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APPARATUS FOR HEAT-SETTING SYNTHETIC FIBRE YARNS

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Fig. 1.

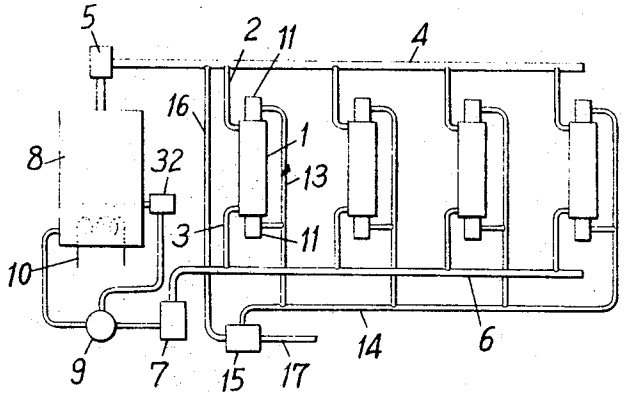


Fig. 2.

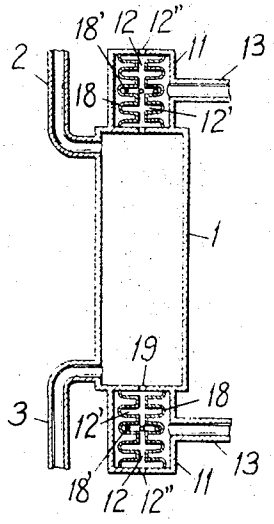


Fig. 3.

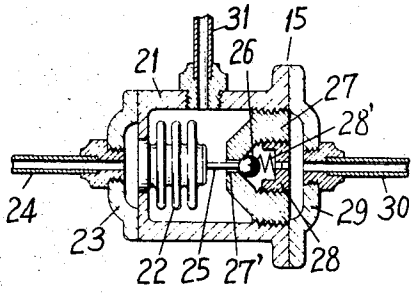


Fig. 4.

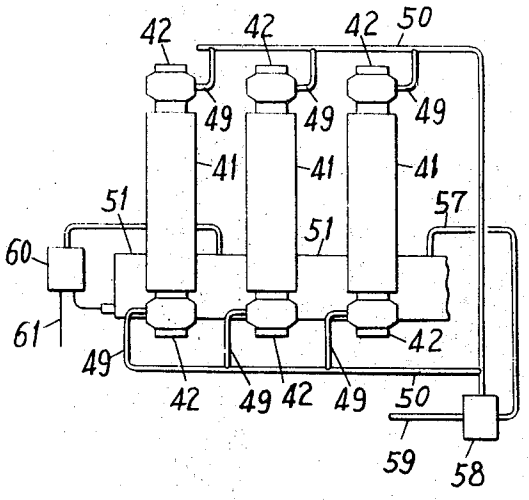
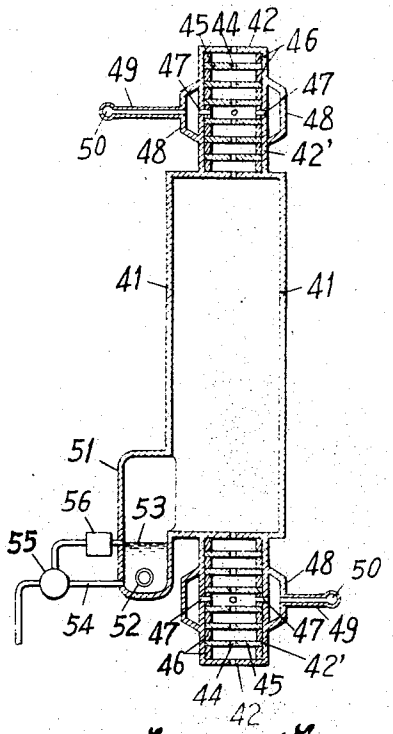


Fig. 5.



Inventors
Nobuhisa Kodaira
Noriq Motegi
33yz Graham & Jones
Attorneys

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APPARATUS FOR HEAT-SETTING SYNTHETIC FIBRE YARNS

Nobuhisa Kodaira and Norio Motegi, both % Saito Patent Office, 7 Nichome, Nihonbashi-dori, Chuo-ku, Tokyo, Japan

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ABSTRACT OF THE DISCLOSURE

Yarn is heat treated by passing it lengthwise through a cylindrical vessel containing vaporized heating medium (e.g. steam) under pressure. At each end of the vessel the yarn passes through a labyrinth chamber to which air is supplied at a pressure equal to that of the heating vapor, to substantially prevent escape of vapor from the vessel. A pressure regulator is disclosed for maintaining air in the labyrinth chamber at the same pressure as vapor in the vessel.

This invention relates to apparatus for heat-setting synthetic fibre yarns such as plyamide, polyester and acetate, delivered from a false-twister, by applying to the yarn latent heat of a vaporized heat transfer medium.

Heretofore the conventional apparatus for heat setting such yarns has comprised either a hot plate in partial contact therewith, or a hollow cylinder having a heated wall, through which cylinder the yarn was passed coaxially, to be heated indirectly by heat radiation from the cylinder wall.

It is one of the general objects of the present invention to provide apparatus for heat treating synthetic fibre yarns of the character described in a manner to produce a better quality yarn than was heretofore obtained with the use of either the hot plate or the heated cylinder apparatus; and in pursuance of that object it is a more specific object of the present invention to provide means for heating the yarn by passing it through a vaporized heat transfer medium such as live steam, in direct contact with such medium so that the yarn is heated by its latent heat.

With the apparatus of the present invention the vaporized heat transfer medium is contained in an upright cylindrical vessel having ports at its top and at its bottom through which the yarn can enter and leave the vessel, and it is another object of the present invention to prevent hot vapor in the cylindrical vessel from leaking out therefrom.

Still another object of the present invention is to allow yarn to be fast cooled at the moment when such yarn comes out the cylindrical vessel after being treated.

Because yarn is treated with saturated vapor in the apparatus of this invention such treatment may be achieved at lower temperature and in less time than with the prior hot plate contact and radiation heat systems. This allows the apparatus to be constructed in a shorter size and also allows yarn to pass therethrough with substantially a higher speed.

Also in the apparatus of the present invention, it is not necessarily required to provide a boiler apart from the heating vessel but such boiler may be made integral

with the respective heating vessels, at the bottoms thereof, whereby vapor piping is dispensed with so that the apparatus is in a compact size.

In addition, the apparatus of the present invention is enabled to effect fast cooling of yarn after it is treated. Generally in carrying out heat-setting of yarn, yarn is first heated to a certain temperature and subsequently such yarn is subjected to a lower temperature for cooling the same.

In the present invention, yarn passing through the cylindrical vessel is heated to the predetermined temperature and just when it comes out of the vessel, due to the sudden change from high pressure (absolute pressure 10 kg./cm. at 180 C.) to the normal pressure, the moisture attached to said yarn instantly vaporizes whereby the yarn is fast cooled substantially in a short time. Moreover the compressed air flushing from the yarn outlet aids in cooling the yarn and vaporizing of the moisture thereon, and thus the yarn is thoroughly heat set.

With these observations and objectives in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawing, which exemplifies the invention, it being understood that such changes in the specific apparatus disclosed herein may be made as come within the scope of the appended claims.

The accompanying drawing illustrates two complete examples of embodiments of the invention constructed according to the best modes s far devised for the practical application of the principles thereof, and in which:

FIG. 1 is a front view of an apparatus embodiment of the present invention.

FIG. 2 is an enlarged longitudinal sectional view of one of the heating vessels of the apparatus shown in FIG. 1.

FIG. 3 is a further enlarged longitudinal sectional view of the air pressure regulator of the apparatus.

FIG. 4 is a front view of a modified embodiment of the invention.

FIG. 5 is an enlarged longitudinal sectional view of one of the heating vessels of the apparatus shown in FIG. 4.

FIG. 1 is a first embodiment in which **1** is an upright cylindrical heating vessel, **2** is a pipe for supplying vaporized heat exchange medium, **3** is a drain pipe for vapor and condensed liquid, **4** is a vapor supplying header, **5** is a pressure regulator for keeping supplied vapor at a predetermined pressure, **6** is a header pipe for drained vapor and condensed liquid, **7** is a condenser, **8** is a boiler to which liquid is supplied from a pump **9**, and **10** is a heating element in the boiler. As shown in FIG. 1, there can be a plurality of heating vessels, identical with one another, all connected in parallel. There is a labyrinth packing **11** at the each end of each of said cylindrical vessels **1**, and compressed air is supplied to each of the labyrinth packings through a duct **13**, the several ducts **13** being connected with a header **14** which is in turn connected with a pressure regulator **15** for equalizing the pressure of compressed air to that of the saturated vapor in said cylindrical vessels **1**. A vapor pipe **16** connects the vapor supply header **4** to said pressure regulator **15** for actuating it in cooperation with an air pipe **17** extending from the compression source. **32** is an indicator for regulating liquid head in the boiler.

The interior configuration of each labyrinth packing **11** is as shown in FIG. 2. This labyrinth packing comprises a cell **18** in which a plurality of narrow channels **12** and chambers **12'** are alternately arranged, and at approximately intermediate the ends of the cell **18** there are provided ports **18'** through which is supplied air from pipe **13** at a pressure as high as that of the vapor in the cylindrical vessel. A port **19** at each end of the cylindrical heating vessel communicates the interior of the heating vessel with the adjacent labyrinth cell **18** and provides for passage of yarn through the heating vessel. The ports **19** are aligned with the ports **12''** in the ends of the labyrinth cells that are remote from the ends of the heating vessel so that yarn can pass successively through the labyrinth cells and the heating vessel without touching the edges of the ports. Air introduced into a cell **18** from its port **18** flows toward the port **12''** which opens to the atmosphere and is thus dispersed evenly to individual chambers **12'** to thus maintain the pressure therein constantly equal to the pressure of heat medium vapor. Accordingly no leakage of vapor from the cylindrical heating vessel **1** through the labyrinth packing **11** will occur.

The internal construction of the air pressure regulator **15** is shown in FIG. 3, in which **21** is a case, **22** a bellows made of elastic material for admission of heat medium vapor, **23** its lid and **24** a vapor pipe. **25** is a rod extending from the head of bellows **22** and which bears against a ball **26** in the valve to unseat the ball when the bellows is expanded. **27** is a valve seat having a bore **27'** in its center which is closed by said ball **26** when the ball is seated. **28** is a receiver for a coil spring **28'** which bears against the ball **26** to bias it towards its seat. **29** is a lid provided on the air entrance side. **30** is a compressed-air supply pipe and **31** a pipe leading to individual labyrinth packings **11**.

When the vapor pressure in the bellows **22** becomes higher then the pressure in the pipe **31** leading to the labyrinth packing **11**, the bellows **22** is stretched and in turn pushes the rod **25** to open the valve through which compressed air is introduced. Thus the labyrinth packing is supplied with compressed air. On the other hand, when the vapor pressure in the bellows becomes lower than that in the pipe **30**, the bellows contracts and the rod **25** is retracted by the action of the spring which closes the valve with the ball. Thus the pressure in the labyrinth packing **11** is lowered. In this way, the air pressure applied to the labyrinth packing **11** is always maintained substantially equal to the vapor pressure in the cylindrical vessel.

Another embodiment is shown in FIGS. 4 and 5. This is a heating apparatus of compact shape consisting of a plurality of upright cylindrical vessels and an integrally provided boiler. Therein **41** designates each of a plurality of cylindrical vessel and at the opposite ends of each there are provided labyrinth packings **42**. Each labyrinth packing **42** is housed in a cell **42'** wherein there are a plurality of disks **45**, each having a central port **44**, wherein there are placed alternately with spacers **46**. Intermediate the ends of each cell **42'**, there are provided communication ports **47** which are surrounded by an outer cover **48** through which extends a compressed air pipe **49**. Connected with a compressed air header **50**. **51** is a tube-shaped boiler extending horizontally along the bottoms of the heating vessels communicating with the bottom of each heating vessel. A heating element **52** is provided along the bottom of said boiler and is immersed in a heat transfer medium liquid **53**. **54** is a pipe from a pump **55** for supplying the heat transfer medium liquid **53** to the boiler. **56** is a liquid head detector so connected with the pump that when the liquid head falls below a predetermined level the pump **55** is actuated to feed liquid to the boiler. **57** is a pipe for supplying vaporized heat medium to a pressure regulator **58** for maintaining the pressure of compressed air equal to that of vapor. **59** is a compressed air supplying pipe. Also **60** is an automatic regulator for maintaining the pressure or temperature of vaporized heat transfer medium at a predetermined value by turning on and off the current from an electric source **61** to the heating element **52**.

From the above it will be apparent that there is provided an improved heat-setting device for synthetic fibre yarns. This is a direct heat treatment device with heat medium liquid which is substantially different from conventional systems employing hot plate contact or radiation heat in a hollow cylinder. Also the problem of vapor leakage which often occurred in the past in this kind of device has been solved because air pressure applied to the labyrinth packings is maintained equal to vapor pressure in the heating cylinders to prevent leakage of vapor out of the heating cylinders.

Thus the apparatus of the present invention is enabled to effect easy heating operation and subsequent fast-cooling for synthetic fibre yarn with a comparatively short cylindrical vessel.

The embodiments here shown are only by way of examples. It is to be understood that any change or modification to the apparatus may be made without departing from the spirit of the present invention.

We claim:

1. Apparatus for treating synthetic yarn comprising:
(A) a treating vessel having spaced inlet and outlet ports through which yarn to be treated enters and leaves the vessel during operation of the apparatus;
(B) means for introducing a vaporous pressurized heating medium into said vessel;
(C) sealing means for sealing said inlet and outlet ports of the vessel against loss of the pressurized heating medium from said vessel, said sealing means comprising wall means defining a series of separate compartments externally of the vessel but adjacent to each of said vessel ports, the compartments closest to the vessel ports being communicated with the vessel interior through said vessel ports, the compartments farthest from the vessel ports having ports through which the yarn enters and leaves the apparatus, and each series of compartments being communicated with one another by ports opening thereto and through which the yarn passes, all of said ports being of a size slightly greater than the diameter of the yarn; and
(D) means for maintaining a pressure in the compartments nearest the vessel ports at least equal to the pressure in the treating vessel.

2. Apparatus for treating synthetic yarn, comprising:
(A) a treating vessel having spaced inlet and outlet ports through which yarn to be treated enters and leaves the vessel during operation of the apparatus;
(B) means for introducing a vaporous pressurized heating medium into said vessel;
(C) sealing means for sealing said inlet and outlet ports of the vessel against loss of the pressurized heating medium from the vessel, said sealing means comprising:
(1) a chamber adjacent to each of said vessel ports externally of the vessel but communicated with the interior thereof through said ports, each of said chambers having a port leading to the exterior thereof and substantially in line with the adjacent vessel port;
(2) partition means in each of said chambers dividing the same into a series of compartments extending between the ports thereof, all of said partition means having ports therethrough whereby the compartments of each of said chambers are communication and through which the yarn passes in entering and leaving the treating vessel, all of said ports being of a size slightly greater than the cross section of the yarn; and

(D) means for maintaining a pressure in the compartments nearest the vessel ports at least equal to the pressure in the treating vessel.

3. The apparatus of claim 1, further characterized in that the means for pressurizing the compartment nearest each vessel port communicates with a compartment in the adjacent series thereof substantially equispaced from the ends of the series.

4. The apparatus of claim 2, further characterized in that the means for pressurizing the compartment nearest each vessel port communicates with a compartment in the adjacent series thereof substantially equispaced from the ends of the series.

References Cited

UNITED STATES PATENTS

1,969,492	8/1934	Adlam	237—9
2,483,378	9/1949	Alpern	34—154
2,820,280	1/1958	Benn	34—155 X
2,873,597	2/1959	Fahringer	34—159 X
2,974,512	3/1961	Carter	34—155 X
2,304,396	9/1965	Foster et al.	34—155 X

EDWARD J. MICHAEL, Primary Examiner

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