April 26, 1966 J. R. WHITEHURST 3,247,551

APPARATUS AND METHOD FOR CONDITIONING TEXTILE MATERIAL BEING DRAFTED

Filed March 11, 1963 6 Sheets-Sheet 1

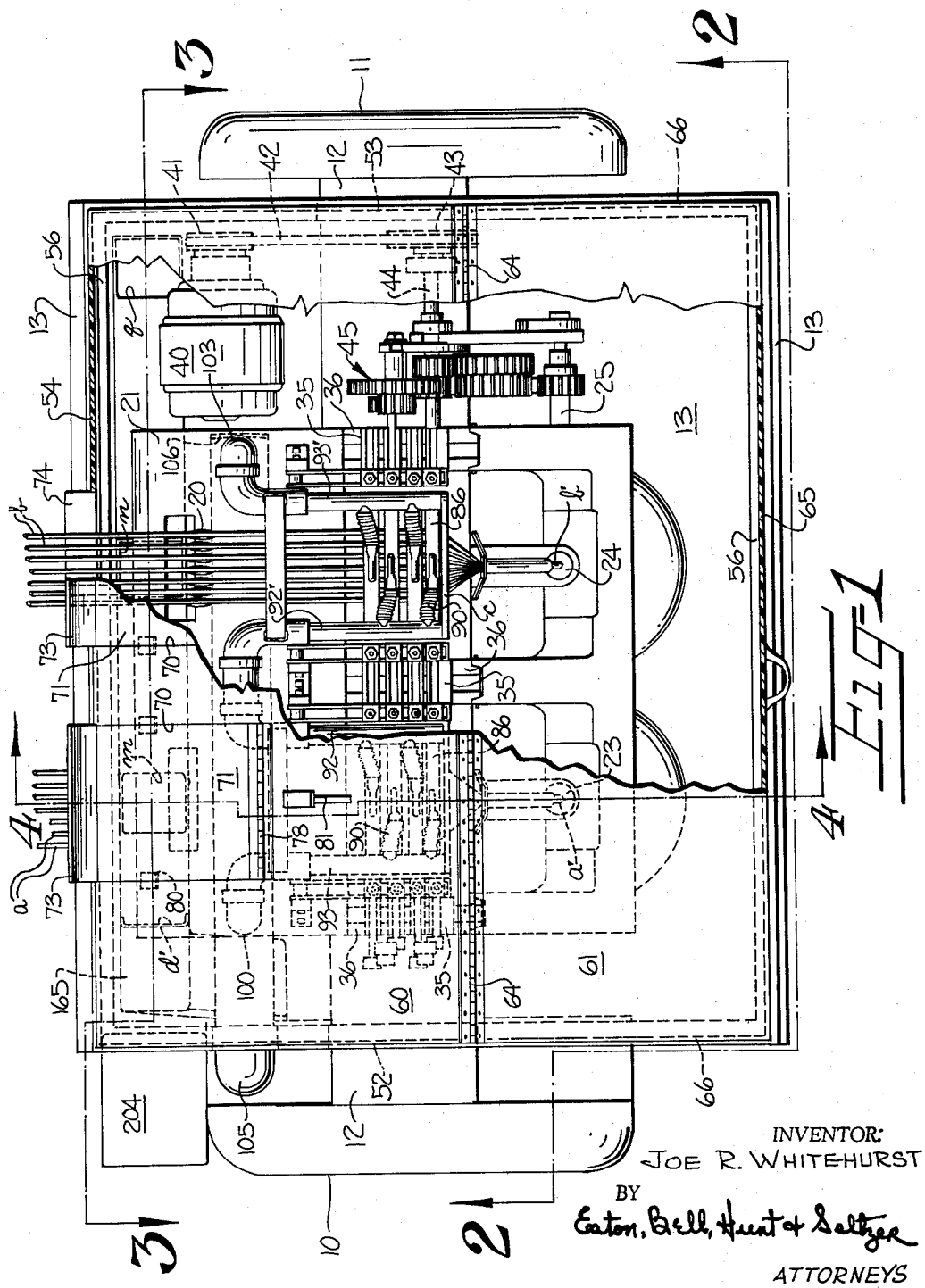


FIG-1

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APPARATUS AND METHOD FOR CONDITIONING TEXTILE MATERIAL BEING DRAFTED

Filed March 11, 1963 6 Sheets-Sheet 2

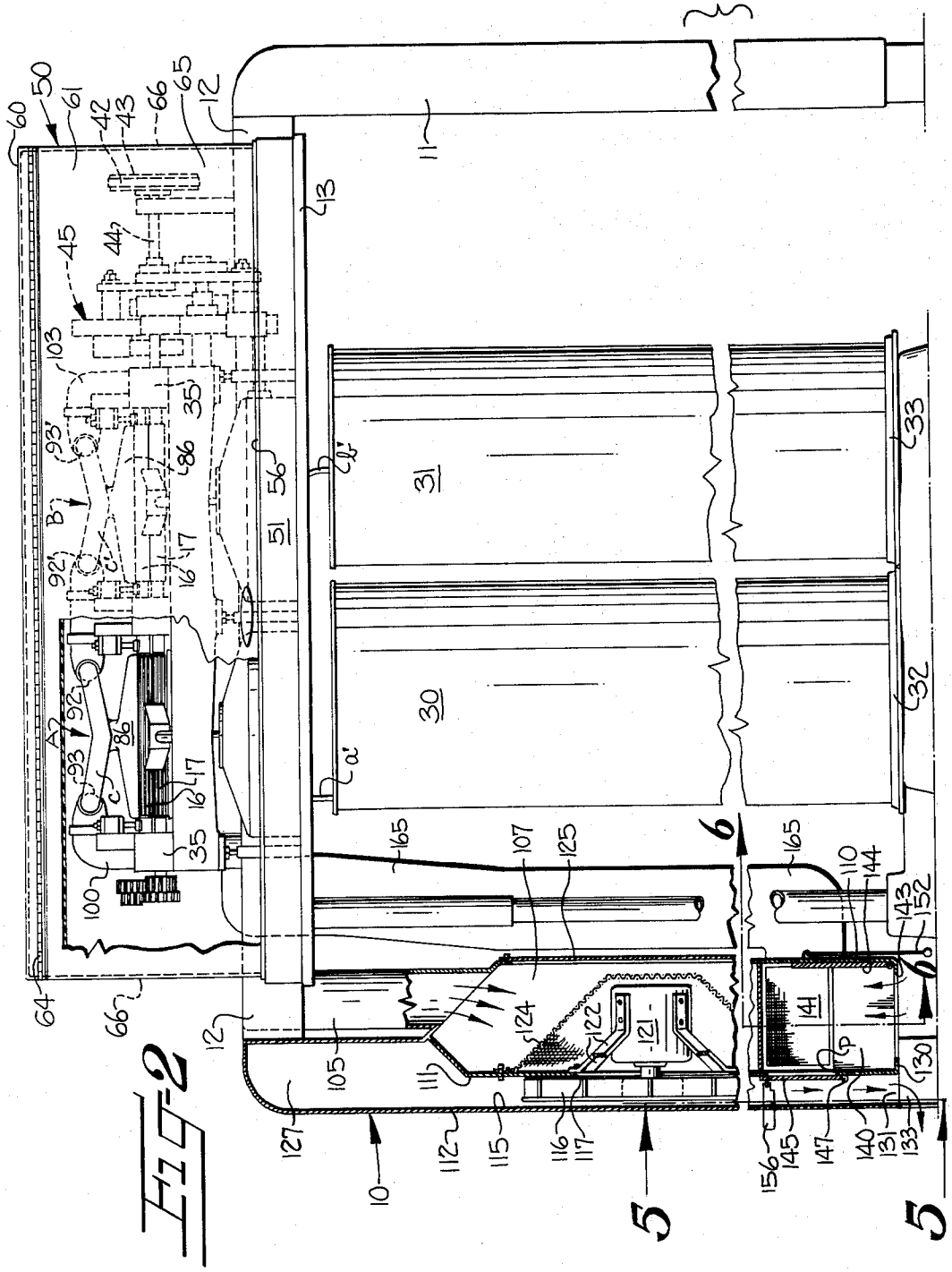


FIG 2

April 26, 1966 J. R. WHITEHURST 3,247,551

APPARATUS AND METHOD FOR CONDITIONING TEXTILE MATERIAL BEING DRAFTED

Filed March 11, 1963 6 Sheets-Sheet 3

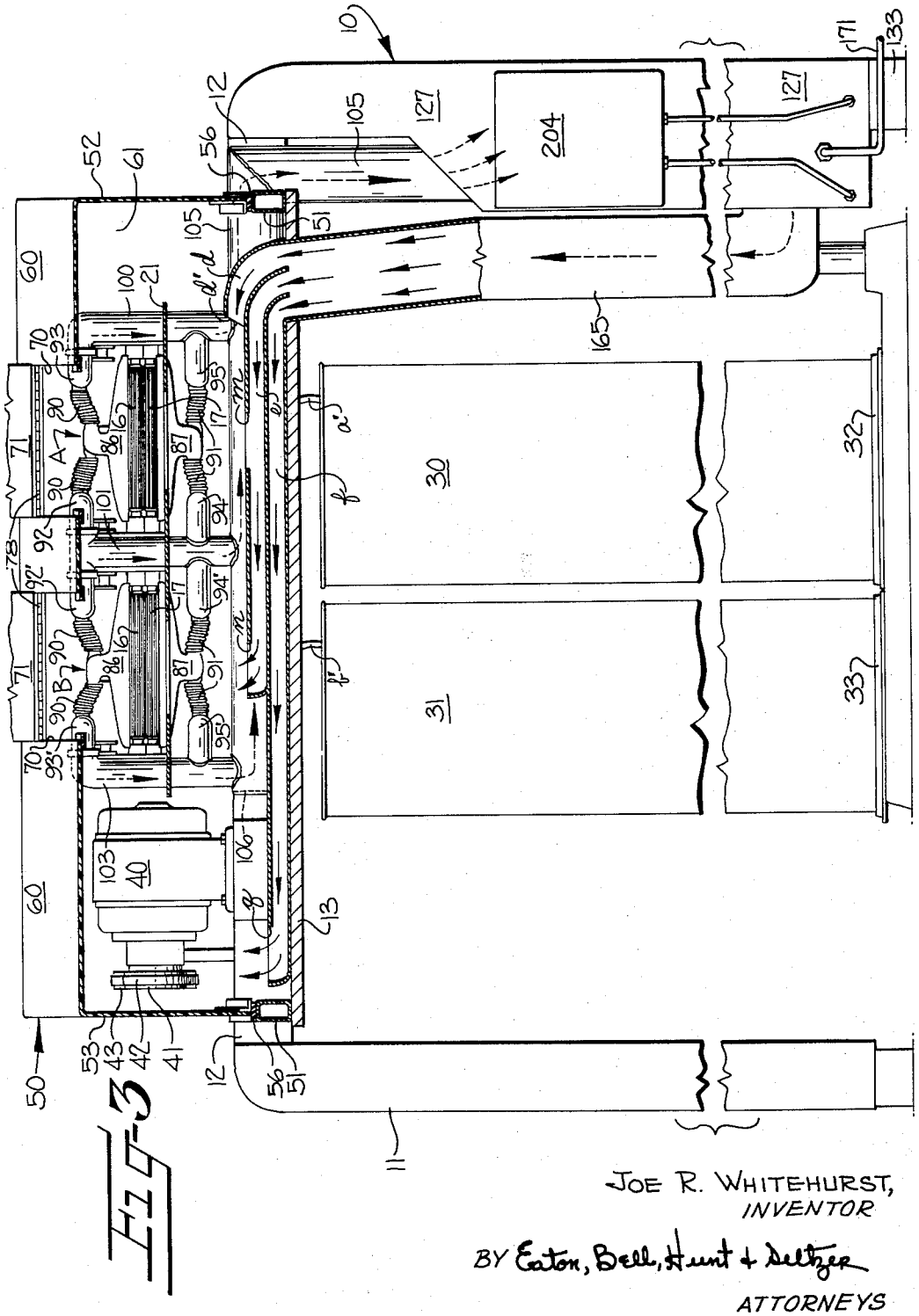


FIG-3

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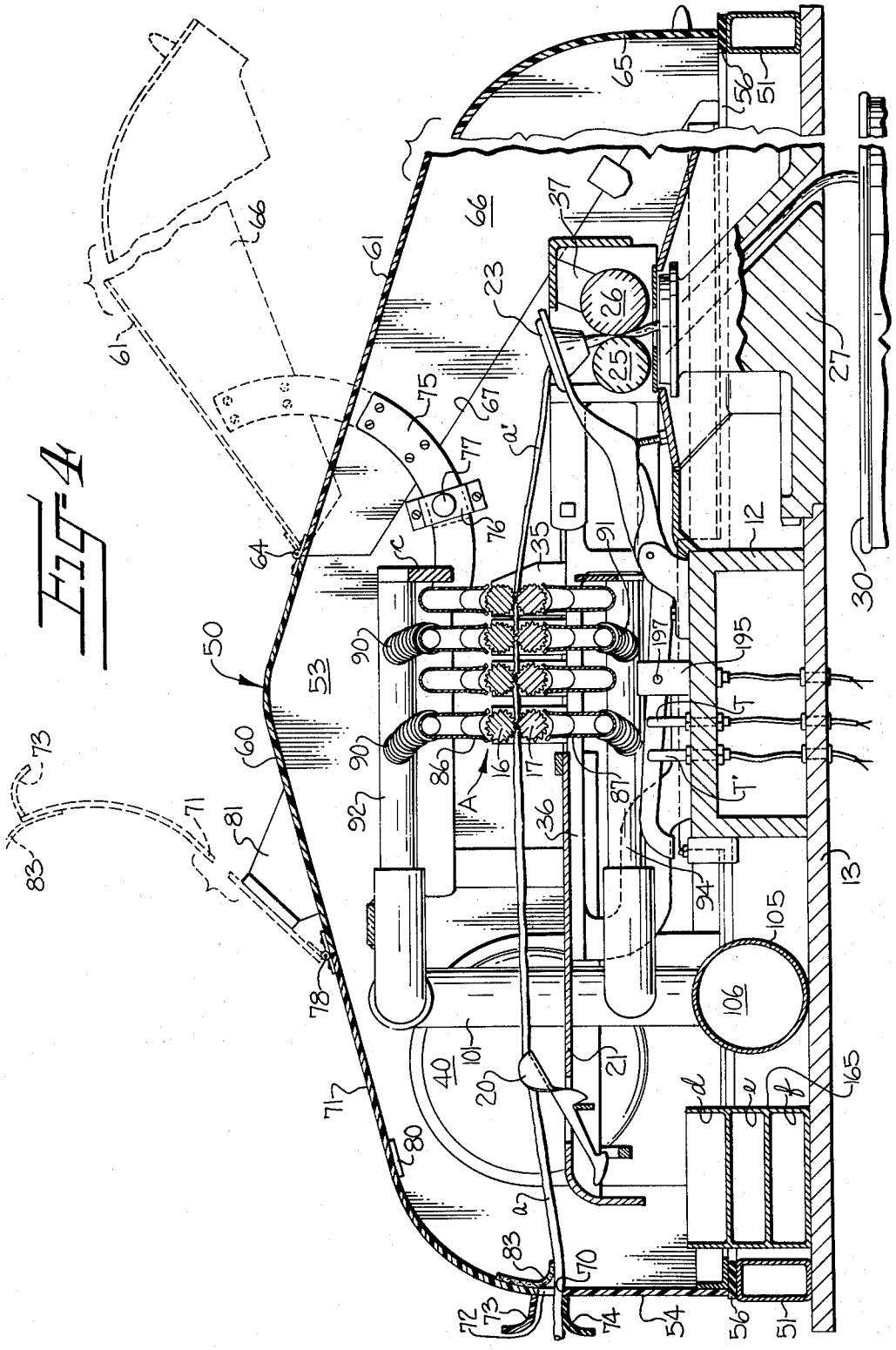
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April 26, 1966 J. R. WHITEHURST 3,247,551

APPARATUS AND METHOD FOR CONDITIONING TEXTILE MATERIAL BEING DRAFTED

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Fig. 4



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APPARATUS AND METHOD FOR CONDITIONING TEXTILE MATERIAL BEING DRAFTED

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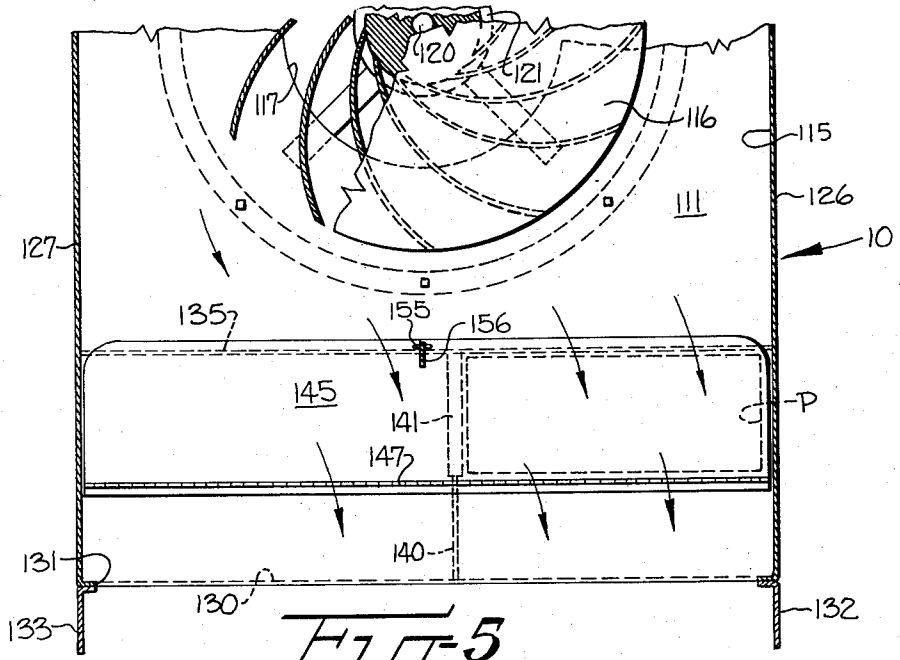


Fig-5

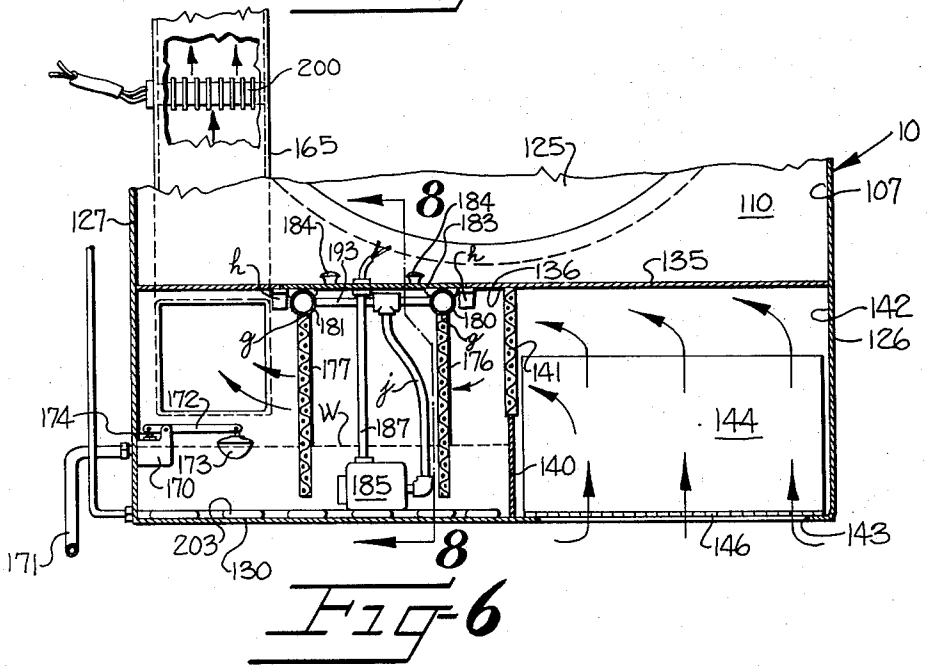


Fig-6

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APPARATUS AND METHOD FOR CONDITIONING TEXTILE MATERIAL BEING DRAFTED

Filed March 11, 1963 6 Sheets-Sheet 6

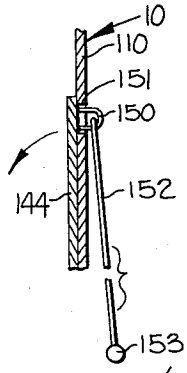


Fig-7

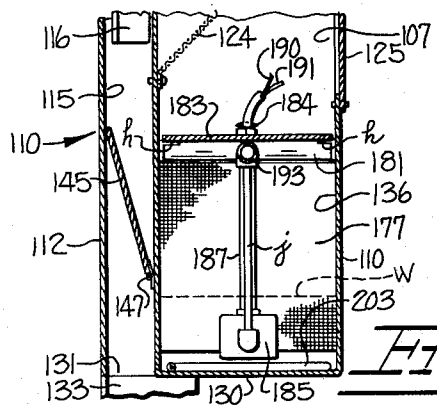


Fig-8

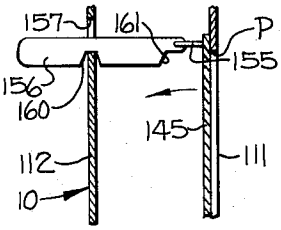


Fig-9

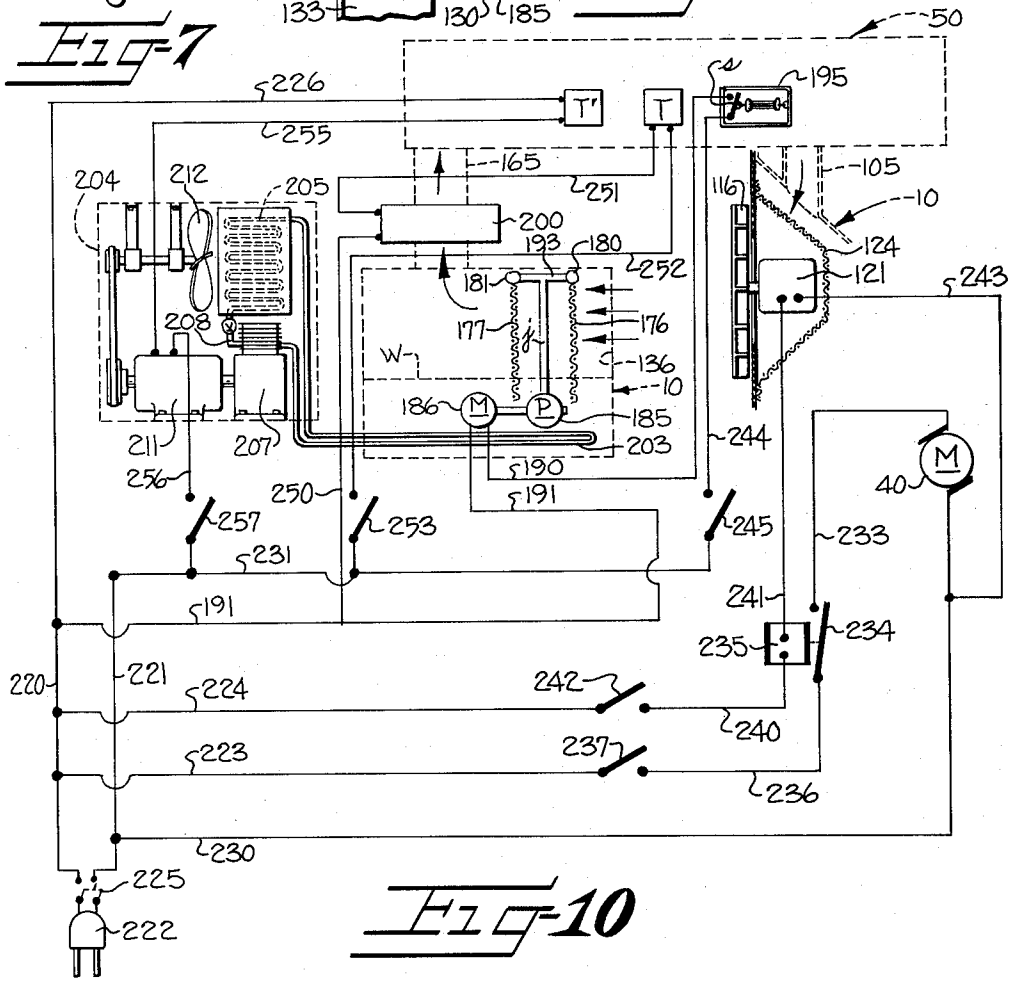


Fig-10

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United States Patent Office 3,247,551 Patented Apr. 26, 1966

3,247,551

APPARATUS AND METHOD FOR CONDITIONING TEXTILE MATERIAL BEING DRAFTED

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Filed Mar. 11, 1963, Ser. No. 264,328
36 Claims. (Cl. 19—66)

This invention relates to the art of drafting textile strand material through series of drafting elements or rolls of drawing frames and the like and, more especially, to an improved method and apparatus for conditioning textile strand material, such as sliver, by sensing and compensatively adjusting the temperature and/or relative humidity of the air immediately surrounding the strand material being drafted and the associated drafting machine elements.

Important among the many factors which present problems in the production of drafted textile material, particularly sliver, are the maintenance of adequate moisture in the strand material, adequate temperature of the strand material and drafting elements upon starting the drafting operation, and the dissipation of excess heat generated by the strand material and the drafting elements during normal operating periods of the drafting elements.

While it is important that these factors are considered in the drafting of sliver and roving on fly frames and spinning frames, they become more critical in the drafting of groups of strands of sliver to form composite strands of drafted sliver therefrom. Therefore, problems particularly related to drawing frames are set forth hereinafter, although it will be apparent that these same problems are inherent, perhaps to a lesser degree, in fly frames, spinning frames and the like.

During slow speed operation of drawing frames, for example, in which the drafted sliver is produced at speeds of less than 400 feet per minute, the heat generated by the drafting operation is negligible, at least to the extent that it is not generally considered as a hazard to the production of satisfactory drafted sliver. Also, the usual types of room air humidification systems are generally considered adequate for the maintenance of moisture in the sliver being drafted at very slow speeds. However, such systems cannot maintain uniform amounts of moisture in the sliver being drafted through all the drawing frames in the same room of a textile mill regardless of the speed of such drawing frames, due to the fact that humidifier nozzles may be positioned closer to some drawing frames than they are to other drawing frames in the same room, some drawing frames may be located in the vicinity of air drafts from doorways, windows or passageways in a room while other drawing frames may not be subjected to such air drafts, or one side of the room may be cooler than the opposite side, for example, all of which affects, adversely, the relative humidity in various areas of the room.

There are instances in which the tension gears and draft gears of drawing frames near the sunny side of a room have had to be changed each morning and each evening in order to compensate for changes in temperature, with consequent changes in relative humidity, effected by the rising and setting of the sun, since variations in the relative humidity cause corresponding variations in the amount of moisture in the sliver which, in turn, causes variations in the weight of the sliver being produced by a drawing frame.

Furthermore, in instances wherein a drawing frame has been shut down for a period of time such that the drafting rolls thereof have cooled substantially below their normal operating temperature, no means have been provided heretofore for heating the rolls or other drafting elements and any sliver therebetween before the drawing frame was restarted so that the cool temperature of the rolls was transmitted to the sliver being drafted during the first hour or more of operation of the drawing frame. Textile fibers are more brittle and are thus more easily ruptured or broken at relatively low temperatures than they are at normal operating temperatures of from 65° to 85° Fahrenheit. At lower than normal operating temperatures the fibers are also affected adversely by static electricity so they tend to repel each other which, in turn, causes the mass of sliver to expand or swell between adjacent drafting elements, or adjacent sets of drafting rolls, or to cling to the walls of coiler cans instead of being properly coiled in the cans as the sliver is magnetically attracted to the drafting elements or rolls, to the walls of the coiler cans and to other adjacent parts of the drawing frame or the like. The aforesaid expansion of the sliver separates the fibers therein so they become dryer even though the room may be provided with a properly functioning humidification system. This is particularly true with respect to cut-staple synthetic fibers.

All the aforementioned problems become more critical as the speed of the drafting elements and the sliver are increased. In fact, sliver could not be produced at speeds of 1000 feet per minute or more heretofore for periods of more than a minute or two, because adequate moisture could not be directed to the sliver being drafted at such high speeds. More importantly, the rolls or other drafting elements would become so hot at such high speeds as to scorch or burn the fibers or, in the case of synthetic fibers, to soften or melt the fibers to such extent that they would even adhere to the drafting rolls in some instances. Also, the heat generated at such high speeds would cause the drafting rolls to become flexed or curved longitudinally, and the bearings, the drive motors, gears and other moving parts associated with the drafting rolls would deteriorate quite rapidly.

During the past few years, many textile mills have materially reduced the number of processes through which textile fibers are passed, so that adequate control of sliver being drafted is becoming more critical than was considered necessary a few years ago. For example, some mills currently pass the textile fibers from the carding process through a one-process drawing and then directly into spinning, therefore affording no opportunity to make adjustments in the drafting machinery to compensate for any errors in the processing of the fibers which may have occurred due to excessive variations in temperature and/or humidity. Up until recent years, the carded fibers were subjected to several processes of drawing and were then subjected to as many as three to five processes of roving, thus providing many opportunities for making any required compensative corrections in the drafting machinery.

With the foregoing in mind it is the primary object of this invention to control the condition of strand material being drafted by sensing and compensatively adjusting the temperature and/or relative humidity of the air immediately surrounding the strand material being drafted and surrounding the associated drafting machine elements.

It is another object of this invention to provide a novel method of conditioning strands of textile material passing through a drafting zone, which comprises passing successive portions of continuous strand material through a confined area surrounding the drafting zone while sensing the temperature and/or relative humidity of the air surrounding the strand material within the confined area and adjusting the condition of the air therein in response to the sensing of the temperature and/or the relative humidity thereof.

It is another object of this invention to provide a novel method of controlling the conditioning of air adjacent

fluted drafting rolls so as to increase the longevity or life of crimp imparted to the fibers by the fluted drafting rolls, which crimp increases the cohesion between adjacent fibers and which cohesion, in turn, serves to increase the elongation of individual fibers during the drafting thereof and thereby increase the average staple length of the fibers.

It is another object of this invention to provide a method of conditioning textile material being drafted which comprises passing successive portions of continuous textile strand material through a confined area while drafting the material through a series of drafting elements positioned within the confined area, and while introducing predetermined amounts of moisture into the confined area and onto the material being drafted to maintain substantially uniform the moisture absorbed by successive portions of the material.

It is another object of this invention to provide novel apparatus for carrying out my novel method which, in its preferred embodiment, comprises a conditioning channel or chamber with means for directing an air stream therethrough and thence into an enclosure within which are positioned drafting elements, such as drafting rolls, and textile material being drafted thereby, with means responsive to variation in the relative humidity of the air within the enclosure, relative to a predetermined range of relative humidity, for compensatively controlling the introduction of moisture into the air stream passing through the enclosure. Means is also provided for compensatively cooling the moisture or water before it is introduced into the air stream upon a detecting means in the enclosure detecting a predetermined maximum operating temperature, and means is provided for compensatively heating the air stream in its course to the enclosure upon a detecting means in the enclosure detecting a temperature therein below a predetermined minimum operating temperature.

It is a more specific object of this invention to provide apparatus of the character last described in which the means for introducing moisture into the air stream includes a filter or water screen through which the air stream passes with means for directing water to the filter and being controlled by hygrostatic means within the enclosure, and wherein the means for directing the air stream comprises blower means whose suction side draws air from points closely adjacent the drafting elements and the sliver being drafted, with the conditioned air stream entering the enclosure at another point or points spaced from the first-mentioned points, and wherein the air stream may be circulated in a closed pneumatic circuit or it may be drawn from and exhausted into the atmosphere externally of the enclosure and its pneumatic circuit.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which—

FIGURE 1 is a top plan view of a drawing frame showing a preferred embodiment of the enclosure for the drafting elements and associated driving mechanism for carrying out the method of the present invention, the enclosure being partially broken away for purposes of clarity;

FIGURE 2 is a front elevation of the drawing frame, which is partially broken away and in cross-section and being taken substantially along line **2—2** in FIGURE 1;

FIGURE 3 is a vertical sectional view taken substantially along line **3—3** in FIGURE 1 showing how air is directed through the enclosure for the drafting elements and their associated driving mechanism;

FIGURE 4 is an enlarged vertical sectional view taken longitudinally of the drawing frame, with respect to the path of travel of the sliver therethrough, substantially along line **4—4** in FIGURE 1, the hinged front and rear doors or covers of the enclosure being shown in closed position in solid lines and in open position in broken lines;

FIGURE 5 is an enlarged fragmentary vertical sectional view taken substantially along line **5—5** in FIGURE 2 showing a return air chamber formed in the head-end of the drawing frame and also showing a portion of the air impeller for circulating air through the pneumatic circuit;

FIGURE 6 is an enlarged fragmentary vertical sectional view taken substantially along line **6—6** in FIGURE 2 showing the novel air conditioning chamber through which the air passes in its course to the main enclosure and showing a portion of the main suction chamber thereabove;

FIGURE 7 is an enlarged detail of the door operating means for closing and opening the air inlet **143** shown in the lower left-hand portion of FIGURE 2;

FIGURE 8 is a fragmentary transverse vertical sectional view through the conditioning chamber taken substantially along line **8—8** in FIGURE 6;

FIGURE 9 is an enlarged detail of the door operating and latching means for opening and closing the passageway P and the air outlet **131** shown in the lower left-hand portion of FIGURE 2;

FIGURE 10 is a schematic diagram of an electrical circuit for controlling the apparatus of the present invention.

Referring more specifically to the drawings, the apparatus of the present invention is shown in association with a drawing frame or machine, the frame of which comprises spaced head-end and foot-end frame members **10** and **11** whose upper central portions are spanned by and connected to opposed ends of a substantially horizontally disposed main frame member or channel bar **12**. A medial portion of a main platform or spectacle plate **13** is suitably secured to the lower surface of main frame member **12**.

The drawing frame illustrated in the annexed drawings is of a type including two sections of drafting elements or roll sections which are generally designated at A, B in FIGURES 2, 3 and 4. Each section A, B, comprises a series of drafting elements embodied in a series of sets of top and bottom drafting rolls **16, 17**. In this instance, there are four sets of upper and lower drafting rolls **16, 17** shown in FIGURE 4 and, as is well known, the rearmost drafting rolls **16, 17** are driven at a given speed and the sets of drafting rolls forwardly thereof are driven at progressively increasing speeds for attenuating or drafting the corresponding groups of textile strand material or sliver.

The groups of strands being drafted by the respective roll sections A, B are indicated at *a, b* (FIGURES 1 and 4). In their course to the roll sections A, B, the groups of strands *a, b* pass over and in engagement with the usual sliver spoons **20** and over a shield plate **21** and, thence, through the corresponding drafting rolls **16, 17**. The composite strands of textile material being delivered from the front sets of drafting rolls **16, 17** associated with the respective roll sections A, B are indicated at *a', b'* in FIGURES 1 and 4.

The composite strands *a', b'* are condensed through respective trumpets **23, 24** and then pass through the usual calender rolls **25, 26** (FIGURE 4) and are thus directed through respective substantially enclosed coiler heads or tube gears, only one of which is shown in FIGURE 4 and which is indicated at **27**. The tube gear **27** is rotatably mounted in the usual opening provided in the spectacle **13**. The coiler tube gears **27** coil the composite strands *a', b'* into respective coiler cans **30, 31** (FIGURES 2 and 3) which rest upon conventional coiler turntables **32, 33**, positioned in eccentric relation to the corresponding tube gears **27**, and which rotate relative thereto, for coiling the composite strands *a', b'* into the coiler cans **30, 31** in a well-known manner.

The drafting rolls **16, 17** of the two roll sections A, B are journaled in bearing blocks **35** carried by roll stands **36**, there being three such roll stands **36** shown in FIGURE 1. It will be observed in FIGURE 4 that plate **21** is mounted on the rear portions of the roll stands **36**, and the front portions of roll stands **36** support suitable bear-

ings 37 in which opposite ends of the calender rolls 25, 26 are suitably journaled.

The drafting rolls 16, 17, calender rolls 25, 26, tube gears 27 and turntables 32, 33 are driven in a well-known manner, such as by means of an electric motor 40 (FIGURES 1 and 3) suitably secured to the upper surface of spectacle plate 13. Electric motor 40 has a pulley 41 mounted on the drive shaft thereof, which pulley is engaged by an endless belt 42. Endless belt 42 also engages a pulley 43 fixed on a main drive shaft 44. The main drive shaft 44 drives a train of gears generally designated at 45, which, in turn, transmit rotation to the drafting rolls 16, 17 and to calender rolls 25, 26. Since the manner in which the gears in gear train 45 may be arranged for driving the drafting rolls 16, 17 and calender rolls 25, 26 is well known in the art, a detailed description thereof is deemed unnecessary. The driving connections between the gear train 45 and the coiler tube gears 27 and the turntables 32, 33 are also well known and, therefore, a description and illustration thereof is deemed unnecessary.

The drawing frame heretofore described is of typical conventional construction and the apparatus for carrying out the method of the present invention is shown in association therewith by way of illustration only, since there are many different types of drafting machines, such as roving frames, spinning frames and the like, with which the present apparatus may be used without departing from the spirit of the invention. Further, although the present apparatus is particularly devised for the use with series of drafting rolls, it is to be understood that the present apparatus may also be applied to other types of drafting mechanisms, such as gill boxes and Pin Drafters which draft textile fibers by means of series of fallers in the form of moving bars having cooperating needles thereon.

As heretofore stated, the method of the present invention is concerned with the conditioning of textile material, such as sliver, being drafted through the drafting elements or drafting rolls 16, 17 while maintaining the drafting elements and the means for driving the same within a given range of operating temperatures, both at the instant that the machine is started and during subsequent very high speed operation thereof and also while maintaining uniform the amounts of moisture in the successive portions of material being drafted.

Accordingly, the drafting elements or drafting rolls 16, 17, the bearing blocks 35 for the drafting rolls 16, 17, the motor 40, the train of gears 45 which transmit rotation from the motor 40 to the drafting rolls 16, 17 and calender rolls 25, 26, the trumpets 23, 24 and the calender rolls 25, 26 all are confined within a common substantially air-tight main enclosure or housing broadly designated at 50. The spectacle plate 13 serves as the bottom wall of the enclosure 50 and has a substantially rectangular frame 51 suitably secured to the upper surface thereof for supporting thereon spaced enclosure side walls 52, 53 (FIGURES 2 and 3) and a rear wall 54 (FIGURE 4).

It is apparent by referring to FIGURES 1, 2, 3 and 4 that the medial lower portions of side walls 52, 53 are suitably recessed to fit over corresponding portions of the main substantially horizontally disposed frame member 12. A suitable sealing element or cushion strip 56 may be adhesively or otherwise secured to the upper surface of the substantially rectangular frame 51 to prevent air from passing between the lower edges of the walls of the housing 50 and the upper edge of the rectangular frame 51. Suitably secured to and spanning the distance between the upper edges of side walls 52, 53 of housing 50 is a relatively narrow top wall 60, which is curved so its opposed front and rear portions extend downwardly in diverging relationship. The top wall of a front cover 61 is hingedly or pivotally connected to the front edge portion of top wall 60, as at 64. The top wall of front cover 61 extends downwardly and forwardly at an angle and has a front wall 65 formed integral therewith which, when in closed position, serves as the front wall of the housing 50. The opposed side edges of cover 61 and its front wall portion 65 are provided with side wall portions or flanges 66 thereon which are adapted to fit in suitable recesses 67 (FIGURE 4) formed in the side walls 52, 53 of housing 50 when the front cover 61 occupies closed position. It will be noted that the lower edge of the front wall portion 65 of cover 61, as well as the lowermost edge portion of each flange 66 adjacent front wall 65, rest upon sealing strip 56 (FIGURE 4).

The rear portion of top wall 60 extends rearwardly and downwardly at an angle and then curves downwardly and is connected to or formed integral with rear wall 54. The rear portion of top wall 60 is also provided with a pair of substantially rectangular openings 70 therethrough, there being one of the openings corresponding to each group of strands of sliver *a*, *b* (FIGURE 1). Each opening 70 is adapted to receive a rear cover or access door 71 therein, which rear cover is preferably of substantially the same configuration as the rear portion of top wall 60 and the upper portion of rear wall 54. However, it will be noted that the rear lower end of each cover 71 (FIGURE 4) terminates in spaced relation above the upper edge of the portion of rear wall 54 defining the bottom of each opening 70, thus providing a slot 72 in the rear wall of housing 50 through which the corresponding group of strands *a*, *b* may pass in their course from a suitable source of supply, not shown, into the housing 50 and to the drafting rolls 16, 17. Only one of the slots 72 is shown in FIGURE 4.

In order to assist in guiding the strands *a*, *b* into housing 50, a pair of outwardly and oppositely curved upper and lower strand guide plates 73, 74 (FIGURES 1 and 4) straddles each slot 72. Each lower guide plate 74 is suitably secured to and extends rearwardly from the rear wall 54 of housing 50 and each upper guide plate 73 is suitably secured to the lower or free edge portion of cover 71 and extends outwardly or rearwardly therefrom when cover 71 occupies the closed position shown in solid lines in FIGURE 4.

It is apparent that covers 61, 71 are provided to permit free access to the drafting rolls and other elements within housing 50 without removing housing 50 from the drawing frame. Accordingly, each side wall or flange 66 of front cover 61 may be provided with an arcuate guide arm or slide 75 (FIGURE 4) movable through a guide block 76 fixed to the inner surface of the corresponding side wall 52 or 53. In order to lock front cover 61 in the desired raised or open position, a hand screw 77 may be threaded through the guide block 76 and may be manually tightened against the corresponding guide arm or slide 75 for locking front cover 61 in the desired raised position.

A front upper edge portion of each rear cover 71 is hingedly or otherwise pivotally connected to the front wall of the corresponding opening 70, as at 78. When rear covers occupy the closed position shown in solid lines in FIGURE 4, and as shown in FIGURE 1, each cover 71 rests upon a pair of stop members 80 suitably secured to the lower surface of corresponding portions of top wall 60 and projecting into the vertical plane of the corresponding opening 70. The top wall 60 has a pair of upwardly and rearwardly projecting stop brackets or abutments 81 suitably secured thereto or formed integral therewith (FIGURES 1 and 4) against which covers 71 may rest while occupying the open position shown in broken lines in FIGURE 4.

In order to permit freedom of movement of the sliver or other textile strand material through the slots 72 and into housing 50 while minimizing the leakage of air through slots 72 (FIGURE 4), the lower or free edge portion of each rear cover 71 has a lightweight flexible sealing strip 83 suitably secured to the inner surface thereof and normally projecting beyond the free end thereof. Sealing strip 83 may be made from a light

impervious material such as cloth, plastic or the like so that it is readily curved in the direction of travel of the textile material as it passes through the corresponding slot **72**, as shown in the left-hand portion of FIGURE 4.

Although housing **50** may be secured to the substantially rectangular frame **51**, it is necessarily relatively heavy and, therefore it preferably merely rests upon the sealing strip **56** on the rectangular frame **51** so that, when major repairs or changes are to be made to structure within housing **50**, the entire housing may then be lifted off sealing strip **56** and removed from the machine. It is thus seen that, with housing **50** positioned on rectangular frame **51** and, when the doors or covers **61, 71** thereof occupy the closed position shown in solid lines in FIGURE 4, the drafting elements and calender rolls (which also have a drafting function and may be considered as part of the drafting elements), the bearing blocks **35**, the motor **40**, the gear train **45** and intervening connections between the motor **40** and gear train **45** all are disposed within a confined area. The enclosure **50** and its doors **61, 71** are preferably made from transparent or translucent material to minimize the weight thereof and to permit inspection of the confined area without opening covers **61, 71**.

In order to direct moisture into enclosure **50** against the material being drafted, and to also maintain the material, the drafting rolls **16, 17** and all other elements within enclosure **50** at an optimum operating temperature, means is provided for directing a stream or mass of conditioned air in a given or predetermined path of travel into and through enclosure **50**. In this instance, since it is desirable that the conditioned air is directed in close proximity to the sliver being drafted, I have found it convenient to utilize a suction cleaning apparatus, in association with the drafting rolls **16, 17**, of a type such as is disclosed in my U.S. Patent No. 2,934,797. Although it will be apparent as the description proceeds that other types of suction nozzles may be positioned in close proximity to the drafting rolls and/or the textile material being drafted for causing the air to move past and against the drafting elements and the material being drafted, without departing from the spirit of the present invention.

Since the nozzles of the suction clearer system and other related elements thereof are fully disclosed in said U.S. Patent No. 2,934,797, only so much of the suction clearer system will be described herein as is deemed necessary to a clear understanding of the present invention. Accordingly, in order to exhaust air from enclosure **50** as it is directed into the enclosure by means to be later described, upper and lower elongate suction nozzles **86, 87** are disposed in close proximity to and extend longitudinally of each respective upper and lower drafting rolls **16, 17** of each of roll section A, B.

The nozzles **86, 87** are suitably supported so that the opposed side walls thereof are positioned in close proximity to the corresponding top and bottom rolls **16** and **17**, but so that they are spaced sufficiently from the corresponding top and bottom rolls **16, 17** to permit air to flow between the front and rear walls of the nozzles **86, 87** and the drafting rolls **16, 17** and thus into the nozzles **86, 87**. The nozzles **86, 87** may be supported in any desired manner, such as by resting against bearing blocks **35** and roll stands **36**, or opposed ends of the nozzles **86, 87** may rest against the necks of the drafting rolls **16, 17** in the manner disclosed in said patent and as shown in FIGURES 2 and 3 of the annexed drawings.

The medial portions of nozzles **86, 87**, remote from the respective top and bottom rolls **16, 17**, have respective flexible conduits **90, 91** communicatively connected thereto (FIGURES 3 and 4) which extend laterally with respect to the path of travel of the strand material or web formed therefrom. A pair of inner manifold pipes **92, 92'** are spaced above proximal portions of the upper elongate nozzles **86** of the two roll sections A, B (FIGURES 1, 2 and 3) and have corresponding ends of alternate flexible conduits **90** associated with the respective roll sections A, B connected thereto. The distal or outer portions of elongate nozzles **86** associated with roll sections A, B also have corresponding manifold pipes **93, 93'** spaced thereabove to which the outer ends of the remaining or intervening flexible conduits **90** are suitably connected.

Forwardly and rearwardly extending pipes or manifolds **94, 94', 95, 95'** are also spaced below the lower elongate nozzles **87** in substantially vertical alinement with the respective pipes **92, 92', 93, 93'** and have the lower flexible conduits **91** connected thereto; that is, alternate flexible conduits **91** associated with roll sections A, B extend inwardly and are connected to the corresponding pipes **94, 94'** and intervening flexible conduits **91** associated with roll sections A, B extend outwardly and are communicatively connected to the corresponding pipes **95, 95'**. Pipes **93, 95, 92, 94, 92', 94', 93', 95'** extend rearwardly and are pivotally and communicatively connected to respective substantially upright pipes or conduits **100, 101, 103**, all three of which extend downwardly and are communicatively connected to a common main suction tube or manifold pipe **105** (FIGURE 3). The free ends of pipes **92, 93** and **92', 93'** are interconnected by respective bars *c, c'* (FIGURE 2) to facilitate swinging upwardly the latter pipes and the suction nozzles **86** as desired.

It will be observed in FIGURES 1 and 3 that one end of main suction tube **105** is closed, as at **106**, and the other end of main suction tube **105** extends through wall **52** of housing **50**, in sealing engagement therewith, (FIGURES 1, 2 and 3) and then extends downwardly and is communicatively connected to the inlet of a main suction chamber **107** (FIGURE 2) defined between an inner wall **110** and a substantially vertical intermediate wall or partition **111** of the head-end frame member **10**. The tube **105**, nozzles **86, 87** and intervening elements through which air flows serve collectively and individually as "conduit means" or "communicative means." The head-end frame member **10** also includes an outer substantially vertical wall **112** which is spaced outwardly from partition **111**, thus forming a return air chamber **115** in head-end frame member **10** (FIGURE 2).

A blower comprising a rotary fan or air impeller **116** is positioned within return air chamber **115** and discharges air into the same as it draws air through an opening **117** (FIGURE 5) formed in partition **111**. Impeller **116** is fixed on the shaft **120** of an electric motor **121**. Electric motor **121** is positioned within suction chamber **107** (FIGURE 2) and has a plurality of circularly spaced motor support brackets **122** fixed thereto which extend outwardly and radially from the housing of motor **121** and are suitably secured to partition **111**.

Since suction chamber **107** serves as a collection chamber for receiving lint and any other light material sucked into suction nozzles **86, 87** by impeller **116**, the opening **117** (FIGURE 5) in partition **111** is covered by a substantially frusto-conical filter or screen **124** (FIGURE 2) positioned within chamber **107**, suitably secured to partition **111**, and enclosing electric motor **121**. Further, an access door **125** is suitably secured to the inner wall **110** and normally closes an opening formed in said wall **110** which is sufficiently large to facilitate removal of lint and the like from within suction chamber **107** and to facilitate installation of and removal of filter **124** and electric motor **121**. As shown in FIGURES 5 and 6, head-end frame member **10** is closed at its upper end and is provided with front and rear walls **126, 127** defining the chambers **107, 115** therebetween. It is apparent that either of the front and rear walls **126, 127**

may be provided with a suitable access door, not shown, to facilitate removal of collected lint and the like from within suction chamber **107** without removing door **125** from frame member **10**.

The head-end frame member **10** is provided with a bottom wall **130** (FIGURES 2, 5 and 6) which extends between inner wall **110**, partition **111** and front and rear walls **126**, **127**, thus defining an air discharge opening, outlet or slot **131** at the bottom of return air chamber **115** (FIGURES 2 and 8). In order that the air discharged through outlet **131** may pass into the room beneath the walls of head-end frame member **10**, the head-end frame member **10** is supported in spaced relation above the floor, on which the drawing frame rests, by suitable legs **132**, **133**.

A substantially horizontally disposed partition **135** is spaced a substantial distance above bottom wall **130** (FIGURES 2, 5, 6 and 8), below filter **124**, and extends between and is suitably secured to inner wall **110**, vertical partition **111** and front and rear walls **126**, **127** of head-end frame member **10**. Partition **135**, bottom wall **130**, the lower portion of rear wall **127**, and the lower portions of partition **111** and inner wall **110** define an air conditioning chamber **136** which is thus in the form of a substantially rectangular duct or conduit. A vertical partition **140**, having a removable filter **141** in its upper portion (FIGURE 6), extends between walls **110**, **130**, and partitions **111**, **135**, thus separating air conditioning chamber **136** from an air ingress chamber **142**.

The bottom wall **130** of head-end frame member **10** is provided with an air inlet **143** communicating with air ingress chamber **142**. The air inlet **143** and outlet **131** are adapted to be closed by respective doors **144**, **145** during closed pneumatic-circuit operation of the apparatus. The lower edges of doors **144**, **145** are hingedly or pivotally connected to the inner wall **110** and vertical partition **111**, respectively, as at **146**, **147**. Since air return chamber **115** extends throughout the width of head-end frame member **10**, between the front and rear walls **126**, **127** thereof, it will be observed in respective FIGURES 5 and 6 that door **145** is substantially longer than door **144**.

Any suitable means may be provided for opening and closing door **144** and for moving door **145** toward and away from partition **111**. By way of example, it will be observed in FIGURE 7 that door **144** has a loop member **150** suitably secured thereto which is adapted to fit in a slot **151** provided in wall **110** when door **144** occupies open position. A handlebar **152**, having a knob or enlarged portion **153** on its free end, is pivotally mounted on loop **150**. Since handlebar **152** may be suspended from loop **150** when door **144** occupies open position, it is apparent that handlebar **152** then maintains door **144** in the open position. On the other hand, it is merely necessary to raise handlebar **152** and push the same inwardly relative to wall **110** of head-end frame member **10** to move door **144** to closed position against bottom wall **130** and overlying inlet **143**.

It will be observed in FIGURE 9 that the upper portion of door **145** also has a loop member **155** fixed thereto to which a handlebar **156** is pivotally connected. Handlebar **156** loosely extends through a slot **157** provided in outer wall **112** of head-end frame member **10** and has a pair of notches **160**, **161** in the lower portion thereof adapted to engage the bottom of slot **157** for locking door **145** in respective outward and inward positions with respect to partition **111**. Since the upper edge of door **145** must be positioned against or in close proximity to the inner surface of outer wall **112** of head-end frame member **10** when the air from impeller **116** is not to be discharged through the air outlet **131** (FIGURES 2 and 8), slot **157** should be formed so as to receive loop member **155** therein when door **145** occupies outward position against wall **112**. When door **145** occupies the latter position, it opens a passageway or opening P formed in partition **111** and thus establishes communication between chambers **115**, **142**.

In order to direct conditioned air into main enclosure **50** and, thus, onto the various elements disposed within enclosure **50**, the lower end of a duct or pipe **165** is connected to inner wall **110** of head-end frame member **10** for communication with the upper portion of conditioning chamber **136** (FIGURES 2, 3 and 6). Duct **165** extends upwardly and rearwardly from chamber **136** and through spectacle plate **13** (FIGURE 3) where it is communicatively connected to a plurality of substantially horizontally disposed channels or ducts, there being three such channels shown in FIGURE 3 and indicated at *d*, *e* and *f*. Channel *d* is provided with a discharge outlet *d'* adjacent side wall **52**, and channel *e* is provided with a pair of air discharge outlets *m*, *n* disposed rearwardly of, below and in substantially longitudinal alinement with the respective roll sections A, B. The free end of channel *f*, adjacent side wall **53** of enclosure **50**, and adjacent electric motor **40**, is provided with a discharge outlet *q*. Channels *d*, *e*, *f* may be formed in a common pipe with suitable partitions therein as shown in FIGURE 3 and may be provided with additional outlets therein, as may be desired. The duct **165**, chambers **142**, **145** and channels *d*, *e*, *f* may be collectively termed as "conduit means" or "communicative means."

From the foregoing description it is apparent that, when the doors **144**, **145** occupy the raised positions shown in FIGURE 2, for example, and while impeller **116** is rotating, impeller **116** draws air into the air inlet **143** in bottom wall **130** of head-end frame member **10**. In so doing, air enters ingress chamber **142**, passes through filter **141** (FIGURE 6), through conditioning chamber **136**, through duct **165**, through channels *d*, *e*, *f* and then passes through air discharge outlets *d'*, *m*, *n*, *q* (see FIGURE 1) and into enclosure **50**.

The air in enclosure **50** is drawn past the textile material being drafted and past the drafting rolls **16**, **17**, through suction nozzles **86**, **87**. The air and any lint or other light material picked up by suction nozzles **86**, **87** is drawn through flexible conduits **90**, **91** through pipes **92**, **92'**, **93**, **93'**, **100**, **101**, **103** and thence through the main suction pipe **105** into suction chamber **107**. The air then passes through filter **124**, thus separating the lint therefrom, and is drawn through opening **117** (FIGURE 5) and into return air chamber **115** by impeller **116**. Since discharge outlet **131**, in the bottom of head-end frame member **10**, is then open, air is exhausted from chamber **115** into the room.

When doors **144**, **145** are so positioned as to close air inlet **143** and air discharge outlet **131**, it is apparent that the air drawn into return air chamber **115** is then directed into air ingress chamber **142** and passes through filter **141** into conditioning chamber **136**, so that room air; i.e., air externally of the housing **50** and the pneumatic circuit heretofore described, does not enter the pneumatic circuit nor is air discharged from the pneumatic circuit. In other words, the pneumatic circuit is then closed to outside air.

In order to condition the air as it flows through conditioning chamber **136** and before it enters the enclosure **50**, the lower portion of the conditioning chamber **136** serves as a reservoir and contains a supply of water W (FIGURE 6) or other suitable liquid therein which is directed into conditioning chamber **136** and maintained at the desired level therein by means of a float valve **170** (FIGURE 6). Float valve **170** may be suitably mounted on rear wall **127** of head-end frame member **10**, and the inlet side thereof is connected to a suitable source of water or other suitable liquid, not shown, by means of a conduit or pipe **171**. Float valve **170** may be of any desired or conventional construction and a detailed description thereof is thus deemed unnecessary.

The housing of float valve **170** has a float lever **172** pivotally mounted thereon, on the free end of which a suitable buoyant float member **173** is mounted. When the

level of the water W in conditioning chamber **136** drops below the desired level, it is apparent that valve lever **172** releases a valve plunger **174** to admit additional water into chamber **136** until float **173** is raised so that lever **172** depresses plunger **174** and closes valve **170**.

Chamber **136** has a pair of spaced filters or screens **176, 177** suspended therein (FIGURES 6 and 8) whose lower portions extend into the water W in the lower portion of chamber **136** so that air entering chamber **136** through filter **141** must pass through filters **176, 177** in its course to duct **165** and housing **50**. In this instance, filters **176, 177** are suitably secured to and suspended from respective pipes **180, 181** which are perforated along their lower portions as at *g*, and are suitably secured, as by welding, to the lower surface of a support plate or cover **183**.

Support plate **183** fits in a corresponding opening provided in horizontal partition **135** and rests upon suitable support bars *h* fixed to the lower surface of partition **135**. Suitable handles **184** may be provided on support plate **183** for lifting pipes **180, 181**, filters **176, 177**, an electrically operable pump **185** and its motor **186** out of chamber **136**, as may be desired for repairing or cleaning the same.

The pump **185** and motor **186** may be mounted in a common housing. The housing for pump **185** and motor **186** has a rigid pipe or conduit **187** extending therefrom and being suitably connected to support plate **183**. Wires or conductors **190, 191**, extend through pipe **187** to electric motor **186**. The outlet side of pump **185** has a conduit *j* extending upwardly therefrom which is connected to a medial portion of a branch conduit **193** whose opposed ends are communicatively connected to pipes **180, 181**.

It is apparent that, whenever pump **185** is operating, it pumps liquid from the lower portion of chamber **136** into pipes **180, 181**, and the liquid in the pipes **180, 181** flows through the perforations *g* onto the respective screens **176, 177**, thus forming a thin sheet of liquid (water screen) for introducing moisture to the air stream passing therethrough in its course to enclosure **50**. Thus, the amount of water or other liquid directed to screens **176, 177** by pump **185** determines the relative humidity of the air flowing into housing **50** and thereby determines the amount of moisture which will be maintained in successive portions of the continuous textile material being drafted through drafting rolls **16, 17**.

Since the relative humidity of air in enclosure **50** determines the amount of moisture which will be maintained in the material being drafted, and it is desirable to maintain a relative humidity in a range of approximately 50 to 65 percent in order to maintain the desired amount of moisture in the material being drafted, the electric motor **186** for pump **185** is controlled by a suitable hygrostat or humidistat positioned within enclosure **50**. In this instance, hygrostat **195** is suitably secured on the main horizontal frame member **12** beneath roll section A and is preferably positioned adjacent the centermost of the three roll stands **36**. However, it is apparent that hygrostat **195** may be positioned at various other points within the enclosure **50**, as may be desired.

Hygrostat **195** may be of a conventional type which will close a switch *s* (FIGURE 10), whenever the relative humidity of air within enclosure **50** is lower than that desired, and which will open the switch *s* when the relative humidity of air in the enclosure **50** rises above a predetermined maximum. Since may different types of switch-operating hygrostats or relative humidity measuring instruments of well-known construction may be used for the intended purpose, a detailed illustration and description of hygrostat **195** is deemed unnecessary. The hygrostat may be similar to the type disclosed in U.S. Patent No. 2,602,589, dated July 8, 1952, for example, and the range of relative humidity which is to be maintained between successive opening and closing cycles of the hygrostatically operated switch *s* may be determined by a suitable control knob **197** mounted on the housing of hygrostat **195** (FIGURE 4) and being operatively connected to the usual control elements of the hygrostat **195**.

The switch *s* of hygrostat **195** is interposed in an electrical circuit to the motor **186** which drives pump **185** so that, when switch *s* is closed, pump **185** directs liquid from the lower portion of conditioning chamber **136** (FIGURE 6) into pipes **180, 181**. The liquid then is discharged from pipes **180, 181** through the perforations *g* and flows over screens **176, 177** and back into the lower portion of chamber **136**. Thus, the air passing through screens **176, 177** picks up moisture therefrom to raise the relative humidity to the desired range as air flows through enclosure **50** to thus open switch *s* and stop operation of pump **185** until switch *s* is again moved to closed position.

The desired range of relative humidity of air in the enclosure **50** (approximately 40 to 90 percent, depending upon the speed of the fibers through the drafting rolls **16, 17**) should be maintained while the temperature of the air in the enclosure **50** is within a range of from 60° to 90° F. For example, in the drafting of cotton sliver, the cotton fibers respond to the drafting operation most effectively when the air in the area of the drafting elements is maintained at a temperature of approximately 75° F. and at a relative humidity of approximately 55 percent. On the other hand, in the drafting of certain synthetic staple slivers, such as Dacron, the fibers respond to the drafting elements most effectively when the air in the immediate area of the drafting elements is maintained at a temperature of approximately 90° F. and at a relative humidity of approximately 60 percent.

Heretofore, to my knowledge, the air adjacent the drafting rolls has not been maintained in substantially constant condition or within the desired ranges of temperature or relative humidity. This has resulted in limiting the longevity or life of the crimp imparted to the textile fibers being drafted by fluted drafting rolls. The maintenance of this crimp in the textile fibers while they are passing through the drafting rolls is very important, since lack of crimp results in reducing the extent to which the individual fibers may be elongated.

This phenomenon of elongation of individual fibers is, in large part, determined by the drag effected on the trailing ends of forwardly moving individual fibers. This drag takes place between adjacent sets of drafting rolls and is caused by the cohesion of those fibers surrounding or adjacent the trailing ends of individual fibers, as explained more in detail in U.S. Patent No. 2,935,435, granted to Marcus G. Whitehurst and myself on May 3, 1960.

It has been determined that the cohesion of adjacent fibers relative to the trailing ends of individual fibers is substantially increased if the crimp imparted to the fibers by the previous drafting rolls is still present to an appreciable degree. Thus, it is evident that this maintenance of ideal conditions of the air adjacent the drafting rolls is very important for effecting extensive elongation of the individual fibers and thereby increasing the average staple length of the fibers in the material leaving the drafting elements as compared to the fibers in the material before it is drafted.

It follows, therefore, that the drafting elements or drafting rolls **16, 17** and the portions of textile material within the enclosure **50** should be brought up to a predetermined minimum temperature and the air in the enclosure **50** should also be brought up to a predetermined minimum relative humidity whenever the drawing frame has been shut off for such a period of time that the temperature and relative humidity of the air in enclosure **50** have dropped below the prescribed minimums before the drawing frame and its drafting elements were again started. Accordingly, in addition to moisture to air in its course to enclosure **50**, means also

are provided, in the form of an electric heater **200**, for heating the air in its course to enclosure **50**.

To this end, electric heater **200** is suitably mounted within a medial portion of duct **165** so that all the air passing through chamber **136** may move past and be heated by electric heater **200** whenever the air within enclosure **50** is below the desired minimum temperature. Energization of electric heater **200** may be controlled by a suitable thermostatic switch T (FIGURES 4 and 10) positioned within enclosure **50** adjacent hygrostat **195**, and being interposed in an electrical circuit to heater **200** in a manner to be later described. Thermostatic switch T may be of a well-known type which is adjustable so as to close the circuit to electric heater **200** whenever the temperature of the air in enclosure **50** is below the predetermined minimum of approximately 65° F., for example, and which will open and break the circuit to the electric heater **200** whenever the air in enclosure **50** is above the predetermined minimum, for example.

As heretofore stated, it is also an important object of this invention to provide means for maintaining the temperature of the air in the enclosure **50** at or below a predetermined maximum temperature regardless of the amount of heat generated by the drafting elements or drafting rolls **16**, **17**, the sliver being drafted thereby and other adjacent operating elements of the machine so that the textile material *a'*, *b'* may pass from the delivery rolls; i.e., the front sets of rolls **16**, **17**, or from the sections of drafting elements A, B at speeds which have heretofore been unattainable, to my knowledge, primarily because of the heat generated by the drafting elements and the material being drafted thereby. For example, by maintaining the temperature of the air in enclosure **50** within prescribed limits while drafting textile sliver, continuous high speed production of up to 1,000 feet of sliver per minute, or more, may be obtained from each of the sections of drafting elements A, B.

In the present embodiment of the apparatus, in order to maintain the temperature in the enclosure **50** at or below a predetermined maximum, thermostatically controlled means are provided for cooling the water in the lower portion of conditioning chamber **136** so that air passing through screens **176**, **177** may pick up a relatively cool moisture which, in turn, lowers the temperature of the air in its course to enclosure **50**. If so desired, pipe **171** connected to valve **170** may extend from a conventional type of water cooler which will cool the water before it passes through valve **170** into conditioning chamber **136** in response to the detection of a temperature above the desired temperature by a thermostatic switch T' positioned adjacent thermostatic switch T within housing enclosure **50**.

In the present and preferred embodiment, however, the temperature of the water in the lower portion of conditioning chamber **136** is maintained below a predetermined maximum temperature by means of a cooling coil or refrigerating coil **203** (FIGURE 6) positioned in the lower portion of air conditioning chamber **136**. A refrigerating unit **204** is positioned externally of head-end frame member **10** and may be suitably secured to the rear wall **127** thereof. Coil **203** may contain the usual refrigerant, such as freon, and one end of cooling coil **203** is connected to a heat exchanger or evaporator coil **205** (FIGURE 10). The other end of coil **203** is connected to a compressor **207**. Compressor **207** has a conduit **208** extending therefrom to the end of evaporator coil **205** opposite from that end to which cooling coil **203** is connected (FIGURE 10). Refrigerating unit **204** also includes an electric motor **21** which drives compressor **207** and which drives also a fan **212** for directing air through evaporator coil **205**.

Thermostatic switch T' may also be of conventional or other construction with suitable control means thereon, not shown, for closing a circuit to electric motor **211** of refrigerating unit **204** whenever the temperature of air in enclosure **50** is above the prescribed maximum temperature of, say, 90° F., and which will open the circuit to electric motor **211** whenever the temperature of air in enclosure **50** is below the prescribed maximum temperature.

Electrical circuit

Referring to FIGURE 10, the numerals **220**, **221** designate lead conductorst adapted to be connected, through a master switch **225**, to a suitable source of electrical energy embodied in a plug **222**. The lead conductor **220** has conductors **191**, **223**, **224**, **226**, connected thereto, and lead conductor **221** has conductors **230**, **231** connected thereto. Conductor **230** leads from conductor **221** to one side of the main drive electric motor **40**. The other side of motor **40** has a conductor **233** leading therefrom to one side of a normally open switch **234** of a relay **235**. The other side of switch **234** has a conductor **236** leading therefrom to one side of a manually operable switch **237**, from the other side of which conductor **223** leads to lead conductor **220**.

The coil of relay **235** has conductors **240**, **241** connected to opposite ends thereof. Conductors **224**, **240** are connected to opposite sides of a manually operable switch **242**. The end of conductor **241** opposite from the coil of relay **235** is connected to one side of fan motor **121**. The other side of motor **121** has a conductor **243** leading therefrom to a medial portion of conductor **230**.

The end of conductor **190** remote from motor **186** is connected to one side of the switch *s* of hygrostat **195**. The other side of switch *s* has a conductor **244** leading therefrom to one side of a manually operable switch **245**. The other side of switch **245** is connected to conductor **231**. The electric heater **200** has corresponding ends of conductors **250**, **251** connected to opposite sides thereof, and the other ends of conductors **250**, **251** are connected to conductor **191** and to one side of thermostatic switch T, respectively. The other side of thermostatic switch T has a conductor **252** leading therefrom to the conductor **231**. Conductor **252** has a suitably manually operable switch **253** interposed therein.

The end of conductor **226** opposite from lead conductor **220** is connected to one side of thermostatic switch T' and the other side of switch T' has one end of a conductor **255** connected thereto. The end of conductor **255** opposite from thermostatic switch T' is connected to one side of electric motor **211**. Motor **211** has a conductor **256** extending therefrom to conductor **231**. A suitably manually operable switch **257** is interposed in conductor **256**.

It will be noted that the electrical circuit heretofore described is so arranged that the main drive electric motor **40** cannot be started until the blower or impeller **116** is rotating and circulating air through the enclosure **50**, since the closing of switch **242** energizes the motor **121** for driving fan **116** and energizes the coil of relay **235** to close switch **234** so that manually operable switch **237** may then become effective, when closed, for energizing the main drive electric motor **40**. The switches **245**, **253**, **257** are provided as a convenience to manually stop the flow of electrical energy to the pump motor **186**, the heater **200** and the compressor motor **211**, respectively, if desired. However, during normal operation of the drawing frame, all three switches **245**, **253**, **257** would occupy closed position.

It is apparent that, whenever the relative humidity of the air in the enclosure **50** is below the predetermined minimum and the manually operable switch **245** is closed, the switch *s* of hygrostat **195** closes and completes the circuit to electric motor **186** for driving pump **185** and thus causing water to flow over the screens **176**, **177** (FIGURE 6) to add moisture to the air flowing into conditioning chamber **136** until such time as the relative hu-

midity of air in enclosure **50** is raised to the desired minimum level. It is also apparent that, whenever the temperature of the air in enclosure **50** is below the desired minimum temperature, thermostatic switch T closes the circuit to heater **200** so air passing through conditioning chamber **136** and duct **165** is heated until it reaches the desired minimum temperature within enclosure **50**, whereupon thermostatic switch T is opened.

Of course, as heretofore stated, whenever the temperature of the air in enclosure **50** exceeds a predetermined maximum temperature, thermostatic switch T' is closed and completes the circuit to electric motor **211** to drive compressor **207** and thereby cool the water in the reservoir formed in the lower portion of conditioning chamber **136**. Upon the temperature of air flowing through enclosure **50** being cooled to the desired extent by the cooled water flowing over screens **176, 177**, thermostatic switch T' then opens and breaks the circuit to compressor motor **211**.

It is thus seen that I have provided an improved method of and means for maintaining the air in the immediate vicinity of the drafting elements, the material being drafted, the bearings for the drafting elements, the drive motor for the drafting elements and the intervening gears within a predetermined range of relative humidity and/or within a predetermined range of temperature, regardless of the rate at which the attenuated textile material is being produced by the drafting elements, thus permitting efficient high speed operation of the drafting elements. Since the relative humidity of the air adjacent to the material being drafted is maintained within predetermined limits, the elongation of the fibers effected by the drafting elements may be accurately controlled to an extent heretofore unattainable, to my knowledge and, although motor **40**, gear train **45**, drafting rolls **16, 17** and calender rolls **25, 26** may be operating at extremely high speeds, all of them are maintained at an efficient operating temperature because of the air surrounding the same being maintained at or below a predetermined maximum temperature, thus not only facilitating the operation of the drawing frame at such extremely high speeds, but also prolonging the useful life of these elements.

The terminology "conditioning the air" as used herein and in the annexed claims includes varying the temperature, moisture content, and/or relative humidity characteristics of the air acting upon the strand material and through which the strand material being drafted passes. Similarly, the terminology of sensing the "condition of the air" includes the sensing of any one or all of the aforementioned characteristics of the air.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

I claim:

1. A method of conditioning fibrous textile strand material being drafted which comprises

(a) passing successive portions of the strand material through a closed pneumatic circuit including a confined area while drafting the strand material by passing the same through a series of drafting elements within the confined area,

(b) while circulating an air stream in said closed circuit, and causing the air stream to flow past and against the drafting elements therein and the strand material being drafted, while sensing the condition of the circulating air stream as it passes through the confined area, and

(c) compensatively conditioning the circulating air stream in response to the sensing of variances in the condition thereof from a predetermined condition.

2. The method of claim **1**, in which the condition of the air being sensed is the moisture content thereof, and the conditioning of the air stream includes introducing moisture thereinto in response to the sensing of less than a predetermined moisture content in the air within the confined area.

3. The method of claim **1**, in which the condition of the air being sensed is the temperature thereof, and the conditioning of the air stream includes heating the same in response to the sensing of lower than a predetermined minimum temperature of the air within the confined area.

4. The method of claim **1**, in which the condition of the air being sensed is the temperature thereof, and the conditioning of the air stream includes cooling the air stream in response to the sensing of higher than a predetermined maximum temperature of the air within the confined area.

5. A method according to claim **1**, in which the strand material being conditioned while being drafted is in sliver form.

6. A method of processing textile strand material to increase the average staple length thereof which comprises

(a) passing successive portions of a continuous length of textile fibrous material through a confined area while

(b) drafting and crimping the fibrous material by passing the same through a series of spaced sets of fluted drafting rolls positioned within the confined area while

(c) sensing the temperature and relative humidity of air within the confined area,

(d) compensatively varying the temperature and relative humidity of air within the confined area in response to the sensing of temperature and relative humidity in the confined area outside of predetermined ranges of temperature and relative humidity for maintaining the life of the crimp in the textile material being drafted as it passes between adjacent sets of drafting rolls, and while

(e) elongating individual fibers being drafted while utilizing the crimp maintained in the fibers for increasing the cohesion between adjacent fibers to increase the extent of elongation of the individual fibers to thereby increase the average staple length of the textile material being processed.

7. A method of processing textile strand material to increase the average staple length thereof which comprises

(a) passing successive portions of a continuous length of textile fibrous material through a confined area while

(b) drafting and crimping the fibrous material by passing the same through a series of spaced sets of fluted drafting rolls positioned within the confined area and while

(c) sensing the temperature and relative humidity of air within the confined area,

(d) compensatively varying the temperature and relative humidity of air within the confined area in response to the sensing of temperature and relative humidity in the confined area outside of a temperature range of about 60° to 90° Fahrenheit and outside of a relative humidity range of about 40% to 90% for maintaining the life of the crimp in the textile material being drafted as it passes between adjacent sets of drafting rolls, and while

(e) elongating individual fibers being drafted while utilizing the crimp maintained in the fibers for increasing the cohesion between adjacent fibers to increase the extent of elongation of the individual fibers and to thereby increase the average staple length of the textile material being processed.

8. A method of conditioning fibrous textile strand material being drafted which comprises

(a) passing successive portions of continuous strand material through a closed pneumatic circuit including a conditioning chamber and a confined area while drafting the strand material by passing the same

through a series of rotating drafting rolls positioned within the confined area,

(b) while circulating an air stream in said closed circuit, and causing the air stream to flow past and against the drafting elements therein and the strand material being drafted,

(c) directing moisture into the air stream in the course of its travel through the conditioning chamber,

(d) detecting variations in relative humidity of the air stream in the confined area with respect to a predetermined relative humidity, and

(e) regulating the amount of moisture being directed into the air stream in response to variations in the relative humidity of air in the confined area being so detected.

9. The method as claimed in claim **8**, which includes

(f) compensatively regulating the temperature of the moisture being directed into the air stream in accordance with variations in temperature in the confined area relative to a predetermined operating temperature.

10. A method of processing fibrous textile strand material being drafted which comprises

(a) passing successive portions of the strand material through a closed pneumatic circuit including a confined area having a series of drafting rolls therein, and while drafting the strand material by the drafting rolls, and

(b) while circulating an air stream in said closed circuit and causing the air stream to flow against and past the drafting rolls while removing lint and other light material therefrom,

(c) sensing the condition of the circulating air stream as it passes through the confined area, and

(d) filtering the removed lint from the circulating air stream and compensatively conditioning the air stream in response to the sensing of variances in the condition thereof from a predetermined condition.

11. In a textile machine having a series of drafting elements for drafting strand material; the combination therewith of an apparatus for conditioning the strand material passing through the drafting elements which comprises

(a) means forming a closed pneumatic circuit including an enclosure carried by the machine defining a confined area within which said drafting elements are positioned,

(b) means for circulating an air stream in said closed circuit including through the confined area and past and against the drafting elements therein and the strand material being drafted,

(c) means for sensing the conditioning of the air within said enclosure, and

(d) means responsive to the sensing of other than a predetermined condition of the air in said enclosure for compensatively conditioning the circulating air stream.

12. A structure according to claim **11**, in which said sensing means (c) comprises means for sensing the moisture content of the air in said enclosure, and said responsive means (d) includes means for introducing moisture into the air stream in response to said sensing means detecting less than a predetermined minimum amount of moisture in the air in said enclosure.

13. A structure according to claim **11**, in which said sensing means (c) comprises means for sensing the temperature of the air within said enclosure, and said responsive means (d) includes means for heating the air stream in response to said sensing means detecting less than a predetermined minimum temperature in said enclosure.

14. A structure according to claim **11**, in which said sensing means (c) comprises means for sensing the temperature of the air within said enclosure, and said responsive means (d) includes means for cooling the air stream in response to said sensing means detecting a temperature of the air in said enclosure above a predetermined maximum temperature.

15. In a machine for drafting fibrous textile strand material, said machine including at least one series of drafting elements, and means for driving said drafting elements including a motor and gear means operatively connecting the motor to said drafting elements; the combination therewith of

(a) means forming a closed pneumatic circuit including means enclosing said drafting elements,

(b) said closed circuit also including conduit means communicatively connected to said enclosing means,

(c) means for directing air into and through said conduit means and into said enclosing means,

(d) said closed circuit also including a conditioning chamber communicating with said conduit means and interposed between said air directing means and said enclosing means,

(e) means sensing variations in the relative humidity of the air in said enclosing means, and

(f) means for directing water from a source into the path of travel of the air being directed through said conditioning chamber in response to the sensing of relative humidity below a predetermined percentage by said sensing means.

16. A structure according to claim **15**, including thermostatic means in said enclosing means, and means responsive to said thermostatic means for cooling the water at said source upon the temperature of air in said enclosing means exceeding a predetermined maximum temperature to thereby reduce the temperature within said enclosing means.

17. A structure according to claim **15**, including thermostatic switch means in said enclosing means, a normally inactive electrically operable heating means interposed in said conduit means between said means for directing water and said enclosing means and being electrically connected to said thermostatic switch means, and said thermostatic switch means being operable to close the circuit to said heating means upon air in said enclosing means dropping below a predetermined minimum temperature to thereby raise the temperature within said enclosing means.

18. In a machine for drafting textile strand material and including at least one series of driven drafting rolls; air conditioning means comprising

(a) means forming an enclosure within which said drafting rolls are positioned and through which pass successive portions of textile strand material being drafted,

(b) blower means having a suction side and an exhaust side,

(c) nozzle means within said enclosure and adjacent said rolls and communicating with the interior of said enclosure and also being communicatively connected to the suction side of said blower means,

(d) conduit means communicatively connected to the interior of said enclosure and extending exteriorly of said enclosure and communicating with the exhaust side of said blower means and through which air is directed into said enclosure by said blower means,

(e) means sensing variations in the relative humidity of the air in said enclosure, and

(f) moisture adding means responsive to the sensing of relative humidity below a predetermined percentage by said sensing means for adding moisture to the air directed through said conduit means for humidifying the same so as to increase the relative humidity in said enclosure to said predetermined percentage and to thus humidify the strand material passing within said enclosure.

19. A structure according to claim **18**, including a normally inactive heating means positioned in said conduit means and past which the air must flow in its course

to said enclosure, and means in said enclosure and being responsive to the existence of a temperature lower than a predetermined temperature in said enclosure for activating said heating means.

20. A structure according to claim **18**, including means for interrupting communication between the exhaust side of said blower means and said conduit means and for establishing communication between said exhaust side and the outside atmosphere exteriorly of said conduit means, and means for establishing communication between said conduit means and the ouside atmosphere exteriorly thereof, said last-named means being located remote from said enclosure with respect to said moisture adding means whereby air is drawn from said outside atmosphere through said moisture adding means, through said enclosure, through said nozzle means and to said blower means, and air is exhausted from said blower means into the outside atmosphere.

21. A structure according to claim **18**, in which said means (*f*) comprises

(1) at least one air filter through which passes the air in its course through said conduit means,

(2) means for introducing and distributing water over the air filter to increase the relative humidity of the air flowing into said enclosure, and

(3) means operatively connecting said sensing means to said means for introducing and distributing water for controlling the same.

22. A structure according to claim **21**, in which said means for introducing and distributing water comprises

(a') a reservoir for containing a supply of water therein,

(b') a perforated pipe means above said filter,

(c') normally inactive pump means for pumping water from said reservoir into said pipe means, and

(d') said means operatively connecting said sensing means to said means for introducing and distributing water serving to operatively connect said pump means to said sensing means.

23. A structure according to claim **22**, including a cooling coil in said reservoir, a normally inactive thermostatic switch in said enclosure, a normally inactive electrically operable refrigerating device coupled to said coil and electrically connected to said thermostatic switch, and said switch being operable to activate said refrigerating device to cool the water in said reservoir upon the temperature in said enclosure rising above a predetermined maximum temperature.

24. In a machine for drafting fibrous textile strand material, said machine including at least one series of drafting elements, and means for driving said drafting elements including a motor and gear means operatively connecting the motor to said drafting elements; the combination therewith of

(a) means enclosing said drafting elements and also enclosing said motor and gear means,

(b) conduit means communicatively connected to said enclosing means,

(c) means for directing air into and through said conduit means and into said enclosing means,

(d) a conditioning chamber communicating with said conduit means and interposed between said air directing means and said enclosing means,

(e) means sensing variations in the relative humidity of the air in said enclosing means, and

(f) means for directing a sheet of water from a source into the path of travel of the air being directed through said conditioning chamber in response to the sensing of relative humidity below a predetermined percentage by said sensing means.

25. In a machine for drafting fibrous textile strand material, said machine including at least one series of drafting elements, and means for driving said drafting elements including a motor and gear means operatively connecting the motor to said drafting elements; the combination therewith of

(a) means enclosing said drafting elements,

(b) conduit means communicatively connected to said enclosing means,

(c) means for directing air into and through said conduit means and into said enclosing means,

(d) a conditioning chamber communicating with said conduit means and interposed between said air directing means and said enclosing means,

(e) means sensing variations in the relative humidity of the air in said enclosing means,

(f) means for directing a sheet of water from a source into the path of travel of the air being directed through said conditioning chamber in response to the sensing of relative humidity below a predetermined percentage by said sensing means,

(g) nozzle means positioned closely adjacent said drafting elements,

(h) said air directing means comprising a blower having a suction side and a blowing side, and

(i) means communicatively connecting said nozzle means to the suction side of said blower.

26. In a textile machine having a series of drafting elements for drafting strand material; the combination therewith of an apparatus built in with the textile machine for conditioning the material passing through the drafting elements which comprises

(a) means forming a pneumatic circuit passing through the machine and including an enclosure carried by the machine defining a confined area within which said drafting elements are positioned,

(b) means for circulating an air stream in said circuit including through the confined area and past and against the drafting elements therein and the strand material being drafted,

(c) means for sensing the condition of the air within said enclosure, and

(d) means responsive to the sensing of other than a predetermined condition of the air in said enclosure for compensatively conditioning the circulating air stream.

27. In a textile machine having a series of drafting rolls for drafting strand material; the combination therewith of an apparatus for conditioning the strand material passing through the drafting rolls which comprises

(a) means carried by the machine and forming an enclosure defining a confined area within which said drafting rolls are positioned,

(b) suction nozzle means positioned in close proximity to the drafting rolls for sucking lint and other light material from the drafting rolls and the strand material being drafted,

(c) means for directing an air stream into the enclosure and past and against the drafting rolls and the strand material and thence into said suction nozzle means,

(d) means for sensing the condition of the air stream passing through the confined area,

(e) means for filtering the lint and other light material from the air stream after it passes into said suction nozzle means, and

(f) means responsive to the sensing of variances in the condition of the air stream from a predetermined condition for compensatively conditioning the air stream before it enters said enclosure.

28. In a textile machine having a series of drafting rolls for drafting strand material; the combination therewith of an apparatus built in with the textile machine for conditioning the material passing through the drafting rolls which comprises

(a) means forming a closed pneumatic circuit including an enclosure carried by the machine defining a confined area within which said drafting rolls are positioned,

(b) said closed circuit also including suction nozzzle means positioned in close proximity to the drafting rolls for sucking lint and other light material from

the drafting rolls and the strand material being drafted,

(c) means for circulating an air stream in said closed circuit such that the air stream flows into the enclosure and past and against the drafting rolls and the strand material and thence into said suction nozzle means,

(d) means for sensing the condition of the circulating air stream passing through the confined area,

(e) means for filtering the lint and other light material from the circulating air stream after it passes into said suction nozzle means and before it enters said enclosure, and

(f) means responsive to the sensing of variances in the condition of the air stream from a predetermined condition for compensatively conditioning the air stream.

29. A method of conditioning fibrous textile strand material being drafted which comprises

(a) passing successive portions of the strand material through a closed pneumatic circuit including a confined area while drafting the strand material by passing the same through a series of drafting elements positioned within the confined area, while

(b) circulating an air stream in said closed circuit, while

(c) sensing the temperature of the circulating air stream as it passes through the confined area, and

(d) compensatively varying the temperature of the circulating air stream in response to the sensing of a temperature in the confined area outside of a predetermined temperature range.

30. A method of conditioning fibrous textile strand material being drafted which comprises

(a) passing successive portions of the strand material through a closed pneumatic circuit including a confined area while drafting the strand material by passing the same through a series of drafting elements positioned within the confined area, while

(b) circulating an air stream in said closed circuit and past and against the drafting elements therein and the strand material being drafted while

(c) sensing the relative humidity of the circulating air stream in its course within the confined area, and

(d) compensatively varying the relative humidity of the circulating air stream in response to the sensing of relative humidity in the confined area outside of a predetermined range of relative humidity.

31. A method of conditioning fibrous textile strand material being drafted which comprises

(a) passing successive portions of the strand material through a closed pneumatic circuit including a confined area while drafting the strand material by passing the same through a series of drafting elements positioned within the confined area, while

(b) circulating an air stream in said closed circuit and past and against the drafting elements therein and the strand material being drafted while

(c) sensing the temperature and relative humidity of the circulating air stream in its course within the confined area, and

(d) compensatively varying the temperature and relative humidity of the circulating air stream in response to the sensing of temperature and relative humidity in the confined area outside of a predetermined range of temperature and relative humidity.

32. A method of conditioning fibrous textile strand material being drafted which comprises

(a) passing successive portions of the strand material through a closed pneumatic circuit including a confined area while drafting the strand material by passing the same through a series of drafting elements positioned within the confined area, while

(b) circulating an air stream in said closed circuit, while

(c) sensing the moisture content of the circulating air stream in the confined area, and

(d) introducing predetermined amounts of moisture into the circulating air stream and onto the strand material being drafted in response to the sensing of less than a predetermined minimum amount of moisture in the air stream in the confined area.

33. In a textile machine having a series of drafting elements for drafting strand material; the combination therewith of an apparatus for conditioning the strand material passing through the drafting elements which comprises

(a) means forming a closed pneumatic circuit including an enclosure carried by the machine enclosing said series of drafting elements therein and through which pass successive portions of the strand material being drafted,

(b) means for circulating an air stream in said closed circuit,

(c) sensing means disposed within said enclosure for sensing the amount of moisture in the air within said enclosure, and

(d) means responsive to the sensing of less than a predetermined minimum amount of moisture within said enclosure by said sensing means for compensatively introducing moisture into the air stream and thus into the enclosure and onto the strand material being drafted.

34. In a textile machine having a series of drafting elements for drafting strand material; the combination therewith of an apparatus for conditioning the strand material passing through the drafting elements which comprises

(a) means forming a closed pneumatic circuit including common enclosure means carried by the machine enclosing all of said drafting elements and successive portions of the strand material being drafted therein,

(b) means for circulating air in said closed circuit and past and against the drafting elements and the strand material being drafted, and

(c) means for sensing the temperature and relative humidity of the air within said enclosure means, and

(d) means responsive to said sensing means for maintaining the circulating air within a predetermined range of temperature and relative humidity.

35. In a textile machine having a series of drafting rolls for drafting strand material; the combination therewith of an apparatus for conditioning the strand material passing through the drafting rolls which comprises

(a) means forming a closed pneumatic circuit including a conditioning chamber and an enclosure carried by the machine enclosing therein said drafting rolls and corresponding portions of the strand material being drafted,

(b) means circulating an air stream in said closed circuit and past and against the drafting rolls and the strand material being drafted,

(c) means within said enclosure for detecting variations in relative humidity of air in said enclosure with respect to a predetermined relative humidity, and

(d) means operatively connected to said detecting means for introducing varying amounts of moisture into the air stream passing through the conditioning chamber in response to variations in the relative humidity of the air in said enclosure being detected by said detecting means.

36. In a machine for drafting fibrous textile strand material, said machine including at least one series of drafting elements, and means for driving said drafting elements including a motor and gear means operatively connecting the motor to said drafting elements; the combination therewith of

(a) means forming a closed pneumatic circuit including means enclosing said drafting elements,

(b) said closed circuit also including conduit means communicatively connected to said enclosing means,

(c) means in said closed pneumatic circuit for directing air into and through said conduit means and into said enclosing means,

(d) said closed circuit also including a conditioning chamber communicating with said conduit means and interposed between said air directing means and said enclosing means,

(e) at least one filter in said chamber and through which the air passes in its course to said enclosing means,

(f) normally inactive means for directing liquid over said filter,

(g) means sensing the relative humidity of the air in said enclosing means and being operatively connected to said liquid means, and

(h) said sensing means being operative upon the relative humidity of the air in said enclosing means dropping below a predetermined percentage for activating said liquid directing means.

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