April 5, 1927. 1,623,080

E. J. ZIOCK

METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES

Filed May 7, 1924 8 Sheets-Sheet 1

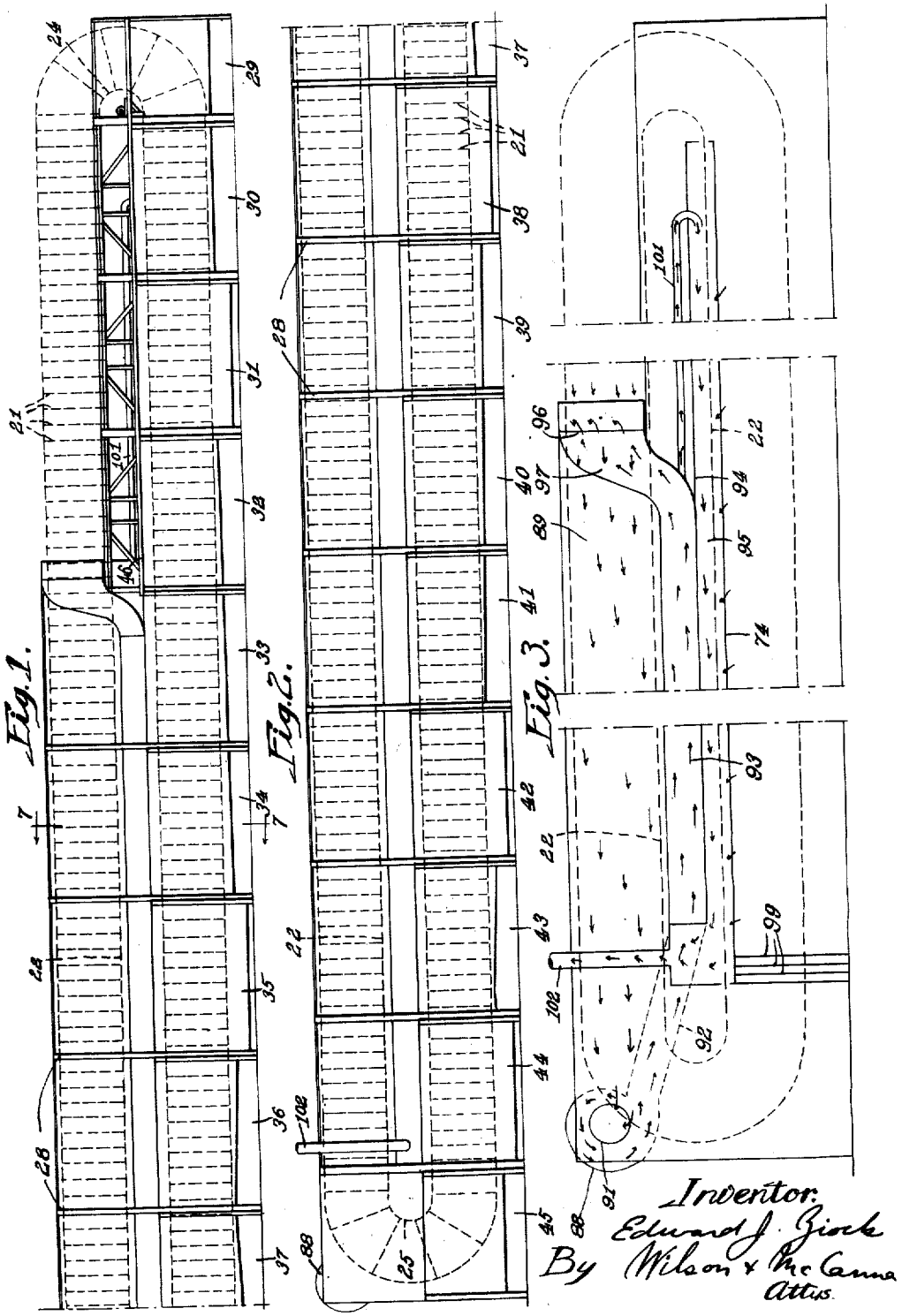


Fig. 1.

Fig. 2.

Fig. 3.

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METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES

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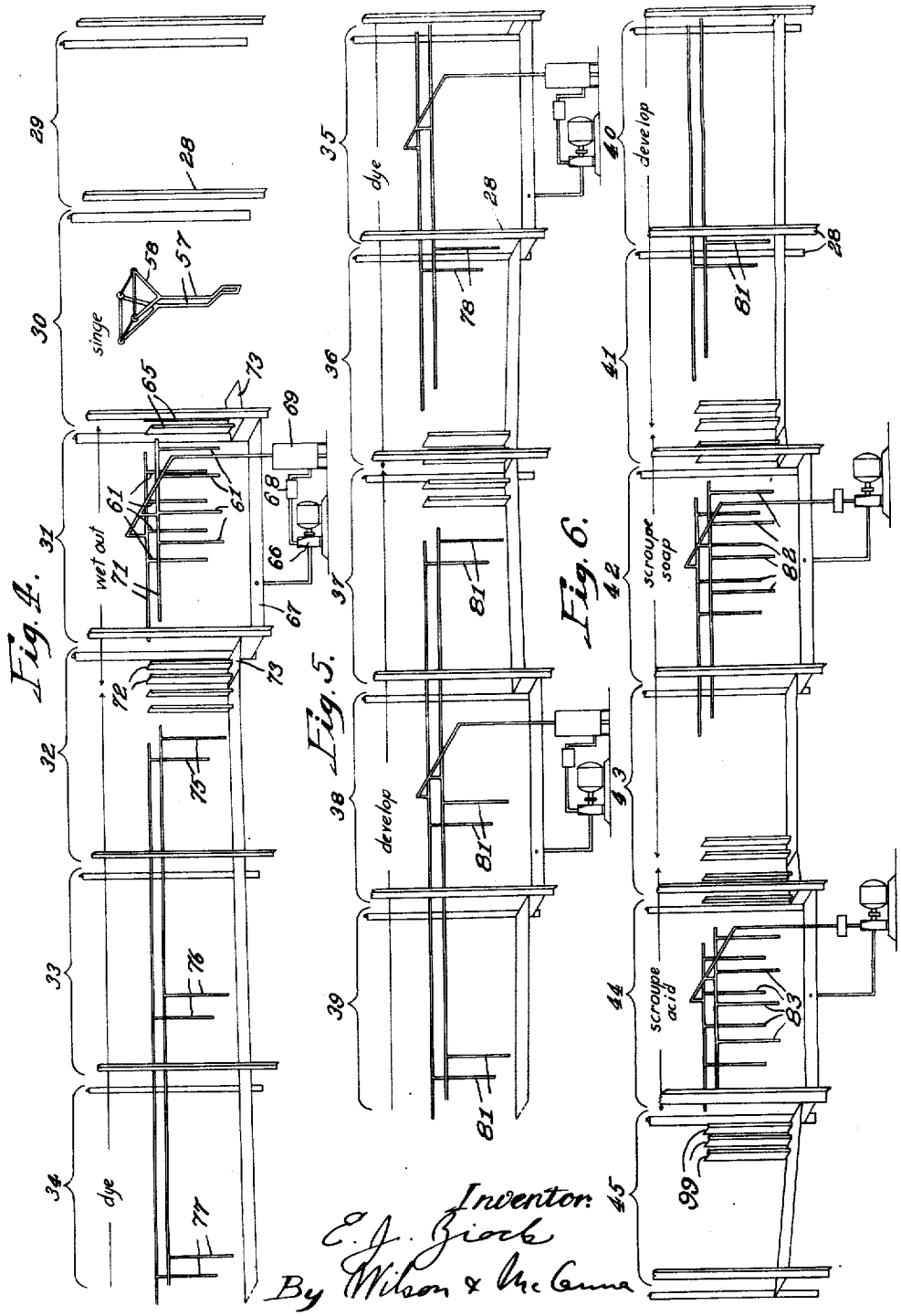



Fig. 4.

Fig. 5.

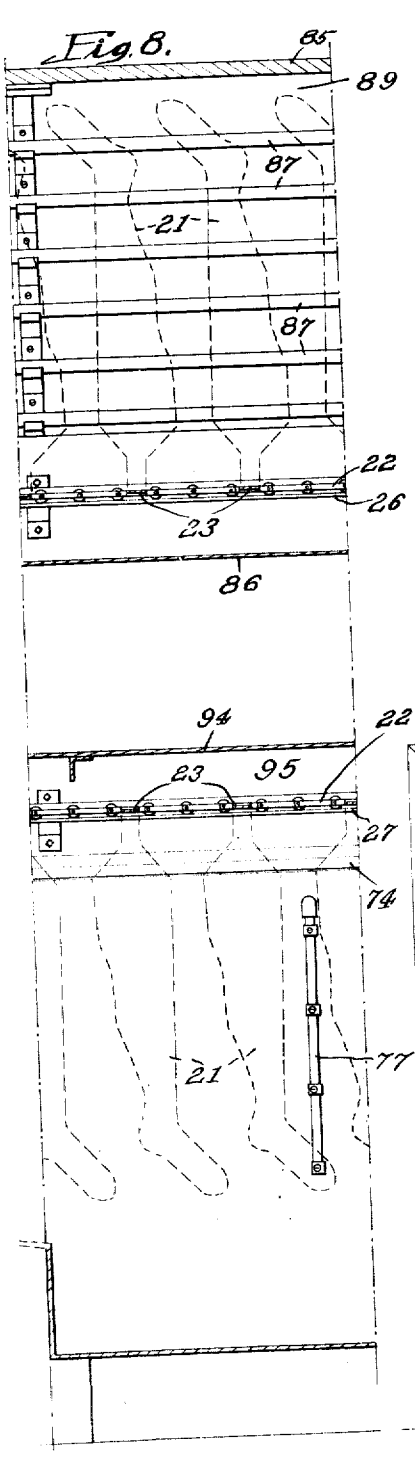
Fig. 6.

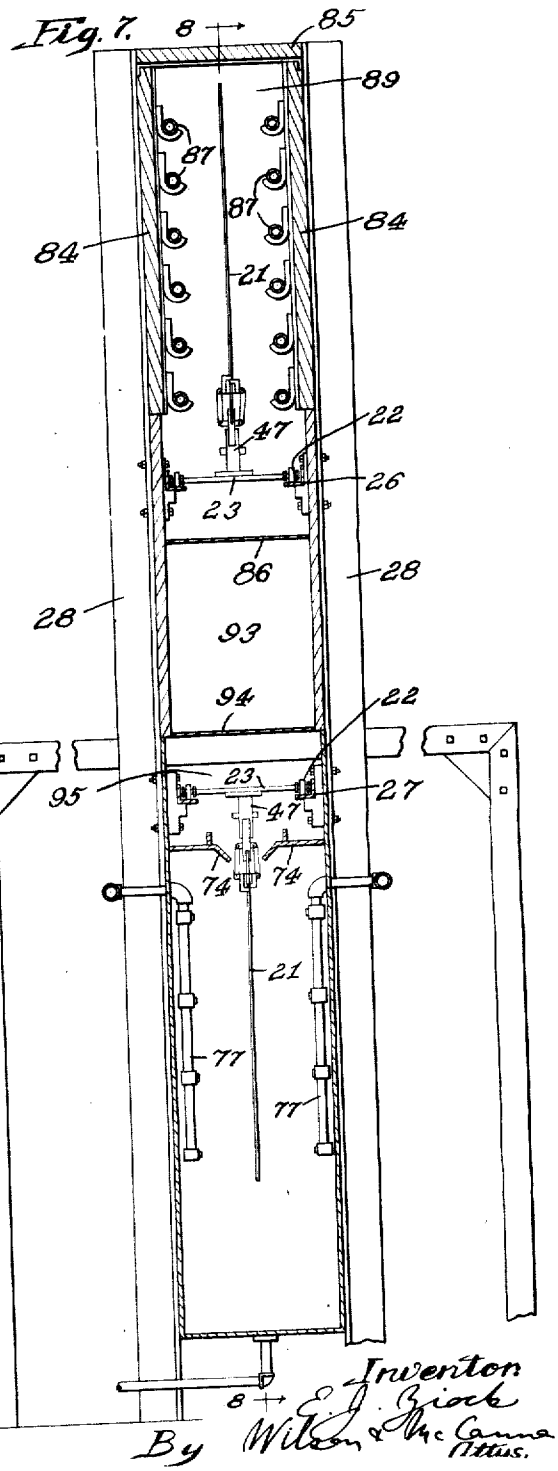
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METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES

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METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES

Filed May 7, 1924 8 Sheets-Sheet 4

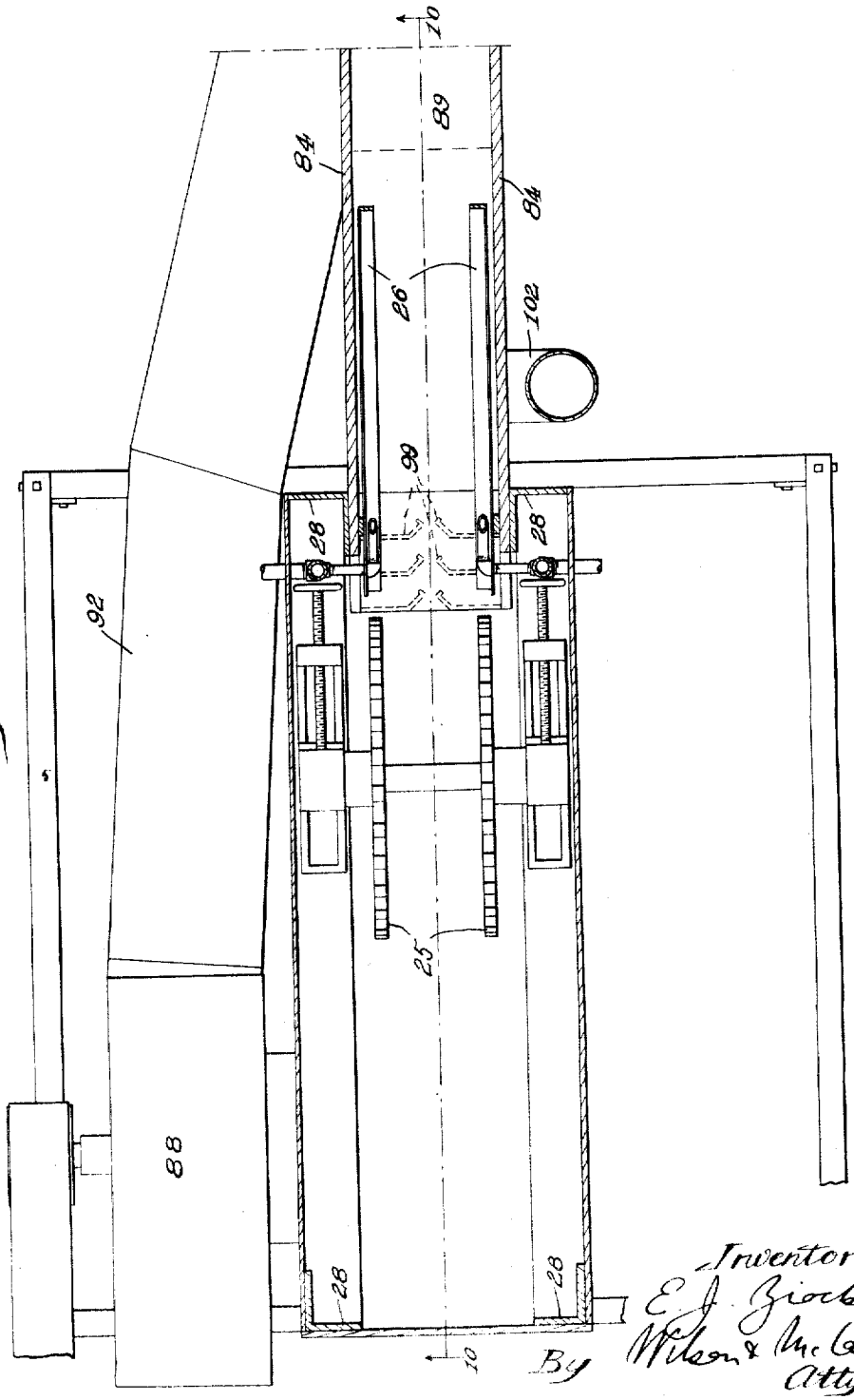



Fig. 9.

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METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES

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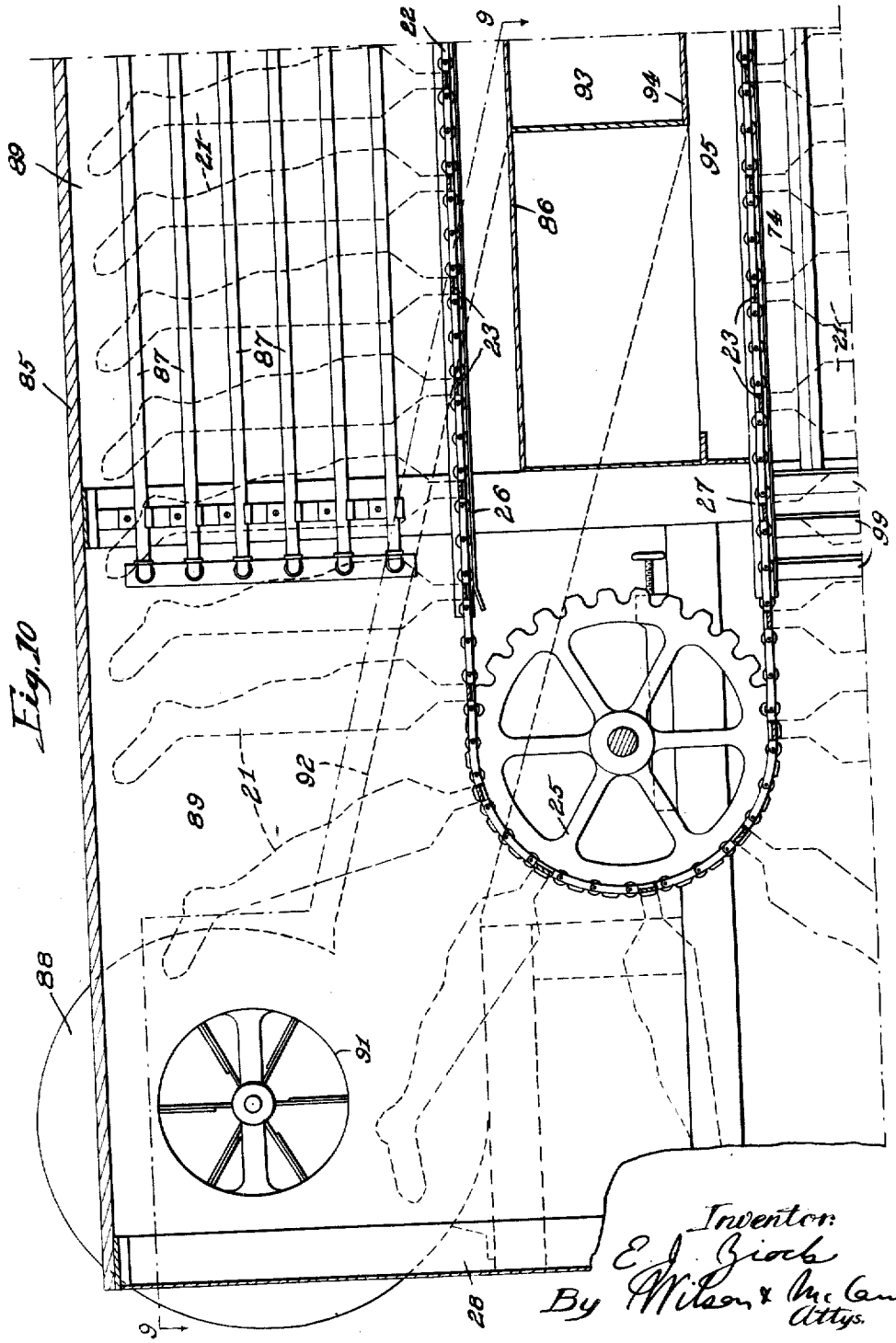



Fig. 10

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METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES

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Fig. 11.

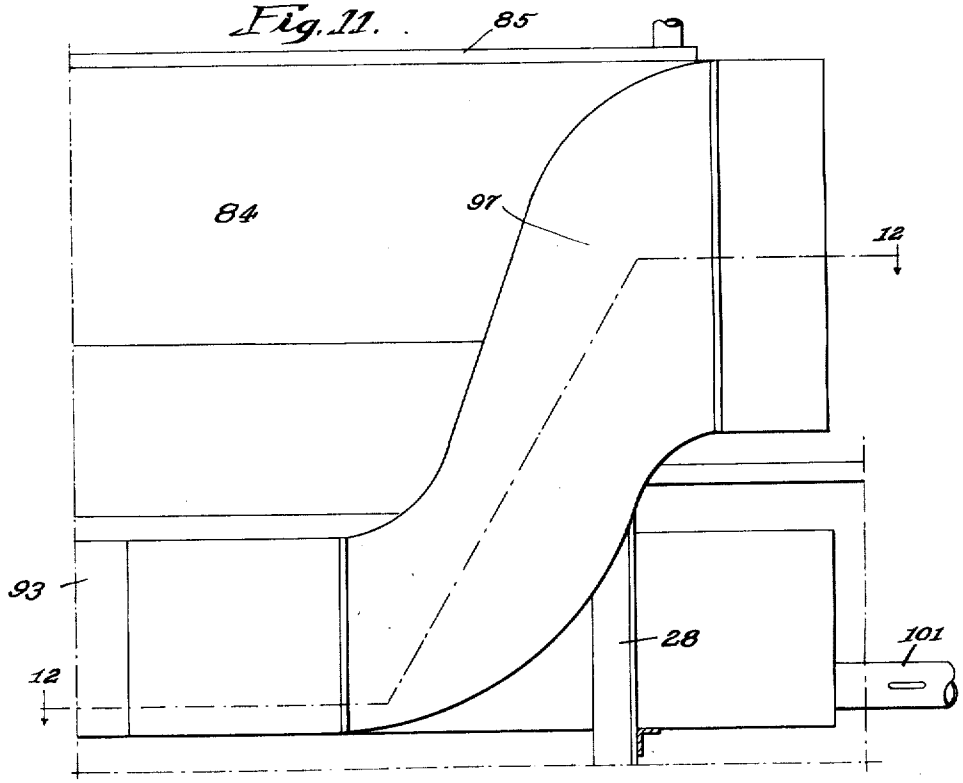
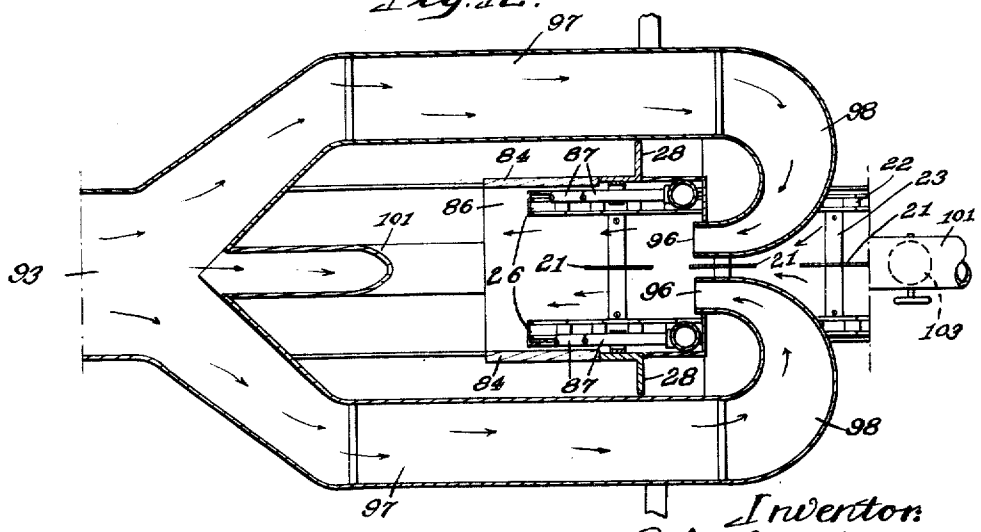



Fig. 12.




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METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES

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Fig. 22.

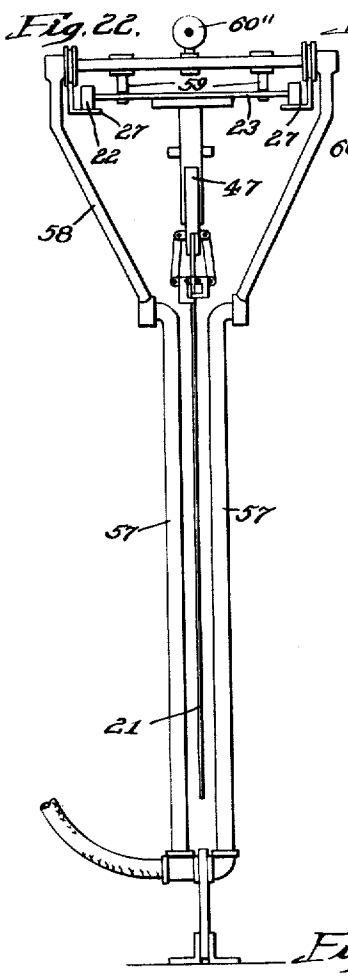



Fig. 21.

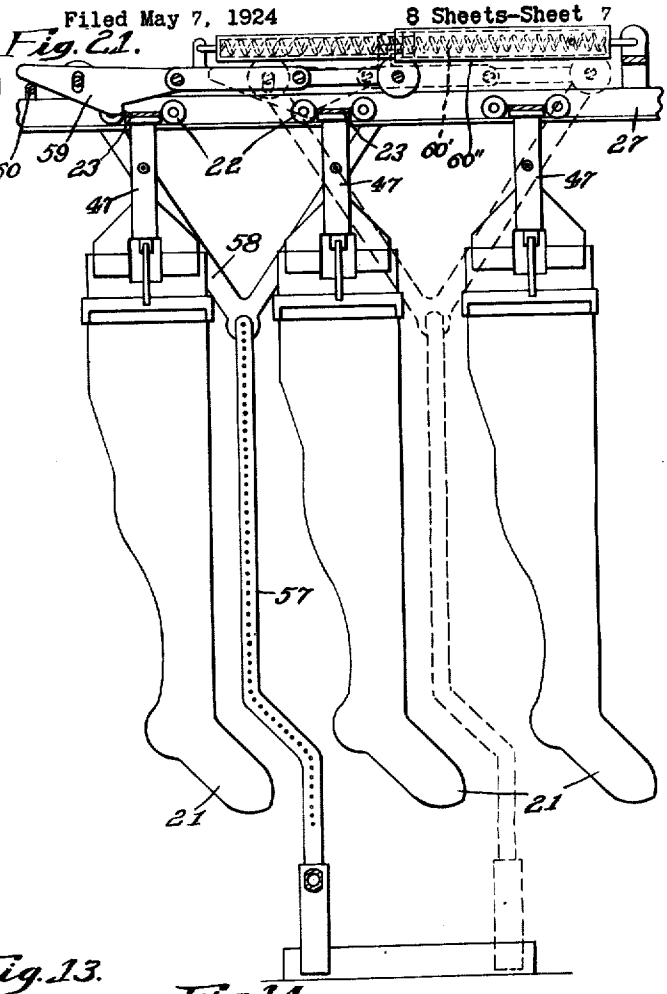



Fig. 13.

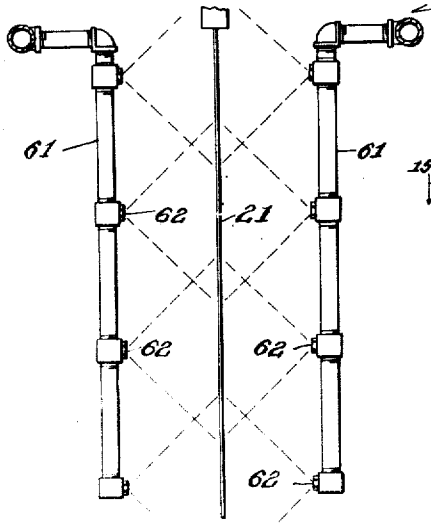



Fig. 14.

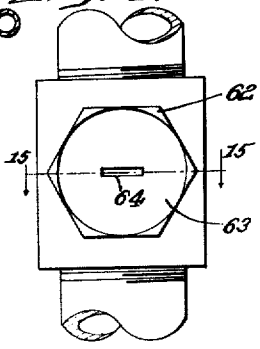
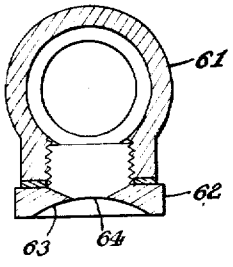



Fig. 15.




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Fig. 16.

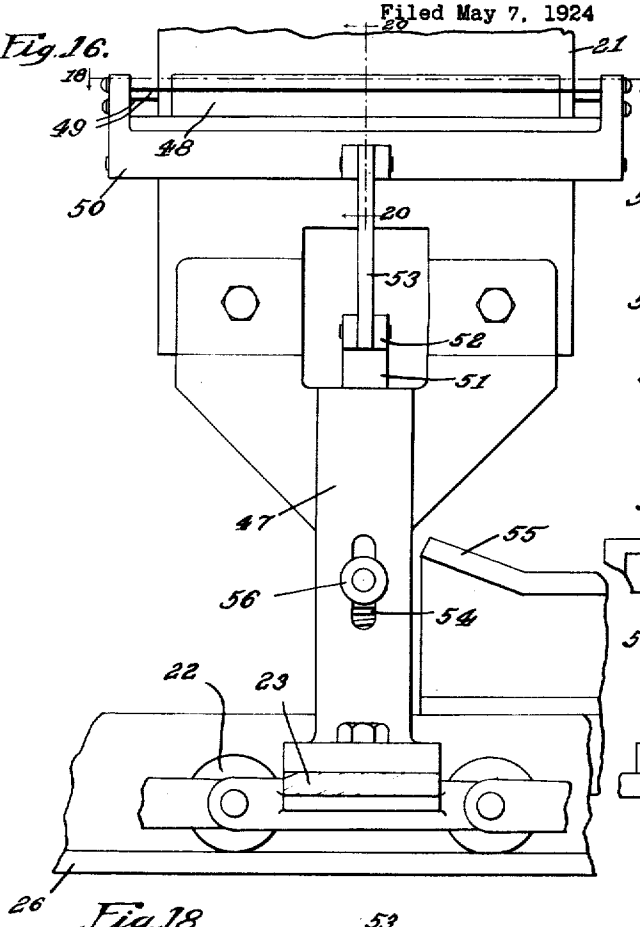



Fig. 17.

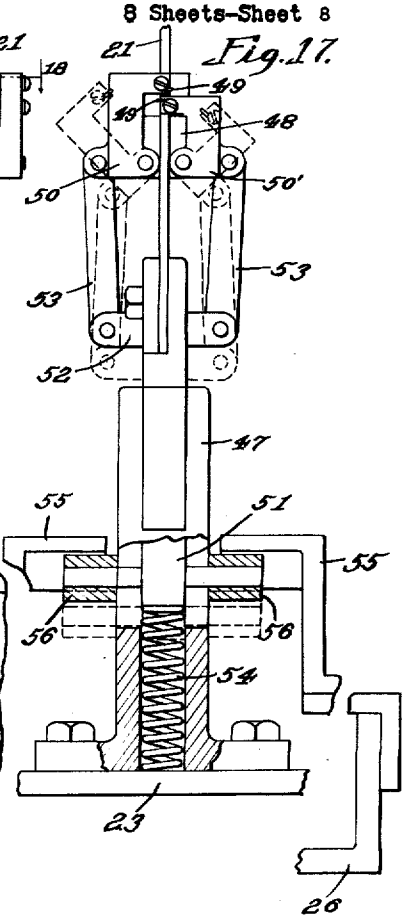



Fig. 18.

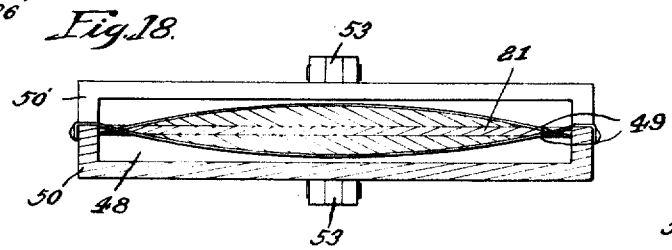



Fig. 20.

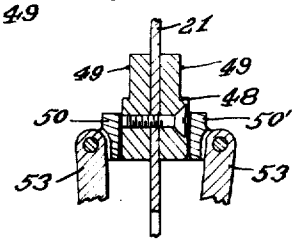



Fig. 19.




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# UNITED STATES PATENT OFFICE.

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## METHOD OF AND APPARATUS FOR FINISHING KNITTED ARTICLES.

Application filed May 7, 1924. Serial No. 711,565.

This invention relates to the finishing of knitted articles after they have been manufactured, that is, knitted and otherwise completed in so far as their fabric structure is concerned. By "finishing" I refer to operations and processes which follow the manufacturing operations and are performed in bleaching, mercerizing, dyeing, etc., and which may consist in developing, singeing, dyeing, drying, pressing and the like. By "knitted articles" I mean fabric articles, either knitted or woven, and especially hosiery. While the present invention is applicable to the finishing of various knitted articles it is intended primarily for finishing stockings, especially those of a high grade and texture which require a fine degree of finish.

One of the purposes of my invention is to provide a new method of and apparatus for finishing knitted articles, whereby to materially lower the cost of production of such articles and at the same time obtain greater uniformity and fineness of finish in the resultant product.

In furtherance of the foregoing my invention contemplates broadly, certain new methods, principles and apparatus so coordinated as to perform in a single machine the many operations required in finishing stockings or other knitted articles, and doing in a comparatively short time, in fact a matter of minutes, what heretofore required in the commercial finishing of stockings in large quantities, many days from the time the stockings entered a stock room where the lots were made up preparatory to entering upon the finishing operations until the finished articles reached the shipping room.

This method consists, generally stated, in completely finishing the knitted articles by a series of operations performed in succession or progressively by coordinated devices. These operations are all performed on each knitted article while it is boarded, that is, carried or held on a board or form which is preferably flat and shaped to conform substantially to the shape of the article and to hold the fabric extended to permanent dimensions. More particularly the method consists, but not necessarily, in boarding the stockings or other articles at a loading station, carrying the boarded stockings at uniformly spaced intervals by means of an endless continuously traveling carrier successively to different stations at which the stockings are singed, wetted out, dyed, subjected to a scroupe bath, dried, shaped, and finally delivered to an inspection station and unloaded. This method, the several steps of which will be explained more fully herein after, makes possible and my invention provides as one of its objects, combining into a single machine, devices for performing in a new and better way certain operations which heretofore were performed by independent machines. The many advantages of this method will be apparent to those skilled in this art when it is considered that under the prior practice the machines for performing the different operations were segregated, due to the nature of their construction and operation, making it necessary to handle and truck the stockings between each operation. This practice also imposed a comparatively high labor and operating cost and, moreover, made it necessary to allow for each batch or lot of stockings a comparatively large surplus number of stockings in order to prevent delay due to losses occasioned by imperfections and roughing the stockings during certain operations, and for other reasons well known in this art. It also required matching the stockings as to shades and length. These limitations imposed a considerable amount of time so that in some hosiery mills it required several weeks or more for the passage of a stocking through the mill for finishing. According to my invention practically all of the operations are performed on a stocking while it is on a board or form and by employing an endless carrier for moving the boarded stockings from station to station and novel devices for performing the several processing or finishing operations. Thus the many manual operations heretofore required are eliminated, a uniform product is obtained and the time for finishing is reduced to a matter of minutes.

My invention also contemplates the provision of an improved method of performing certain of the processes in which the stockings are subjected to liquid solutions, consisting in spraying such solutions onto the boarded stockings as will be explained more fully hereinafter. This is especially desirable and advantageous in applying the dye solution and in this regard the manner in which the dye is sprayed onto the stockings

and the time elements involved are important factors in the practical application of my invention.

Still another object is to provide apparatus for performing these methods; and while this apparatus embodies certain principles of operation and construction which are very desirable and advantageous, nevertheless it should be understood that my invention in its broader aspects is not limited to the use of the apparatus disclosed herein nor to the mode of operation disclosed.

Other objects and attendant advantages will be appreciated by those skilled in this art as the invention becomes better understood by reference to the following description when considered in connection with the accompanying drawings, in which—

Figure 1 is a side elevation, diagrammatic, of one half the length of a machine embodying my invention, showing the loading and unloading end;

Fig. 2 is a similar view of the other half of the machine;

Fig. 3 is a diagrammatic view illustrating the air circulating system;

Figs. 4, 5 and 6 are diagrammatic views illustrating the different stations at which the stockings are subjected to processing operations:

Fig. 7 is an enlarged vertical transverse section through the machine taken substantially on the line 7—7 of Fig. 1;

Fig. 8 is a section taken on the line 8—8 of Fig. 7;

Fig. 9 is an enlarged horizontal sectional view of the carrier return end of the machine, taken substantially on the line 9—9 of Fig. 10;

Fig. 10 is a vertical section taken substantially on the line 10—10 of Fig. 9;

Fig. 11 is an enlarged vertical sectional view showing in side elevation the air injector end, also referred to hereinafter as the stocking-exit end, of the drying compartment;

Fig. 12 is a section taken substantially on the line 12—12 of Fig. 11;

Fig. 13 is a cross-sectional detail showing the action of one set of the liquid spray-delivering nozzles;

Fig. 14 is a face view of one of the spray nozzles;

Fig. 15 is a section taken on the line 15—15 of Fig. 14;

Fig. 16 is a side elevation of a clamping device employed with each of the stocking holding forms;

Fig. 17 is an end view of said clamping device;

Fig. 18 is an enlarged section taken on the line 18—18 of Fig. 16;

Fig. 19 is a top view of one of the clamping members removed from the device;

Fig. 20 is a section taken on the line 20—20 of Fig. 16; and

Figs. 21 and 22 are side and end views respectively, of the singeing device.

Before entering into a detailed description of the apparatus herein disclosed I will describe briefly the method of finishing stockings, taking the operations as they are performed in sequence. At a loading station the stockings are boarded, that is, they are drawn onto boards or forms which are preferably comparatively flat and shaped to conform to the shape of the knitted stocking so as to hold the fabric extended. That is, the stocking is held to permanent dimensions so that the fabric will be uniformly presented throughout its area to the action of the several processing devices. The stocking will be drawn onto the form to predetermined length and held to such length by a suitable clamping or holding device. The stocking forms are attached at uniform intervals to an endless carrier which in the present instance has an upper and a lower run or flight and is propelled continuously so that the stocking forms travel in one direction on the upper run and in the opposite direction on the lower run. In this instance the stockings are boarded at a loading station located at the end of the upper run. The boarded stockings will be carried from the loading station by travel of the carrier to the beginning of the lower run at which is located a singeing device. This device includes singeing elements on opposite sides of the forms, which devices may be either stationary or caused to move relatively to the forms so that the heating elements travel across the flat sides of the stockings at a uniform speed, according to the nature of the singeing elements employed. It will be here noted that each stocking form is arranged with its flat plane parallel with the travel of the carrier so that the knitted fabric at each side of the board will be at a uniform distance from the singeing devices, spray nozzles, heating medium and other instrumentalities which may be employed in the different processes, with the result that the fabric of each stocking will be uniformly treated over its entire surface as will be more fully described hereinafter. The boarded stockings will then be carried between opposed spray nozzles which deliver an alkaline solution, this operation being termed "wetting out." The purpose of this is to condition the fibres so as to aid penetration and precipitation of the dye. The dye is also applied preferably by means of spray nozzles positioned in opposed relation so that the boarded stockings travel between the nozzles. A series of dye sprays are spaced apart in the direction of travel so that a time element intervenes between each dyeing opera-

tion. The purpose of this and the advantages of this method of dyeing will be explained hereinafter. Following this, the dyed stockings will be carried between plural series of sprays which deliver a developing solution, a soap or acid solution or both, known as "scroupe," the purpose of which is to remove surplus dye, fix the dye and to condition the dyed fabric as is well known in this art. These spraying operations are preferably, but not necessarily, performed in succession during travel of the boarded stockings on the lower run. From here the stockings will be raised to the beginning of the upper run and carried into a drying compartment which in the present embodiment of my invention extends throughout the major portion of the upper run. The drying process also shapes the stockings on the forms so that the stockings emerge from the drying compartment finished and ready for inspection. The stockings will be inspected on the forms and will be carried to an unloading station at which they will be removed and packed in boxes ready for shipping. The unloaded forms are then carried to the loading station and the operation repeated.

The apparatus herein disclosed for performing the method just described of completely finishing stockings by progressive steps or operations performed on the stockings while they are held on continuously traveling forms, is merely for purposes of illustration and other constructions might be employed with variations in the steps and operations, although the present apparatus embodies certain novel principles which are desirable and beneficial in the practical application of my improvements to finishing knitted articles such as stockings. The boards or forms designated generally by 21 are preferably of aluminum, shaped to conform to the knitted shape of the article or to any given shape which it is desired the article shall conform to when finished, except that the form is flat and tapered at its edges to a sharp but rounded edge so that the fabric of the stocking is held extended or taut without appreciable stretching. Each stocking will be drawn onto the form to a predetermined length and held at such a length throughout the operation by a suitable clamping or holding device which will be described presently. These forms are suitably attached to an endless carrier designated generally by 22 which in the present instance comprises a pair of roller chains (Fig. 7) connected together by cross bars 23 which may serve to carry the stocking forms. The carrier chains are trained over sprocket wheels 24 and 25 horizontally spaced apart and supported for rotation on a suitable frame structure. This provides upper and lower carrier runs or flights which are supported from end to end by suitable tracks 26 and 27 respectively (Figs. 7 and 8). In this case the stocking forms extend outwardly from the carrier and are spaced apart at uniform intervals as indicated by the dotted line positions in Figs. 1 and 2 and are arranged in a common plane with the flat plane of the forms parallel with the line of travel of the carrier as clearly shown in Figs. 7 and 8. The purpose of this is to uniformly present the fabric at each side of a form to the action of the singeing device, sprays and drying agencies, so that the action and effect of each such instrumentality and process will be the same on the fibres throughout the area of the entire fabric of each stocking. The carrier will be propelled by suitable mechanism (not shown), preferably continuously at a constant speed, in a clockwise direction viewing Figs. 1 and 2.

The frame supporting the endless carrier is at present composed of structural iron such as angle irons and suitable intermediate connections, braces, side walls and partitions which enclose and house the operating devices and provide the desired passages, conduits, compartments, etc. The frame and housing might obviously be of any suitable construction best adapted for the particular conditions at hand and the size of machine desired. In the instant case the machine has a total overall length of approximately 160 feet. For convenience in building this machine I employ upright angle iron frame members 28 spaced apart transversely as shown in Fig. 7 to define a comparatively narrow passage way between which the stocking forms travel and upon which the carrier tracks 26 and 27 are mounted. These upright frame members are also spaced apart lengthwise of the machine, in this instance approximately 10 feet apart defining between adjoining pairs of frame members a section, these sections being indicated in Figs. 1, 2, 4, 5 and 6, by reference numerals 29 to 45 inclusive. The frame structure intermediate the uprights defining these sections may be suitable for the purposes for which such sections are devoted, and in the drawings I have therefore for purpose of simplicity and clarity shown only such frame structure and such transverse and longitudinal sections through the machine as are necessary for an understanding of the invention. The reference herein to sections is therefore simply for purpose of illustration and clarity and in no way a limitation on the scope of the invention.

Referring to Fig. 1 it will be observed that above the sections 30, 31 and 32 I provide at each side of the carrier a platform 46 on which the operators stand for performing the operations of inspection, unloading and loading. At these sections the forms are exposed and freely accessible, whereas at prac-

tically all other times the forms are carried within an enclosure of one form or another as will be presently apparent but to which access may be had at convenient points for inspection of the different processing operations. The section 30 at the upper run of the carrier, may therefore be termed the loading station. The stockings may be loaded onto the forms by operators positioned on both sides of the carrier, although the particular means and method employed for drawing the knitted articles onto the forms is not essential since the forms might be loaded when detached from the carrier and after being loaded might be operatively attached thereto.

It is important however in loading or boarding the stockings that they shall be drawn down onto the form a predetermined distance and held at such position until removed from the form when completely finished. Any of various clamping or holding devices might be employed for this purpose, but preferably one which will not obstruct the dye and other solutions unless a dye excluding clamp such as disclosed in my copending application Serial Number 585,828 is employed for the purpose of making a trade mark or other impression. In the present instance I employ a clamping device for each form, shown in Figs. 16 to 20 inclusive, covered in my copending application, Serial No. 738,756, filed September 20, 1924. The stocking form 21 is carried in an upright position by a bracket 47 the base of which is bolted to one of the carrier chain connecting-bars 23, above mentioned. To each side of the form is fixed above the form-supporting bracket, a clamp-supporting part 48 the upper portion of which is convex on its outer face and serves as a platen against which the stocking fabric is adapted to be clamped. The converging taper at each end of these convex sides is continued on the interposed form plate providing pointed edges. The hem of the stocking will be drawn down over this platen portion and clamped thereagainst by wire clamping members 49. These are carried by clamping levers 50 and $50^1$ which are pivotally mounted on the clamp-supporting part 48 so as to swing into and out of clamping position. The clamping levers are adapted to be operated by a thrust rod 51 vertically slidable in the bracket 47 and connected by means of a cross-head 52 and links 53 to the levers. A coiled compression spring 54 acting against the lower end of said rod constantly urges the latter upwardly in a direction to transmit clamping pressure and hold the clamping wires yieldingly against the fabric with sufficient tension to prevent the fabric from creeping on the form. Suitable means may be provided for releasing the clamping wires, such for example as one or more stationary cams 55 located at the loading and unloading stations which engage rollers 56 carried by the thrust rod 51 at the outer side of the bracket 47 and retract the thrust rod against the pressure of the spring 54 thus withdrawing the clamping wires. The clamps will be held in the open position by the stationary cam structure 55 until a stocking has been drawn onto the form again to the proper length, whereupon the roller 56 will be released permitting the spring 54 to actuate the clamps and grip the stocking as described. The stocking will be held by the clamping wires throughout the processing operations.

From the loading station the boarded stockings will be carried to the lower run through the end section 29 and during passage through the section 30 will be singed by a suitable device such as that shown in Figs. 21 and 22 covered in my copending application, Serial No. 738,754, filed September 20, 1924. This comprises a pair of singeing elements, in the present instance a pair of vertical gas burners 57 or the equivalent and means for moving them back and forth in a quick singeing stroke in which the gas flames rapidly traverse both sides of a stocking during its travel and in a return stroke into operative relation to the next succeeding stocking for repeating the operation. The burners 57 are mounted on a carriage 58 which is supported by rollers to travel back and forth on the upright flanges of the carrier tracks 27, a suitable guide being in this case employed for preventing lateral displacement of the lower end of the burners. A gas supply hose is attached to said lower end, as shown in Fig. 22. The carriage has a pair of pawls 59 adapted to engage a connector bar 23 for movement therewith and to be released therefrom at a predetermined point by striking a stationary abutment 60. The burners normally occupy a position intermediate two adjoining stocking forms as shown in Fig. 21 with the pawls 59 engaging a bar 23 on the carrier, so that the burner carriage travels with the carrier. During travel of the burner carriage the distance between centers of said two adjoining forms, a spring tension will be stored up in a coiled contractile spring $60'$ attached to the carriage and to a stationary part, with the result that when the pawls 59 are released at the end of said travel the spring will return the carriage in a rapid movement to a starting position at which the pawls will be engaged by the next succeeding connector bar 23. During this rapid stroke the burners traverse the stocking in a movement opposite to the travel of the stocking and thus singe any protruding fibres on the surface thereof. The rapid singeing stroke may be cushioned by any suitable means such as an air cylinder $60''$

which in the present case serves as a housing for the spring 60'. This operation is repeated, automatically, on each stocking. It should be understood however, that the singeing device herein disclosed is for purpose of illustration merely, and that any suitable or preferred device may be employed for this purpose if in the particular finishing job at hand the stockings require a singeing operation. When gas burners are used for singeing, the jets should deliver a uniform length flame from end to end of each burner.

Following the singeing operation the boarded stockings will be wetted out, thus extinguishing any continued combustion of the fibres and also conditioning them preparatory to the dyeing process. The wetting out process is performed in the section 31 by a series of spray nozzles carried by headers 61 (Fig. 4) located at each side of the stocking passage so that each stocking travels between successive sets of opposed sprays and is subjected to a series of spray baths from each side. The arrangement of a single set of headers is shown in Fig. 13 and the construction of one of the nozzles in Figs. 14 and 15. Each nozzle delivers what is known as a fish tail spray and the nozzles are so arranged as shown in Fig. 13 that the spray from one nozzle will overlap that of the next adjoining nozzle, thus delivering a continuous line-like spray from top to bottom of the stocking, the velocity and volume of which will be substantially uniform throughout the length of such spray. These nozzles may be used as gas burners for the singeing operation above described and also throughout the various processes which follow and in which various liquids such as dye solutions and others are sprayed onto the stockings. As shown in Fig. 15 the nozzle 62 has a countersunk face 63 intersected by a horizontal narrow slot-like orifice 64. The fluid delivered through this orifice under pressure builds up opposing forces in such manner that as it passes out of the nozzle it is flattened into a fish tail shape at right angles to the slot. This thin wide spray covers a maximum area per nozzle, thus reducing the number of nozzles necessary to be used and likewise reducing pump sizes. One of the greatest advantages of this type of nozzle is the fact that the fluid strikes a stocking throughout the length of the spray under approximately uniform velocity which it will be shown later is an important factor in effecting uniform dyeing. The first spray delivered by these nozzles may be located relatively close to the point at which the stockings leave the singeing device, thus serving as a quenching means. Suitable baffles 65 at each side of the stockings intercept passage of the spray into the singeing compartment. The following spray headers 61 deliver an alkaline solution such for example as brine at a high temperature and velocity. The stocking fabric will be wetted from the outer side by direct impact of the spray and from the inner side by rebound impact resulting from the action of the spray striking the solid, imperforate form. Thus the fibres will receive the full benefit of the salt contents in the solution, this content being in practice carried preferably almost to the saturation point. The time interval between the successive sets of headers permits the brine contents to penetrate the fibres without washing off.

The foregoing spray-delivering unit is in principle and construction very similar to other units of the same kind which function at later stages in performing other processes. This unit includes as shown in Fig. 4 a suitable pump 66, in this case motor driven, which draws the solution from a tank or sump 67 beneath the nozzles and delivers the solution under pressure through a strainer 68, heater 69 and suitable piping connecting the spray nozzle headers 61. In practice the headers 61 are adjustable on overhead supply headers 71 so as to vary the time element between the successive sprays to suit the particular job. It will be manifest that the sides of the section 31 and all similar sections in which a spray is delivered will be suitably enclosed so as to confine the solution and prevent loss. Suitable baffles are also interposed between adjoining sections as a means of further separating the different solutions. In reference to the section 31, one end is protected by the baffles 65 and the other end by baffles 72. Suitable drain boards 73 collect any solution which drips from the forms or from the baffles and carry it back to the tank. The spray compartment is closed at its top by suitable baffles 74 (Fig. 7) which prevent the spray from striking the carrier.

The next operation, dyeing, involves a new method. This consists in spraying a dye solution onto the stockings preferably after they have been treated by a wetting out process, allowing a time interval to elapse, and applying one or more additional spray solutions with intervening time intervals. In this case the first dye spray is administered by the headers 75 in the section 32, these headers and nozzles being similar in construction and arrangement to those shown in Figs. 13, 14 and 15 described above. In the event that an alkaline solution is used in the wetting out process the presence of the salt in solution in the fibres hastens penetration and precipitation of the dye. The dye will be applied to the stocking by external and internal impact as described above with reference to the wetting out process and the dye content per unit of area will

be uniform by reason of the method of delivering the spray and by the fact that the stocking travels past the spray at a constant speed. Following this application of dye by spraying, a time interval, (in this case approximately one minute) elapses before the stocking reaches the next succeeding set of spray headers 76. During this interval the stocking carries a film of dye in solution which penetrates the fibres so that the dye content of the solution is utilized to the greatest degree and becomes effective without being washed off. The spray headers 76 repeat the dyeing operation with the result that loose surface dye is washed off and a new application of dye administered, the impact effect of which is the same as in the first instance. This may be repeated with the intervening time interval by succeeding sets of dye spray headers 77 and 78. By this method the dye content in solution may be kept low which is desirable for reasons well known in this art, and the number of dye sprays will determine the depth of color. It will be manifest that in practice a greater or lesser number of dye sprays may be employed and the time interval varied according to the location of the spray headers and depending on the shade or depth of color desired. As shown in Figs. 4 and 5 the dye is delivered to the spray headers 75 to 78 inclusive by a pumping and heating unit similar to that described with reference to the wetting out process.

Following the dyeing process the stockings will, during their travel of the remainder of the lower run, be sprayed by a developing solution, a soap solution and an acid solution, the latter two solutions being a finishing process known to the trade as scroupe. These solutions may be applied by sprays in the order mentioned, in the same manner as the wetting out and dyeing processes, the developing solution being applied by the spray headers 81, the soap solution by headers 82 and the acid solution by headers 83. In other words, for each solution there is a unitary system adapted for independent control as to the temperature and contents of the solution, and the number and spacing of the spray nozzles. The foregoing processes are used in dyeing black and other colors, and in the case of bleaching and mercerizing processes and the like, the requisite solutions will be used.

Following the final spraying process the stockings will be carried through the end section 45 up onto the upper run and into a drier which in the present machine extends from the beginning of the upper run to the inspection station above mentioned located at the section 32. This drier is in the form of a long narrow compartment formed between the uprights 28 by side walls 84 and a top wall 85 of insulation material and a bottom wall 86. Within this compartment extending longitudinally thereof at each side of the stockings are heating pipes 87, at present supported directly by the side walls. These heating pipes extend from the section 33 to the section 44 and may be supplied with a heating medium in any suitable manner to maintain the desired temperature in the drier, although an additional temperature control is provided as will be presently apparent. The stockings thus travel through this drying compartment 89 from the inlet end thereof at the beginning of the upper run to the outlet end at the inspection station. In order to hasten the drying, and the carrying off of the moisture contents and to aid in shaping the stockings on the forms, I have provided an air circulating system as fully shown in my copending application, Serial No. 738,755, filed September 20, 1924, which will now be described. By means of this circulating system and the heating pipes or coils the stockings are dried and shaped according to a process or method which is an important factor contributing to the practicability of my invention. Air circulation is produced by a centrifugal fan or blower 88 (Figs. 3, 9 and 10) located in the present instance at one side of the drier compartment with the intake opening 91 of the fan in communication with the drier compartment. The fan discharges through a conduit 92 into a conduit 93 beneath the drier compartment and extending the full length thereof, the conduit 93 being separated by a partition 94 from the compartment 95 in which the lower run of the carrier travels, this compartment 95 constituting an air passage as will be presently described. The air discharged by the fan into the conduit 93 will flow lengthwise therein as indicated by arrows in Fig. 3 and will be discharged therefrom through air nozzles 96 (Fig. 12) into the drier compartment in close proximity to and at each side of the stocking forms. At this end the conduit or passage 93 is divided into two laterally spaced passages 97, one at each side of the drier compartment, which passages are turned at 98 and terminate in the air nozzles 96 above-mentioned which discharge the air into the air drier compartment in the direction opposite to the travel of the stocking forms therein. Air will thus be delivered under pressure into the drier compartment at the carrier outlet end thereof and will flow in the same direction the full length of such compartment. Inasmuch as there is a 90° turn in the flow of air from the drier compartment into the fan intake a slight pressure will be built up at this end which prevents air from being drawn into the fan from the adjacent spraying compartment below, that is from the lower compartment in the sections 44 and 45, although

the only passage way between the spray compartment in the section 44 is between the baffles 99.

In order to prevent saturation of the air a predetermined volume is constantly bled off or exhausted through a bleeder pipe 101 at the end of the conduit 93 remote from the fan. This bleeder pipe discharges into the compartment or conduit 95 located immediately above the spray compartment and having a vent pipe 102 at its end nearest the fan. As a result of this construction a predetermined volume of air will be continuously exhausted through the bleeder pipe 101, conduit 95 and vent pipe 102, thus keeping the moisture content in the air circulating system comparatively low and promoting drying efficiency. The volume of air exhausted in this manner may be controlled by suitable means such as a butterfly valve 103 in the pipe 101. As a result of continuously exhausting a given percentage of the air in circulation, fresh air will be drawn into the system by an injector action of the nozzles 96, the air inlet being between said nozzles. Thus a cool, comparatively dry fresh air is continuously drawn past the stockings as they emerge from the drier, the effect of which is beneficial in its final drying, and in cooling and contracting the stockings which will better adhere to the shape of the form. By reason of this method it will be apparent that the air is coolest at the end it enters the drying compartment and is gradually raised in temperature as it approaches the end of the compartment at which the stockings enter in the moistened condition. Thus the greatest moisture content is carried off at the end of the compartment at which the stockings enter and carry the greatest moisture, and, inversely, the dry stockings leave the drier at a point at which the air has the lowest moisture content. The warm air passing out through the compartment or conduit 95 draws off with it the steam and vapors rising from the spray compartments, thus greatly reducing the tendency for vapor to escape and also promoting greater efficiency in the general operation.

The stockings emerging from the drier will be inspected by operators at each side of the carrier and will then be removed from the forms and packed in boxes ready for shipping.

It is believed that the foregoing conveys a clear understanding of the objects and principles of my invention which is herein illustrated simply in one embodiment as applied to certain operations in the finishing of knitted stockings. Applicant believes that the present invention discloses broadly new methods and principles as applied to the finishing of fabric articles and therefore, that suitable construction and a wide range of mechanical equivalents may be employed in practice without departing from the spirit and scope of the invention as expressed in the appended claims, in which—

I claim:

1. The method of finishing stockings consisting in boarding the stockings, moving the boarded stockings on an endless continuously traveling carrier, subjecting the boarded stockings at progressive stages of their travel on the carrier to different processing operations in which solutions are applied to the stockings, applying said solutions by spraying devices from opposite sides of the stockings with predetermined time intervals intervening between the spraying operations, and passing the boarded stockings on said carrier through a drying compartment.

2. The method of dyeing stockings consisting in boarding a stocking on a shaped form, and delivering a uniform spray of dye solution over the entire area of the stocking.

3. The herein described method of finishing stockings including boarding a stocking on a shaped form, holding the stocking to a predetermined length on the form, delivering a spray of dye solution onto the boarded stocking by a spray impact over the entire area of the stocking, and drying the stocking while it is on the form.

4. The method of dyeing stockings consisting in boarding a stocking on a shaped form, and delivering a line spray against each side of the stocking from end to end thereof accompanied with relative movement between the stocking and spray so that the spray operates across the stocking at a constant speed.

5. The method of dyeing knitted articles consisting in passing them on forms between sets of nozzles which deliver the dye solution in a spray onto the articles by direct impact and by rebound impact from striking the form.

6. The method of dyeing knitted articles consisting in passing them on forms between a plural series of spray nozzles which deliver a dye solution onto the article from opposite sides and are spaced apart so that a time interval intervenes between the spraying operations.

7. The method of dyeing stockings consisting in spraying a dye solution onto a boarded stocking in a line spray of substantially uniform velocity from end to end of the stocking during relative movement between the stocking and spray so that the latter operates at a constant speed across the stocking.

8. The method of dyeing stockings consisting in spraying a dye solution onto a boarded stocking in a line spray of substantially uniform velocity from end to end of the stocking during relative movement between the stocking and spray so that the

latter operates at a constant speed across the stocking, said line spray being applied simultaneously from each side of the stocking.

9. The method of dyeing stockings consisting in spraying a dye solution onto a boarded stocking in a line spray of substantially uniform velocity from end to end of the stocking during relative movement between the stocking and spray so that the latter operates at a constant speed across the stocking, the spray being composed of a series of separate fish tail sprays relatively disposed so that the individual sprays overlap one another.

10. The method of dyeing stockings consisting in passing boarded stockings between opposed sets of spray-delivering devices with the flat plane of the stocking form parallel with the direction of travel and delivering a line spray onto each side of the boarded stockings by said devices.

11. The method of applying dyeing and processing solutions to knitted articles consisting in boarding the knitted articles, passing them at a constant speed between plural opposed sets of spraying devices, spacing each opposed set of spraying devices apart in the direction of travel of the boarded articles so that a time interval intervenes between each dye spraying operation, and delivering a uniformly distributed spray by each set of spray devices onto each side of the boarded articles so that the spray is applied from end to end of the boarded articles in successive operations with intervening time intervals.

12. The method of dyeing stockings consisting in boarding each stocking on a shaped form, moving the boarded stockings at constant speed between plural sets of spraying devices, each set of which delivers a spray of dye solution substantially from end to end of the stockings on opposite sides thereof, and successively subjecting each stocking to such spraying operation by spacing said sets of spraying devices apart in the direction of travel of the stockings so that a predetermined time interval intervenes between each spraying operation.

13. The method of dyeing stockings consisting in boarding a stocking on a shaped comparatively flat form, the sides of which are imperforate, delivering a spray of dye solution onto each side of the boarded stocking substantially from end to end thereof, and effecting relative movement between the boarded stocking and spray in a direction transverse to the plane of the spray.

14. The method of dyeing stockings consisting in boarding a stocking on a shaped comparatively flat form, the sides of which are imperforate, delivering a spray of dye solution onto each side of the boarded stocking subsantially from end to end thereof, and effecting relative movement between the boarded stocking and spraying device in a direction transverse to the plane of the spray and repeating said spraying operation after a predetermined time interval.

15. The method of finishing knitted articles consisting in boarding the articles, each on a comparatively flat form shaped to conform to the design of the articles, carrying the boarded articles on a continuously moving endless carrier with the flat plane of the form parallel with the direction of travel so as to present substantially the entire body of the knitted fabric at opposite sides, carrying each boarded article at successive periods during its travel between opposed processing devices which function to singe, wet out, dye, develop and dry the boarded articles.

16. The method of completely finishing stockings consisting in boarding each stocking on a comparatively flat, shaped form, mounting the forms in uniformly spaced relation on an endless continuously traveling carrier with the flat plane of each form parallel with the direction of travel, causing the carrier to travel in an upper and lower horizontal run, performing successive pocessing operations on the boarded stockings as they travel along the lower run, said operations being performed by devices at different stations operating on opposite sides of the boarded stockings and consisting in singeing, wetting out, dyeing, and developing, and drying and shaping the boarded stockings during their travel along the upper run until reaching an inspection station, inspecting the boarded stockings, and unloading them.

17. The method of completely finishing stockings consisting in boarding each stocking on a comparatively flat, shaped form, mounting the forms in uniformly spaced relation on an endless continuously traveling carrier with the flat plane of each form parallel with the direction of travel, causing the carrier to travel in an upper and a lower horizontal run, performing successive processing operations on the boarded stockings as they travel along the lower run, said operations being performed by spraying devices at different stations operating on opposite sides of the boarded stockings, causing a predetermined time interval to intervene between each operation, and drying and shaping the boarded stockings during their travel along the upper run.

18. The method of completely finishing stockings consisting in boarding each stocking on a comparatively flat, shaped form, mounting the forms in uniformly spaced relation on an endless continuous traveling carrier with the flat plane of each form parallel with the direction of travel, causing the carrier to travel in an upper and a lower horizontal run, with the forms extending outwardly, boarding the stockings at a load-

ing station near the end of the upper run, singeing the boarded stockings by devices operating on both sides of the stockings at the beginning of the lower run, performing successive processing operations on the boarded stockings as they travel along the lower run, said operations being performed by spraying devices at different stations, each spraying device comprising a plural set of spray delivering nozzles, each set having spray nozzles in opposed relation on opposite sides of the stockings for delivering a line spray from end to end of the stockings and the spray sets of each device being spaced apart so that a predetermined time interval intervenes between each spraying operation, said spraying operations consisting in wetting out, dyeing, and developing, and drying and shaping the boarded stockings during their travel along the upper run until reaching an inspection station, the drying being accomplished by passing the boarded stockings through a drying compartment having heating pipes between which the stockings pass and by discharging air into said compartment so that it travels lengthwise therein toward the stocking entrance end of the compartment, inspecting the boarded stockings, and unloading them.

19. Apparatus for finishing stockings including dyeing the same comprising, in combination, a traveling carrier, stocking forms spaced thereon, means for holding each stocking to a predetermined length on its form, means for subjecting each stocking while on its form to a series of liquid processing operations with a predetermined time interval between each dyeing operation, and means for drying each stocking while on its form.

20. Apparatus for finishing stockings comprising, in combination, a traveling carrier, stocking forms spaced thereon, means for holding each stocking to a predetermined length on its form, means for subjecting each stocking while on its form to a liquid processing and dyeing operation, means for drying each stocking while on its form, and means for causing said carrier to move the stocking forms so as to subject each stocking to said processing and dyeing and drying operations.

21. Apparatus for finishing stockings including the dyeing thereof comprising, in combination, a traveling carrier, stocking forms spaced thereon, means for holding each stocking to a predetermined length on its form, means for spraying a processing solution and also a dyeing solution onto each stocking from opposite sides thereof, each solution being applied during a given period in the stocking's travel, and means for drying each stocking on its form during a subsequent period.

22. Apparatus of the character described comprising, in combination, an endless continuously traveling carrier, stocking forms mounted on said carrier at uniformly spaced intervals and arranged with the flat plane of each form parallel with the direction of travel, and devices at different stages in the travel of the carrier for subjecting the stockings on the forms to different operations including the spraying of dye, said devices including plural series of spray delivering headers, each set comprising a pair of headers in opposed relation on opposite sides of the forms equipped with spray delivering nozzles for delivering a spray onto the stockings as they pass between the nozzles, said sets of spray delivering headers being spaced apart in the direction of travel of the forms so that a predetermined time interval intervenes between each spraying operation.

23. Apparatus of the character described comprising, in combination, an endless continuously traveling carrier, stocking forms mounted on said carrier at uniformly spaced intervals and arranged with the flat plane of each form parallel with the direction of travel, and devices at different stages in the travel of the carrier for subjecting the stockings on the forms to different operations such as the spraying thereon of dye, including plural series of spray delivering headers, each set comprising a pair of headers in opposed relation on opposite sides of the forms equipped with spray delivering nozzles for delivering a spray onto the stockings as they pass therebetween, said sets of spray delivering headers being spaced apart in the direction of travel of the forms so that a predetermined time interval intervenes between each spraying operation, a drying compartment through which the stockings travel and means for blowing heated air through said compartment in the direction opposite to the travel of the forms therein.

24. Apparatus for finishing knitted articles comprising, in combination, an endless carrier having an upper and a lower horizontal run, article holding forms at spaced intervals on the carrier projecting outwardly therefrom, each form being comparatively flat, shaped to conform to the design of the article so as to hold it extended and being arranged with its flat plane parallel with the direction of travel, a loading station at the upper run adjacent to the end thereof at which station the articles are adapted to be drawn onto the forms, a singeing station at the beginning of the lower run at which the boarded articles are singed, a series of processing stations at the lower run following the singeing station and consisting in apparatus for wetting out the boarded articles, dyeing them and subjecting them to a developing bath while they are traveling along said lower run, and a drying station at the

upper run reaching substantially from the beginning thereof to the loading and unloading station and through which the boarded forms are carried.

25. Apparatus for finishing knitted articles comprising, in combination, an endless continuously traveling carrier equipped at spaced intervals with outwardly projecting forms shaped for holding knitted articles with the fabric extended, the endless carrier having an upper and a lower horizontal run so that the article holding forms travel in opposite directions, a series of processing stations at the lower run through which the boarded articles are carried in succession, a drying compartment at the upper run comprising an enclosure open only at opposite ends through which the forms pass, and means for causing heated air to be circulated through said compartment in the direction opposite to the travel of the boards.

26. Apparatus for finishing knitted articles comprising, in combination, an endless continuously traveling carrier equipped at spaced intervals with outwardly projecting forms spaced for holding knitted articles with the fabric extended, said carrier having an upper and a lower horizontal run, a loading and unloading station at which finished articles are removed from the form and untreated articles are loaded thereon, apparatus for subjecting the boarded articles at different periods during their travel to a series of processes including dyeing, a drying compartment through which the boarded articles are carried after being processed, and means for circulating heated air through said compartment in a direction opposite to the travel of the carrier.

27. Apparatus for finishing knitted articles comprising, in combination, an endless continuously traveling carrier equipped at spaced intervals with outwardly projecting comparatively flat forms each shaped for holding a knitted article with the fabric extended and arranged with the flat plane of the form parallel with the travel of the carrier, a loading station at which the articles are boarded, apparatus for processing the boarded stockings at different periods during their travel, including dye delivering nozzles for spraying the boarded articles at spaced intervals.

28. Apparatus for finishing knitted articles comprising, in combination, an endless traveling carrier having an upper and a lower horizontal run and equipped at closely spaced intervals with outwardly projecting forms shaped for holding knitted articles with the fabric extended, a loading and an unloading station near the end of the upper run, devices at spaced intervals at the lower run for successively subjecting the boarded articles to different processing operations, and a drying compartment extending along the upper run from substantially its beginning to said loading and unloading station through which the boarded stockings travel.

29. Apparatus for finishing knitted articles comprising, in combination, an endless traveling carrier having an upper and a lower horizontal run and equipped at closely spaced intervals with outwardly projecting forms shaped for holding knitted articles with the fabric extended, devices at spaced intervals at the lower run for successively subjecting the boarded articles to different processing operations, a drying compartment extending along the upper run through which the boarded stockings travel, and apparatus for discharging heated air into said compartment adjacent to the carrier-outlet end thereof and for drawing said air from the compartment adjacent to its carrier-inlet end.

30. Apparatus as set forth in claim 34, including a return air passage connecting said ends of the compartment and located intermediate the compartment and said processing devices.

31. Apparatus as set forth in claim 34, in which the last mentioned apparatus for circulating heated air lengthwise through said drying compartment, includes a blower connected with the air inlet and outlet ends of the compartment, and means at the air inlet end for producing an injector action for drawing fresh air into the drying system.

32. Apparatus as set forth in claim 34, in which the last mentioned apparatus for circulating heated air lengthwise through said drying compartment, includes a blower connected with the air inlet and outlet ends of the compartment, means at the air inlet end for producing an injector action for drawing fresh air into the drying system, and means for continuously exhausting a predetermined volume of air from the system.

33. Apparatus of the character described comprising, in combination, an endless carrier having an upper and a lower horizontal run, stocking holding forms mounted on the carrier at uniformly spaced intervals extending outwardly therefrom, means for holding each stocking to a predetermined length on its form, a spraying device below the lower run including plural sets of spray nozzles, each set including nozzles at opposite sides of the stockings for delivering a spray from end to end thereof, said sets of spray nozzles being spaced apart in the direction of travel of the stockings so that a predetermined time interval intervenes between each spraying operation, and means for drying the boarded stockings including a drying compartment along the upper run, a centrifugal fan the intake opening of which is in communication with said drying compartment at a point adjacent to the en-

trance of the boarded stockings into said compartment, a discharge conduit connecting said fan for discharging air into said compartment adjacent to the end at which the boarded stockings leave the compartment, whereby an air circulation is produced in which the air travels through said compartment in the direction opposite to the travel of the boarded stockings, and means for heating said air.

34. Apparatus of the character described comprising, in combination, an endless carrier having an upper and a lower horizontal run, stocking holding forms mounted on the carrier at uniformly spaced intervals extending outwardly therefrom, means for holding each stocking to a predetermined length on its form, a spraying device below the lower run including plural sets of spray nozzles, each set including nozzles at opposite sides of the stockings for delivering a spray from end to end thereof, said sets of spray nozzles being spaced apart in the direction of travel of the stockings so that a predetermined time interval intervenes between each spraying operation, and means for drying the boarded stockings including a drying compartment along the upper run, a centrifugal fan the intake opening of which is in communication with said drying compartment at a point adjacent to the entrance of the boarded stockings into said compartment, a discharge conduit connecting said fan for discharging air into said compartment adjacent to the end at which the boarded stockings leave the compartment, whereby an air circulation is produced in which the air travels through said compartment in the direction opposite to the travel of the boarded stockings, means for heating said air, and means for continuously exhausting a predetermined volume of said air for maintaining a low moisture content.

35. Apparatus of the character described in combination, an endless carrier having an upper and a lower horizontal run, stocking holding forms mounted on the carrier at uniformly spaced intervals extending outwardly therefrom, means for holding each stocking to a predetermined length on its form, a spraying device below the lower run including plural sets of spray nozzles, each set including nozzles at opposite sides of the stockings for delivering a spray from end to end thereof, said sets of spray nozzles being spaced apart in the direction of travel of the stockings so that a predetermined time interval intervenes between each spraying operation, and means for drying the boarded stockings including a drying compartment along the upper run, a centrifugal fan the intake opening of which is in communication with said drying compartment at a point adjacent to the entrance of the boarded stockings into said compartment, a discharge conduit connecting said fan for discharging air into said compartment adjacent to the end at which the boarded stockings leave the compartment, whereby an air circulation is produced in which the air travels through said compartment in the direction opposite to the travel of the boarded stockings, means for heating said air, means for continuously exhausting a predetermined volume of said air for maintaining a low moisture content, and means whereby an injector action is produced by the discharge of said air into the drying compartment so that fresh air is drawn in at each side of the stockings emerging therefrom.

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trance of the boarded stockings into said compartment, a discharge conduit connecting said fan for discharging air into said compartment adjacent to the end at which the boarded stockings leave the compartment, whereby an air circulation is produced in which the air travels through said compartment in the direction opposite to the travel of the boarded stockings, and means for heating said air.

34. Apparatus of the character described comprising, in combination, an endless carrier having an upper and a lower horizontal run, stocking holding forms mounted on the carrier at uniformly spaced intervals extending outwardly therefrom, means for holding each stocking to a predetermined length on its form, a spraying device below the lower run including plural sets of spray nozzles, each set including nozzles at opposite sides of the stockings for delivering a spray from end to end thereof, said sets of spray nozzles being spaced apart in the direction of travel of the stockings so that a predetermined time interval intervenes between each spraying operation, and means for drying the boarded stockings including a drying compartment along the upper run, a centrifugal fan the intake opening of which is in communication with said drying compartment at a point adjacent to the entrance of the boarded stockings into said compartment, a discharge conduit connecting said fan for discharging air into said compartment adjacent to the end at which the boarded stockings leave the compartment, whereby an air circulation is produced in which the air travels through said compartment in the direction opposite to the travel of the boarded stockings, means for heating said air, and means for continuously exhausting a predetermined volume of said air for maintaining a low moisture content.

35. Apparatus of the character described in combination, an endless carrier having an upper and a lower horizontal run, stocking holding forms mounted on the carrier at uniformly spaced intervals extending outwardly therefrom, means for holding each stocking to a predetermined length on its form, a spraying device below the lower run including plural sets of spray nozzles, each set including nozzles at opposite sides of the stockings for delivering a spray from end to end thereof, said sets of spray nozzles being spaced apart in the direction of travel of the stockings so that a predetermined time interval intervenes between each spraying operation, and means for drying the boarded stockings including a drying compartment along the upper run, a centrifugal fan the intake opening of which is in communication with said drying compartment at a point adjacent to the entrance of the boarded stockings into said compartment, a discharge conduit connecting said fan for discharging air into said compartment adjacent to the end at which the boarded stockings leave the compartment, whereby an air circulation is produced in which the air travels through said compartment in the direction opposite to the travel of the boarded stockings, means for heating said air, means for continuously exhausting a predetermined volume of said air for maintaining a low moisture content, and means whereby an injector action is produced by the discharge of said air into the drying compartment so that fresh air is drawn in at each side of the stockings emerging therefrom.

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## CERTIFICATE OF CORRECTION.

**Patent No. 1,623,080.** **Granted April 5, 1927, to**

**EDWARD J. ZIOCK.**

**It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 10, lines 86, 91 and 99, claims 30, 31 and 32 respectively, for the numeral "34" read "29"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.**

**Signed and sealed this 10th day of May, A. D. 1927.**

**M. J. Moore,**
**Acting Commissioner of Patents.**

**Seal.**

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M. J. Moore,
Acting Commissioner of Patents.