United States Patent [19]

Harrill

[11] **3,887,120**

[45] **June 3, 1975**

[54] **HOSIERY HANDLING METHOD AND APPARATUS**

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[22] Filed: **Sept. 25, 1974**

[21] Appl. No.: **509,058**

[52] **U.S. Cl.** **223/43**

[51] **Int. Cl.** **A41h 43/00**

[58] **Field of Search** 223/39–43, 223/75–77; 15/304; 66/147, 149

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[57] **ABSTRACT**

Hosiery from a knitting machine is placed on a hollow tubular form while still in a string, the first in-line hose is everted or turned by suction through the open end of the form, the hose is separated from the string and is pulled off the open end of the form and deposited in everted form at a stacking station. The portion of the hose adjacent the open end of the form is doubled over and the pulling-off operation is performed by a pair of grasping fingers engaging the doubled over portion. The separating operation is preferably performed simultaneously with the pulling-off operation by breaking a knitted connector ring attaching the hose to the string. Initially, pulling the hose on the form over the open end and bunching the string on the form is facilitated by inducing egress of air during the pulling-on operation. A rotating roller may also be utilized to facilitate this loading operation. The grasping fingers engage a flattened side of the form to grip the doubled over portion of the hose and a spring loaded over-center linkage operates the fingers. First and second stops actuate the linkage to grip and release, respectively, and first and second bumpers assure operation by momentum action of the linkage means at the extreme travel positions.

20 Claims, 9 Drawing Figures

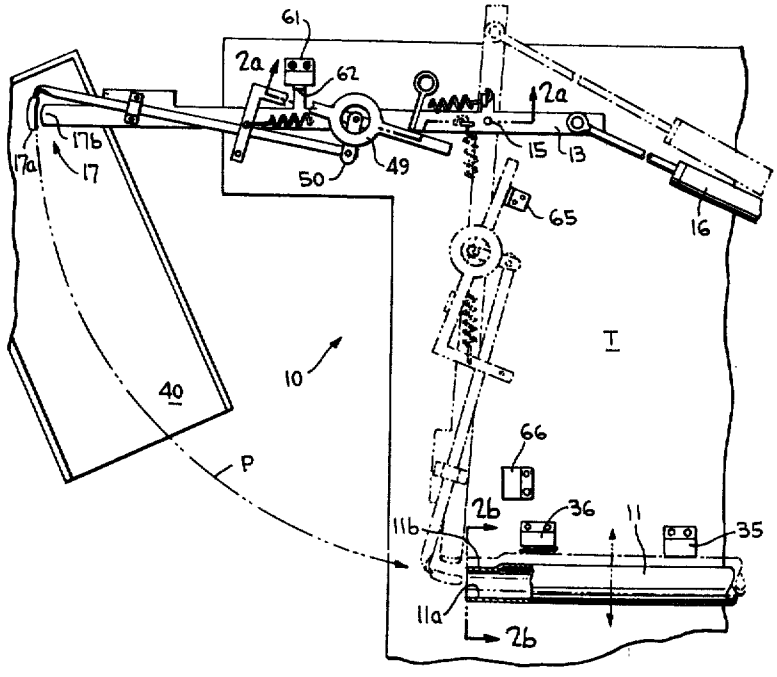

FIG. 1

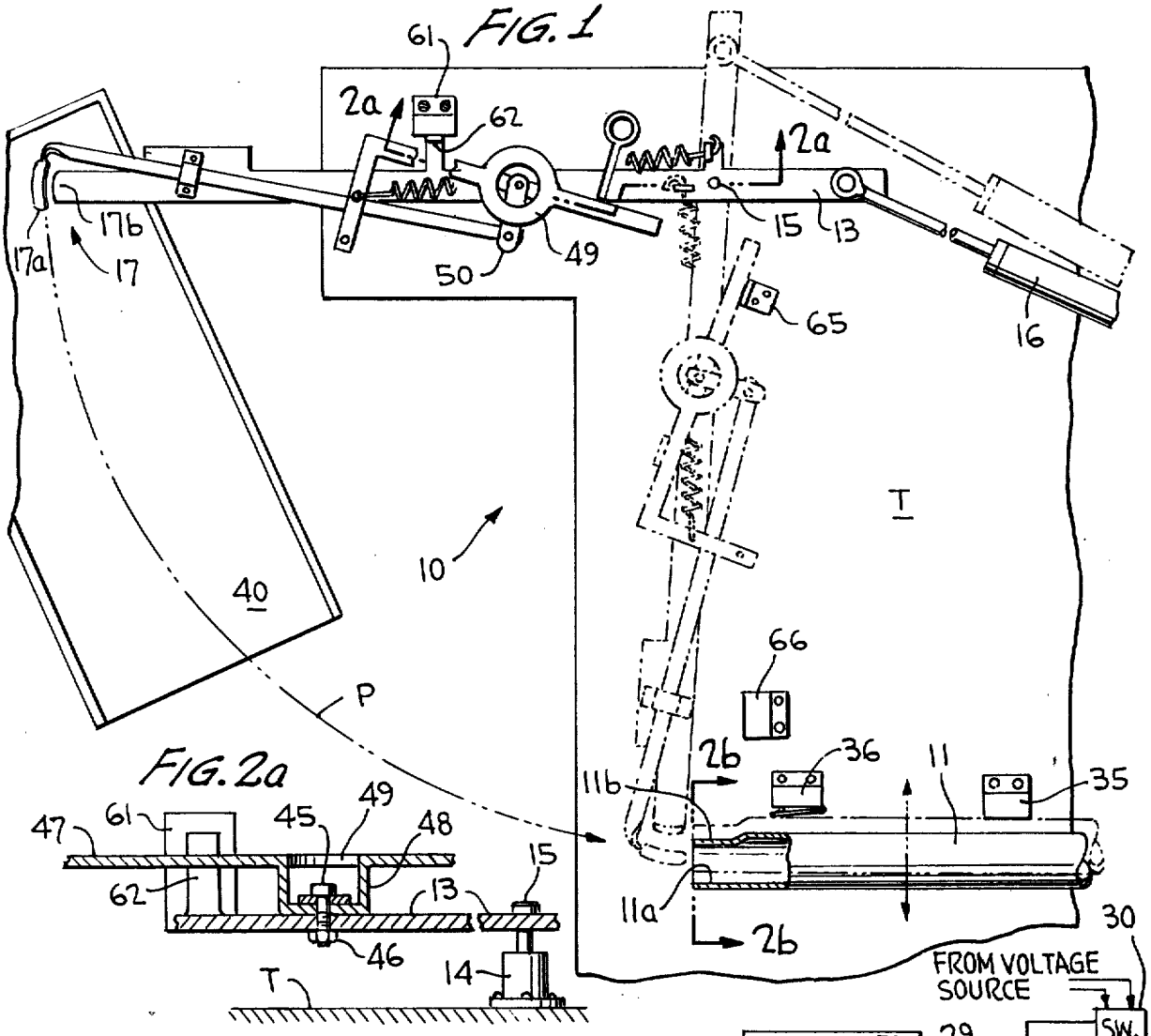

FIG. 2a

FIG. 3

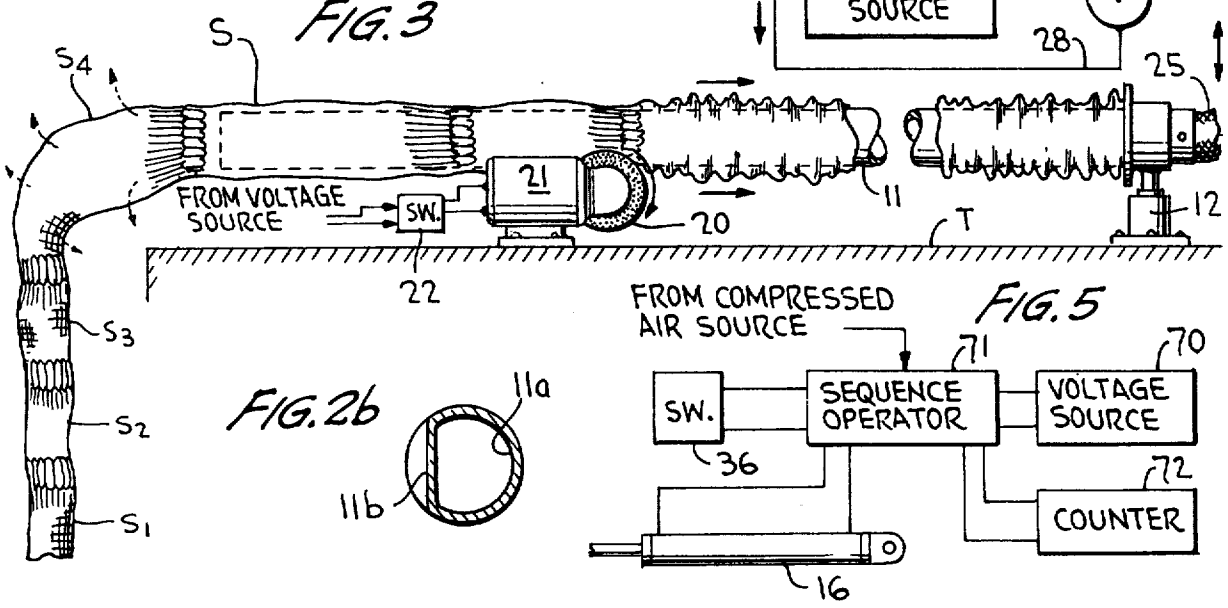

FIG. 2b

FIG. 5

FIG. 2

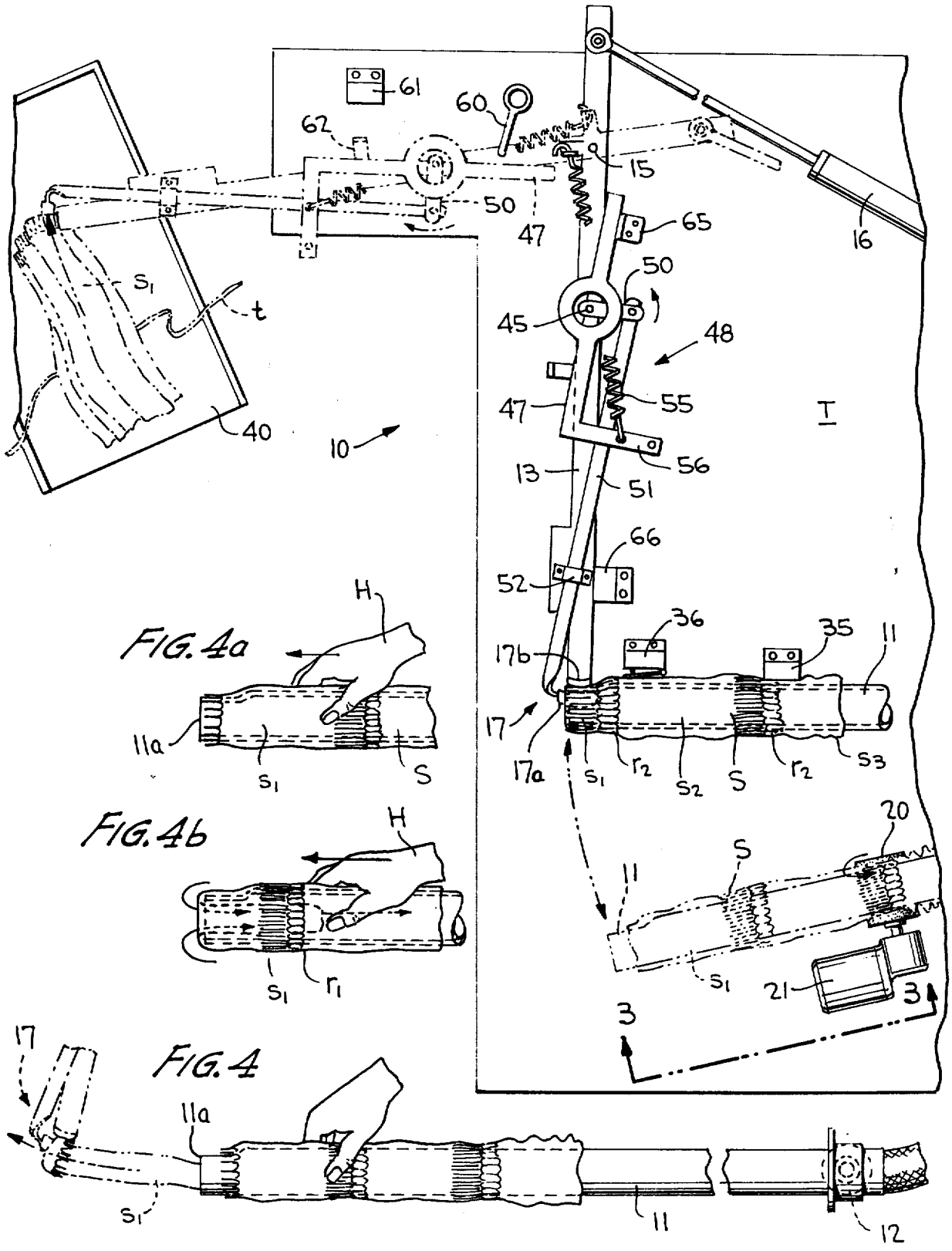

FIG. 4a

FIG. 4b

FIG. 4

HOSIERY HANDLING METHOD AND APPARATUS

FIELD OF THE INVENTION

The present invention relates to handling of hosiery during the manufacturing process, and more particularly, to an improved arrangement wherein the individual hose are turned, separated from the string, pulled off the turning form and stacked.

BACKGROUND OF THE INVENTION

During the manufacture of hosiery, particularly socks, it is common practice to knit the hosiery in a continuous elongated tube. Periodically, this tube or string of hosiery is removed from the output container of the knitting machine for further processing into a finished product. The individual hose of the string of hosiery is connected to the string by a knitted ring of break-away thread. This facilitates the separation of each hose in turn, that is required before the further processing can proceed. This preliminary manipulative or handling step has typically been performed by simply grasping the first in-line hose in one hand and the remainder of the string in the other, and pulling the two apart.

The next processing step to be performed on the hose, that is, after being separated from the string, is the sewing or closing of the toe. However, since the hose is usually knitted in the right side-out condition, it is required that the hose at the time of separation also be turned inside-out for the seamstress. Thus, heretofore, the preliminary everting operation has been typically performed by hand just after the manual separation step, and is usually performed by this same operator. The everted hose are counted and stacked by hand to complete the preliminary handling steps prior to delivery to the seamstress.

The performance of these preliminary handling tasks by hand is an extremely tedious and slow process. Furthermore, operating on the string of hose by hand greatly limits the number of hose on a string that can be conveniently handled at one time. That is, the strings have been required to be relatively short in order to be manageable. This causes additional time loss as more handling is naturally required to manipulate the extra number of strings. Also, even with the short lengths, this preliminary separating, turning and stacking process is likely to result in inadvertent soiling of the hosiery or a snagging of threads by the operator. Finally, manual handling as described can result in occasional failure to turn or completely turn the hose, as well as result in failure to form a neat stack required for efficient toe closing.

Heretofore, it has been proposed to provide a form to assist in this manual operation. Essentially, the form serves merely as a substitute for the person's arm that is performing the manual turning. One such proposed form is shown in British Patent No. 784,206, issued Oct. 2, 1957. This form, while possibly relieving the operator's arm from considerable irritation caused by repeated pulling of a string of hose over the same, has failed to gain acceptance in the hosiery manufacturing field. I conclude this is so mainly due to the failure to make any significant improvement in terms of speed of operation; and indeed using this prior form probably slows the operation. Furthermore, the prior art form fails in reducing the harmful effects of manual handling since it is still necessary to grip the socks with the fingers of the hands to pull the hose apart from the string and to pull the same off the form over the end collar. The counting and stacking, of course, must still be done manually in accordance with this prior art teaching.

OBJECTS OF THE INVENTION

Thus, it is a main object of the present invention to provide a semi-automatic method and apparatus for turning and separating hosiery that overcomes the aforementioned objections of manual handling.

It is a related object of the present invention to provide an arrangement for turning and separating hosiery where the only manual handling is sliding the hose along a tube.

It is still another object of the present invention to provide a method and apparatus for (1) turning a hose in a vacuum tube, (2) separating the hose after turning by engagement of a double over portion, and (3) counting and/or depositing the hose in a stack for further processing.

It is still another object of the present invention to provide a method and apparatus of handling hose wherein the preliminary separating function is performed simultaneously with the pulling of the hose off a vacuum tube in which the hose has been turned.

It is another object of the present invention to provide a turning, separating, counting and/or stacking arrangement that operates at a speed substantially above the speed of manual operation previously attained, with or without a solid form of the prior art.

BRIEF DESCRIPTION OF THE INVENTION

A new method of efficiently handling hosiery comprises the steps of placing a string of hose on a hollow form, inducing ingress of air through the open end of the form, moving the string to draw the hose into the form to evert or turn the hose, holding a portion of the hose adjacent the open end, separating the hose and pulling the hose off the form to move the same to a stacking station. The hose is doubled-over on itself at the open end of the tube for easier grasping by the pulling and stacking arm. The hose making up the string are interconnected to each other by a knitted ring of polyester yarn having a low tensile strength, such as Alignate yarn. The separating step is advantageously performed simultaneously with the pulling-off step by manually holding the string and allowing the pull on the hose to break this connector ring.

As the hose moves off the end of the form it is delivered in the same motion over a stacking station and released, forming a stack ready for tying after a predetermined number have been stacked.

A string is placed on the form by pulling-on over the open end of the form and bunching the string toward the opposite end. In accordance with another feature of the invention, this step is performed while inducing egress of air from the open end to preopen the string and reduce the frictional resistance. An endless moving surface, such as a power driven roller, may be utilized to engage the string during the pulling-on operation for additional assist.

The apparatus for pulling-off the hose from the string comprises a pair of fingers adapted to be positioned on opposite sides of a flattened side of the mouth of the form. One finger extends into the mouth of the form with the other finger on the outside. The hose is stopped short of a full turn so that a doubled-over por-

tion of the hose is thereby gripped. The fingers are carried on an oscillating arm that moves in an arc from the position where the hose is pulled off the form and free of the string to the stacking station. The end of the form is flattened in this area to assure a secure grip on the hose.

The finger extending inside the tube moves toward the finger on the outside, which is in fact formed by the end of the oscillating arm. A spring loaded over-center linkage operates and holds the fingers in the gripped position. A first stop at the limit of travel toward the form operates the linkage to grip the hose, and a second stop provides the release at the other extreme of travel adjacent the stacking station. Bumpers are provided to cause the operating lever of the over-center linkage to be urged by momentum in the proper direction to assist the tripping operation.

The spring of the over-center linkage is attached at one end to the arm and at the other end to the operating lever so that said spring passes over the pivot point of the lever between the gripping and releasing positions. A crank and slide are used to operate the finger extending inside the tube from the operating lever.

Still other objects and advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description, wherein I have shown and described only the preferred embodiment of the invention, simply by way of illustration of the best mode contemplated by me of carrying out my invention. As will be realized, the invention is capable of other and different embodiments, and its several details are capable of modification in various obvious respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top view of a preferred embodiment of the apparatus of the present invention, said apparatus being suitable to carry out the method of the present invention and shown in two operative (full and dotted line) positions;

FIG. **2** is a top plan view of the same apparatus as shown in FIG. **1** but with a string of hose mounted for operation and showing additional full line and dotted line positions;

FIG. **2***a* is a cross-sectional view taken along line **2***a*—**2***a* of FIG. **1** and showing the operating lever and pivot support of the arm;

FIG. **2***b* is a cross-sectional view taken along line **2***b*—**2***b* of FIG. **1** showing the end profile of the mouth of the form;

FIG. **3** is a side view of the form being loaded with a string of hose and taken along line **3**—**3** of FIG. **2**;

FIG. **4** is a schematic showing of the initial step according to the method of the present invention where a turned hose has just been pulled off the form and the next in-line hose is held and ready to move forward;

FIG. **4***a* is a step immediately following the step of FIG. **4** wherein the string of hose is moved forward toward the open mouth of the form;

FIG. **4***b* shows the next step in the operation wherein the hose is turning and is moving into the form and approaching the position shown in FIG. **2**; and

FIG. **5** is a schematic diagram of an operating circuit useful with the apparatus of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. **1** and **2** of the drawings, there is shown a preferred embodiment of an apparatus for turning, separating and stacking hose in accordance with the principles of the present invention. Specifically, a turning, pulling and stacking apparatus, generally designated by the reference numeral **10** is illustrated mounted on a work table T. The apparatus includes a hollow tubular form **11** pivotally mounted on the table T by a suitable pivot stand **12** (see FIG. **3**). An oscillating arm **13** of the apparatus **10** is pivotally mounted on a similar stand **14** (see FIG. **2**a) with a pivot pin **15.** A pneumatic cylinder **16** is pivotally attached to one end of the arm **13** to oscillate the same about the pivot pin **15.** A hose grasping means, generally designated by the reference numeral **17,** is carried on the opposite end of the arm **13.** The grasping means include two opposed fingers **17***a*, **17***b* and these move along the arcuate delivery path P, as shown best in FIG. **1.** As will be seen later in detail, the arm **13** moves during the operation between extreme limit positions of the full line position of FIG. **1** and the full line position of FIG. **2.**

With reference to FIG. **3,** there is shown a string of hose S as is being initially preloaded onto the tubular form **11.** The string S is made up of a plurality of individual hose or socks s_1, s_2, s_3, $s_4 \ldots s_x$ connected by connector rings r, r_2, r_3 $r_4 \ldots r_x$ of Alginate yarn. The tubular form **11** during this handling step has actually been bodily pivoted on the stand **12** to the dotted line loading position of FIG. **2.**

In this preliminary operation, one end of the string S is placed on the form **11** and pulled up to a point where roller **20** rotated by a motor **21** may engage the string S. The form is moved down into the roller **20,** and with the inside of the tube serving as a back-up to the endless moving driving surface, the string S is rapidly moved onto the form. The tube is tightly bunched at the end, as shown in FIG. **3,** so that a relatively long string may be accommodated. As the string clears the roller the feeding stops and the tube **11** is lifted and pivoted in the direction of the arrow in FIG. **2,** in readiness for the next handling step.

A suitable switch **22** (FIG. **3**), that may be a foot operated switch or a position sensitive switch mounted on stand **12,** supplies current to the motor **21** from a suitable voltage source, as will be described later. Once the string S is on the tube **11** and the first in-line sock s_1 is moved forward adjacent mouth **11**a (FIGS. **4** and **4***a*) of the tube **11** (FIG. **4**), the pulling operation in accordance with the present invention is ready to begin, as will momentarily be described.

The open mouth **11**a is provided with a flattened side **11***b*, as best shown in FIG. **2***b*. This flattened side is provided to present a surface that can be best engaged by the fingers **17***a*, **17***b* of the grasping means **17.** The doubled-over portion of the sock is held flat so that the fingers **53, 54** securely grasp the sock. As the sock is pulled free of the flattened side **11***b*, the fingers **53, 54** close more completely to grasp the double thickness of the sock and assure the sock is not dropped during the travel along the path P.

In order to operate to load the string S and to turn the hose first in-line on the string S on the hollow tubular form **11,** a pneumatic feed tube **25** is connected to the

form (see FIG. 3). A two-way valve **26** provides either compressed air or vacuum from the source **27** through the connections **28, 29,** respectively. The valve **26** is operated by a second switch **30** (either foot-operated or form **11** position responsive) that is provided current from the voltage source as best shown in FIG. **3.**

Supplying the compressed air through the valve **26** and out the mouth **11**a of form **11** is of considerable advantage in the present invention (as best shown in FIG. 3) since the air egressing from the open mouth causes the hose just beyond the end, such as hose s_4 of the string S, to be temporarily streteched outwardly. This preopens the string S to reduce the frictional resistance at the open mouth **11**a of the tube and greatly enhances the speed and efficiency of loading operations. With the combined blowing of air and the rotating roller **20** to assist in moving the string S onto the tube **11,** the operator is able to load a full string of socks in a very short time.

When the entire string S has been loaded, the form **11** is bodily pivoted from the dotted line position of FIG. **2** to approach the full-line position of FIG. **1.** The movement of the tube **11** toward the full-line position operates the switch **30** to change the valve **26** for connection to the vacuum side of source **27** so that ingress of air through the open mouth **11**a begins. The operator with his hand H, as shown in FIG. **4***a*, simultaneously moves the first sock s_1 toward the open mouth. The hose or sock s_1 is drawn into the open end of the tube as the hand continues to move, as shown in FIG. **4***b*.

The sucking of the hose s_1 into the form **11** does of course effect a turning. When the position of FIG. **2** is reached, a substantial full turn of sock s_1 is complete with the majority of the sock being inside the form **11.** The connector ring r_1 attaching the hose s_1 to the hose s_2 is stopped just short of the open mouth **11***a*. A doubled-over portion, preferably the welt end, is now positioned in readiness to be gripped across the flattened side **11**b of form **11** by the grasping fingers **17***a*, **17***b*. The operator pivots the form **11** inward the final distance against the positioning stop **35.** This aligns flattened side **11***b* of the tube **11** with the open grasping means **17** (compare FIGS. **1** and **2**). In this operative position, the form hits and closes switch **36** (see FIG. **2**). The cylinder **16** is activated sweeping the arm **13** along path P of FIG. **1.** In FIG. **2,** the arm has reached the extreme inward position and the grasping fingers **17***a*, **17***b* are just ready to close on the doubled-over portion of the sock s_1.

In FIG. **4,** the fingers **17***a*, **17***b* (dotted line outline) have closed and the arm has reversed, breaking the connector ring *r*, and pulling the sock s_1 out of the open mouth **11***a* of the form **11** in the everted position. The arm **13** moves the hose s_1 along the predetermined path P to the dotted line position of FIG. **2.** The hose is counted and is dropped in a stack on a suitable tray **40,** which stack when complete is ready to be tied by a suitable tie *t* into a bundle ready to be transferred to the seaming station for closing of the toes.

From just the foregoing and before discussing in more detail the particular apparatus and control, it can be realized that the method operation of the present invention is advantageously simple and capable of rapid and efficient execution. All the operator needs to do is load the string S and then move by a gentle sliding motion each succeeding sock s_1, $s_2 \ldots s_x$ toward the open mouth of the form for turning. He stops and holds the doubled-over portion of each sock adjacent the open mouth. The grasping means **17** on the end of the arm **13** engages and securely grips the doubled-over portion of each sock, as shown in FIG. **2,** and then pulls the socks in turn off the tube, simultaneously separating each connector ring r_1, $r_2 \ldots r_x$. In the same motion, each sock is moved along the delivery path P to the stacking station on the tray **40** where the bundle is formed.

With reference now to FIGS. **2** and **2***a*, the arm **13** is provided with a bolt **45** having a lock-nut for mounting a pivotal operating lever **47** of an over-center mechanism, generally designated by the reference numeral **48.** The lever **47** is raised from the surface of the arm **13** by a U-shaped support and ring **49.** A laterally extending crank **50** is mounted on the pivot bolt **45** for movement with the lever **47.** The crank **50** in turn moves a slide **51** held on the arm **13** by a yoke **52** (see FIG. **2**). The end of the slide **51** is turned and bent over and provided with a resilient pad to form the moving finger **17***a* of the grasping means **17.** The other finger **17***b* of the grasping means **17** may be formed by a similar resilient pad mounted on the terminal end of the arm **13.**

A spring **55** has one end attached to the arm **13** adjacent the pivot pin **15** (see FIG. **1** and FIG. **2**) with the other end attached to a lateral extension **56** of the operating lever **47** of the over-center mechanism **48.** When operating lever **47** is in the position shown in FIG. **2,** the spring **55** has moved to the right in the Figure over the pivot point at the bolt **45.** This means that the crank **50** is biased counterclockwise (note arrow in FIG. **2**) so as to hold the two fingers **17***a*, **17***b* firmly together against the doubled-over end portion of the hose s_1. The arm **13** is then moved so as to pull or withdraw the hose s_1 from the form **11.** The fingers grip and hold sufficiently firm to breakaway the connector ring r_1 so that the sock is separated in the same withdrawing motion, as desired.

As the dotted line position of FIG. **2** is reached, a first stop **60,** stationarily mounted on the table T, engages the operating lever **47** and trips the mechanism **48.** The lever turns clockwise about the pivot bolt **45** and the spring moves over-center causing the crank **50** to likewise move clockwise (note dotted line arrow in FIG. **2**). Almost simultaneously, a first bumper **61** is engaged by a projecting member **62** on the arm **13** so that momentum of the bodily moving lever **47** with the extension **56** assures the proper movement of the crank **50** and the opening of the fingers **17***a*, **17***b*. The opening of the fingers **17***a*, **17***b* drops the sock s_1 on the stack and the next sock s_2 is then ready to be turned and pulled.

A second stop **65** engages the operating lever **47** to push the lever and trip the same for the closing action, as previously described (see dotted line position of FIG. **1**). A second bumper **66** serves to abruptly stop the arm **13** in just the right position for the fingers **53,** 54 to engage the doubled-over portion of the sock. As before, the stopping action causes the momentum of the arm **47** to make certain that over-center travel of the spring **55** is effected, as clearly shown by comparison of the dotted line position of FIG. **1** to the full line position of FIG. **2.**

In FIG. **5,** there is shown a typical control circuit that may be utilized with the apparatus **10** of the present invention. A voltage source **70,** such as 110-volt AC, is

provided. This same source may also provide the power for the operation of the motor **21** and of valve **26** (FIG. **3**), described above. A sequence operator **71** is shown to depict a suitable electrically operated switch-valve combination to supply compressed air from the source **27** to the operating cylinder **16** in the sequence desired. A counter **72** registers each cycle and thus each hose that is placed in the stack. The switch **36** controlling the combination is operated by the finger of the operator as the form **11** is brought into an operative position for the separating function, as previously described.

Briefly summarizing, it can be seen from the above description that an improved method and apparatus for turning, separating and stacking hose, all in one handling operation, has been provided. First, a string of hose taken directly from the knitting machine is pulled onto a hollow tubular form aided by preopening action on the string S by induced flow of air from the open mouth **11a** of the form and by a rotating wheel **20.** After the string S has been loaded on the form **11**, it is pivoted from the dotted-line position of FIG. **2** toward the full-line position. Prior to engaging the limit stop **35** by the side of the form, the switch **30** switches the valve **26** to provide a vacuum in the form reversing the flow thereby inducing ingress of air through the open end. The operator slides his hand H forward, as shown in FIG. **4a**, continuing until the first hose s_1 is drawn into the open mouth and turned (FIG. **4b**). The operator stops and holds the string when the doubled-over portion of the sock s_1 remains outside the form **11**, as shown in FIG. **2.** The form **11** is moved the short distance into abutment with stop **35** with the flattened side **11b** aligned with the path of the grasping fingers **17***a*, **17***b* (FIG. **2**). The operator in the same motion activates the switch **36** causing the sequencing of the apparatus **10.** With one rapid, full cycle oscillating motion of arm **13**, the first sock s_1 is grasped, separated and pulled off, (FIG. **4**) and stacked (FIG. **2**). Each sock s_2, $s_3 \ldots s_x$, in turn, is rapidly handled by the simple, short in and out motion of the form **11** (see FIG. **1**) and the concurrent sliding of the string S forward (FIGS. **4a** and **4b**).

In this disclosure, there is shown and described only the preferred embodiment of the invention, but, as aforementioned, it is to be understood that the invention is capable of use in various other combinations and environments and is capable of changes or modifications within the scope of the inventive concept as expressed herein.

What is claimed is:

1. A method of handling hosiery comprising the steps of:

placing a string of hose on a hollow tubular form,

inducing ingress of air through the open end of said form,

moving the end of said string on said form over said open end to extend the first in-line hose into said form thereby everting the hose,

holding a portion of said hose adjacent said open end of said form,

separating said hose from the remaining hosiery on the string, and

pulling said portion of said hose to remove the hose off the open end of said form and move the same along a predetermined delivery path.

2. The method of claim **1** wherein the step of moving the string of hose on the form comprises:

positioning the hose over the open end of the form so that said portion is doubled-over on itself, and the pulling-off operation is performed on the doubled-over portion.

3. The method of claim **2** wherein the doubled-over portion of the hose that is pulled-off is the welt end.

4. The method of claim **1** wherein the step of separating said hose is performed during the pulling-off operation.

5. The method of claim **4** wherein the separating operation is performed by breaking a knitted connector ring by the force exerted during pulling-off.

6. The method of claim **1** wherein is further provided the step of:

delivering said hose in the same motion as the pulling-off step along said delivery path to a stacking station, and

releasing the hose at the stacking station.

7. The method of claim **1** wherein the string is placed on said form by pulling-on over the open end and bunching the string toward the opposite end of the form.

8. The method of claim **7** wherein is further provided the step of:

inducing egress of air from the open end of said form during pulling-off of the string thereby preopening the string to reduce the frictional resistance.

9. The method of claim **8** wherein the pulling-on operation includes applying an endless moving surface to the outside of said string, the inside of said string being supported in the area of said moving surface by said form.

10. A hosiery handling apparatus for turning, separating and stacking hose from a string comprising:

a hollow tubular form for receiving the hosiery string, said form having an open mouth forming one end,

a source of vacuum connected to the opposite end of said form to evert the first in-line hose through the mouth and into the form,

means for separating said hose from said string, and

means for pulling said hose off the open end of said form after eversion, whereby the hose is separated from said string and delivered away from said form along a predetermined path.

11. The apparatus of claim **10** wherein said pulling-off means comprises:

means for grasping a doubled-over portion of the first in-line hose over a side of said form adjacent the open mouth after eversion, and

reciprocating means carrying said grasping means for moving the same along said predetermined path.

12. The apparatus of claim **10** wherein said hose is interconnected to said string by a break-away connector ring, said separating means being formed by said pulling-off means operative as the hose moves off the open end of the form.

13. The apparatus of claim **12** wherein said break-away connector comprises:

a knitted ring of polyester thread with relatively low tensile strength.

14. The apparatus of claim **11** wherein the side of said form to be engaged by said grasping means is flattened, said grasping means including:

a pair of fingers adapted to be positioned on opposite sides of said flattened side to grip the doubled-over portion of the hose.

15. The apparatus of claim 14 wherein said reciprocating means comprises:

an arm, power means for operating said arm, and means for releasing said grasping means to deposit the hose at a selected stacking station along said delivery path.

16. The apparatus of claim 15 wherein said grasping means further comprises:

a spring loaded over-center linkage for operating and holding said fingers in the gripped position, a first stop for tripping said linkage over-center to grip, and

said releasing means comprises a second stop for tripping said linkage over-center in the opposite direction to open and hold open said fingers to release.

17. The apparatus of claim 16 wherein is further provided a pivot support to render said arm oscillatable whereby said grasping fingers move along a predetermined arcuate path.

18. The apparatus of claim 17 wherein said over-center linkage is mounted on the oscillating arm,

bumper means in the path of said arms at both extremes of travel, said over-center linkage including a pivotal operating lever adapted to turn in the direction of movement of the arm so as to be urged by momentum over-center when said extremes of movement are reached, whereby to assure proper operation of said grasping fingers.

19. The apparatus of claim 18 wherein said over-center linkage includes:

a spring having one end attached to said arm and the other end to said lever so that said spring passes over the pivot point of said lever between the gripping and releasing positions, and a crank and slide connected to one of said fingers.

20. The apparatus of claim 19 wherein said grasping fingers include:

the terminal end of said arm, and

an opposing terminal portion of said slide bent over to extend into the mouth of the form and cooperate with said terminal end to grip said hose.

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