June 16, 1964 T. V. McCLURE ETAL 3,137,056

METHOD FOR DYEING AND TREATING TEXTILE MATERIAL

Filed Dec. 27, 1961 3 Sheets-Sheet 1

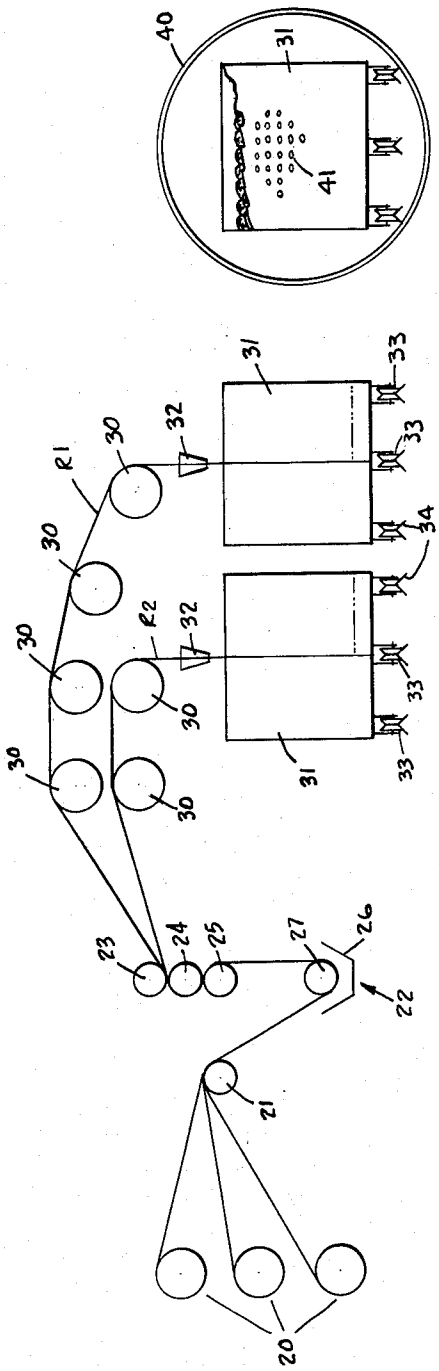

FIG. 1A

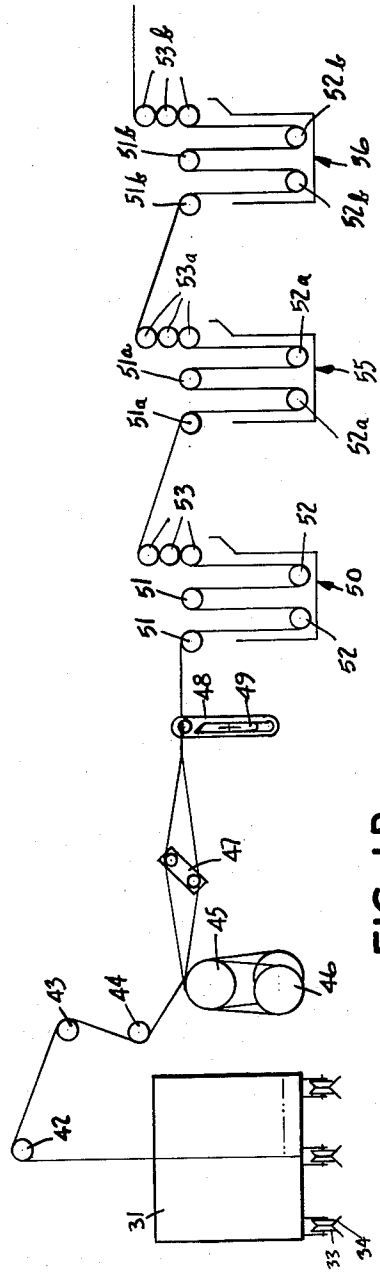

FIG. 1B

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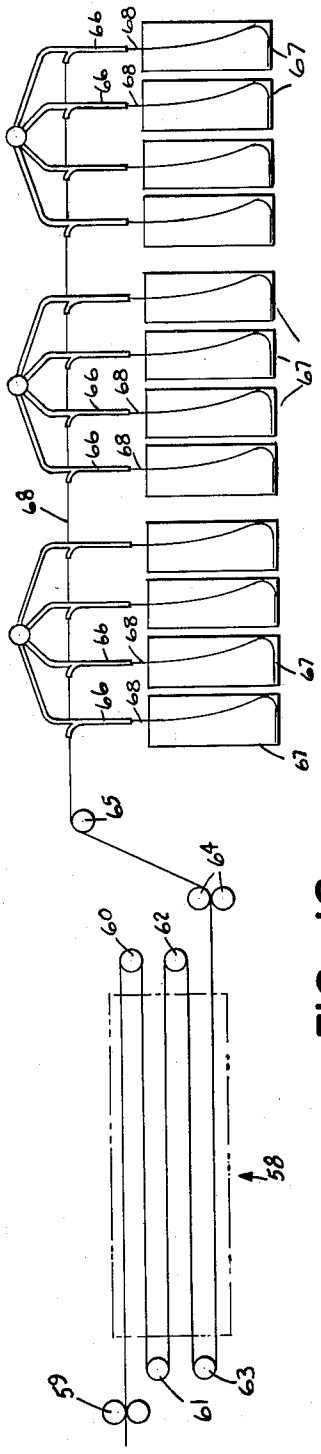

FIG. IC

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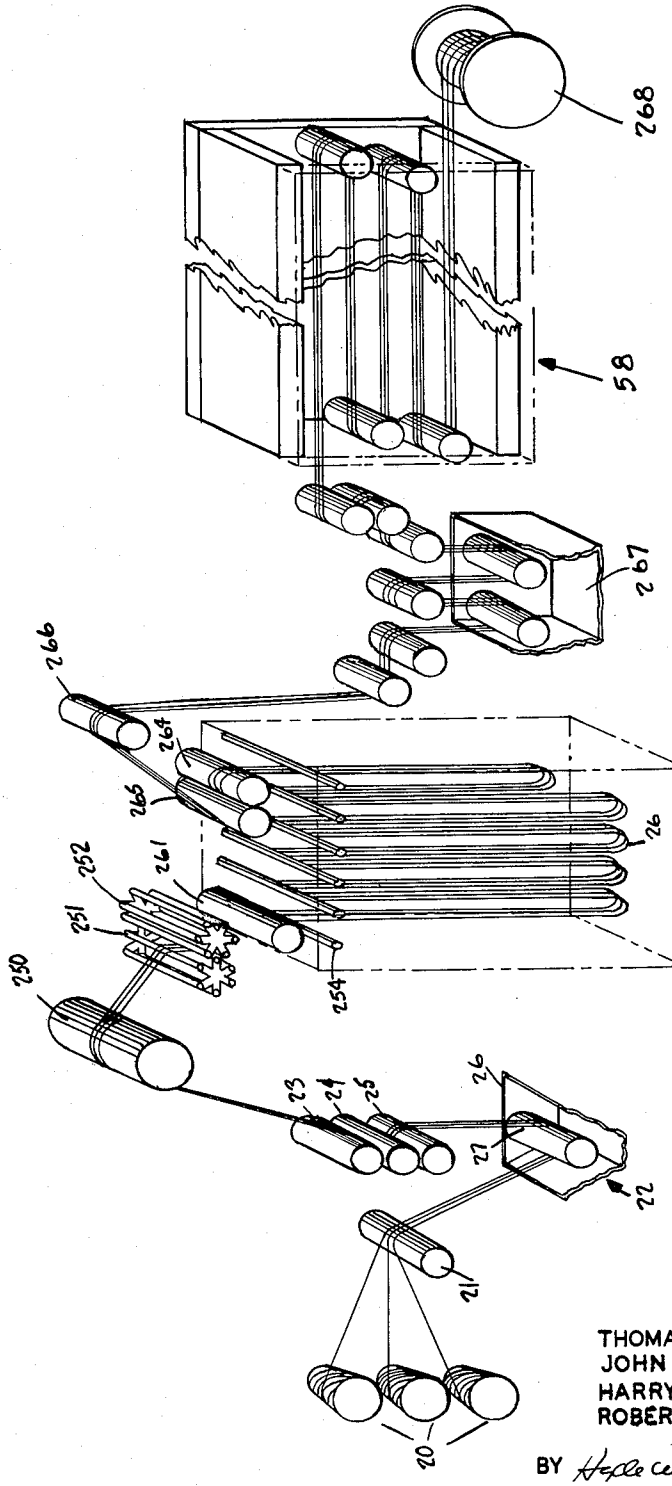

FIG. 2

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METHOD FOR DYEING AND TREATING TEXTILE MATERIAL

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This invention relates to the dyeing of yarn and more particularly to an improved apparatus and method for dyeing and treating roving and/or yarns of continuous filament synthetic fiber.

In the processing and dyeing of continuous filament yarns it becomes of major importance to provide a fast, highly flexible pad dyeing operation for treating two or more groups or "rovings" of approximately 28–30 yarn ends simultaneously. In the manufacture of soft floor coverings the well-known procedures for stock dyeing and skein dyeing natural fibers are too slow and expensive to be used satisfactorily for certain types of synthetic yarns currently popular in these fabrics. A controlled semi-continuous dyeing operation gives far superior dyeing characteristics, reduces waste, and greatly expedites the yarn handling operation. The yarn packages as received from the yarn manufacturer can be taken directly from a creel, introduced into a padder, and then wound on beams, or otherwise prepared for further spinning or twisting of the yarn. The most important requirement in the dyeing and treatment of continuous filament yarn resides in the fact that the "bulk" or "crimp" produced in this yarn when manufactured must be retained during the application of the dye and later processing steps. If excess tension is applied to such bulked or crimped yarn at elevated temperatures, the crimp will be removed. The yarn, therefore, must be handled under conditions of relaxed tension, particularly during the steaming operation. The requirements for processing a crimped synthetic yarn, such as nylon, preclude satisfactory employment of either stock or skein dyeing since the raw material as supplied by the manufacturer is not in condition to be stock dyed and the skein dyeing in accordance with known equipment is too slow, expensive, and will not satisfactorily retain the desired bulk or crimp.

The present invention accomplishes the most satisfactory dyeing and treatment of a bulked continuous filament synthetic yarn, such as nylon, without injuring the yarn or removing the pre-set crimp characteristic. Furthermore, a preferred form of the present invention has a distinct advantage as compared to a completely continuous system because a broken end in the wet processing section does not require shutting down the padding equipment and vice versa. A sectionalized system in accordance with the present invention provides the maximum overall efficiency and proper production of the material.

A primary object of the invention, therefore, is to provide an improved method for dyeing and treating running lengths of textile yarn.

A further object of the invention is to provide an improved method for dyeing running lengths of a bulked continuous filament textile yarn.

A further object of the invention is to provide a completely continuous system for dyeing, steaming, wet processing, and drying running lengths of bulked continuous filament yarn.

Further objects will be apparent from the specification and drawings in which:

FIGURES 1*a*–1*c* show a schematic representation of the yarn processing steps in accordance with the present invention, and

FIGURE 2 is a schematic diagram of a continuous yarn-dyeing and steaming apparatus.

The invention comprises the continuous running of a roving of yarn from yarn packages on a creel to a padder and thence to a plurality of wheeled, perforated yarn trucks. Preferably the roving is divided into two groups so that two trucks are fed simultaneously. These trucks are then inserted bodily into an autoclave where the yarn is steamed while in a relaxed condition. The trucks are then transferred to an unloading station where the roving is continuously removed and opened up. A series of wet processing treatments are given to the yarn and these may comprise an acid bath, a water bath, and an antistat bath. Depending upon the type of yarn and the dye, one or more of the liquid-treating baths may be omitted. The roving is then separated into individual yarns, fed through a drier, and from the drier each individual yarn passes through a delivery tube and is deposited into a can. In the efficient dyeing and treating of synthetic yarn, it is important that the yarn pattern in both the trucks and the cans be such that the yarn can be removed therefrom at relatively high speed without rupturing or snarling. For this purpose the yarn trucks, which in the specification will be called the autoclave trucks, are mounted upon a carriage to which there is imparted an oscillating motion in one direction and a stepped or intermittent motion in a direction 90° to the oscillating motion. In the case of the final delivery into the yarn cans, the feeding equipment is given a composite, planetary motion which serves to form layers of yarn in the cans. As mentioned above, there is an advantage in processing the bulked continuous filament yarn by interrupting the continuous travel of the yarns and performing the steaming operation at this point of interruption. However, in a modified form, it is possible to utilize a continuous steamer in which the yarn is loosely festooned over a series of gradually progressing bars in a steam chamber. The introduction and removal of the yarn in this chamber progresses at a rate sufficiently slow to permit adequate steam treatment.

Referring now more particularly to the drawings, the yarn to be dyed and liquid-treated is fed from yarn packages in a creel, shown generally at **20**, over a feed roller **21** and into the padder **22** which comprises a series of squeeze rolls **23**, **24**, and **25**, a dye trough **26**, and the dip roll **27**. After leaving the padder, which may be constructed in accordance with the detailed showing in application Serial No. 54,735, filed September 8, 1960, the yarn ends, in the form of two separate groups or rovings, pass over a series of arcuately concave spools **30**, **30** which deliver the separate rovings **R1** and **R2** into each of two autoclave trucks **31** through funnels **32**, **32**. The autoclave trucks are provided with suitable grooved wheels **33**, **33** which roll on tracks **34** in a manner to be more fully described hereinafter. It is of importance to

insure that the rovings be deposited in the autoclave trucks so that they can quickly be removed without any interference or snarling. On completion of each pass the carriage on which the trucks are mounted shifts longitudinally a pre-determined increment so that the rovings are zig-zagged back and forth in the truck to provide a substantially even layer. After the carriage has completed one full longitudinal pass to deposit a layer of zig-zag roving on the bottom of the truck, the carriage returns in equal increments of movement until each truck is substantially full.

After each of the trucks **31** has been filled, the truck is then removed from the oscillating carriage and transferred to an autoclave **40** whereupon empty trucks can immediately be positioned beneath the funnels **32, 32**. The truck sides are perforated as shown at **41** in FIGURE 1A to permit adequate penetration of the steam to all the yarn. After suitable steam treatment in the autoclave, the truck is removed to the position shown at the left of FIGURE 1B whereupon the roving is withdrawn from the truck over a series of guide rollers or guides **42, 43**, and **44**. From thence the individual ends of each roving are separated by passing over and under two pairs of biased thread-advancing rollers **45** and **46**. A revolving yarn opener or beater **47** is positioned between groups of the yarn ends to maintain their separation. The yarns then pass through suitable drop wires **48** positioned over an electrode **49** to detect any broken ends or improperly tensioned yarns. From thence the yarns are carried through the first liquid-treating padder **50** having a series of upper rollers **51, 51** and a series of submerged rollers **52, 52**. A bank of squeeze rollers **53** carries yarns out of the bath **50**, delivers them to the second bath **55** which may be identical to the first bath and having upper rollers **51***a*, **51***a* and submerged rollers **52***a*, **52***a* and squeeze rollers **53***a*. Additional liquid treatments as, for example, antistat applications and rinses, may be applied by means of further liquid-treating baths, such as bath **56**, which in turn has upper rollers **51***b*, **51***b* submerged rollers **52***b*, **52***b*, and squeeze rollers **53***b*.

After the passing through the appropriate liquid treatment apparatus, the yarn ends are fed through a drier assembly **58** which comprises a first pair of control rollers **59** and suitable direction reversing rollers **60, 61, 62**, and **63**. Drive rollers **64** then feed the yarn over a yarn guide **65** from whence each individual end is carried through an air jet tube assembly **66, 66** for delivery of each end into one of the yarn cans **67, 67**. The air jets **66, 66** are mounted on a movable framework to which a planetary motion is imparted but which provides a particular advantage in that each yarn end is supplied to a can in overlapping symmetrical layers. The individual yarn ends deposited in the cans **67, 67** are each designated with reference number **68** and the control and movement of each of these yarn ends **68** is identical so that the description of one applies to all.

After the yarn ends have been opened up as described above, they are given a series of liquid treatments which may include an acid treatment applied in bath **50** (FIGURE 1B), a rinsing bath **55**, and the application of a suitable size or antistat liquid in bath **56**. The liquid treating baths **50, 55**, and **56** are conventional in design and operation and in themselves form no part of the present invention.

Under circumstances where it may be considered desirable to use a completely continuous yarn dyeing and processing sylstem, a steam chamber shown schematically in FIGURE 2 may be substituted for the autoclave. In this case the yarn ends coming from the padder **22** are carried over a guide **250** from which they are fed through interdigitating feed beaters **251** and **252**. A steam chamber **253** is provided with a means for advancing the yarn through the chamber **253** in a relaxed or relatively untensioned condition. As the chains carry the yarn festoons through the steam chamber, the yarns are withdrawn therefrom by means of pair of driven nip rollers **264** and **265**. The yarns are then carried over a guide **266** and into one or more liquid treating baths **267** of the type described above and thence through the drier **58** whereupon they may be wound on a beam **268** for further utilization.

The present invention achieves substantially more efficient and uniform treatment of continuous filament yarns both in the continuous and semi-continuous forms as compared to a strictly batch process. The elimination of manual handling of the rovings reduces snagging and permits the rapid treatment of the yarns without shut-down due to broken ends of other conditions prevalent in the handling continuous filament synthetic yarns. This improvement is noticeably more beneficial in the case of bulked or crimped yarns which, if anything, have a greater tendency to snag. The dyeing and subsequent steam treatment of these yarns under relaxed tension is an important feature of the invention and permits a far better product to be obtained and at much higher rates of production.

Having thus described our invention, we claim:

1. The method of continuously treating running lengths of textile yarns which comprises the steps of introducing said running lengths into a dye bath, removing excess amounts of dye liquor from said running lengths, feeding each of said lengths into a container in even linear layers, steaming said running lengths under conditions of relaxed tension, removing the lengths from the containers, separating each length into individual yarns, applying a liquid treatment to said separated yarns, drying the yarns, and continuously supplying each of said yarns to a yarn take-up device.

2. The method of treating running lenghts of continuous filament bulked fibers which comprises the steps of introducing said running lengths into a dye bath, removing excess amounts of dye liquor from said running lengths, feeding each of said lengths into a container in even linear layers, steaming said running lengths under conditions of relaxed tension, removing the lengths from the containers, separating each length into individual yarns, applying a liquid treatment to said separated yarns, drying the yarns, and continuously supplying each of said yarns to a yarn take-up device.

3. The method of claim 2 in which the container for steaming the yarns is oscillated in linear paths 90° to each other.

4. The method of claim 2 in which the separated yarns are given an acid bath.

5. The method of claim 2 in which the separated yarns are given an antistat bath.

6. The method of claim 2 in which the separated yarns are given an acid bath, a rinse bath, and an antistat bath.

7. The method of claim 2 in which the yarns are continuously supplied in layers into yarn cans by means of a planetary motion.

8. The method of claim 2 in which the yarns are taken up by means of winding them on beams.

9. The method of claim 2 in which all of the steps are performed in continuous sequence.

10. The method of claim 2 in which the yarn is dyed and deposited in the containers in a continuous sequential operation and subsequently removed from the containers and supplied to the take-up device in continuous sequence.

11. A method of treating a running length of bulked fibers which comprises the steps of immersing said fibers in a dye bath, removing excess amounts of the dye liquor in said dye bath, feeding said fibers in even layers into a container, subjecting the container and the fibers to steam treatment under conditions of relaxed tension in the fibers, subjecting the fibers to an acid bath, subjecting the fibers to a rinse bath, subjecting the fibers to an antistat bath, continuously passing the fibers through a drying zone, and depositing even layers of the fibers into a plurality of cylindrical receptacles by means of a planetary motion.

12. The method of claim 11 wherein the fibers are spun into a series of yarns and the yarns are grouped into rovings before immersion in the dye bath.

13. The method of claim 11 wherein the rovings are separated into individual yarns before passing through the drying zone.

14. The method of claim 11 in which all of the steps are performed in continuous sequence.

15. The method of claim 11 in which the yarn is dyed and deposited in the containers in continuous sequence and subsequently removed from the containers and deposited into the receptacles in continuous sequence.

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