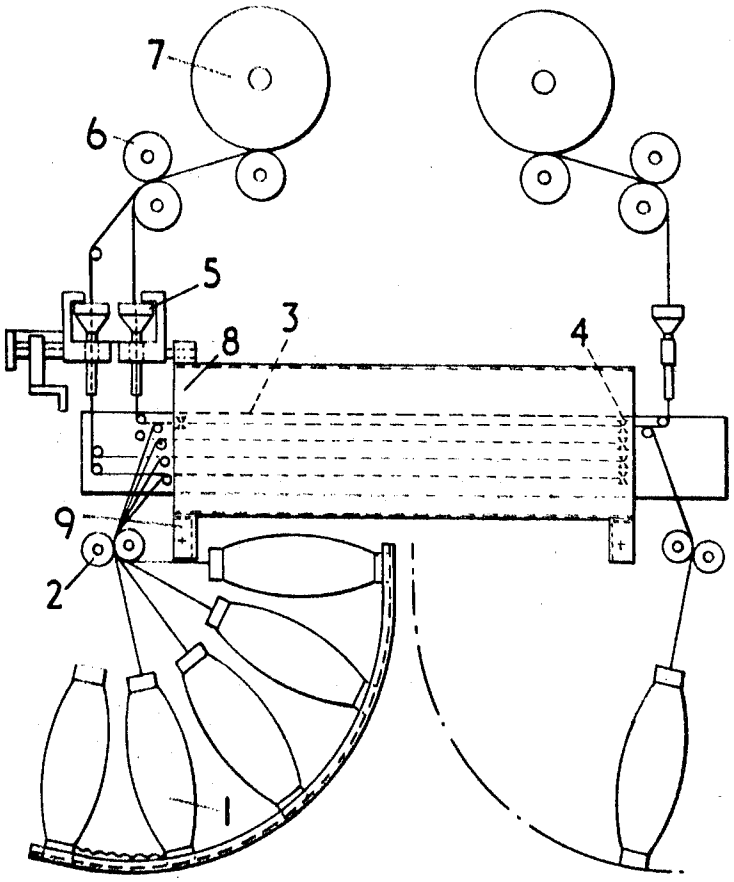


FIG. 1.

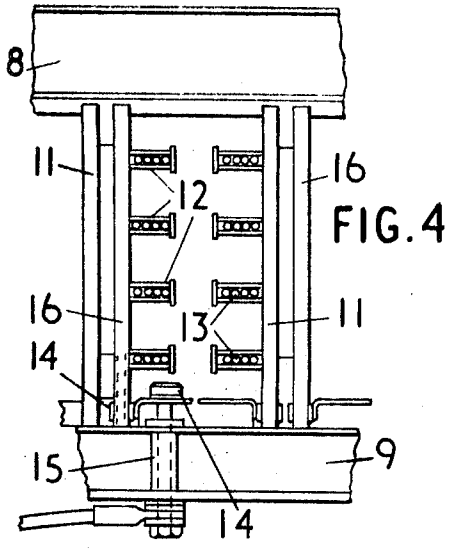


FIG. 4

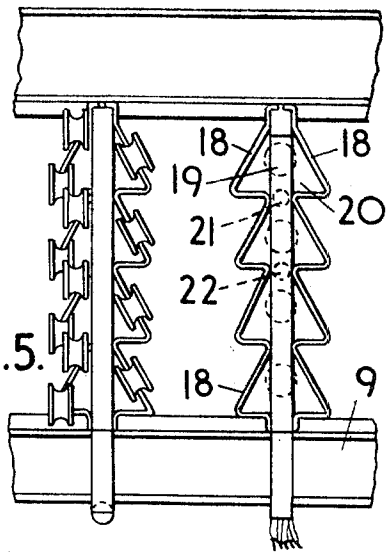


FIG. 5.

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# United States Patent

[11] 3,581,455


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[45] Patented **June 1, 1971**
[32] Priority **Jan. 19, 1968**
[33] **Great Britain**
[31] **3030/68**


[54] **MACHINES FOR THE HEAT TREATMENT OF TEXTILE YARNS**
**12 Claims, 9 Drawing Figs.**


[52] **U.S. Cl.** ..... **57/34,** 28/62
[51] **Int. Cl.** ..... **D02g 3/00,** D02j 13/00
[50] **Field of Search** ..... 57/34, 34 (HS), 157 (TS); 28/62



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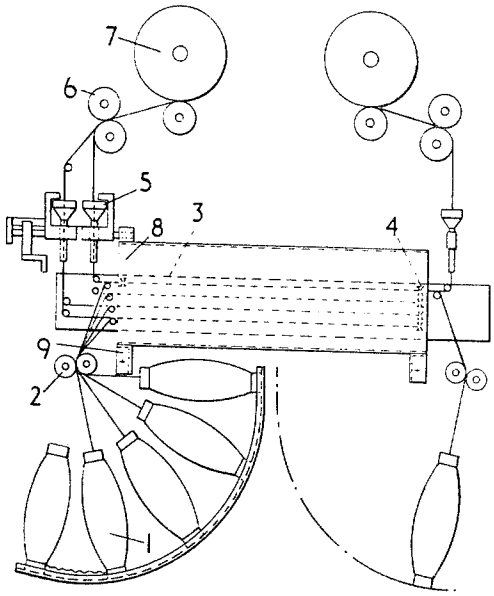
**ABSTRACT:** This invention relates to yarn-processing machinery and is characterized in that a yarn-processing machine comprises at least one electrical yarn-heating unit which is slidably mounted transversely of the machine. Each yarn-heating unit has a heat transfer surface or plate disposed in a nonvertical and preferably substantial horizontal plane with its longitudinal axis extending transversely of the machine, means being provided for guiding the yarn transversely of the machine past the heat transfer surfaces or plates.

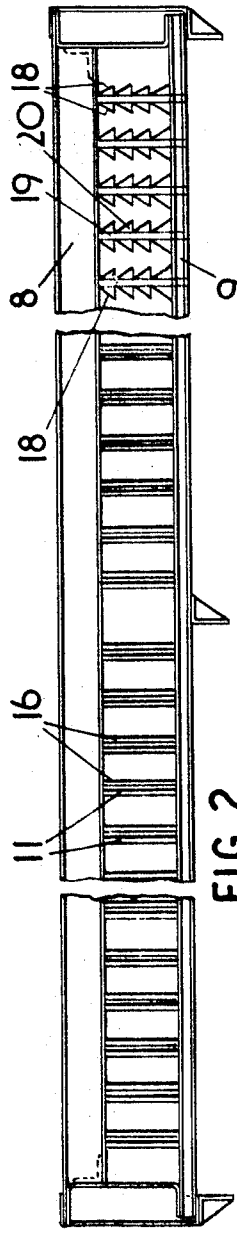



FIG. 2.

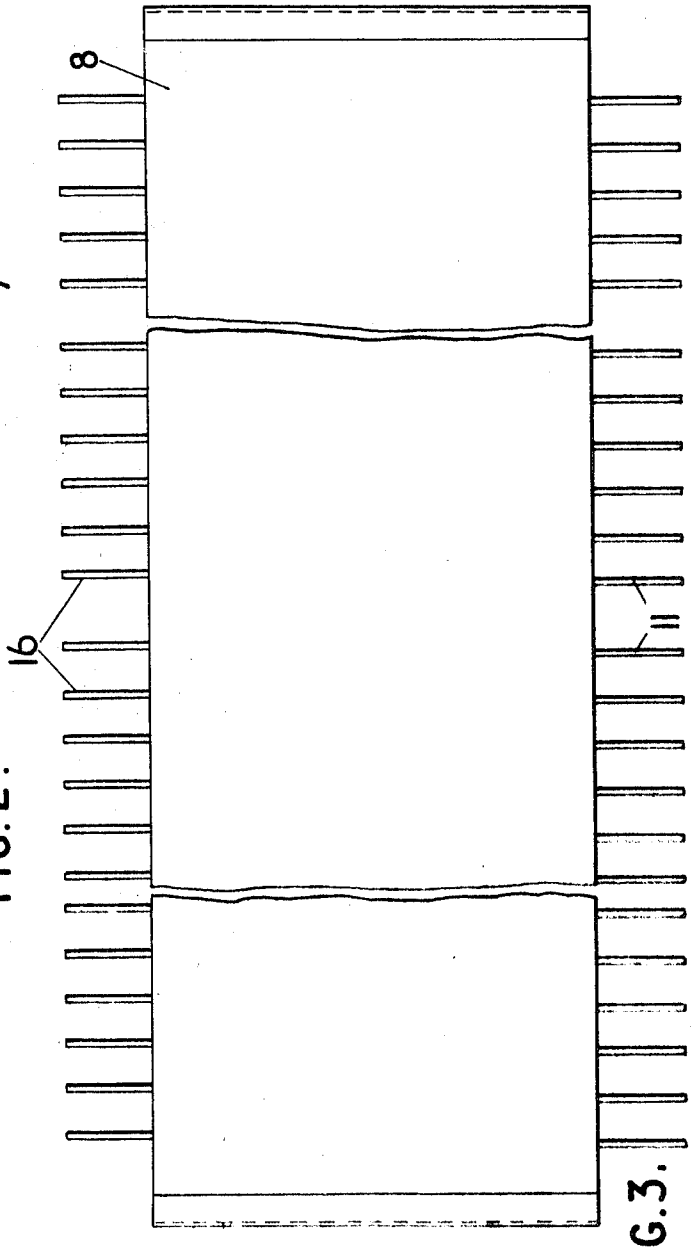



FIG. 3.

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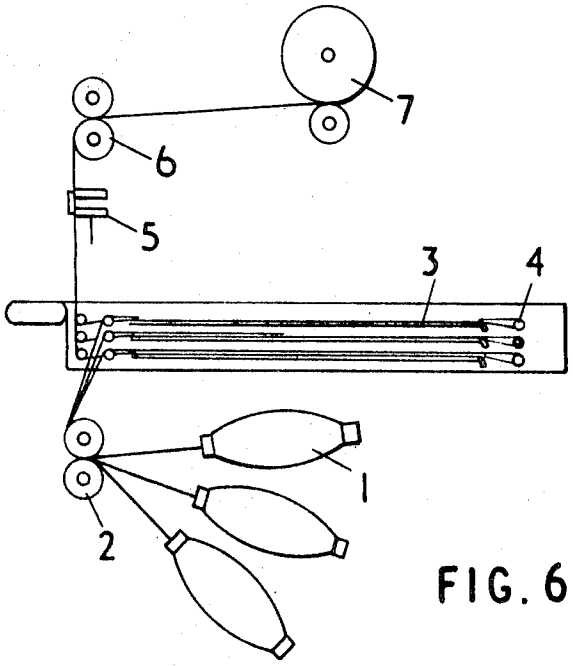


FIG. 6.

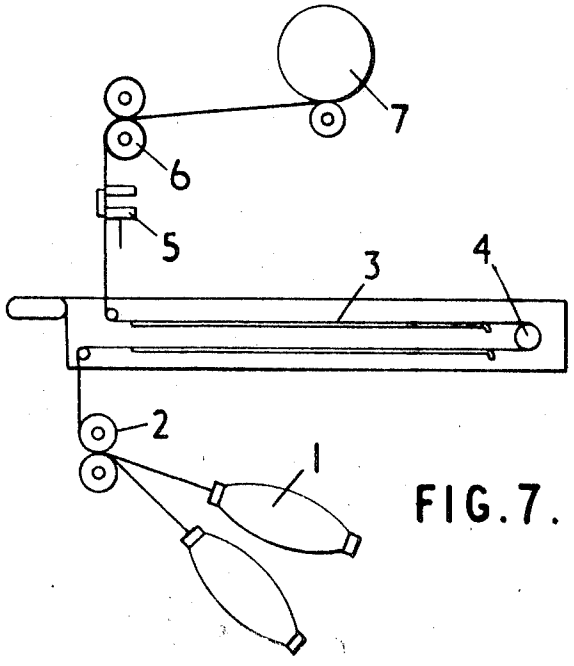


FIG. 7.

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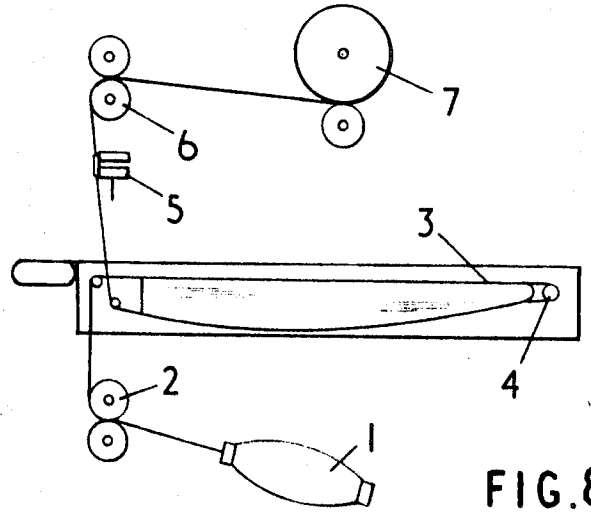


FIG.8.

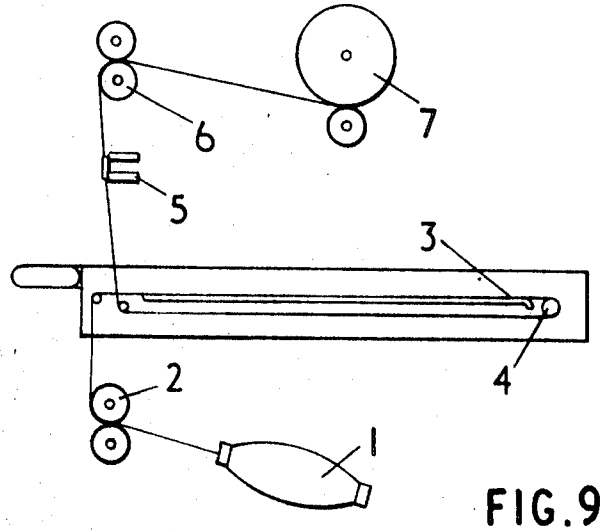


FIG.9.

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# MACHINES FOR THE HEAT TREATMENT OF TEXTILE YARNS

This invention relates to machines for the treatment of textile yarns, and usually synthetic yarns, by a process involving some heat treatment. The invention is particularly applicable to false twist crimping machines.

At the present time machines of the kind referred to incorporate heating units of bar form which are contained in heat-insulated casings. These are usually situated vertically adjacent to each other and extend vertically down each side of the machine substantially along the whole of its length. In consequence a large volume of space within the machine is rendered inaccessible so that it cannot be effectively used. Such space could otherwise contain components such as the yarn supply bobbins and dispense with the need for a separate creel which usually stands alongside each side of the machine using up considerable floorspace. Moreover, it is usually necessary for the yarn-feeding device to be sited inconveniently near to floor level.

Also a yarn-heating path which is vertical has a disadvantage in that owing to the thermodynamic increase in yarn length which occurs, the working height of the machine has to be increased thus giving rise to further and inaccessible an unusable space within the machine.

Further, a vertically disposed heating unit is subject to convection affects along the whole of its length; consequently the lower portion of the yarn-heating path is at a lower temperature than the upper portion and the heat gradient is not linear.

Further, the vertical attitude of the yarn whilst it is being heated subjects it also to the effects of convection which causes uneven stretching and bad heat transfer since uniformity of heat transfer into the yarn is dependent upon the degree of contact of the yarn with the heated surface. This, on a vertically disposed heating surface, is dependent upon the tension applied to the yarn over the heating surface and it is required to pull the yarn back onto the heated face. Thus the consequent increase in the tension in the yarn causes extension in the thermoplastic yarns and variation in the yarns being processed at the various positions along the length of the machine. In the processing of some yarns it is necessary for the yarn to pass over the heated surface at a very low tension and this on a vertical heating surface allows the yarn to twirl and sag away from the heated surface with consequent variations in the heat transfer.

The width of the vertical heating surfaces combined with their individually heat-insulated cases occupy a substantial width along the machine and consequently the number of positions for yarns that can be processed is limited for a practical length of machine. Thus the total output of the machine for a given floor area and machine volume is limited.

A disadvantage of using tubular heating units for yarn in machines is the tendency for fumes and vapors from the heated yarns to condense upon the walls of the tubes due to the restricted ventilation within the heated tube and the fact that part of the tube is unheated. These deposits form a highly viscous tarlike residue which increases the frictional drag between the yarn and the tube wall causing a serious increase in the tension in the yarn. This condition, varying from tube to tube, causes variations in the yarn process and results in poor quality or substandard yarn.

The roughness of the residue also causes poor heat transfer with consequent further deterioration in the yarn quality. At times tubes become completely blocked and the condition of the interior surface cannot be visually inspected.

Expensive expedients then become necessary, as for instance the introduction of a hot airstream blown through the tubes to prevent condensation, and the use of suction drainage via small holes in the tubes to draw off the condensate and which in turn may become blocked themselves.

A yarn-heating path should be perfectly clean and smooth to give the best and most uniform heat transfer to the yarn but the cleaning and polishing of the interior surface of the tubular heating elements is difficult particularly when the tubes are



curved and fixed within the machine. The use of flexible cables, plugs or other pullthrough devices often result in scoring the tube wall and it is difficult to ascertain whether these devices have removed all deposits.

Finally, when the tube walls are not perfectly smooth and clean some difficulty is experienced in drawing or threading a new yarn through the tubes by either suction or air pressure, and frequently a cable or hooks have to be used.

A yarn left stationary, momentarily within the heated tube will cause it to adhere to the walls of the tube and melt thus causing a further difficult restriction.

Some difficulties exist with a further type of machine for processing yarn which uses a heated surface which is continuous along both sides of the machine in that the yarns being heated pass diagonally and obliquely across the surface in close proximity so that a broken yarn at one processing position interferes and intertwines with the adjacent yarn and consequently the breakages become progressive and rapidly escalate along the length of the machine. This occurs with what is regarded as a normal spacing of yarn-processing positions along a machine and elaborate means are used to prevent it. Because of this the capacity and ability of a machine of this type to decrease its yarn spacing and increase its output is seriously limited.

Further, the open type of heating surface employed is difficult to enclose and insulate and consequently is subject to considerable heat loss.

The present machine has been devised with the general intention of avoiding the foregoing limitations and disadvantages inherent in the machines at present used.

According to the present invention therefore a yarn-processing machine is characterized by at least one electrical yarn-heating unit which is slidably mounted transversely of the machine and has a heat transfer element disposed in a nonvertical and preferably substantially horizontal plane with its longer dimension extending transversely of the machine and means for guiding the yarn transversely of the machine past the or each heat transfer element.

Normally a plurality of heating units with heat transfer elements of single or multiple platelike form are provided and these may be disposed in sets along the machine with the units of each set parallel with each other.

The yarn-guiding means is effective to feed a plurality of yarns back and forth over or under the heated elements and the outward or return paths of any particular yarn or yarns may be parallel or inclined one to the other.

The plates or sets of plates may be slidably mounted in a rack or magazine so as to be easily removable for purposes of cleaning, polishing, maintenance, replacement or repair.

The rack or magazine may thus have partitions, guide rails or the like which define compartments transversely of the machine for accommodating the heating units.

The magazine may also be constructed so as to act as a heat-conserving or -insulating device and a fume extractor. A part of each heating unit can form a seal or cover to assist in retaining the heat within the magazine.

For a better understanding of the invention, however, reference should be made to the accompanying diagrammatic drawings which illustrate five typical and preferred heating unit arrangements and in which:

FIG. 1 is an end elevation;

FIG. 2 is a side elevation of a magazine shown accommodating two different forms of heating unit;

FIG. 3 is a plan view equivalent to FIG. 2;

FIGS. 4 and 5 are end elevations of two different forms of heating unit; whilst

FIGS. 6, 7, 8 and 9 are end elevations of four alternative arrangements of heating units in a yarn-processing machine.

Referring now primarily to FIG. 1 there is shown a plurality of yarn supply bobbins 1 from which the yarn is unwound by a feeding device 2 and passed by guide rollers along a yarn-heating path transversely of the machine between and against a series of individually removable electrical yarn-heating units

each comprised of a horizontal heat transfer element or plate 3 which extends transversely from side to side of the machine.

The yarn then passes around a guide 4 returning along the same yarn-heating path in a parallel direction on through a false twisting device 5, through a second yarn-feeding device 6 and passing to a processed yarn receiving bobbin 7.

In the opposite direction from the right side of the machine as shown in FIG. 1 a supply of yarn is taken from the supply bobbin through the yarn-feeding device over the yarn-heating surface and through the false twist device, through the second yarn-feeding unit and onto the receiving bobbin for processed yarn.

The heating units are vertical and slidably mounted in a magazine comprising upper and lower members 8, 9 respectively so that they can be individually removed and replaced as will be apparent from FIG. 2 and alternate units are removable from the same side of the machine. The left and right ends of FIG. 2 indicate different forms of heating unit which are shown in greater detail in FIGS. 4 and 5.

Referring now to FIG. 4, wherein the yarn-guiding means, for purposes of clarity, are not shown the yarn-heating units comprise vertical standards 11, 16 which each support a series of parallel horizontal heat transfer plates 12. Each such plate is hollow and contains insulated sheathed resistance wire elements 13 supplied by a relatively low voltage electric current.

The heating unit standards 11 pick up the current by means of pairs of contacts 14 through posts 15. Each heating unit can be readily removed for cleaning purposes. Each alternate yarn-heating unit 11 and 16 is operated from the same side of the machine every other intermediate unit being operated from the opposite side of the machine.

FIG. 5 shows a pair of heating units of alternative preferred suitable design and each comprised of a vertical standard to which there is attached a series of four heat transfer elements each providing a pair of inclined platelike heat transfer surfaces 18. Four of these surfaces to one side of the standard heat yarn supplied from one side of the machine whilst the four surfaces on the other side of the standard heat yarn supplied from the opposite side of the machine. In FIG. 5 the yarn guides have been omitted from the view of one heating unit to simplify the drawing. Electrical resistance heating elements 19 are inserted as shown and surrounded by a heat-conducting medium 20 which fills the cavity.

A thermocouple 21 is arranged to indicate the temperature and a thermistor 22 to control the preset temperature.

An advantage of this design is that a single unit carries eight heating surfaces per unit instead of four as shown in FIG. 4 and the heating elements, thermistor and thermocouple are common to all eight heating surfaces.

A further advantage is that the yarn is less likely to drag on the inclined heating surface for although the yarn will be held into contact with the heater face by gravity only a component of the weight is bearing onto the heater surface, a feature which is useful when heating fine denier yarns under low tension.

An alternative to be used when several yarns are to be processed whether in combination or not is shown in FIG. 6 as follows:

The yarn from two or more supply bobbins 1 is fed *via* the yarn-feeding device 2 over the various yarn-heating plates 3 around the guides 4 returning over the respective yarn heater paths through the false twisting device 5 *via* the second yarn-feeding device 6 onto the yarn-receiving reels 7.

An alternative for two or more yarns over the same yarn-heating plates is shown in FIG. 7 where two or more yarns travel outwards from the supply bobbin along the lower yarn heating plate 3 around the guide returning along the upper yarn-heating path 3 through the false twist unit 5 through the second yarn-feeding device 6 and onto the receiving reel 7 for processed yarn.

A further alternative is shown in FIG. 8 where the yarn to be processed is fed from the supply bobbin 1 through the yarn-feeding device 2, over the upper side of the yarn-heating plate 3 around the guide 4 returning along the opposite side of the yarn-heating unit through the false twisting device 5 *via* the second yarn-feeding unit onto the receiving reel for processed yarn 7.

A further alternative is shown in FIG. 9 where the yarn to be processed travels outwards from the supply bobbin 1 through the yarn-feeding device 2 over the yarn-heating path 3 around the guide 4 on through the false twisting device 5 through the second yarn-feeding device 6 and onto the receiving reel 7 for processed yarn. In this case it is to be noticed that the heated yarn is passed around the guide 4 returning in "free air" off the yarn-heating path as shown.

Further possible arrangements would be ones in which FIGS. 1 to 9 inclusive are inverted so that the yarn supply bobbins are above the yarn-heating plates and likewise the yarn-receiving reels are below the yarn-heating plates.

It should be apparent from the foregoing that since the heating plates are disposed in horizontal planes and are transversely of the machine, and may be slidably inserted for example, they occupy little space both in vertical planes and lengthwise of the machine as a whole. This arrangement enables as much as four times the number of yarns to be processed simultaneously as compared with the more usual machines.

Space which is unusable in previous machines can now accommodate the yarn supply bobbins and in addition the yarn-feeding device and its driving means can be mounted at a more convenient level above the floor.

Also, in view of the facility now afforded whereby the yarn may be fed and returned over the same heating plate or a different one to the same side of the machine the length of the yarn being heated at any given time can be increased substantially without affecting the height of the machine.

Further, a horizontal yarn-heating plate is only subject to convection over its cross section, is not subject to a heat gradient along its length and the temperature of it should not vary in the path of feed or return of any particular yarn or yarns. More uniform heating of yarn is thus ensured.

Since the yarn which traverses a horizontal heating path is not subject to varying convection effects along its length and since the heat transfer to the yarn does not depend to the same extent upon the tension in the yarn for its contact with the heating surface but rather on the force of gravity the yarn can be treated when it is in a more relaxed condition. This is very useful when part of the yarn process is to obtain maximum crimp contraction or shrinkage in the yarn since it is then necessary that the yarn should pass over the heating surface under minimum tension to enable the contraction to take place freely.

Another advantage of the machine according to the present invention is its capacity to produce four times the number of processed yarns for a given machine floor area or machine cubic capacity. This results from the compact arrangement of the heating units within the magazines if such are fitted, from the closely adjacent vertically separated heating paths and from the increase in throughput speed which is possible.

Also the proximity of the yarn-heating units or plates within a magazine reduces heat losses to atmosphere and promotes uniformity of temperature throughout the magazine and between the heating paths.

In a machine according to the present invention the yarn-heating units can be readily removable from the machine for examination and to facilitate cleaning and repolishing of the heated surfaces. The vapors are not held in close proximity to the heating paths and can to some extent disperse in the atmosphere within the magazine where they are drawn away at low pressure and condensed into a vessel in some other part of the machine.

The facility of removal of the heater units simplifies cleaning, polishing and inspection of them and the open nature of the paths permits easy and reliable threading when necessary.

I claim:

1. A yarn-processing machine comprising yarn feed means and yarn-receiving means, a magazine defining at least one

heating chamber which is traversed by yarn in transit between the yarn feed means and the yarn-receiving means, at least one yarn-heating panel detachably mountable within said chamber and having a plurality of substantially horizontally extending and parallel heating bars, and means for guiding yarn through said at least one heating chamber in proximity to the panel heating bars.

2. A yarn-processing machine comprising yarn feed means and yarn-receiving means, constituted by a plurality of false twist spindle units, a magazine defining at least one heating chamber which is traversed by yarn in transit between the yarn feed means and the yarn-receiving means, vertical yarn-heating panels detachably mounted within each said chamber and having a plurality of substantially horizontally extending and parallel heating bars and means for guiding yarns through said at least one heating chamber in proximity to the panel-heating bars and in planes containing the yarn-receiving means.

3. A yarn-processing machine as claimed in claim 2 in which each said heating chamber is elongated in the direction of the length of the machine.

4. A yarn-processing machine as claimed in claim 3 in which each said yarn-heating panel is elongated in the direction of the width of the machine.

5. A yarn-processing machine as claimed in claim 1 in which each said yarn-heating panel is slidably mounted in said magazine.

6. A yarn-processing machine as claimed in claim 1 in which said yarn-heating panels are insertable into the magazine alternately from opposite sides of the machine.



7. A yarn-processing machine as claimed in claim 1 in which said heating bars are arranged in tiers projecting from at least one side of said panel.

8. A yarn-processing machine as claimed in claim 1 in which said heating bars are hollow, have horizontal top surfaces and are heated by internal electrical heating elements.

9. A yarn-processing machine as claimed in claim 1 in which said heating bars are hollow, have inclined top surfaces and are heated by internal electrical heating elements.

10. A yarn-processing machine as claimed in claim 1 in which said heating bars are heated by means of electric resistance heating elements and regulated by temperature-sensing and -controlling device.

11. A yarn-processing machine as claimed in claim 1 in which said magazine is provided with a fume extraction device.

12. A yarn-processing machine comprising on the same side of the machine means for feeding a plurality of yarns and a plurality of false twist spindle units, a magazine defining at least one chamber which is traversed by yarns in transit between said feeding means and said spindle units, a yarn-heating panel detachably mounted within said chamber and having a plurality of substantially horizontally extending and parallel heating bars, and means for guiding yarn back and forth through said at least one heating chamber in proximity to said panel heating bars.