July 14, 1970 J. C. BOLLES ET AL 3,520,262

METHOD AND APPARATUS FOR CLOSING STOCKING TOES AND PUTTING STOCKINGS ON BOARDING FORMS FOR PROCESSING

Filed Aug. 23, 1967 4 Sheets-Sheet 1

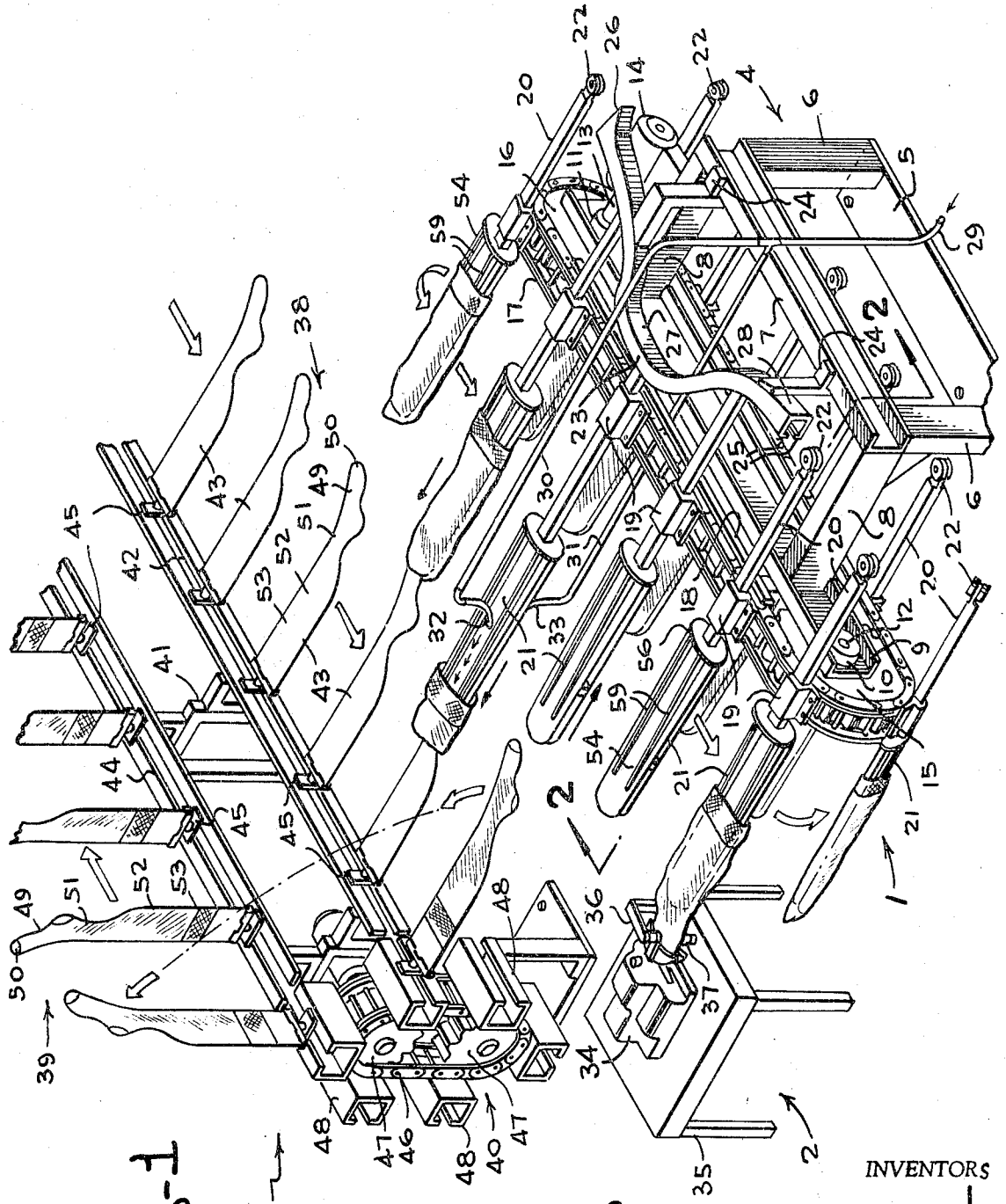


FIG. 1


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METHOD AND APPARATUS FOR CLOSING STOCKING TOES AND PUTTING STOCKINGS ON BOARDING FORMS FOR PROCESSING

Filed Aug. 23, 1967 4 Sheets-Sheet 2

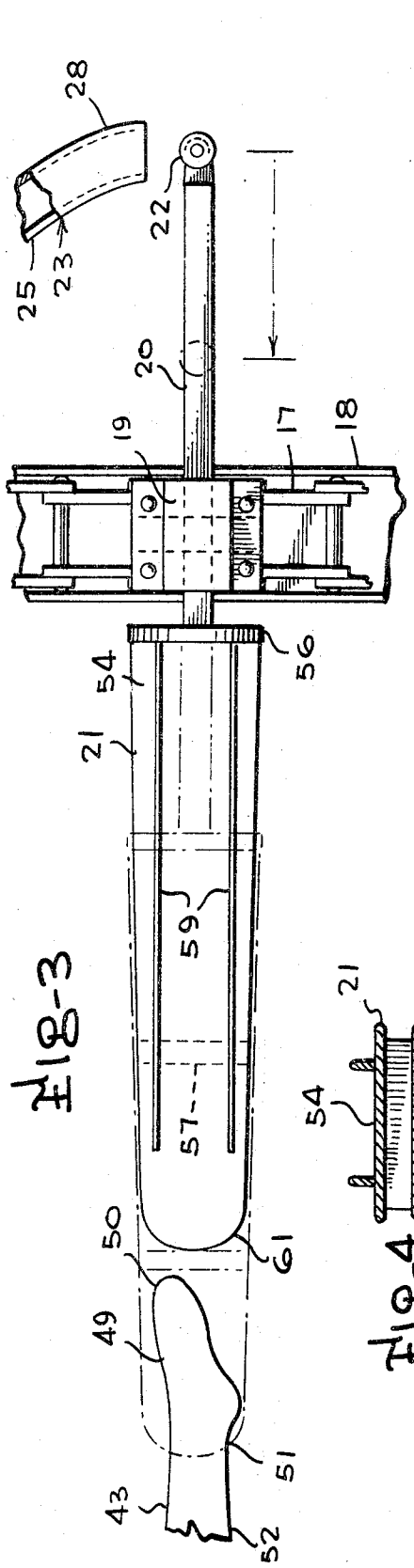


FIG 3



FIG 4

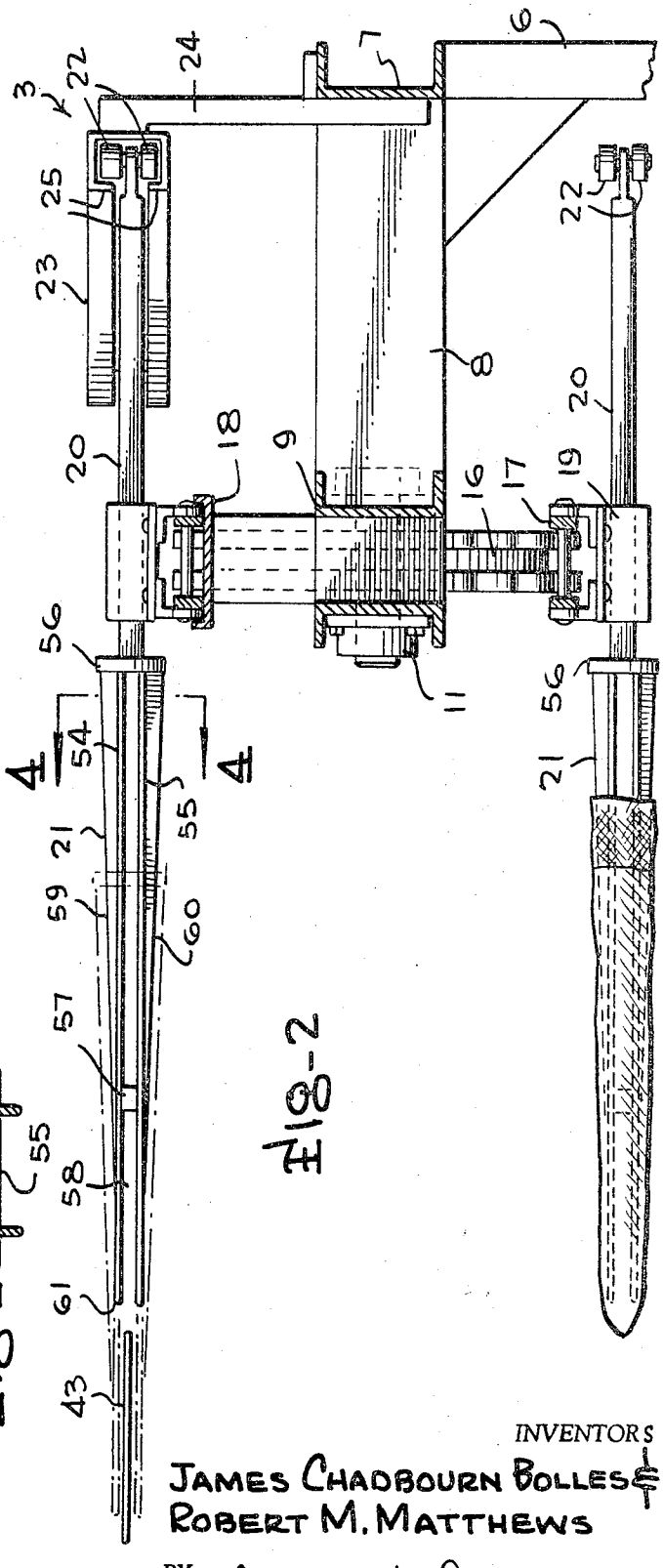


FIG 2

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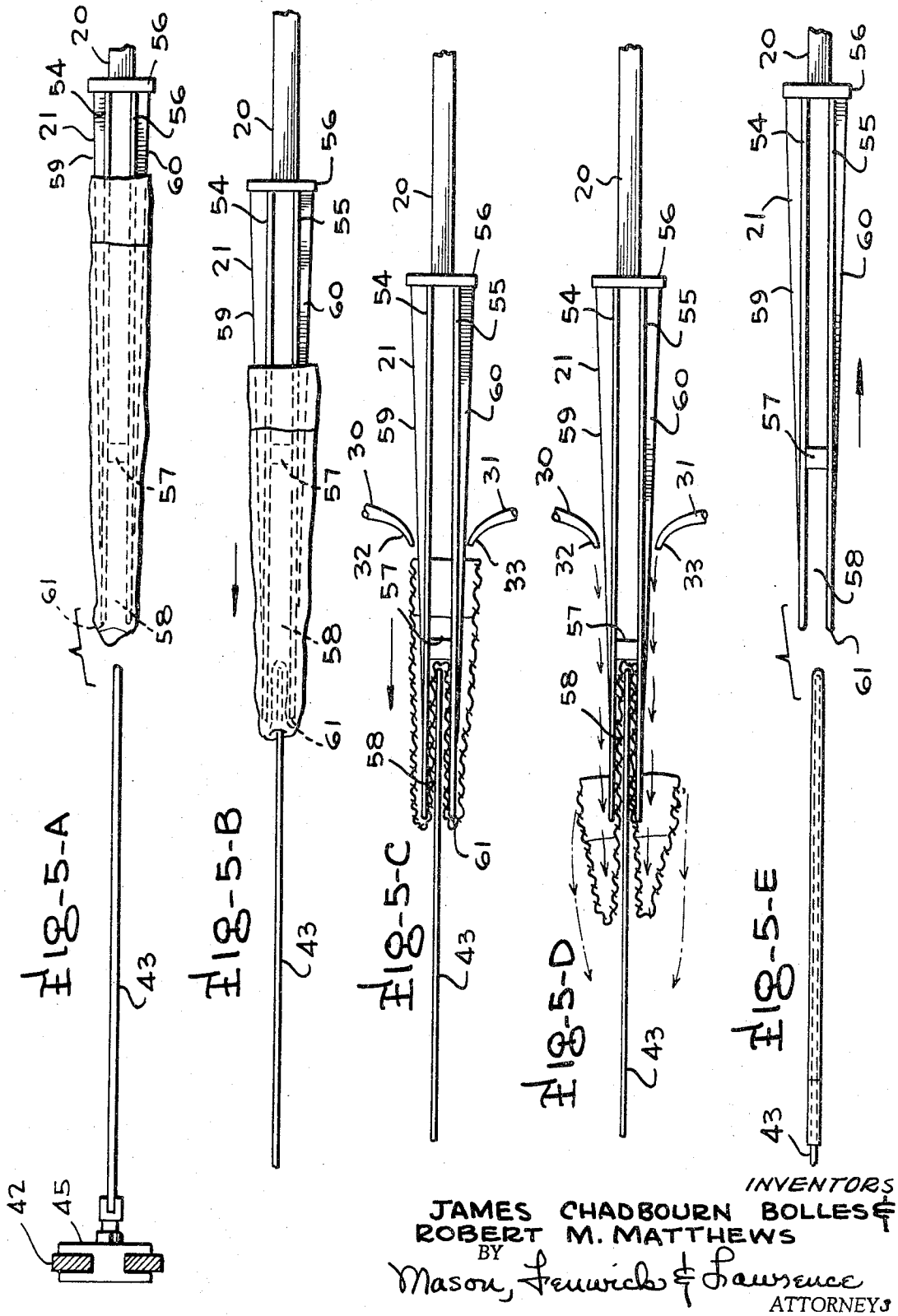
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METHOD AND APPARATUS FOR CLOSING STOCKING TOES AND PUTTING STOCKINGS ON BOARDING FORMS FOR PROCESSING

Filed Aug. 23, 1967 4 Sheets-Sheet 3




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Filed Aug. 23, 1967 4 Sheets-Sheet 4

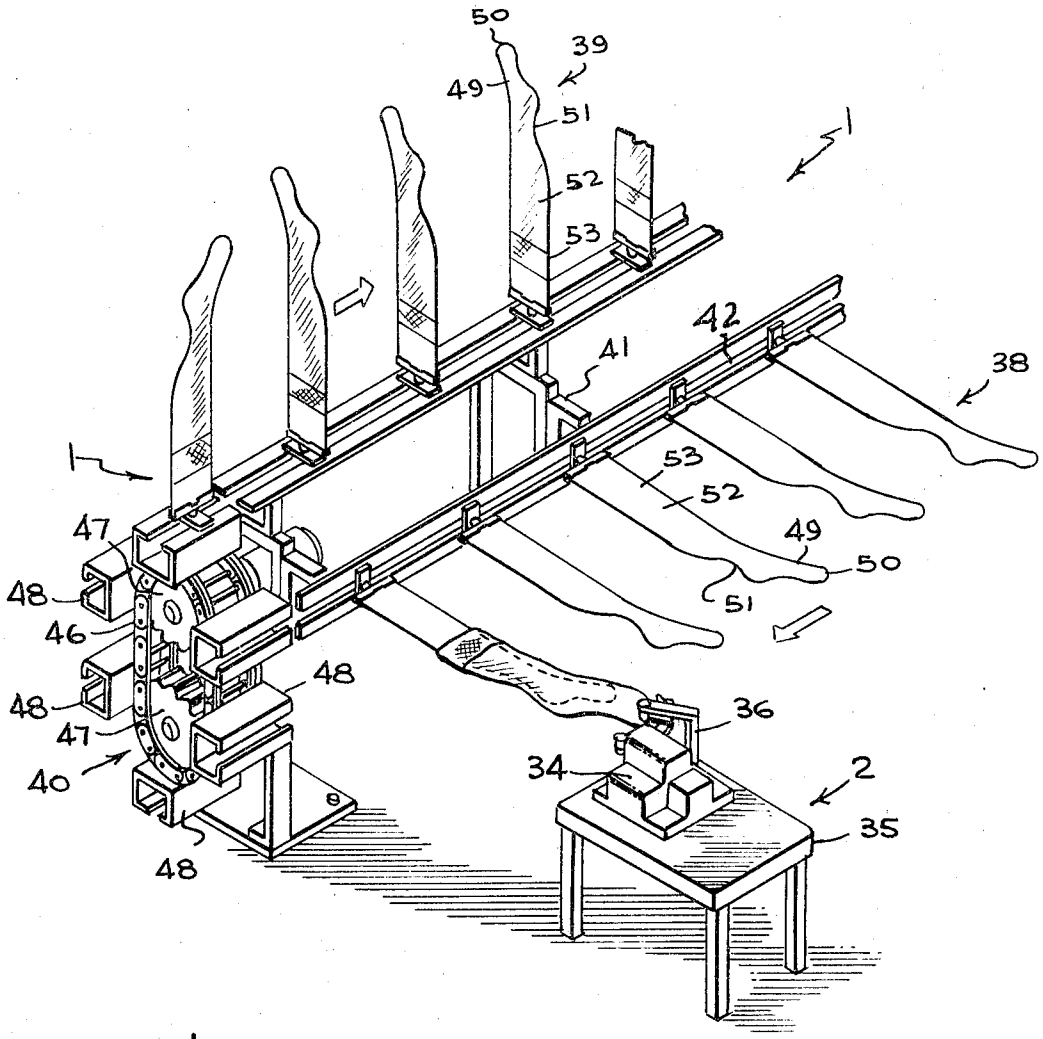



Fig-6

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3,520,262

# METHOD AND APPARATUS FOR CLOSING STOCKING TOES AND PUTTING STOCKINGS ON BOARDING FORMS FOR PROCESSING

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U.S. Cl. 112—121.29 13 Claims

## ABSTRACT OF THE DISCLOSURE

A method and apparatus for closing stocking toes and putting stocking on boarding forms for processing to eliminate manual transfer of stockings from forms on which they are drawn prior to toe closing to boarding forms wherein the stockings can be drawn directly onto boarding forms with the toe portions overhanging the form end for toe closing and drawn fully on the form for further processing, or, the stockings are put on the forms having a recess in the end for toe closing and, after toe closing, the forms and stockings are brought into end-to-end alignment with boarding forms and the two forms moved relatively to insert the toe end of the boarding form into the recess of the toe-closing form to evert the stocking and draw the closed toe onto the toe end of the boarding form. The remainder of the stocking is then blown from the toe-closing form onto the boarding form to complete eversion of the stocking and transfer from one form to the other.

## BACKGROUND OF THE INVENTION

This invention relates to methods and means for handling stockings during toe closing and processing which eliminates manual transfer of stockings from sewing forms to boarding forms, and to apparatus for automatically transferring stockings from an inspection form to a boarding form.

Many stockings are now made by knitting tubular lengths, each including a turned welt, leg and foot, on a battery of knitting machines, and conveying the open toe tubes to a central location where the toe is closed by a single operator. The operator pulls the tubular knit lengths onto inspection forms, inspects them and properly orients them for toe closing. The toe end is then pulled out and inserted into a clamp which holds, and guides, the fabric during the arcuate stitching and trimming operation. As soon as the toe end is in the clamp, the knit tube is stripped from the form and the welt end slipped over a small tube and within a larger one which is concentric to the first. Vacuum is applied within the annulus between the outer and inner tubes to hold the knit length taut. As soon as the toe is closed, the toe is released from the clamp and the vacuum reversed in the double tube assembly to apply the vacuum to the smaller, inner tube. This causes the toe to be drawn into the inner tube and the stocking to be turned to place the toe seam inside. The vacuum conveys the stocking to a collection point.

Later, the stockings are drawn over boarding forms for dyeing and processing. This operation is performed by an operator, who slips the welt over the toe end of the board and draws the stocking down smoothly in place. The board has the proper leg shape, so that the stocking will have the proper contour when set.

This procedure requires the handling of the stockings by two operators. Despite great precaution taken in the



care of the operators' hands, and the use of gloves in many instances, snagging and pulling occurs at each of the two handling positions with a resultant loss in first quality goods.

## SUMMARY OF THE INVENTION

The principal object of the present invention is to provide a method of handling stockings during the above set out steps of manufacture, wherein the stockings are handled by an operator only once, thus reducing by half the likelihood of damage by operator handling.

Another object of the invention is the provision of a method of transferring a stocking from a form having a bifurcated end by inserting the end of a boarding form into the end of the stocking to press the stocking toe into the bifurcation and, while turning the stocking, putting the toe and at least part of the foot onto the boarding form, and then completing the transfer by using air to blow the remainder of the stocking from the first form onto the boarding form.

A further object is to provide a method of closing a stocking toe and processing the stocking wherein the knitted tube with open toe is pulled onto a boarding form, leaving the toe end of the stocking projecting beyond the toe of the boarding form, closing the toe while the stocking is on the form, and then drawing the stocking fully onto the form.

Still another object of the invention is the provision of a machine incorporating a line of moving inspection forms on which open toed stockings are placed for closing, and a moving line of boarding forms adjacent to the inspection form line, with means for transferring the stockings from the inspection forms onto the boarding forms.

Yet a further object is to provide apparatus for imparting relative movement between a form having a bifurcated end and a conventional boarding form to cause the toe of the boarding form to move between the bifurcated ends of the other form to evert the toe of a stocking on the bifurcated form and place it on the boarding form, with means for completing the transfer, and eversion of the stocking from the bifurcated form to the boarding form.

Another object is the provision of apparatus causing a line of boarding forms to move adjacent a toe closing sewing machine so that stockings on the boarding forms can have their toes closed.

Other objects of the invention will become apparent from the following description when taken in conjunction with the drawings which accompany, and form part of, this specification.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of apparatus for carrying stockings to a toe closing sewing machine and for transferring completed stockings onto boarding forms for processing;

FIG. 2 is an enlarged vertical section taken on the line 2—2 of FIG. 1;

FIG. 3 is a top plan view of the structure shown in FIG. 2;

FIG. 4 is a horizontal section through one of the inspection forms, and is taken on the line 4—4 of FIG. 2;

FIGS. 5A, 5B, 5C, 5D and 5E show various stages of the transfer of a stocking from the inspection form to the boarding form; and

FIG. 6 is a perspective view of a boarding form conveying line with stockings having the toes closed while on the boarding forms.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The method forming part of the present invention can be performed in several ways. Two examples of the method will be described, and one phase of one of the illustrative methods will be specifically set out.

In one procedure, an open toed stocking from the knitting machine is placed upon an inspection form having a bifurcated end and examined for flaws. The toe end of the stocking is left projecting beyond the end of the inspection form so that it can be inserted in the usual clamp and fed in an arcuate pattern to the sewing machine. After the toe is closed, the clamp is released and the stocking is pulled up on the form. There is no requirement for the stocking to be pulled tightly on the form and, in fact, the method is performed to better advantage if the stocking is loose and the toe is not up in engagement with the end of the form. The stocking will now be on the form, its toe will be closed, and the seam closing the toe will be on the outside.

The form with the stocking in place is then aligned with a boarding form and the two forms are brought into end to end proximity. The relative longitudinal movement of the forms is continued so that the toe of the boarding form contacts the toe of the stocking and moves it into the space between the arms of the inspection form. As the boarding form moves deeper into this space, the stocking is slowly everted and fitted over the toe and foot portion of the boarding form. As the stocking toe is pressed further into the space between the arms, the leg portion slides freely down the outer surface of the inspection form.

At this point in the procedure, air flow is directed along the surface of the inspection form in the direction of the toe end. The air is traveling so that it will enter the leg and welt sections of the stocking still remaining on the inspection form and blow them outwardly. This will cause the leg and welt sections to evert and to be pushed up the leg portion of the boarding frame to complete the transferal of the stocking from the inspection form to the boarding form. The stocking has also been completely turned so that the toe closing seam is now on the inside. The stocking can then be dyed and processed in the normal manner while on the bording form.

A variation of the method just described consists oin slipping the open toed stocking directly onto a boarding form, leaving a portion of the toe and extending beyond the toe of the boarding form. The extending portion is then put in the clamp and the toe will be closed in the usual manner. After release of the toe from the clamp, the stocking will be drawn fully onto the boarding form in the usual fashion. It can then proceed through the necessary processing steps.

The alternate procedures set out above, and the specific steps of transferring a stocking from one form to another while turning the stocking comprise the method which forms the basis of the present invention.

Turning now to FIG. 1 of the drawings, there is shown apparatus for carrying out the first obove-described method. Basically, the structure includes an endless line **1** of inspection forms, movable past a toe closing machine **2** and parallel, and adjacent to, an endless line **3** of boarding forms to allow transfer of stockings from the inspection forms to the boarding forms.

The inspection form line **1** may be mounted on a suitable frame **4** having a fixed base plate **5** carrying vertical end posts **6** that are bridged at their tops by a heavy channel **7**. Supporting arms **8** extend horizontally and parallel from the ends of channel **7**, and have their outer ends connected by a mounting beam **9**. Beam **9** is shown as being longer than channel **7**, with its ends projecting beyond the arms **8** and having hubs **10** and **11** mounting a stub shaft **12** and a drive shaft **13**, respectively. A motor **14** is coupled to shaft **13**, and is mounted upon the adjacent arm **8**. Shafts **12** and **13** carry sprockets **15** and **16** over which a chain **17** is trained. A suitable guide track **18**, in which the upper flight of the chain rides for support, is carried by the beam **9**. As shown, the top flight of chain **17** is driven by motor **14** to move toward the toe closing machine **2**.



At equally spaced intervals along chain **17**, slide bearings **19** are mounted with their slide openings arranged transversely of the chain. A control rod **20** carrying an inspection form **21** is slidably mounted in each bearing **19**. The bearing openings and the control rods are shown as square in cross-section, but any arrangement may be used which will allow movement of the rods through the bearings while maintaining the inspection forms with their flat surfaces parallel to the path of movement of the top flight of chain **17**. The rods have cam-following rollers **22** rotatably fixed to their free ends for cooperation with a cam **23** supported by brackets **24** on channel **7**. Cam **23** may be channel-shaped in cross-section, having guide flanges **25** extending inwardly from its open side to form tracks for rollers **22**. In plan, the cam has a flared entrance mouth **26** to receive the rollers of fully retracted control rods and inspection forms, and follows a double reverse curve pattern to provide an inward swell **27**, to project inspection forms outwardly, at its midsection, and an exit end **28** equidistant with the entrance mouth from chain **17**, so that the inspection forms will be fully retracted when they move beyond the cam area toward the toe closing machine.

There is an air line **29** adjacent the frame **4** with horizontal branch lines **30** and **31** located, respectively, above and below the top flight of chain **17**, and extending centrally of the swell **27** of cam **23**. The branch lines terminate in nozzles **32** and **33** positioned just above and below the planes of the top and bottom surfaces of inspection forms moving along the top flight of chain **17**. The nozzles will be located approximately at the transverse center of inspection forms when the rollers **22** of the inspection form control rods are at the peak of the swell **27** of cam **23**. This is an at rest position of the forms in their intermittent orbital movement, as will be described later in more detail.

The toe closing machine **2** is of standard construction. It consists in a sewing machine **34**, mounted on a stand, or table, **35**, and having a toe clamp **36**, which is usually foot operated and is mounted upon a post **37** for pivotal movement to feed the stocking toe to the sewing machine in an arcuate path to obtain a curved closure seam in usual manner.

The boarding form line **3** could be any conveying system to transport stockings to a processing operation, but the structure shown is part of a boarding range of the type shown in co-pending application Ser. No. 448,700, filed Apr. 16, 1965, Smith et al., inventors, now Pat. No. 3,331,506. The portions shown are the exit line **38** from the stocking stripping area of the machine, the stocking feed line **39**, and a transfer mechanism **40** for moving forms from one line to the other. This structure can be mounted on any suitable frame **41**, which supports a form track **42** from boarding forms **43** moving from the stripping area, and a track **44** for forms being fed to a retort, or other processing equipment. The forms are on carriage **45** riding in the respective tracks. The transfer mechanism **40** includes a chain **46** on sprockets **47** on frame **41**, and the chain has appropriate receivers **48** into which carriages **45** move from track **42**, and from which they move into track **44**. Suitable means, not shown, will advance the transfer chain step-by-step, and the carriages along the tracks in desired steps.

To carry out the present invention it is essential that the boarding forms on exit line **38** move in the same horizontal plane as the inspection forms of the flight of chain **17** from which stocking transfer is to be made, that the forms on these move in equal steps and in unison, and that the inspection forms and boarding forms

be in longitudinal alignment in the area between track **42** and chain **17**.

The boarding forms **43** are of conventional shape, being elongated, flat members having their side edges contoured to approximate leg shape to provide a foot **49** with a toe **50**, ankle **51**, leg **52** and welt area **53**. It is attached to carriage **45** at the welt area end, and the foot and toe extend outwardly.

Inspection form **21** is shown as comprising two identical plates **54** and **55**, joined in spaced, parallel relation to a header **56**. The header is connected to control rod **20**. A spacer block **57** is placed between plates **54** and **55** to maintain parallelism, but the block is placed some distance inwardly of the ends of the plates, leaving a recess, or notch, **58** in the end of the form. This is important, as the form can be formed of one piece so long as the recess is present. The illustrated form has inclined ribs **59** and **60** on the respective plates, the ribs being on the outer sides of the plates and including from the outer end **61** of the form to the header **56**. These serve two purposes, they hold the stocking fabric spaced from the plates for easy inspection, and they permit air from nozzles **32** and **33** to get under the stocking fabric and inside the stocking to facilitate blowing the stocking from the inspection form and complete eversion on the boarding form. The drawing of the stocking on the inspection form and the transfer to the boarding form is aided by having plates **54** and **55** taper outwardly and be rounded at the form outer end **61**.

The forms **21** and **43** are so positioned on their respective supports that when they are in adjacency in end-to-end alignment the form **43** and the plates **54** and **55** of form **21** lie in parallel planes, with the form **43** occupying a plane intermediate the plates **54** and **55** to ensure entry into the recess **58** of form **21** when the forms are brought together.

When the apparatus is operated, boarding forms **43**, leaving the area where the stockings they carried have been stripped off, travel horizontally along track **42** (in the direction of the arrows) in stepped increments. As each form reaches the end of track **42**, it moves into a receiver **48** of the stationary chain **46**. During the time forms are motionless on track **42**, chain **46** moves forward, causing the receiver into which a form **43** has just entered to move around upper sprocket **47** through an arc of 90° to rotate the form to vertical position and to align its carriage with track **44**. This will bring another receiver into alignment with track **42** so that upon the next movement of forms along the tracks another form from track **42** will enter the new receiver and the now vertical form will move onto track **44**. This movement continues as long as the machine is in operation. At the same time, chain **17** will start so that the forms **21** on its top flight will move in unison with the forms **43** on track **42**.

An operator will be stationed at the toe closing machine, and, as an inspection form reaches the end of its travel along the top flight of chain **17**, the operator will pull a knit open-ended tubular stocking onto the form, welt end first. This positions the toe end adjacent the toe closing machine. This end is inserted in the clamp **36** and the clamp closed and the fabric fed to the sewing machine **34**. During these operations and the sewing, the operator will inspect the stocking for imperfections, and if flaws are found the stocking will be removed. The operation is timed so that the toe is closed during the rest interval of the form advancing means, and the toe is closed and the clamp released by the time the chain is ready to move another step. The operator will draw the closed stocking further onto the form as the operation is completed.

In the structure illustrated, the stockings on the inspection forms will move around sprocket **15**, along the bottom flight of chain **17** and around sprocket **16** before transfer of the stocking is begun. This is done to have the inspection forms moving in the same direction during transfer so that the transfer can be effected over an area embracing several steps of chain movement. If the transfer is accomplished at a single pause in chain movement, it is not necessary for the chains to travel in the same direction. Transfer at a single station can be had by using a solenoid, or other quick operating means, to project the inspection forms in place of the cam **23**.

When an inspection form takes its first step of movement after having arrived on the chain top flight, the rollers **22** on control rod **20** will enter the mouth **26** of cam **23**, so that subsequent movement of the form along the chain path will result in movement of the form longitudinally.

In the first step of form movement under cam control, the inspection form will move outwardly toward the boarding form, so that the toe of the boarding form will contact the stocking toe on the inspection form and push it into the recess **58** of the inspection form. This will evert the fabric of the toe, while drawing the stocking toe onto the toe **50** of the boarding form. This is the position shown in FIG. 5B of the drawing.

As the forms advance another step, the inspection form will move further under influence of the cam, causing the boarding form to enter deeper into recess **58** and evert and draw more of the stocking onto the boarding form toe until the entire foot is within the recess and the stocking is in place on the foot and ankle of the boarding form, leaving only the leg and welt portions still on the inspection form. As the stocking is pressed deeper into recess **58**, the leg of the stocking will slide forward on the inspection form. Due to the tapering shape of the inspection form and ribs **59** and **60**, the stocking becomes looser and freer on the form as it moves outwardly. This is substantially the position of the elements when the forms stop after the second indexing movement, and is the position shown in FIG. 5C.

When the forms complete the second step of indexing movement under cam control, the nozzles **32** and **33** will be centrally aligned with the inspection form above and below the forms. The nozzle ends will be back of the stocking top, so that air from the nozzles will move under the stocking top edge into the stocking welt and leg. The air nozzles can be in constant operation or they can be automatically turned on at the completion of each indexing step of the forms and turned off during form advance. In either event, air will go into the stocking tops blowing the stockings outwardly off of the inspection forms and onto the boarding form. At the same time, the completion of the eversion will take place. FIG. 5D shows the stocking being blown onto the boarding form, and FIG. 5E shows the stocking on the boarding form after complete eversion.

In some instances, it may be necessary for an operator to smooth the stocking on the boarding form to achieve perfect processing and setting, but the stocking is not handled by an operator in removing from the inspection form or in drawing it onto the boarding form. This greatly reduces likelihood of stocking damage.

During the next step of conveyor movement, cam **23** will retract the inspection form almost to its original position. On the next step, the form will be fully retracted and the rollers **22** on the form control rod will exit from the cam track. The form is now ready to receive another stocking for toe closing.

While the inspection form outward movement has been shown as cam controlled and covering several indexing steps, the forms can be moved outwardly and retracted at a single pause in indexing by using solenoids, or air cylinders in place of the cam. Of course, with substitute form moving means the form may be advanced at one step of conveying movement and retracted at another.

It is contemplated that the manual transfer of stockings from inspectoin forms to boarding forms can also be eliminated by putting the stockings directly on the board-

ing forms and closing the toes while on these forms. Apparatus for doing this is shown in FIG. 6.

The structure shown in FIG. 6 is a duplicate of the boarding form conveying line 3 of FIGS. 1 to 5, and the toe closing machine 2. For this reason, the same reference characters have been used. The only structural differences between the first disclosed one and the present one are elimination of the inspection form conveying line and placement of the toe closing machine adjacent one of the boarding form at rest positions along track 42. The toe closing machine is placed so that the toe areas of stocking projecting beyond the toe end of the boarding form will be at the clamping position.

In using this embodiment of the invention, the boarding forms will advance along track 42 step-by-step as before. When the form reaches the closing position, the operator will slip an open toe stocking over the form and insert the toe area into clamp 36. The clamp will feed the fabric into sewing machine 34, and the toe will be closed. When the clamp is released, the boarding form advances to its next position.

Closing the toe in this manner permits the stocking to be placed on one form and remain there during closing of the toe and subsequent processing. The stocking toe will project somewhat beyond the form toe and will have to be pulled into place later, probably while traveling along track 44. As the stocking is not everted, the seam will be on the outside, but this is not undesirable for at least some purposes.

In both of the disclosed apparatus embodiments, the stockings are drawn manually upon a form but once. If the stockings are to be turned so that the seam will be inside, the stocking toe is closed while on one form and mechanically transferred to a boarding form for finishing. If it is not necessary to turn the stocking, only the boarding form is used and the toe is closed and the stocking finished on the one form.

What is claimed is:

1. A method of handling a stocking during closing the toe and subsequent processing at steaming and setting stations to eliminate manual transfer of the stocking from one boarding form to another comprising, drawing a knit stocking onto said boarding form leaving the open toe end of the stocking protruding loosely beyond the boarding form end, moving the boarding form to a sewing machine, stitching the protruding open toe end of the stocking to close the toe, applying a force by pulling the stocking to move the stocking toe and the remainder of the stocking snugly onto the boarding form, and moving the form with the stocking in place to the selected steaming and setting processing stations.

2. A method of handling a stocking during closing the toe and transferal from a toe closing form having an end recess to a boarding form comprising, mounting an open toed knit stocking on a form having an end recess with the toe end protruding beyond the form end, stitching the protruding toe end to close the toe, bringing the form carrying the stocking into end alignment with a boarding form, moving the forms together to insert the toe end of the boarding form into the recess of the toe closing form to evert the stocking toe and draw it onto the toe end of the boarding form, and blowing into the welt end of the stocking to complete the eversion of the stocking and the transfer to the boarding form.

3. A method of transferring a stocking from a form having a recess in its end covered by the toe of a stocking mounted thereon onto a boarding form comprising, bringing the form on which the stocking is mounted into end-to-end alignment with a boarding form, bringing the two forms together to insert the toe end of the boarding form into the recess of the form on which the stocking is mounted to evert the stocking toe and draw it into the toe of the boarding form, and blowing into the welt end of the stocking to complete the eversion of the stocking and its transfer onto the boarding form.



4. A method as defined in claim 3 including, blowing air into the stocking welt on both sides of the form.

5. Apparatus for transferring stockings from one form to another comprising, an elongated inspection form having a support end and an outer end and a recess in its outer end dividing the end into upper and lower plates, a boarding form having a support end and a leg, foot and toe, the inspection form and boarding form being mounted for longitudinal alignment with the outer end of the inspection form and the toe end of the boarding form adjacent with the recess in the inspection form and the boarding form lying in the same plane, means to cause relative longitudinal movement of the inspection and boarding forms to move the toe end of the boarding form into the recess in the inspection form to evert a stocking toe on the inspection form and draw the everted stocking toe onto the toe of the boarding form, and means to move the remainder of a stocking on the inspection form off of that form and onto the boarding form in everted position.

6. Apparatus as claimed in claim 5 wherein, the means to move stockings off the inspection form is an air nozzle located adjacent the inpsection form at a point to direct an air stream into the welt end of a stocking on the inspection form.

7. Apparatus as claimed in claim 6 wherein, there are two air nozzles, one on each side of the inspection form.

8. Apparatus as claimed in claim 7 wherein, there are ribs on the inspection form to hold the stocking spaced from the form surface.

9. Apparatus as claimed in claim 7 wherein, there is an endless conveyor mounting the inspection form, and there is a second endless conveyor adjacent the inspection form conveyor mounting the boarding form.

10. Apparatus as claimed in claim 9 wherein, there is a stocking toe closing machine adjacent the inspection form conveyor.

11. Apparatus as claimed in claim 10 wherein, the inspection form is one of a plurality on the inspection form conveyor, and the boarding form is one of a plurality mounted on the boarding form conveyor.

12. Apparatus as claimed in claim 11 wherein, the boarding forms are fixed to follow a predetermined path relative to the boarding conveyor, and the inspection forms are slidably mounted on the inspection conveyor for movement longitudinally of the inspection form toward and away from companion boarding forms on the boarding form conveyor.

13. Apparatus as claimed in claim 12 wherein, the means to cause relative longitudinal movement between the inspection forms and boarding forms is a cam controlling sliding movement of the inspection forms.


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