn).

No. of bobbin	1	2	3
τ external (τ_e)	1.79	2.10	3.35
τ base (τ_f)	1.94	2.09	3.51
$\Delta\tau$	0.15	0.01	0.16
$\frac{\Delta\tau}{\frac{\tau_f+\tau_e}{2}}$ in percent	8	0.48	4.7

It follows from this table that the relative difference in

the amount of oil is small, and that for practical purposes the oil deposition is uniform.

EXAMPLE 6

A 256 decitex (230 denier) 33 filament yarn of polyethylene terephthalate is stretched over a drawing pin at 80° C. at a speed of 200 m./min. and at a stretch ratio of 3.4.

The yarn is dyed in two colours by passing it between two porous partitions of sintered stainless steel of grain size 75 microns, mounted with their faces opposite each other and 4 mm. apart, and fed with different dye solutions as shown in the table below, and bringing it into contact with the film of dye solution on each partition alternately. The necessary lateral displacement of the yarn is effected by a cam mounted above the partitions on the spindle of an electric motor provided with a variable speed control which allows the speed to be varied between 600 and 1000 r.p.m. The track traversed by the cam is slightly greater than the distance between the two partitions. On leaving the cam the yarn passes first over a guide to damp out vibrations caused by the movement of the cam, and then between the two partitions.

DYEBATH COMPOSITION

Partition No. 1: 10 g./l. of a farinaceous thickener based on carob grain; 3 ml./l. of acetic acid; 15 g./l. of the blue; dye Rezolin FBL (C.I. Disperse Blue 71). Viscosity at 25° C.=9 centipoises.

Partition No. 2: 10 g./l. of a farinaceous thickener based on carob grain; 3 ml./l. of acetic acid; 15 g./l. of the yellow; dye Setacyl P–GSL (C.I. Disperse Yellow 50). Viscosity at 25° C.=9 centipoises.

The dyed yarn is wound up on a cop, and after fixing the dye by heating to 160° C. for 1 minute there is obtained a yarn alternately coloured blue and yellow with good contrast.

("C.I." denotes the Color Index, 2nd edition 1956 and supplements, published by the Society of Dyers and Colorists and the American Association of Textile Chemists and Colorists.)

What is claimed is:

1. A process for treating a moving textile material in the form of a yarn or a strip with a liquid which contains a textile finishing agent, wherein a stable film of the liquid is formed on an essentially plane external surface of a porous partition by passing the liquid through the said partition, and the continuously moving textile material is brought into continuous contact with the said film without direct contact with the porous partition.

2. A process according to claim **1**, wherein the liquid is an oiling composition.

3. A process according to claim **1**, wherein the liquid is a sizing composition.

4. A process according to claim **3**, wherein the sizing composition contains a volatile constituent.

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