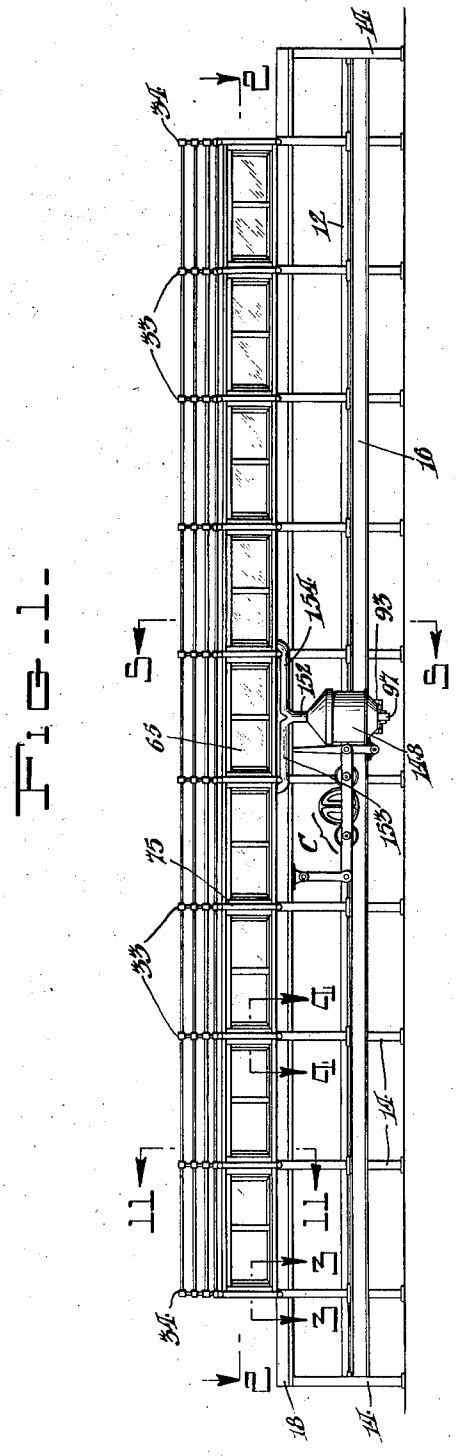
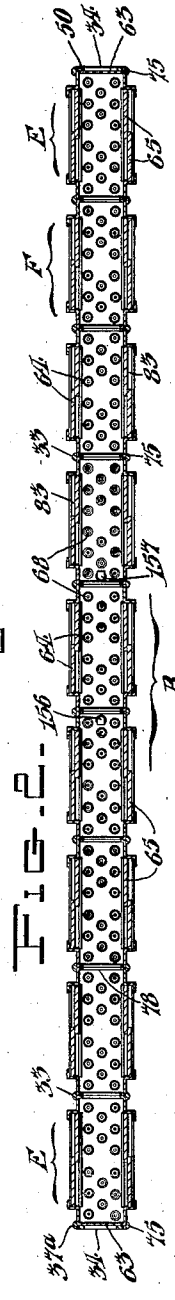
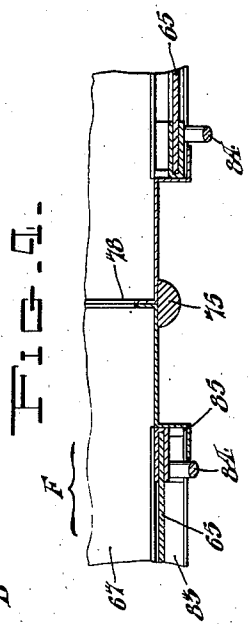
Jan. 5, 1937. H. JANSSEN 2,066,781

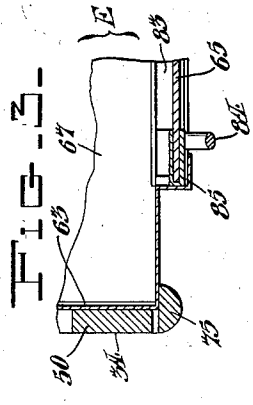
METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

Filed March 30, 1935 9 Sheets-Sheet 1









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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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FIG. 5.

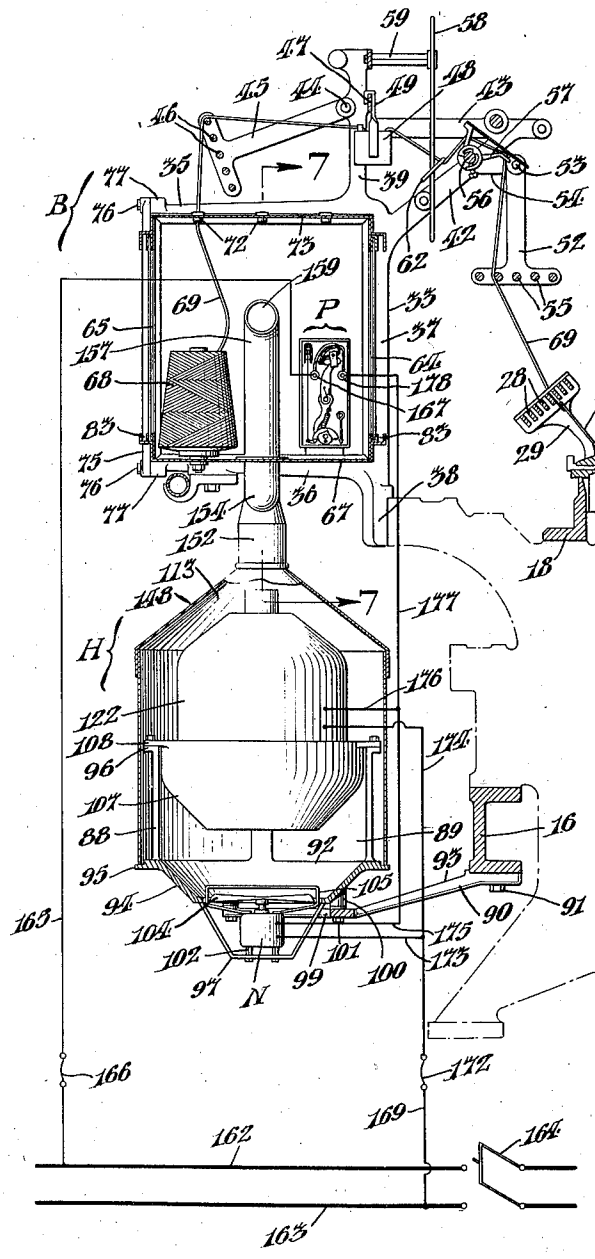
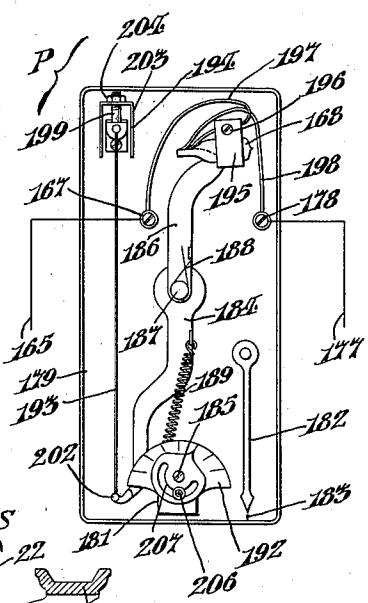
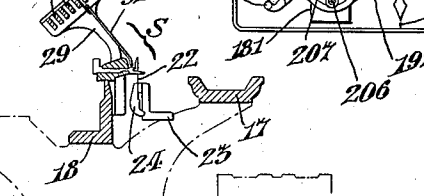
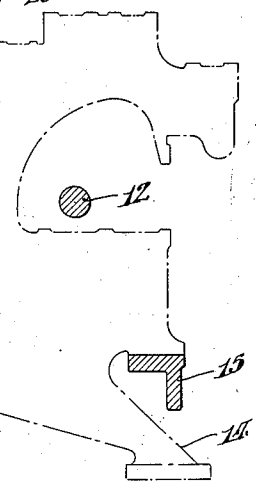


FIG. 6.







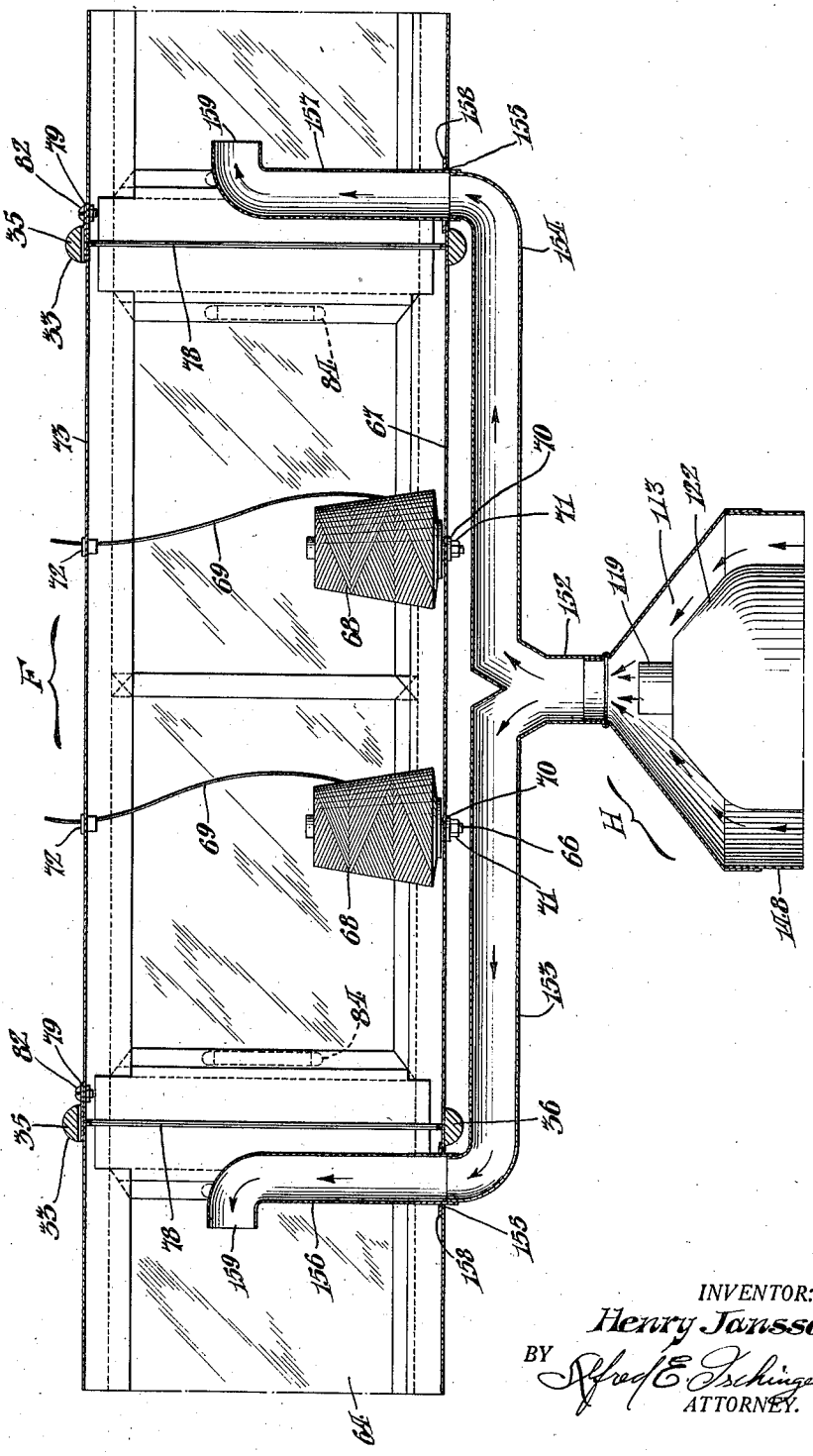
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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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Fig. 7.



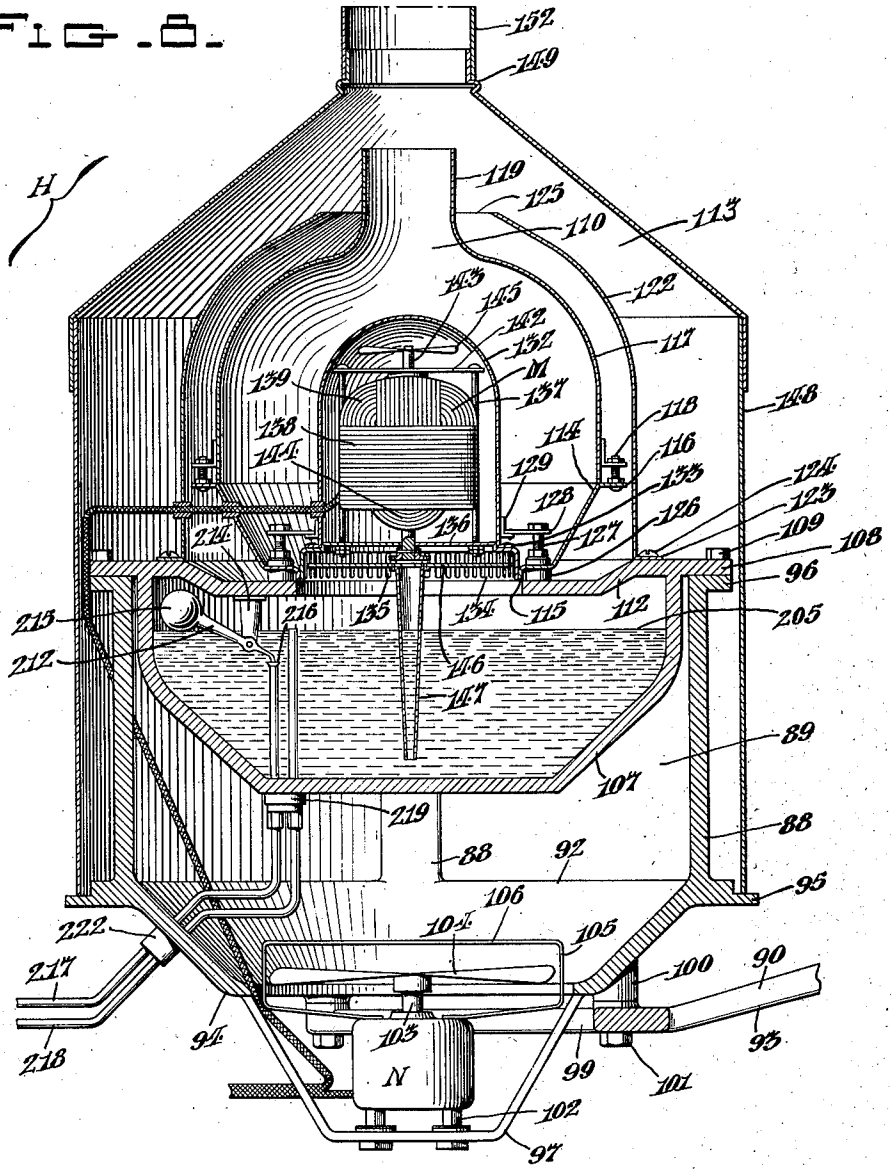
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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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FIG. 8.



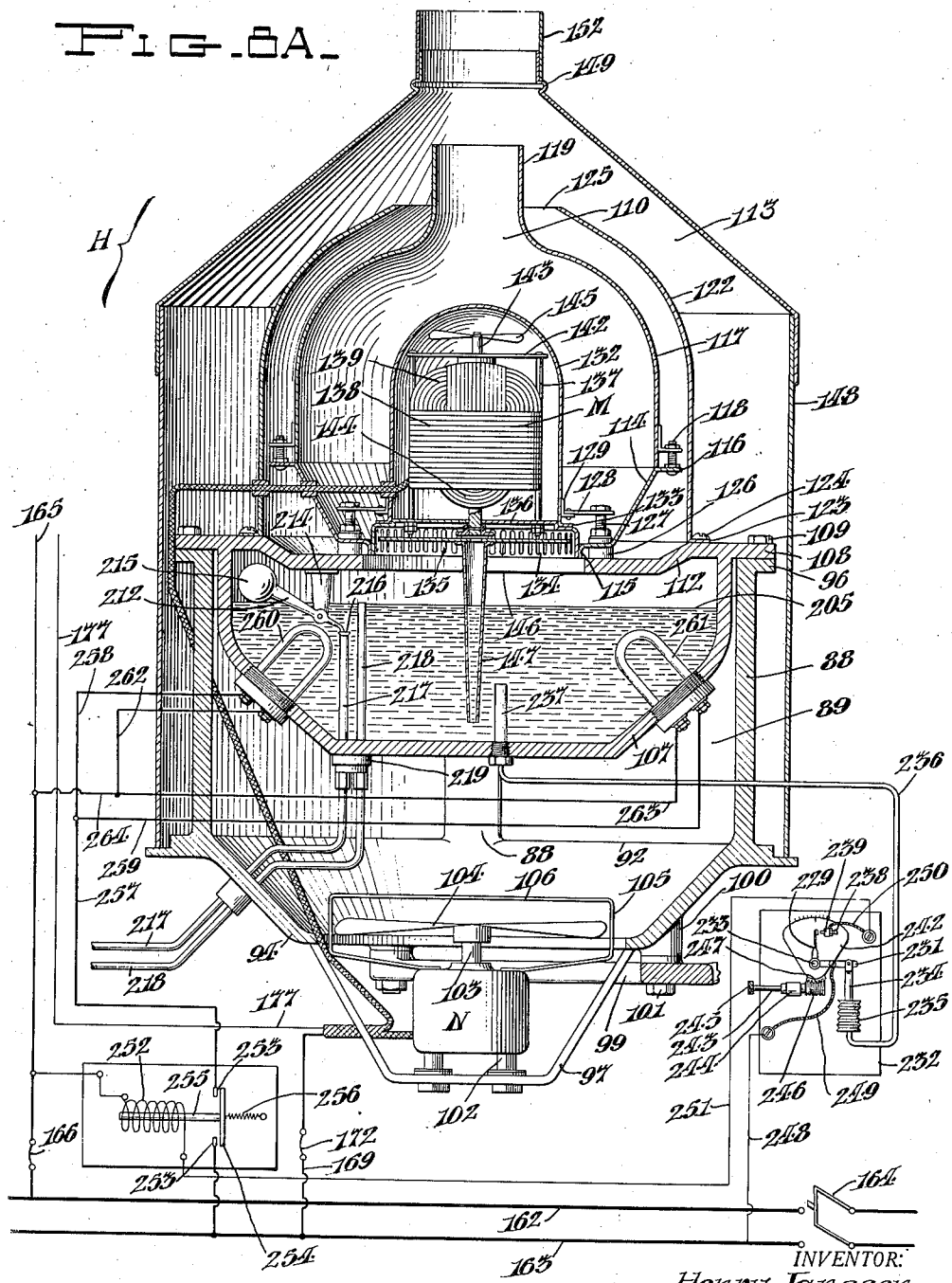
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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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FIG. 8A.



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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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Fig. 9.

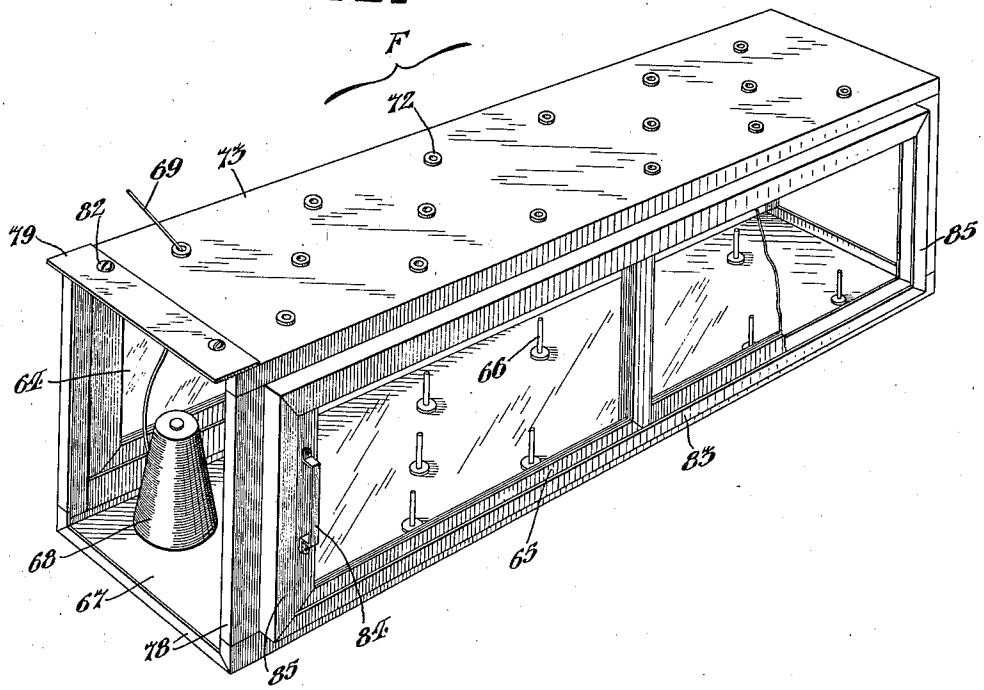
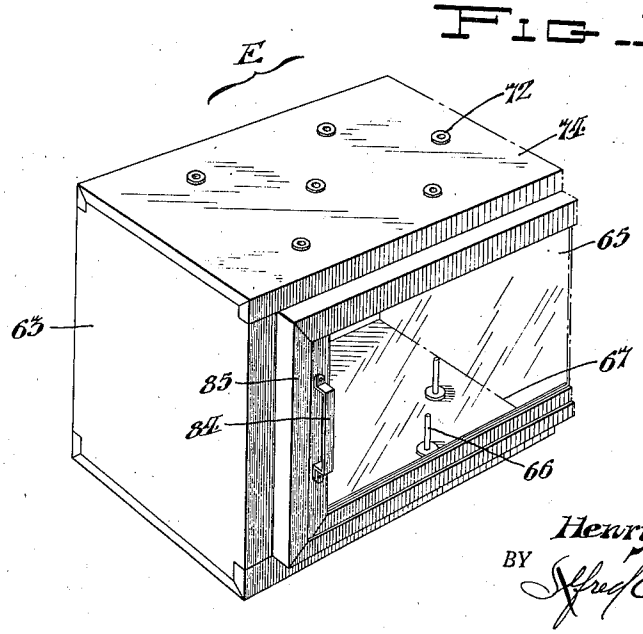


Fig. 10.



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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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FIG. 11.

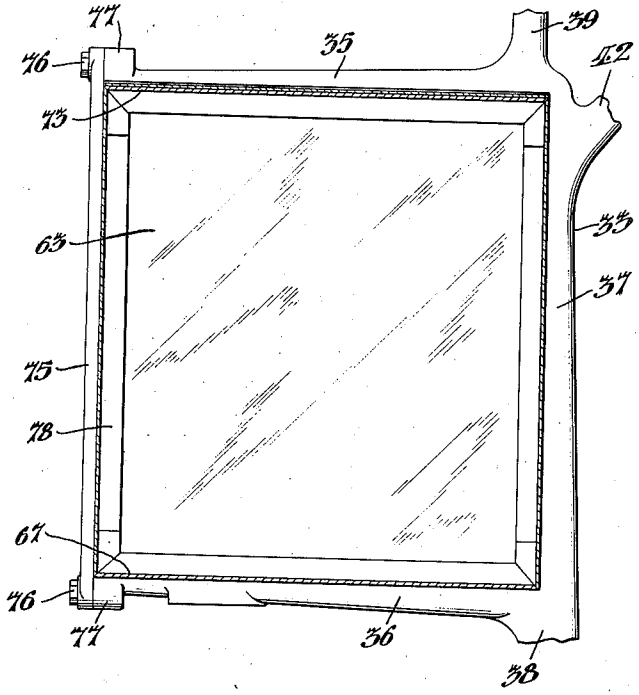


FIG. 12.

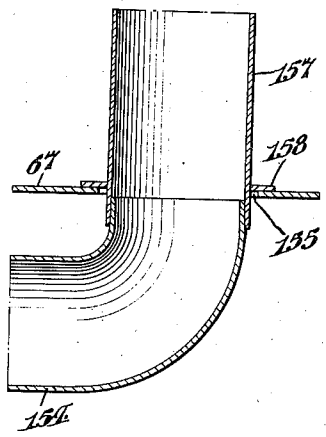


FIG. 13.

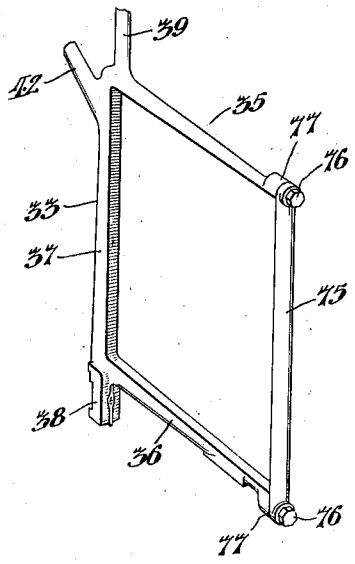
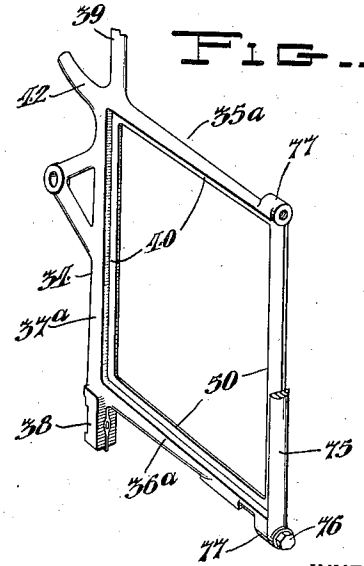


FIG. 14.



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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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Fig. 15.

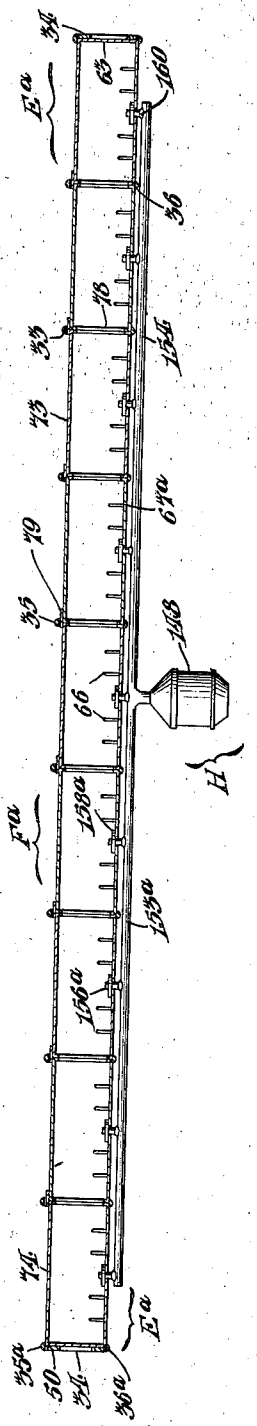


Fig. 16.

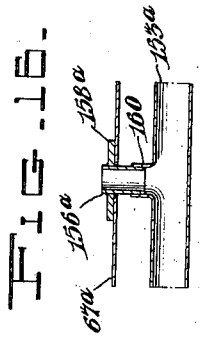


Fig. 17.

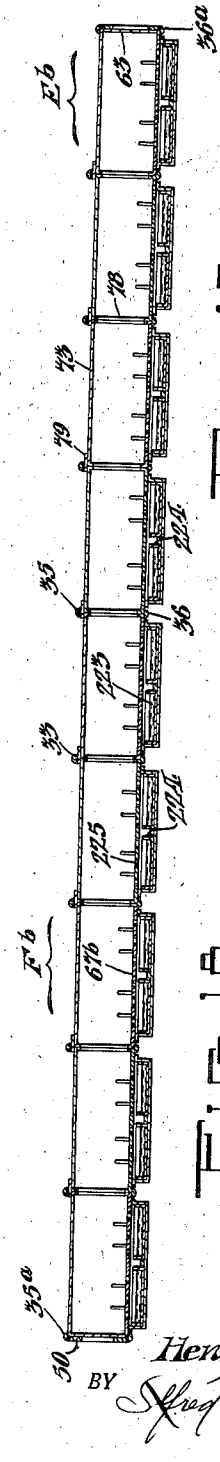


Fig. 18.

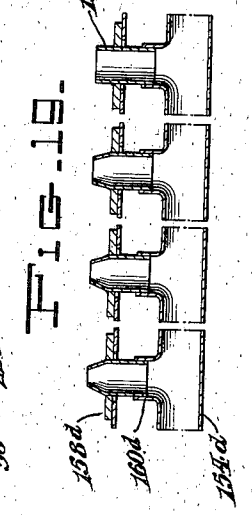
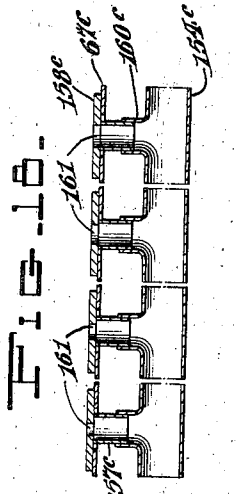


Fig. 18.



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METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

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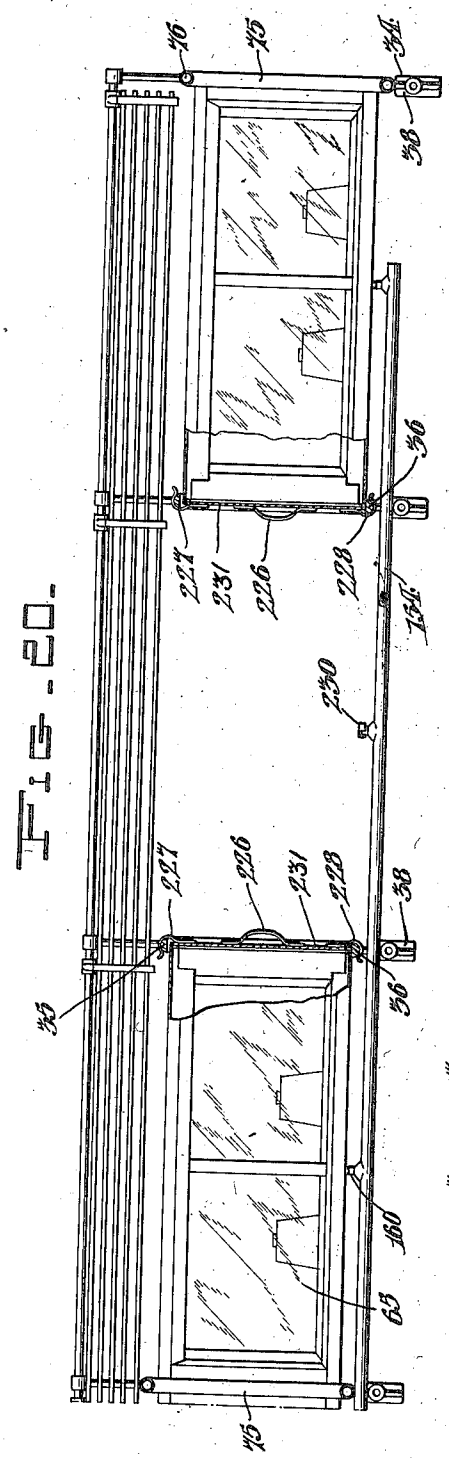


Fig. 20.

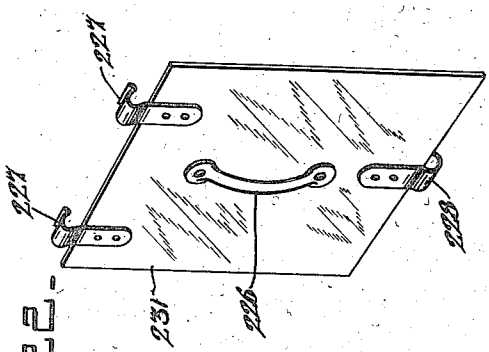


Fig. 22.

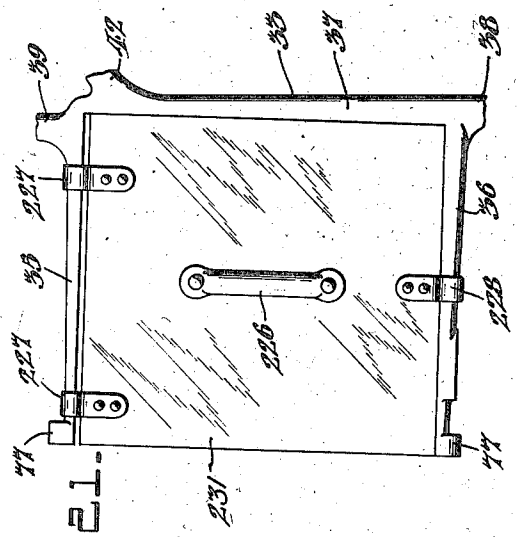


Fig. 21.

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Patented Jan. 5, 1937 2,066,781

UNITED STATES PATENT OFFICE

2,066,781

METHOD OF AND MEANS FOR EFFECTING VAPOR TREATMENT OF YARN IN A YARN FABRICATING MACHINE

Henry Janssen, Wyomissing, Pa., assignor to Textile Machine Works, Wyomissing, Pa., a corporation of Pennsylvania

Application March 30, 1935, Serial No. 13,858

18 Claims. (Cl. 66—125)

My invention relates to a method of, and to means for, effecting treatment by a vapor or other medium of the yarn in a yarn fabricating machine, such as a full fashioned knitting machine or the like, thereby causing the yarn to be more uniformly conditioned for proper feeding to, and fabrication by, the machine; and it has for one of its objects to provide a novel method, and a novel means, of this character.

In working or knitting certain fine yarns, particularly silk, in the form of sheer-silk hosiery, underwear, and the like, difficulty is encountered in having the yarn assume effective shape or relation to the needles and other working parts to ensure a uniform fabric, this objection resulting from the inherent tendency of the yarn to curl or crinkle unevenly. This results in irregular areas in the fabric, delays and expense from tangles, and interruption of operation of the machine, as well as other detrimental effects.

Another object of the invention is, therefore, to avoid the above-mentioned undesirable features, which is effected by a method, and a machine for practicing the method, to ensure a more thorough and uniform conditioning or moistening of the variable supply of yarn in the machine before it is directly fed from a container to the working parts for efficient manipulation by the needles, sinkers and dividers at the time of knitting, whereby the curling tendency is precluded or sufficiently reduced such that the yarn cooperates with the working parts to produce the desired fabric with greater facility, and at reduced cost.

It has heretofore been customary to moisten silk yarn, for use in knitting machines, by encasing the yarn-packages or cones in receptacles called moistening boxes, in which bodies or pools of liquid are disposed, and to lead the yarn from these boxes, and through the so-called moistening troughs, to the needles.

Such devices depend entirely on the inherent ability of the liquid body to give off moisture, as affected by variable surrounding atmospheric conditions, to condition the air in the moistening boxes, with the result that the effect on the yarn is as variable as the above-mentioned conditions.

Another object of the invention is therefore, to properly treat the yarn with vapor irrespective of the variable atmospheric conditions surrounding the machine, to maintain the atmosphere about the yarn uniformly humidified for any given yarn at all times, and to provide a device and a system for this purpose.

With yarns of different size, twist and texture, the rate and degree of humidification should accordingly be different, to greater degree than can feasibly be produced for all yarns by merely varying the area of the aforementioned liquid bodies or pools.

It accordingly, is another object of the invention to produce a forced draft or circulation of conditioned air against the yarn, either in the box or receptacle in which the yarn is maintained or at another suitable position, to adjust this flow or circulation for reception by the yarn to the requirements of different kinds and quantities of yarn, as at a rate corresponding to the varying rate of absorption of the medium by the yarn, and to automatically maintain such flow against effects tending to vary it.

In the arrangement whereby the yarn is first conditioned in the moistening box, and then led through a moistening trough, before reaching the yarn carriers and knitting mechanism, the intention is to pre-condition or pre-prepare the yarn in the box, so that it may more effectively cooperate with the liquid in the trough, or, in other words, to first affect the yarn by a relatively slight subjection to moisture in the box at an appreciable interval of time before reaching the trough, and to then give it a main bath or submersion in the trough. This operation is intended to so start the absorption process at the box, and to so allow it to work during transit of the yarn to the trough, that, at the latter, the operation at the trough will be facilitated. However, the delicate balance of such cooperation is very much affected by yarns of different sizes, twists and textures, as well as by the rate of feed.

It is a further object of my invention to provide for adjustment of the rate of subjecting to vapor the particular yarn in use, so that each yarn, irrespective of size, twist or texture, will be more effectively preconditioned in accordance with the rate of feed, and its ability to take up the liquid in the trough.

Moistening boxes employing liquid pools for knitting machines have previously been constructed either to hold the pools in false bottoms of the boxes, or in removable pans, either of which required periodic renewal with sufficiently rapid recurrence, to render the feature appreciably undesirable and of considerable expense. This was caused by rust, corrosion and accumulation of sludge or foreign matter, whereby the boxes and pans relatively quickly become unsightly and badly conditioned for their work.

Another object of the invention is to practically eliminate these objections by not requiring the use of the pools, and by so generating feeding and regulating the supply of properly moistened air, as to have it supplied at a varying rate substantially only as needed by the yarn, in accordance with variations in the quantity, rate of medium-receiving quality, and feeding of the yarn to the knitting mechanism of the machine, and not in such excess as to allow any substantial accumulation on the surrounding parts. Thus, the initial cost of the device is reduced, by not requiring

pans and other provisions for the pools, and the life is extended by the elimination of the above-mentioned effects of the pools.

Previous moistening boxes were also provided in number in accordance with the number of knitting sections in a machine, which arrangement is not only expensive, but also renders it difficult to have the several boxes of the same degree of humidity so that the products of the several sections were not always of the desired degree of uniformity. It also so affects the air in an individual box when the latter is opened to renew yarn, or for other reason, as to require considerable time for the air in the box to resume its former condition.

It is another object of the invention to improve the uniformity of simultaneously produced articles, such as full-fashioned stockings, by providing a single box, yarn receptacle or equivalent structure for an entire machine, irrespective of the number of its sections, whereby the yarn-treating medium is uniformly distributed and homogeneous throughout the receptacle or housing structure and the yarns are more nearly all subject to the same treatment, this box being preferably constructed as a multi-section composite unit extending continuously along a plurality of machine sections in which the cooperating container sections or series related units are separately removable to permit access to adjacent parts of the machine, to facilitate manufacture, storage and shipping, to render it easy and economical to replace locally damaged parts, and to have other advantages. This box, whether a humidifier of the old, or of the new and improved, type be employed therewith, will cause less effect on the air when one of its sections is opened, as to supply new cones of yarn.

Other objects include effecting the novel vapor treatment at a preselected temperature or range of temperatures; the manual and automatic control of the temperatures; novel means for effecting the temperature control; reducing the size or action of, or eliminating, other conditioning means, in cooperation with, or in addition to, the means of the invention, either prior, or subsequent, to the treatment by such means; reducing the yarn-treating means of the machine in size, number of parts, weight, cost and operating expense; preventing the escape of conditioned air when a receptacle for such air is opened; controlling the vapor in accordance with a tendency to lowered pressure along a conduit between the pressure source and distribution positions; the provision of novel gallows for supporting a moistening box, and a clamping means for holding such box in position; a novel mounting for a humidifier unit; and other features of construction and operation, such as vapor-ejector nozzles, sealing various parts against escape of the vapor and compensating for discrepancies of fit, or expansion, between various parts.

With these and other objects in view, which will become apparent from the following detailed description of the illustrative embodiment of the invention shown in the accompanying drawings, my invention resides in the novel method, elements, features of construction and arrangement of parts in cooperative relationship, as hereinafter more particularly pointed out in the claims.

In the drawings:

Figure 1 is an outline view, in rear elevation of a multi-section full fashioned knitting machine embodying a yarn-conditioning device of my invention;

Fig. 2 is a view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is an enlarged detail view, taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is an enlarged detail view, taken substantially along the line 4—4 of Fig. 1;

Fig. 5 is an enlarged transverse vertical sectional view of the knitting machine, as equipped with the invention, taken substantially along the line 5—5 of Fig. 1, a frame of the machine being shown in broken lines, and a diagram of electrical circuits being included;

Fig. 6 is an enlarged detail view of a humidistat embodied in the invention, as indicated in Fig. 5;

Fig. 7 is an enlarged detail view of a portion of adjoining ends of two sections of the moistening box of the invention, taken substantially along the line 7—7 of Fig. 5;

Fig. 8 is an enlarged view, partially in side elevation and partially in vertical plane section, of a humidifier unit embodied in the invention;

Fig. 8A is a view, similar to Fig. 8, of a modified form of the invention whereby the temperature of the humidified air or vapor is controlled;

Fig. 9 is a perspective view of one of the intermediate detachable and removable sections of a multi-section moistening box structure constituting part of the invention;

Fig. 10 is a view similar to a portion of Fig. 9 of one of the end sections of the moistening box structure of Fig. 9;

Fig. 11 is an enlarged view, taken substantially along the line 11—11 of Fig. 1;

Fig. 12 is an enlarged detail view of a portion of a conduit structure and its relation to the moistening box of the invention, as viewed near the right-hand end of Fig. 7;

Figs. 13 and 14 are perspective views, with parts broken away, of brackets for supporting the box at positions intermediate the ends, and at the ends thereof, respectively;

Fig. 15 is an outline view, similar to a portion of Fig. 1, showing a modification of corresponding parts, and omitting other parts for clearness;

Fig. 16 is an enlarged detail sectional view of one of several like nozzle structures as viewed in Fig. 15;

Fig. 17 is a view, similar to Fig. 15, of another modified form of the invention wherein the composite multi-section box unit is adapted for use with a pool or pools of water instead of a forced vapor draft;

Fig. 18 is a view, similar to Fig. 16, of a series of nozzles having apertures of progressively different sizes;

Fig. 19 is a view similar to Fig. 18, of a modification of the nozzles of Fig. 18;

Fig. 20 is a view of a portion of the composite box, and adjacent parts, as seen from the rear of the machine, and end closure elements, cooperating with adjacent ends of sections from between which a section is removed;

Fig. 21 is a view, similar to Fig. 11, showing one of the end closures of Fig. 20; and

Fig. 22 is a perspective view of the closure of Fig. 21.

In all of the figures, corresponding parts are designated by corresponding reference characters.

Referring to the drawings, a means for practicing the method of the invention is shown as applied to a "Reading" full fashioned knitting

machine, only the parts of which, necessary to a complete understanding of the invention are shown, the other parts and the operation of the machine being well known, as fully shown and described in the "Reading" Full Fashioned Knitting Machine Catalogue, copyright 1929, and published by the Textile Machine Works, Reading, Pennsylvania.

Referring to Figs. 5 and 1, in an eighteen section full fashioned knitting machine, selected merely by way of example, a cam shaft 12, supporting cams for imparting movement to various units of the machine, is rotatably journaled in bearings on end and center frames 14, which are held in spaced relation along the machine by tie members including a front beam 15, a back beam 16, a front bed 17 and a center bed 18.

Banks of needles 22, only one of which is indicated, Fig. 5, are each held to a needle bar 23 by clamps 24, and cooperate in a usual manner with the sinkers, dividers and knockover bits of a sinker head assembly S mounted on the center bed 18. Carrier rods 28, longitudinally reciprocably mounted on brackets 29 on the center bed 18, support yarn carriers 32 for laying courses of the yarn to the needle banks 22. A coulier motion mechanism C, Fig. 1, is provided at the rear of the machine for actuating the knitting mechanism, all of the parts so far enumerated being as heretofore constructed in the above-mentioned "Reading" machine.

In the parts as added or modified by the invention for combination with the above-mentioned or equivalent structure, a plurality of intermediate and end brackets 33 and 34, respectively, Figs. 1, 11, 13 and 14, are secured one to each of the frames 14 for supporting a composite multi-section moistening box unit B.

The intermediate brackets 33, of which, in this example, there are eight, as seen in Fig. 1, have main body portions each of which is generally of C-shape having upper and lower horizontal arms 35 and 36, respectively, a vertical portion 37, a lower branch extension 38 for direct attachment to a frame 14 and upper vertical and diagonal branches 39 and 42, respectively, joined by a horizontal portion 43, all of these parts preferably being of one integral casting.

Similarly, the end brackets 34 have main body portions of substantially C-shape each having an upper horizontal arm 35*a*, a lower horizontal arm 36*a*, a vertical portion 37*a*, a lower vertical branch extension 38 for direct attachment to the corresponding frame 14, and upper vertical and diagonal branches 39 and 42, respectively. However, a preferably integral vertical plane flange 50, in the form of a rectangular substantially closed loop is embraced by the arms 35*a*, 37*a* and 36*a* of each end bracket 34 to form therewith a substantially rabbet groove 40 embracing three sides of the box, the top, bottom and rear, at the box ends, whereby to hold the box longitudinally in both directions, and to provide a support to permit the ready mounting and removal of the sections by front to back sliding movement in the grooves.

The branches 39 each have a pivot support 44 about which may be adjustably fixed a bracket 45 of substantially T-shape for the support of yarn-guide rods 46 extending between the heads of adjacent of the brackets 45. Bars or straps 47, mounted on the upper vertical arms 39, are provided for the support of moistening troughs 48 by means of hooks or clips 49; the bracket 45, the straps 47, the troughs 48 and the hooks 49 being substantially as heretofore employed. Other brackets 52, similar to the brackets 45, are likewise adjustably fixed on pivot supports 53, disposed one on each of branch arms 54 of the diagonals 42, for supporting guide rods 55. The diagonals 42 also support a shaft 56 for "snappers" 57 by which the feeding and tension of the yarns are controlled in a well known manner. Each of a plurality of vertical rods 58 is held in a bracket 59 on one of the arms 39, and positions a tension ring 62 floatingly embracing both the rod and the yarn, on which it imposes its weight.

The moistening box unit B comprises intermediate sections F, and end sections E, as better shown in Figs. 2, 9 and 10, disposed end to end in the general form of an elongated tube of rectangular cross section at the rear of the machine, the intermediate sections F each being open at each end, and the end sections E each being closed by a wall or panel 63 at one end, and together providing the remote ends of the composite box.

All of the sections F and E are preferably constructed of galvanized sheet metal and have sliding front and rear glass-paneled doors 64 and 65, respectively. Bobbin-supporting pins 66, supported on the bottom walls 67 of the box sections F and E, by washers 70 and nuts 71, are provided to support yarn packages or cones 68 which supply yarns 69, through eyelets 72 in the top walls 73 and 74 of the intermediate and end box sections, respectively, over one of the guide rods 46, through the moistening trough 48, through the tension rings 62, through the snapper 57, against one of the guide rods 55 and along the carriers 32 to the sinker head assembly S and the needles 22.

The box sections F and E fit relatively closely between the upper and lower bracket arms 35 and 36, against the rear bracket arm 37, relative to which they are clamped by upright front members 75 secured to the end and intermediate brackets, as by screws 76 in bosses 77, see Figs. 13 and 14. The arms 35, 36 and 37 are preferably of semi-circular cross section having flat sides against the flat sides of the box, as indicated in Fig. 7. The arms 35*a*, 36*a* and 37*a* of the end brackets E are similarly of substantially semicircular cross section, except for the flange 50, integral therewith at one edge of each to therewith form the rabbet groove 40.

As better seen in Figs. 7, 9 and 11, the intermediate box sections F have inturned end perimetral flanges 78 for abutting plane-face relation to the flanges 78 of the next adjacent sections; this construction being provided to lend greater thickness dimension to the abutting ends of the box section walls, to provide better fit, to effect a better seal at the joints between the sections, and to reinforce the box radially of its length. Each end section E also, is provided, at its inner end, with a like flange 78 for abutting relation to a corresponding flange of the next adjacent intermediate section.

Each section F and E, except the left-end section E, as viewed from the rear of the machine, is provided, at its left-hand end, with an overhanging sheet metal member or plate 79, see Figs. 7 and 9, secured thereto, as by screws 82 and projecting to the left, in the plane of the box top. This feature is to compensate for any vertical dimensional discrepancy between the box and the horizontal bracket arms 35 and 36, whereby the adjacent box section ends may be brought together with a snug fit, to securely

position the sections and to seal the joints therebetween, at approximately the centers of the arms 35 and 36 longitudinally of the box.

The end brackets 34 are substantial duplicates of the intermediate brackets 33, except for the provision thereon of the flanges 50, see Figs. 3 and 14 which embrace the ends of the composite unit in the rabbet grooves 40.

In each box section E and F, each of the front and rear doors 64 and 65, respectively, comprises halves slidable in adjacent offset parallel planes, see Figs. 3 and 4, in sheet-metal channel portions 83 of the corresponding box walls, and provided with handles 84 for moving any half door longitudinally of the box, whereby the halves of each door overlap at adjacent ends in closed position to provide effective closure of the box; the remote, or vertical end edges of the half doors of each pair fitting in vertical channels 85.

By removing the front clamp bars 75 from the brackets 33 or 34, the box sections may be individually or collectively removed from the brackets, by sliding the sections to the left, as viewed in Figs. 5 and 11, and conversely replaced or renewed by moving the same or new sections to the right; it being also necessary to remove the nozzles of a conduit system, as will hereinafter appear, for the above-mentioned removal and replacement of the box sections.

A mechanical humidifying or vaporous-medium producing unit H, disposed at the rear of the machine near the coulier motion mechanism C, see Fig. 1, and not of my invention except in combination with, and as modified for, the other elements herein set forth, comprises, as better shown in Fig. 8, a base 92 supported on the back beam 16 by a bracket 93, an apertured depending bottom wall 94, an annular side ledge 95, and a top open-end or perimetral flange 96 supported on uprights 88 spaced about the flange 95 and having spaces 89 therebetween. A bracket 97, secured to the bottom wall 94 supports a motor N, as by standards 102 on the bracket 97, and carries on its shaft 103, a fan 104 in a shield 105 having an open top 106. The bracket 93, as shown, is in the form of a fork having main arms 90 secured to the back beam 16, as by bolts 91, and branched or forked arms 99 secured to bosses 100 on the bottom wall 94, as by screws 101.

A tank or reservoir 107, constituting a source of water or other liquid, is disposed in the base 92 and secured thereto suspended above the bottom thereof by top lugs 108 disposed on the flange 96, and secured thereto by screws 109. An apertured depending top wall 112, of the tank 107, constitutes a base ring or support for a basin rim 114 having a bottom perimeter 115 sealed about the perimeter of the opening in the ring 112; the rim 114 being of inverted substantially frusto-conical shape having a top flange 116 to which a basin cover 117 is secured in sealed relation thereto, as by bolts 118.

The basin cover 117 is in the form of an inverted funnel having a reduced open top 119. A dome 122 conforming generally to, but substantially larger than, the basin cover 117, is disposed over and around the cover on the base ring 112 to which a bottom flange 123 of the dome is sealingly secured, as by screws 124; the top 125 of the dome being disposed somewhat below the tip of the basin top 119.

Rubber bushings 126, on the base ring 112, project upwardly through apertures in the basin rim 114 in sealed relation thereto, and enclose bolts or supports 127 on which are supported a ring 128. Elements 129, of substantially L-shape, each is secured, by one of its arms to the ring 128. The other arm of each element 129 is secured to a dome-like cover 132 for a motor M near the bottom of the cover, which has an annular bottom flange 133 sealingly seated on a grid element 134 in the form of an inverted pan having perimetrally-spaced vertical slots or apertures 135, a bottom perimeter sealingly fitted in the bottom perimeter 115 of the basin rim 114, and a slightly elevated closed top wall 136 about which the cover 132 fits.

Relatively long bolts 137 are secured to the grid top 136, and support the stator of the motor M, which stator comprises an electromagnet field-iron portion 138, and coils 139. A top bridge 142, between the bolts 137, supports the shaft 143 of the armature 144 of the motor M; the lower end of the shaft 143 being positioned by the top wall 136 of the grid 134. A fan 145 is provided on the shaft 143 for cooling the motor M.

A disc 146, and a cone 147 in the form of a downwardly-converging tapered tube, are supported at the lower end of the shaft 143 such that, upon high-speed rotation of the shaft, water in the tank 107 is drawn upwardly in the cone 147 and whirled by the disc 146 through the grid slot 135, being broken up into fine spray as it is impelled into the space 110 formed in the basin rim 114 and the basin cover 117.

The air draft from the fan 104 travels upwardly through the spaces 89 into a space 113 between the dome 122 and an outer cover 148 which is seated on the ledge 95, and encloses all of the upper elements of the unit. In passing the basin top 119, the air in the space 113 tends to create a vacuum in the basin whereby to atomize the spray or convert it into a completely vaporized yarn-treating medium therein, and impel the medium solely in vaporized form upwardly through the top 149 of the cover 148 into a conduit 152 extending along and adjacent to the sections E and F, Figs. 1, 5 and 7.

From the conduit 152, the mixture of air and atomized liquids travels along branch conduits 153 and 154 to upright nozzles 156 and 157 at the ends thereof extending through openings 155 in two of the sections F, at opposite ends of one of the intermediate sections F near the longitudinal center of the box, these openings being sufficiently larger in diameter than the nozzles, in the lengthwise direction of the composite box, see Fig. 12, to compensate for expansion, contraction, and any discrepancies of dimensions which might occur between the conduit structure and the box.

The ejector nozzles or conduit portions 156 and 157 are disposed in detachable longitudinally overlapping interfitted end-to-end relation to the conduit portions 153 and 154, respectively, and are provided with aprons or flanges 158, slidably mounted on the bottom wall portions 67, to seal the openings 155, see Figs. 7 and 12. The top ends of the nozzles 156 and 157 extend at right angles to the nozzle bodies proper to provide jet openings 159, see Fig. 5, facing oppositely toward the respective composite box ends 63; the moist air being thereby introduced into the box at a plurality of spaced positions suspended intermediate the walls of the box above the bottom portions 67.

Referring to Figs. 5, 6 and 8 for an under-

standing of the electrical and fluid circuits, and control apparatus, there are provided supply conductors 162 and 163, having a master switch 164 therein. A conductor 165, having a fuse 166 therein extends from the supply conductor 162 to one terminal 167 of a mercury-tube switch 168, Fig. 6, disposed in the composite box. A conductor 169 extends from the supply conductor 163 through a fuse 172 to branch conductors 173 and 174 extending to the electro-responsive motors N and M, respectively, which are thereby connected in parallel relation. Conductors 175 and 176, from the motors N and M, respectively, are branches of a conductor 177 which continues the circuit of conductor 169 to the other terminal 178 of the mercury switch 168. The latter constitutes part of a control device or humidistat P, not of my invention, except in combination with the other elements set forth for controlling a regulator structure, including the motors M and N, in determining the vapor output of the unit H, and comprising further, a panel 179, a pendulum pointer 182 for cooperation with a mark 183 to determine the level of the instrument, a main actuating arm 184 pivoted on a shaft 185, at the lower part of the device, an auxiliary arm 186 pivoted to the main arm 184 by a pintle 187, a spring 188, a spring 189, an adjusting sector 192, a moisture-extensive filament device 193, an adjusting terminal 194 for the device 193, an arm 195 pivoted on a pin 196 for carrying the mercury tube switch 168, and flexible leads 197 and 198 for extension from the terminals 167 and 178, respectively, to the terminals of the mercury tube 168.

The moisture extension device 193 preferably comprises a plurality of parallel horse hairs, or other filaments, strung in parallel between a stud 199 of the terminal 194 and the lower end 202 of the main lever 184. By adjusting the stud 199 in its stationary supporting bracket 203, and locking it with a nut 204, various adjustments of the device 193 may be effected for causing the switch 168 to operate at different degrees of humidity. The pintle 187 and the auxiliary arm 186 move in unison with the main arm 184 in an arc about the lower pin 185; the arm 186 being loosely connected, as by a fork, to the lever 195 whereby to actuate the latter a certain distance to make and break the circuit between the contact members in the tube 168, irrespective of variable throw of the arm 184. The spring 188 constitutes a yielding connection between the arms 184 and 186 whereby to compensate for the variable throw of the arm 184. The spring 189, connected between the arm 184 and a stationary bracket 181 of the device behind the sector 192, biases the arm 184 counterclockwise about its pivot pin 185, as viewed in Fig. 6, whereby to open circuit of the switch 168, when the device 193 becomes too wet for the degree of humidity desired to be maintained. By adjusting the sector 192 about the shaft 185, and setting it with a screw 206 in an arcuate slot 207 of the sector, the device may be caused to open and close the circuit of the switch 168 at any desired degrees of humidity in the composite yarn-moistening box.

As shown in Fig. 8, the level of the water 205 in the tank 107 is maintained substantially constant by a float lever 212 pivoted on a bracket 214 depending from the base ring 112, and having a ball float 215 at one end and a valve closure element 216 at the other end. The element 216 cooperates with the upper end of a water-inlet supply pipe 217 which, with an overflow pipe 218, extends through the bottom of the tank 107, and through the bottom wall 94 of the humidifier base 92, through sealing gaskets 219 and 222, respectively.

In operation, depending on the size, texture, degree of twist or other characteristics of the yarn 69, the humidistat is adjusted to close the mercury-tube switch 168, when the humidity of the moistening box, comprising sections F and E, falls below a predetermined point. With the master switch 164 closed, this action connects the motors M and N to the supply circuit conductors 162 and 163, whereby to start the motors to effect the above-mentioned atomizing action from the water in the tank 107 upwardly in the conical tube 147, radially outwardly along the disc 146, through the grid slots 135, upwardly in the space 110, and through the conduits 152, 153 and 154 to the nozzles 156 and 157. From the latter, the vapor is directed oppositely toward the end walls 63 of the composite box, and is preferably supplied in quantity just sufficient to properly moisten the various yarns, or sufficiently close to such quantity, to prevent excessive accumulation of condensed moisture in the box. When the humidity in the box attains a certain value, the switch circuit is opened, and a repetition of closing and opening of this switch maintains the humidity of the box substantially constant at all times.

By the several adjustments or simultaneously operable multi-control features provided, the degree of humidity, the temperature and the quantity of vapor or condensed moisture disseminated in the container may be closely predetermined and controlled, and may be different for different numbers of cones, different kinds of yarns, different surrounding conditions and various other factors. Thus, a control over a precise degree of humidification of the yarns is obtained which is not possible with the static pool, and a uniformity of moistening procured in all of the yarns of the multi-section knitting machine, not feasible with the separate box structure. By the elimination of many separate box end walls and other elements, the weight and number of parts are reduced, and economy effected.

As shown diagrammatically in Fig. 8A, a contact member 229 is pivotally mounted on an insulating panel 232 by a pivot pin 233 and provided with a crank arm 231 secured, by a link 234, to a bellows 235 which is connected by a conduit 236 to a bulb 237 in the tank 107 below the level of the liquid 205.

The bellows 235, the conduit 236 and the bulb 237 are filled by a substantially incompressible liquid which, when subject to temperature drop in the liquid 205, causes the bellows 235 to contract whereby to move the contact member 229, about its pivot pin 233, into engagement with a normally stationary contact member 238. The latter is in the form of a screw adjustably mounted in a lug 239 on an insulating plate or sector 242 which is also pivotally mounted on the panel 232 by the pin 233. An operating shaft 243, mounted on the panel 232 in a bearing 244 has a knurled handle 245 and a worm screw 246 which engages a worm-wheel sector 247 on the insulating sector 242 whereby to adjust the latter about the axis of the pivot pin 233. Thus, by turning the handle 245, the normally stationary contact member 238 may be moved bodily so that the distance required by the movable contact mem-

ber 229 to be moved to engage the stationary contact member may be varied. This distance may be further adjusted by turning the stationary contact screw 238 in its lug 239. This structure constitutes a regulator for engaging and disengaging the contact members 229 and 238 at selected temperatures of the liquid 205 in the tank 107, and consequently, of the incompressible liquid in the bellows 235, the conduit 236 and the bulb 237.

A circuit extends from the main circuit conductor 163, through a conductor 248, a flexible conductor 249, the crank arm 231, the movable contact member 229, the stationary contact member 239, a flexible lead 250, a conductor 251, and an electromagnetic switch or relay coil 252, back to the opposite main circuit conductor 162. This circuit controls the opening and closing of another circuit, between the main circuit conductors, through stationary switch members 253, and a movable switch contact member 254 that is biased to closed-circuit position against the contact members 253 by a solenoid core 255 against the action of a spring 256; the latter circuit continuing from the main-line conductor 163 and the switch-contact members, through a conductor 257. The latter has branch lines 258 and 259 leading, respectively, to one terminal each of electric heaters 260 and 261 in the tank 107 below the level of the water 205. From the heaters 260 and 261, conductors 262 and 263, respectively, join a conductor 264 leading back to the other main circuit conductor 162.

The handle 245 is manipulated to place the stationary contact member 238 at a selected position relative to the movable contact member 229, representing the temperature at which it is desired to maintain the liquid 205 in the tank 107. If, at the time of so operating the handle 245, the temperature of the liquid 205 in the tank 107 is lower or higher than the selected value, since the movable contact member 229 will be at a position representing the actual temperature of the liquid at the time of the adjustment, such operation will engage or disengage the contact members accordingly. In the first case, the circuits of the coil 252, and of the heaters 260 and 261, are closed to raise the temperature of the liquid in the humidifier H to such point as to expand the bellows 235 and open the circuits. Cooling of the liquid in the humidifier contracts the bellows to close the circuits, and this cycle is repeated at each small departure from the temperature at which it is desired to maintain the water 205. This temperature is such that the temperature of the vapor in the composite box B is maintained at a desired point, preferably substantially below the temperature of steam, yet sufficiently high to effectively accelerate the penetrating action of the vapor into the yarns 69.

With the humidifiers heretofore employed, when a machine is shut down for any appreciable period of time, as over night or longer, the yarn in the box is found to be too dry for use, thus necessitating loss of time and labor in correcting this condition, which is caused by the fact that, after the cones are brought from a conditioning room and placed in the box, altho the humidity of the air in the box may be sufficient to retard drying of the yarn so long as the machine is kept fairly busy, it is not sufficient to prevent excessive drying of the yarn over long periods of inactivity.

With the device of my invention, the above condition may be entirely eliminated by maintaining the humidifier in operation at all times during the ordinary working and idle periods of the machine.

By the uniform conditioning of the yarns, much operating trouble is avoided, a better fabric is produced, operating costs are lowered, and a device is obtained which is substantially more effective than, and an improvement over, other devices in its field.

Also, the conditioning of the yarn by the invention may be such as to preclude the requirement for preconditioning in the above-mentioned conditioning room, and to render unnecessary any subsequent treatment, as by passing the yarn through the moistening troughs; in which latter case, the length of yarn between the cones and the carrier will be shortened by the elimination of the troughs.

In the modification of my invention, indicated in Figs. 15 and 16, instead of directing the moist air oppositely along the interior of the composite box, and from only two jets, as in the above-described form of the invention, the air is directed vertically from the bottom center of each box section E*a* and F*a*, to accomplish which result, conduits 153*a* and 154*a*, longer than the conduits 153 and 154, are extended from the humidifier unit H along the box, and are provided with tubular side outlets 160 into which are fitted short tubular nozzles 156*a* having flanges 158*a* resting on the bottom walls 67*a* of the box sections; the nozzles 156*a* being of the same diameter relative to each other.

As shown, in Fig. 18, the nozzles 157*c*, fitting outlets 160*c*, of the conduit 154*c*, have jet apertures 161 of progressively increasing diameter from the nozzle 157*c* nearest to the humidifier unit H to the nozzle 157*c* in the right end box section, whereby to compensate for pressure drop along the conduit, and to thus ensure more uniform expulsion of the vapor from the nozzles of the various sections, it being understood that the nozzles to the left of the humidifier unit also have progressively larger jet openings. In this form, the nozzles are simple cylindrical tubes having washer-like flanges 158*c* resting on bottom walls 67*c*, in which flanges the variably sized apertures 161 are provided. In the various forms of the invention shown, the brackets 33 and 34 remain the same.

In Fig. 19, the variably-sized jet apertures are obtained in nozzles 157*d* by variously tapering the top ends of tubes of originally the same diameter throughout. These tubes are provided with flanges 158*d*, and are fitted into outlets 160*d* of conduit 154*d*, which, like the conduit 154*c* corresponds to the conduit 154 of the previously described figures.

Fig. 17 illustrates a sectionalized box, similar to the previously described boxes of Figs. 1 and 15, except that, instead of being adapted for cooperation with a forced-draft humidifier system, is adapted for a stationary pool humidifier. It comprises end and intermediate box sections E*b* and F*b*, similar to the corresponding sections of the above-described structures, inturned end flanges 78, as in the described structures, the sheet-metal members 79, the end walls 63, and other elements, as above described, the main difference being that the humidifier unit H, and its associated conduits and nozzles, are omitted, and stationary pools 223 of water provided either directly in the bottoms 67*b* of the box sections or in removable pans 224, below the

bottoms 67b of the sections and giving its vapor through openings 225 in the bottoms as shown, and similar to usual structures of this kind. The end and intermediate brackets 34 and 33 may be the same as above set forth.

In prior art structures, in which each box has its individual pan of water, when the door of one box is opened, although the air in the other boxes is not thereby affected, the air in the opened box loses a certain amount of its humidified air which is replaced only in a relatively slow manner by the comparatively small water pool of such box, so that even where an active humidifying unit is not employed, the composite box structure of Fig. 17 will operate better than the individual box arrangement with the stationary water pools. This is because of the open end communication between the box sections, such that, when the door of one section is opened, although the air in all of the sections may be slightly affected, this effect will be very materially less than the above mentioned corresponding effect in the individual box structure. Also, by reason of the intercommunication between the sections, the pools in these sections aid each other in affecting the interior space of the sections as a whole, so that, after a section has been opened and closed, the recovery from any loss of humidified air will be materially quicker.

As illustrated in Figs. 20, 21 and 22, provision is made for removing one or more of the component box sections E and F from service, while another or others remain in operative position, and closed at the end or ends. Closure plates or lids 231, of which two are preferably provided with each composite box, are provided with handles 226, a pair of top clips 227 and a bottom clip 228. The clips 227 and 228 have a certain amount of resiliency and are shaped such that, when the plate is grasped by the handle 226 and thrust against the end of a box section in parallel plane relation thereto, the clips spring over the arms 35 and 36 of the bracket 33 to effectively bind the plate against the box. It is contemplated that four such lids could be employed, with two of them as above set forth in connection with Figs. 20, 21 and 22, and two of them as readily removable permanent end closures in the places of the end walls 63, whereby all the box sections would be alike and interchangeable. When a section is removed, as illustrated in Fig. 20, the corresponding nozzle top of the conduit 154 will be closed, as by a cap 230.

Of course, the improvements specifically shown and described, by which the above-mentioned results are obtained, may be changed in various ways without departing from the invention as set forth and claimed.

I claim:

1. The method of treating yarn in a knitting machine yarn container, which comprises generating a yarn treating medium, surrounding the yarn within the container with said medium to provide for continuous reception by the yarn of the medium at a varying rate in accordance with variations in the quantity, rate of medium-receiving quality, and feeding of the yarn to the knitting mechanism of the machine, and generating the yarn treating medium, and supplying the same to the yarn, in accordance with said varying rate of reception by the yarn of the medium.

2. The method of conditioning yarn in a knitting machine provided with a yarn receptacle from which yarn is fed to the knitting mechanism, which comprises the mechanical conversion of a liquid from a supply into a vaporized medium, uniformly conditioning the yarn in the receptacle by the liquid in the form of said vaporized medium by distributing said medium uniformly throughout the receptacle, and controlling such conditioning by automatically regulating said mechanical conversion in accordance with conditions in the receptacle.

3. The method of ensuring that the variable supply of yarn of a knitting machine shall be maintained in predetermined condition for most efficient manipulation by the needles, sinkers and dividers of the knitting mechanism at the time of knitting a fabric from the yarn, which comprises enclosing the yarn in a container from which the yarn feeds directly to the knitting mechanism, providing in the closed container in contact with the yarn supply a vaporous medium produced from a yarn-treating liquid, and controlling the temperature of the liquid to have any one of a selection of values.

4. In a multi-section machine for producing knitted fabrics, a continuous yarn housing structure extending along a plurality of machine sections and comprising separate cooperatively associated yarn container units for enclosing a yarn-treating medium, and means for maintaining the yarn-treating medium uniformly distributed and homogeneous throughout the length of said housing structure, comprising means cooperatively connecting said yarn container units, said units and said maintaining means being arranged to effect free distribution and homogenization of the medium throughout the length of the housing structure.

5. The combination with a machine for producing a knitted fabric from a plurality of yarns, of a yarn housing arranged to contain a preconditioned medium for treating the knitting yarn within said housing, a reservoir for a substance to be converted into a yarn treating medium, means for producing a preconditioned yarn treating medium including generating means for converting a portion of said substance into yarn treating medium at a rate corresponding with the varying rate of absorption of the medium by the yarn, means for varying the temperature of the medium, a regulator for the medium generating means, a regulator for the medium temperature varying means and a control device for one of said regulators motivated by a change in the condition of the medium within said housing.

6. In a machine for producing a knitted fabric, the combination with knitting mechanism, and a yarn conditioning system including a yarn housing containing a yarn treating medium, means for supplying a yarn treating medium to the housing, means for varying the humidity of the medium, and means for varying the temperature of the medium; of multi-control means for regulating said yarn conditioning system to maintain the character of the yarn conditioning medium at different predetermined values, including means responsive to variations in humidity of said medium, and means responsive to variations in temperature of said medium, said responsive means being arranged to cooperate with the means for varying the humidity of the medium and the means for varying the temperature of the medium for simultaneously maintaining the humidity and temperature of the medium at predetermined values.

7. In a knitting machine, knitting mechanism, a continuous yarn receptacle including a plurality

of separately removable sections connected in series, a conduit extending along and adjacent to said sections, separable connections between said sections and conduit, liquid supply means, and mechanical means for converting such liquid into a vaporized medium and forcing said medium through the conduit into the sections for the uniform conditioning of the yarn in said sections.

8. In a multi-section knitting machine, knitting mechanism, an elongated continuous yarn receptacle including a plurality of separately removable sections connected in series to form a continuous passage for a vaporized conditioning medium, and means for introducing conditioning vapor into the sections, arranged to effect circulation of the vapor between the sections within the passage for the uniform conditioning of the yarn in said sections.

9. In a multi-section knitting machine, knitting mechanism; an elongated sectional yarn receptacle extending along a plurality of sections of the knitting machine and having a plurality of separately removable sections connected in series; and means for vaporizing a liquid conditioning medium and disseminating said vapor within the receptacle by forced circulation for the uniform conditioning of yarn in the receptacle.

10. In a multi-section knitting machine, knitting mechanism; an elongated sectional yarn receptacle extending along a plurality of sections of the knitting machine and having a plurality of separately removable sections connected in series; and means for vaporizing a liquid conditioning medium and forcing the medium in vaporized condition into the receptacle for the uniform conditioning of yarn in said receptacle.

11. In a knitting machine, knitting mechanism, means including a series of separable sections forming a continuous yarn receptacle, a conduit extending along and adjacent to said sections, separable connections between said conduit and sections, liquid supply means, and mechanical means for converting such liquid into a vaporized medium and forcing said liquid in the form of such vaporized medium through said conduit into the sections for the uniform conditioning of the yarn in said sections.

12. In a knitting machine, knitting mechanism, a continuous yarn receptacle including plurality of separately removable sections connected in series, a conduit extending along and adjacent to said sections, separable connections between said conduit and sections, liquid supply means, and mechanical means for converting such liquid into a completely vaporized medium and forcing said liquid solely while in the form of such vaporized medium through said conduit into the sections for the uniform conditioning of the yarn in said sections.

13. A yarn-conditioning device, for a textile-working machine, comprising a box, yarn-package supporting means in the box, means for humidifying the air in the box including a source of moisture, an air-impelling device and an ejector conduit extending from said device and having a plurality of jet openings in the box of successively larger sizes from a jet next to the impelling device to a jet furthest therefrom, and means for leading the yarn from the box toward the machine.

14. A yarn-conditioning device for a knitting machine comprising a support, a composite elongated box unit on the support including a plurality of longitudinal communicating component box sections, yarn-package supporting means in the box, means for leading the yarn from the box toward the machine, means for humidifying the air in the box, means for readily detachably connecting said sections to each other, and means for closing an end of one of said sections in operative position when the section adjacent to said end is displaced from operative position.

15. A yarn-conditioning device for a knitting machine comprising a support, a composite elongated box unit on the support including a plurality of longitudinal communicating component box sections, yarn-package supporting means in the box, means for leading the yarn from the box toward the machine, means for humidifying the air in the box, means for readily detachably connecting said sections to each other, and means for closing the ends of two of said sections in operative position when a section or sections normally intermediate said two sections are displaced from operative position.

16. A yarn-conditioning device, for a yarn-fabricating machine, comprising a base, a box structure, means for mounting the box structure on the base including a bracket having an element for attachment to the base and a portion of substantially C-shape for surrounding three sides of the box structure, a clamp for attachment to the ends of the legs of the bracket and closing the open side thereof in clamping cooperation with the box, means for humidifying the air in the box, yarn-package supporting means in the box, and means for leading the yarn from the box toward the machine.

17. A yarn-conditioning device, for a yarn-fabricating machine, comprising a base, a box structure, means for mounting the box structure on the base including a bracket having an element for attachment to the base and a portion of substantially C-shape for surrounding three sides of the box structure, said bracket having an integral flange of closed-loop shape in a plane transversely to the longitudinal axis of the box opposite an end of the box adjacent thereto and, with said portion of C-shape, forming substantially a rabbet groove on said three sides, a clamp for attachment to the bracket along said flange at the fourth side of the box to clamp the box in position, means for humidifying the air in the box, yarn-package supporting means in the box, and means for leading the yarn from the box toward the machine.

18. A yarn-conditioning device comprising a composite elongated box including separable longitudinal sections having adjacent longitudinally-abutting transverse perimetral end flanges, a plate mounted on one of said sections and overlapping the adjacent section, a base and means for mounting the box on the base including a bracket having an element for attachment to the base and a portion of substantially C-shape embracing three sides of the box transversely thereto over said plate, said portion of C-shape spanning adjacent ends of said box sections longitudinally of the box, a clamp for attachment to the ends of the legs of the bracket across the fourth side of the box, also spanning said ends longitudinally of the box and clamping the sections in position, yarn-package supporting means in the box sections, means for humidifying the air in the box sections, and means for leading the yarn from the box sections.

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