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Kodaira

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[54] **APPARATUS FOR HEAT TREATMENT OF SYNTHETIC FIBROUS YARN**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **432/59,** 165/105

[51] **Int. Cl.** **F27b 9/28,** F28d 15/00

[58] **Field of Search** 432/8, 59; 165/105; 34/77, 34/78; 219/325, 439, 440

[56] **References Cited**

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[57] **ABSTRACT**

Apparatus for heat treatment of synthetic fibrous yarn consisting of a plurality of longitudinal vessels, an upper common pipe communicated to a gas reservoir through a tube, a valve provided therebetween may be maneuvered at any time even in the time of operating the apparatus. After the valve is closed, heat medium vapor and low boiling-point material vapor in the gas reservoir condensate thus the interior of the gas reservoir comes lower pressure than that of the inside of the vessels. when the temperature in the upper portion of the apparatus becomes somewhat lower than that in its below middle and lower portions said valve is slightly opened thereby gas in the upper common pipe and upper portions of the vessels are fastly absorbed in the gas reservoir, thus the temperature of the upper portion of the apparatus is recovered. When the pressure in the gas reservoir comes equal to the vapor pressure in the vessels, said valve is closed after which a narrow tube provided at the bottom of the gas reservoir is vented to exhaust condensate of heat medium vapor and low boiling-point material vapor and gas. After the gas reservoir is evacuated, the end of the narrow tube is closed.

4 Claims, 4 Drawing Figures

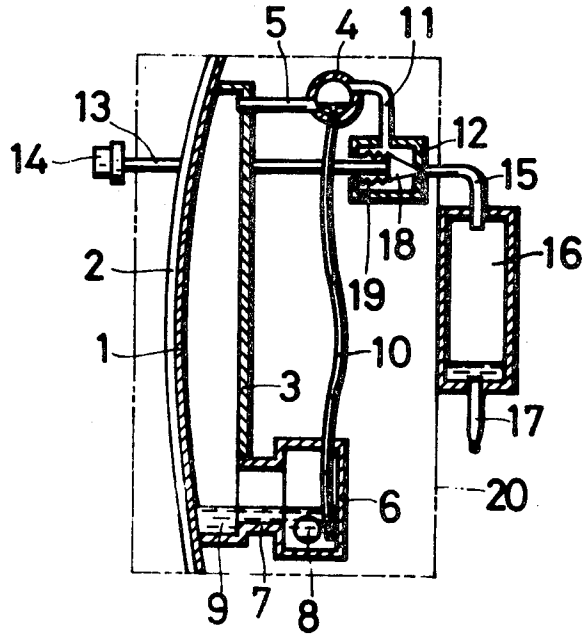

FIG. 1

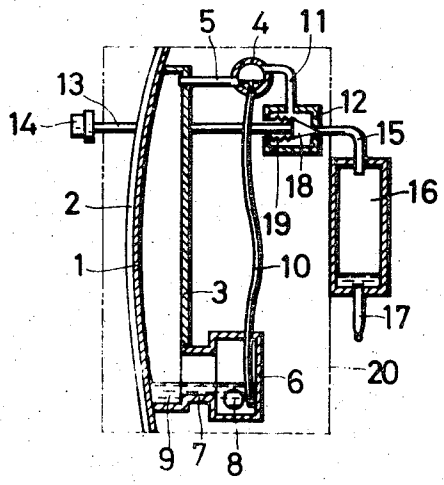

FIG. 2

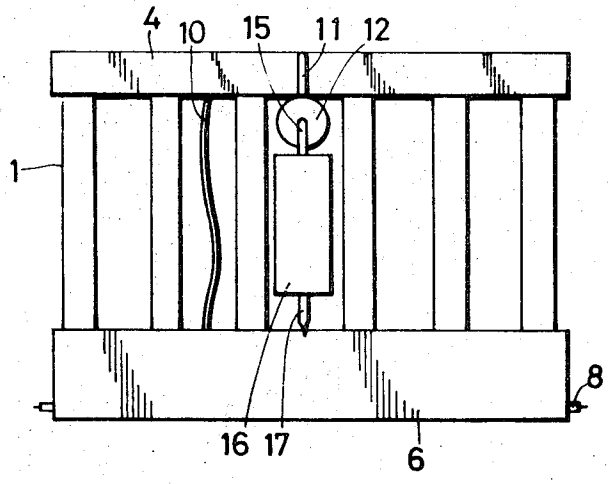

FIG. 3

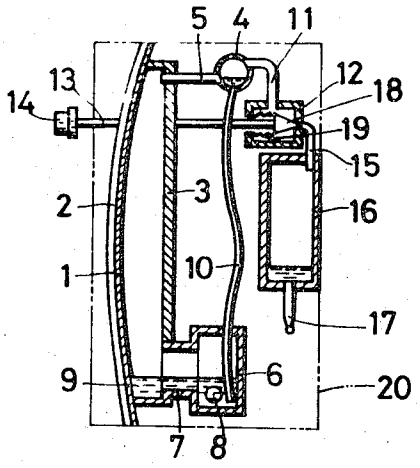
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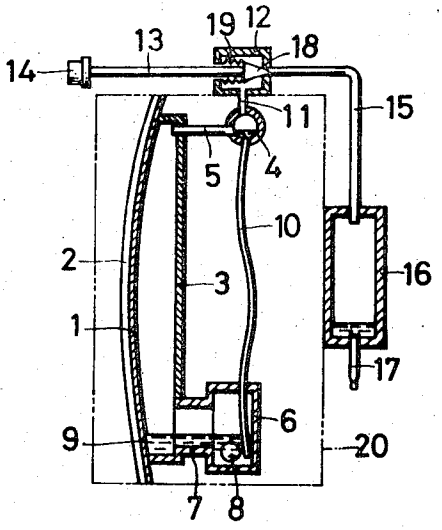
FIG. 4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APPARATUS FOR HEAT TREATMENT OF SYNTHETIC FIBROUS YARN

This invention relates to an improved apparatus for heat treatment of synthetic fibrous yarn. More particularly, this apparatus is to effect heat treatment for a length of synthetic fibrous yarn while yarn is moving in contact with or close to the heating surface of the apparatus.

This apparatus of the present invention is consists of a plurality of longitudinal vessels arranged in parallel spaced relation to one another, the upper portion of each vessel communicates directly with a laterally extending upper common pipe and the lower portion of each vessel communicates to one another by a lower common pipe. A heating body is provided in the bottom of the lower common pipe. After the interiors of said vessels as well as the upper and lower common pipes have been thoroughly evacuated, a small amount of heat medium liquid is filled in the lower common pipe. The liquid is heated by the heater and with thereby produced heat medium vapor, the vessels are uniformly heated to heat yarn.

The apparatus of this kind is featured by accurate and uniform distribution of temperature of its heating surface. In pouring heat medium liquid therein, the interiors of vessels and pipes are thoroughly cleaned and air as well as gas depositing on the inside wall and welded portion of the vessels is completely exhausted so as to be evacuated by heating with temperature at a degree higher than that in usual operation. Then the vessels are filled with completely refined heat medium liquid by removing foreign matter such as inert moisture or gas and low boiling-point material contained therein. However since such heating vessels and pipes to be completely closed are of complexed construction having many welded portions, it makes difficult to remove gas absorbedly remaining at the portions of welded or lapped plates. Further when the apparatus is operated for a long time, gas and low boiling-point material dessolved from liquid gradually accumulate in the upper portions of the vessels and upper common pipe, as these are of lower specific gravity than that of pure heat medium liquid, thus the temperature therearound comes to drop. So far methods of removing such impurities are considered, yet there are many questions to be settled.

The object of the present invention is to furnish an improved heat treatment apparatus for yarn in which gas and low boiling-point material staying in the upper portions of the vessels are removed into a gas reservoir at any time even when the apparatus is under operation.

Other object of the present invention is to furnish an improved heat treatment apparatus for yarn in which operation for removing gas may be effected repeatedly until the gas reservoir is filled with such gas to the full.

Still another object of the present invention is to furnish an improved heat treatment apparatus for yarn in which when the gas reservoir is fully filled with exhaust gas, such gas is easily removed therefrom.

Further object of the present invention is to furnish such heat treatment apparatus in which gas staying in the upper portions of the vessels may be exhausted even when the apparatus is under operation at lower temperature than the boiling point of heat medium liquid.

The construction of the apparatus to be most suitable for the objects of the present invention consists of a plurality of longitudinal vessels arranged in spaced relation to one another, each vessel having a yarn contacting surface at its front on which a length of synthetic fibrous yarn to be heated passes, the upper portions of the vessels being communicated with an upper common pipe and the lower portions of the vessels being communicated with a lower common pipe, a heating body is provided in the interior bottom of the lower common pipe. In this heat treatment apparatus, after the longitudinal vessels and upper and lower common pipes are thoroughly evacuated, a heat medium liquid is filled in the lower common pipe in an amount so that the heating body is scarcely submerged therein. From the upper portion of the upper common pipe, a narrow tube extends downwardly to a gas reservoir provided at the back of the apparatus with a valve in its way. A narrow vent tube extends downwardly from the bottom of the gas reservoir, the end of which is normally closed is opened to exhaust residuals from the gas reservoir to the outside. Said valve is provided with a rod to be handled at the front of the apparatus so as to open and close the valve.

Other objects and advantages of the present invention will become more apparent as description proceeds with reference to accompanying drawings in which:

FIG. **1** is a longitudinal section view of a heat treatment apparatus of the present invention.

FIG. **2** is a rear elevational view.

FIGS. **3** and **4** are longitudinal section views of another embodiments respectively.

In drawings, numeral **1** generally designates a longitudinal vessel. A plurality of such vessels are arranged in spaced apart relation to one another. **2** is a groove extending in each longitudinal vessel **1** through which a length of yarn passes. Though not shown, instead of such groove, a narrow channel for passing yarn may be provided in each vessel. **3** is a back plate of the longitudinal vessel. **4** is an upper common pipe laterally extending at the upper portions of the vessels **1** and communicated through tubes **5** to the vessels **1. 6** is a laterally extending lower common pipe communicated through a pipe **7** of comparatively larger diameter to each vessel. **8** is a heater provided at the inside lower portion of the lower common pipe. **9** is a heat medium liquid in the lower common pipe sealed in an extent that the heater **8** is submerged. Such liquid is poured after the inside of the vessels and the upper and lower common pipes have been completely evacuated. **10** is a narrow tube leading from the bottom of the upper common pipe **4** to the lower common pipe **6** whereby condensed heat medium liquid in the upper common pipe **4** returns to the lower heat medium liquid. **11** is a tube extending from the upper portion of the upper common pipe **4** downwardly. **12** is a valve provided in the way of said tube. **13** is a rod to close and open the valve **12** by moving a needle **18** of the valve **12** and this portion of the rod **13** is sealed with a bellows **19** to prevent leakage. The other end of the rod **13** extends out of the front face of the heat treatment apparatus and provided with a knob **14** for operating the rod to close and open the valve. **15** is a tube extending from the outlet of valve **12** to the upper portion of a gas reservoir **16.** The gas reservoir is formed of a cooling wall to be naturally cooled by atmosphere. **17** is a narrow vent

tube extending from the bottom of the gas reservoir **16** and one end of which is kept closed. In FIGS. **1** and **2**, the gas reservoir **16** is mounted at the outside from the back of the heat treatment apparatus. However this may be mounted at the inside of the back of the case **20** of heat treatment apparatus as seen in FIG. **3**. In this instance, the cooling wall face of such reservoir is attached to the back plate of the case **20** of the heat treatment apparatus or to be exposed to the atmosphere for cooling and a vent tube **17** is bent into the outside of the case **20** of the heat treatment apparatus. The inner capacity of the gas reservoir **16** may be sufficient with about 1,000 c.c. Whereas the valve **12** in FIGS. **1** and **3** is mounted within the case, such valve **12** may be mounted above the upper common pipe **4** as seen in FIG. **4** whereby condensed liquid will not stay in the valve **12**. However, this will be somewhat inconvenient since it occupies an extra space.

Before heat medium liquid is sealed in the bottom of the vessel **1** and lower common pipe **6**, the interiors of the vessels are evacuated. The valve **12** being kept open is shut just before heat medium liquid is poured. At the time of initial operation, the inside of the gas reservoir **16** is kept evacuated condition without liquid or so.

Upon energization of the heater **8**, the heat medium liquid **9** in the lower common pipe **6** is heated into vapor whereby the vessel **1** is filled with heat medium vapor. The vapor flows from the upper portions of the vessels into the upper common pipe **4** whereat it is cooled into liquid. The condensed heat medium returns through the narrow tube **10** to the heat medium liquid **9** in the lower common pipe **6**. In the meantime, the yarn contacting portions **2** of the vessels are heated.

When the apparatus is operated under this condition for a long time, gas left unremoved at the time when heat medium liquid **9** is poured in the vessel or gas partly dessolved from the heat medium liquid comes to stay in the upper common pipe **4**. When such gas increases to fill the upper common pipe **4**, it makes heat medium vapor difficult to circulate. Also gas staying in the upper portions of the vessels **1** comes to mix with the heat medium vapor whereupon the temperature therearound comes lower than that in the middle and lower portions of the vessels. At this moment, if the valve **12** is opened, the gas with heat medium vapor staying therein is fast absorbed into the gas reservoir **16**, hence the pressure in the reservoir is lower than that in the upper common pipe **4** as it ever having been evacuated as said before, thus the temperature in the upper portions of the vessels **1** restores as before and then the valve **12** is closed. Immediately after this, the pressure in the gas reservoir **16** comes temporarily to approximate to that in the common pipe **4** and when the heat medium vapor therein condensates, its inside pressure again drops. By repeating the opening and closure of the valve **12** several times, the pressure therein comes to be equal to that in the upper common pipe **4**, thus the temperature drop in the upper portions of the vessels **1** is compensated. When the gas reservoir **16** is filled with gas and would not absorb gas any more, the valve **12** is firmly closed and the end of the narrow tube **17** is opened to exhaust heat medium liquid. Then the gas or so in said gas reservoir is removed by suction of pump and under this state, the end of the narrow tube **17** is closed. Then the inside of the gas reservoir **16** returns to its original state to be able to absorb gas.

What is claimed is:

1. Heat treatment apparatus for synthetic fibrous yarn consisting of a plurality of elongate vessels arranged in parallel spaced relation to one another, each presenting a surface over which yarn is to be passed, the upper portion of each vessel communicates to an upper common pipe and lower portion of each vessel communicates to a lower common pipe, a heater provided in said lower common pipe, the vessels are filled with heat medium liquid in an amount that the heater is submerged, said apparatus comprising:

A. A gas reservoir having cooling wall and connected to the upper common pipe,

B. A valve provided in the way between said upper common pipe and gas reservoir,

C. A narrow tube for exhausting accumulated material, one end of which is connected to the bottom of said reservoir and the other end is closed.

2. Heat treatment apparatus for synthetic fibrous yarn as claimed in claim **1** characterized in that a gas reservoir is provided at the outside and from the back of the case of the heat treatment apparatus.

3. Heat treatment apparatus for synthetic fibrous yarn as claimed in claim **1** characterized in that a gas reservoir is provided at the inside from the back of the case of the heat treatment apparatus.

4. Heat treatment apparatus for synthetic fibrous yarn as claimed in claim **1** characterized in that a rod combination with a needle valve is provided with a bellows for sealing the valve.

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