

- [54] **METHOD AND APPARATUS FOR
KNITTING SLIVER HIGH PILE
FABRICS**

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"Pile Fabrics" by Daniel Frishman, reprinted from Textile Industries, 1760 Peachtree Rd., N.W., Atlanta, Georgia-30309, Copyright 1964-1965; pages 1, 2 necessary.

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[21] Appl. No.: **139,516**

- [52] **U.S. Cl.**.....66/9 B, 19/107, 302/28
[51] **Int. Cl.**.....D04b 9/14
[58] **Field of Search**.....66/9 B, 80; 19/107;
302/28

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[57] **ABSTRACT**

A pneumatic system for sliver high pile fabric knitting machines whereby the usual air jets, disposed adjacent the needle circle and operative during knitting, are eliminated, and suction is employed for retaining the sliver fibers on the needles during knitting and for removing loose fibers from within the needle circle to a location remote from the needle circle, from which location the loose fibers either may be handled as waste or conveyed back to the machine for re-delivery to the needles.

15 Claims, 14 Drawing Figures

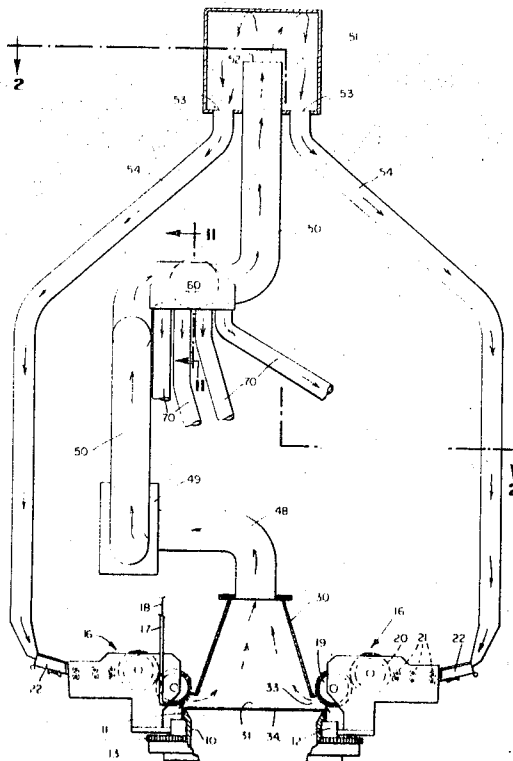


Fig. 1

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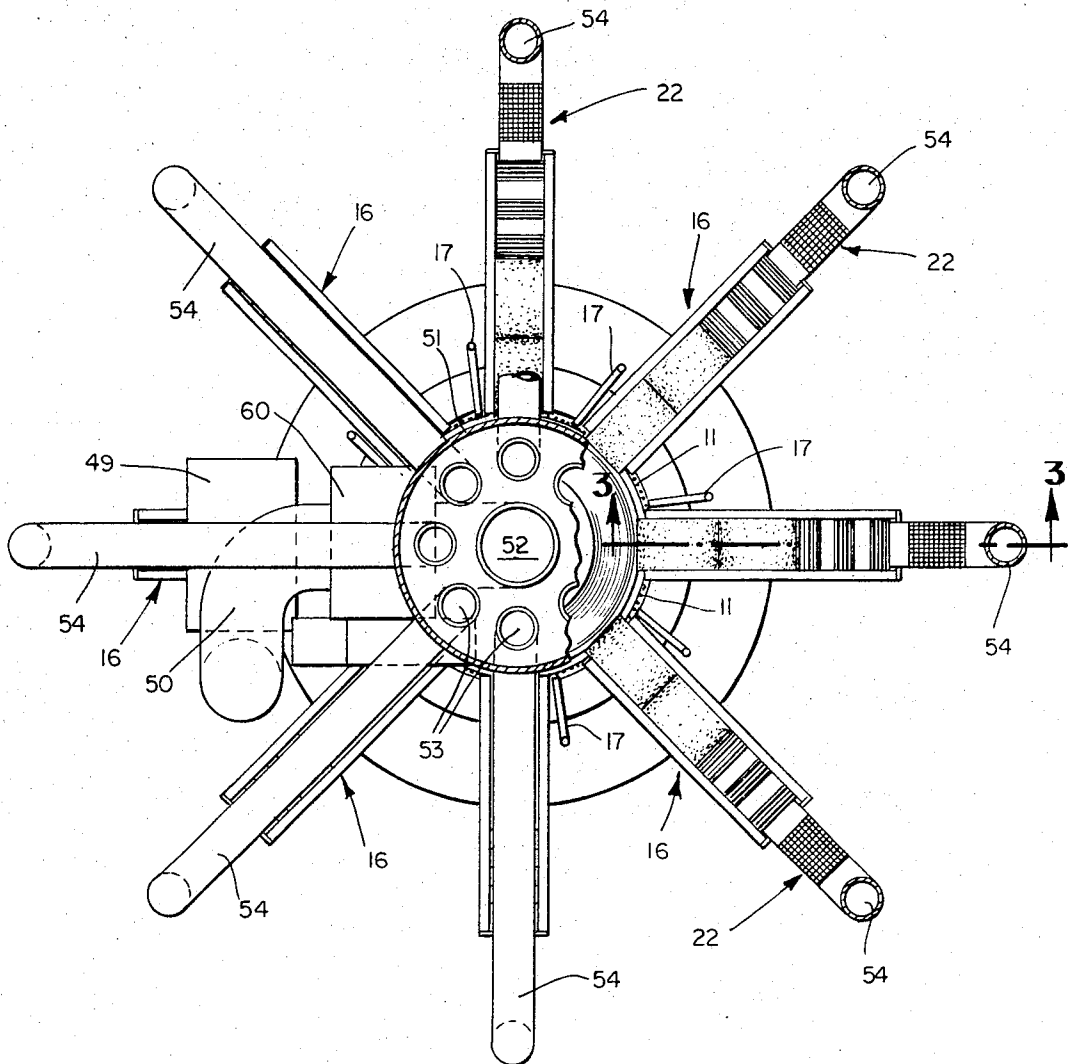


Fig. 2

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Fig. 3

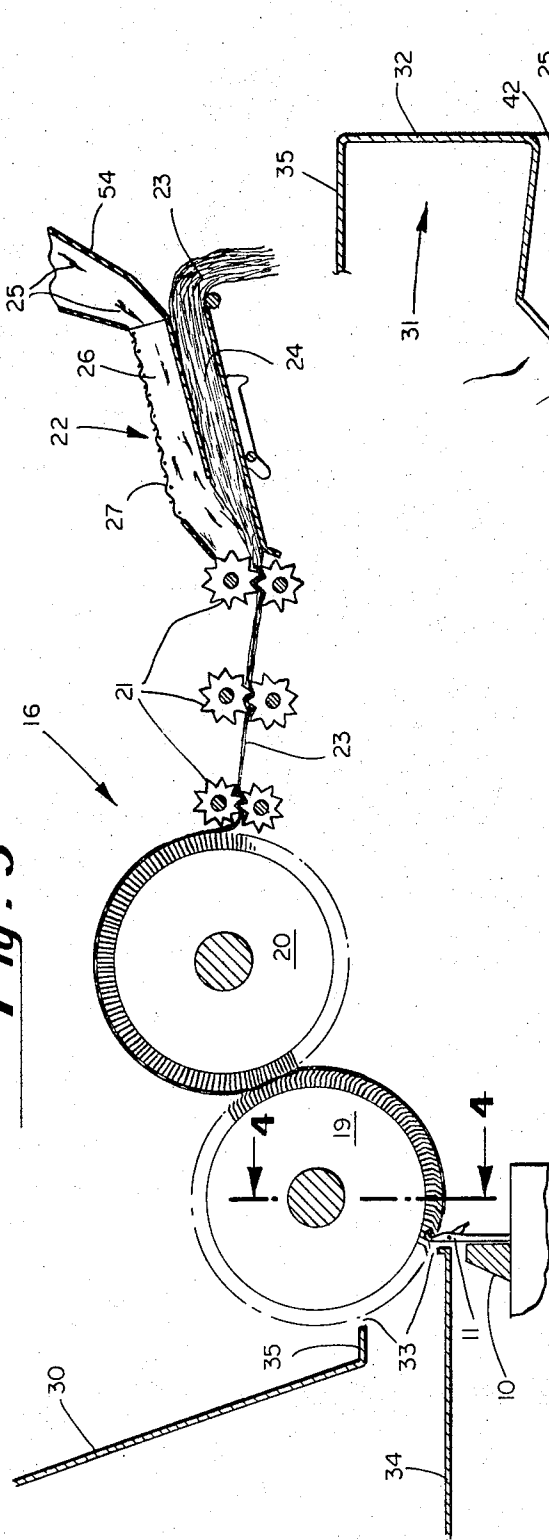


Fig. 5

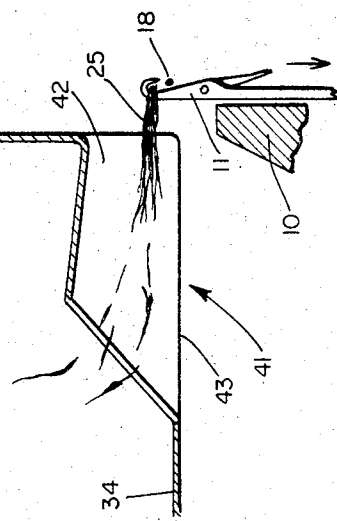
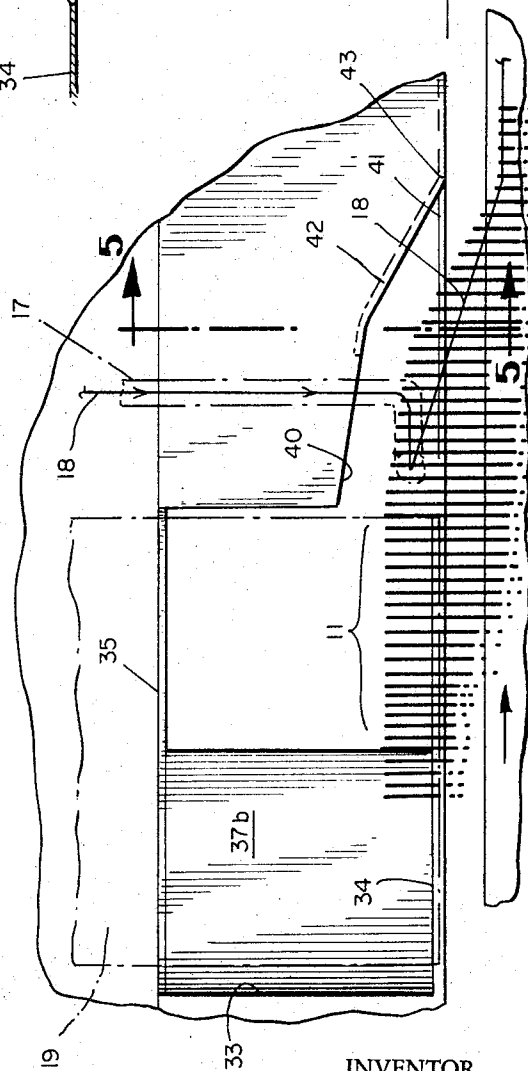


Fig. 4



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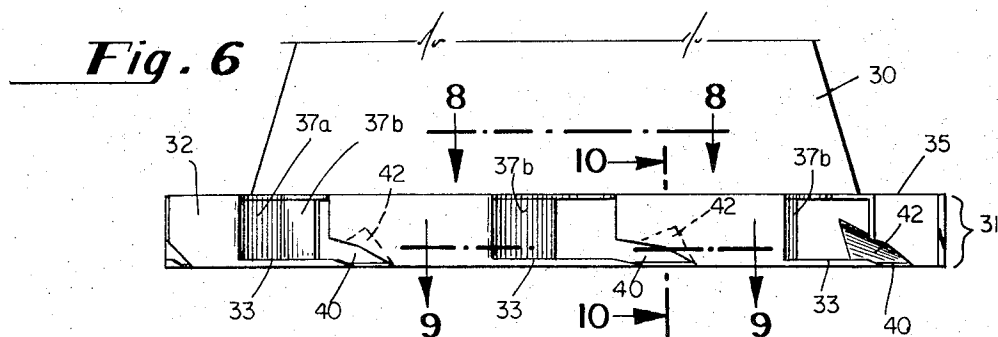
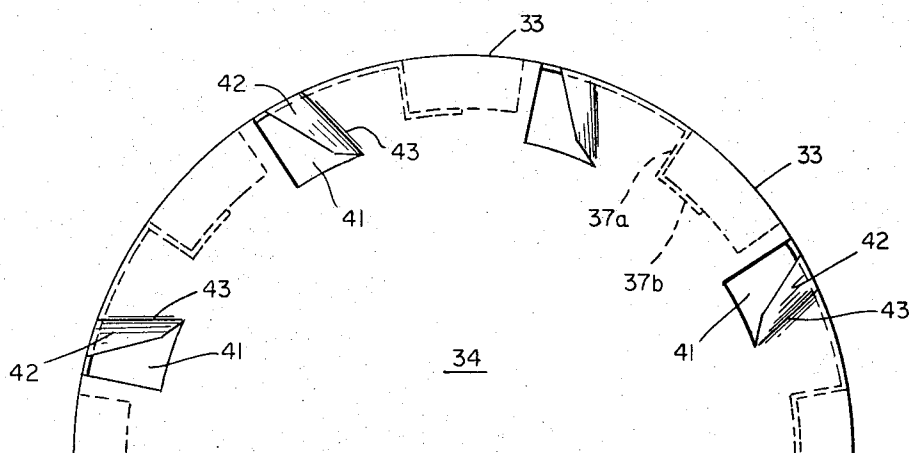


Fig. 7

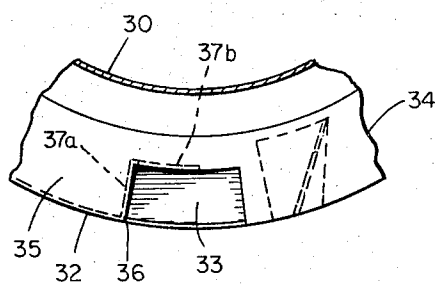


Fig. 8

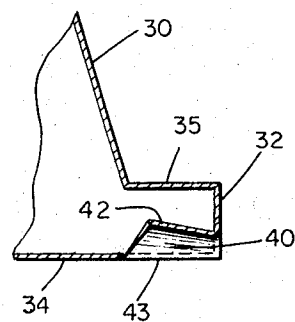


Fig. 10

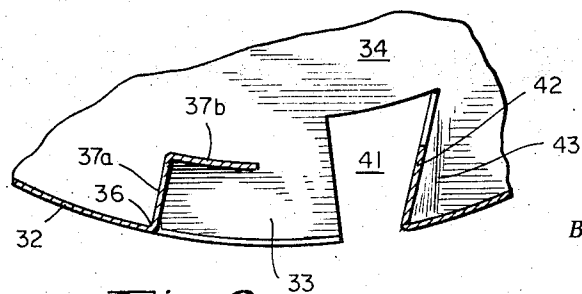


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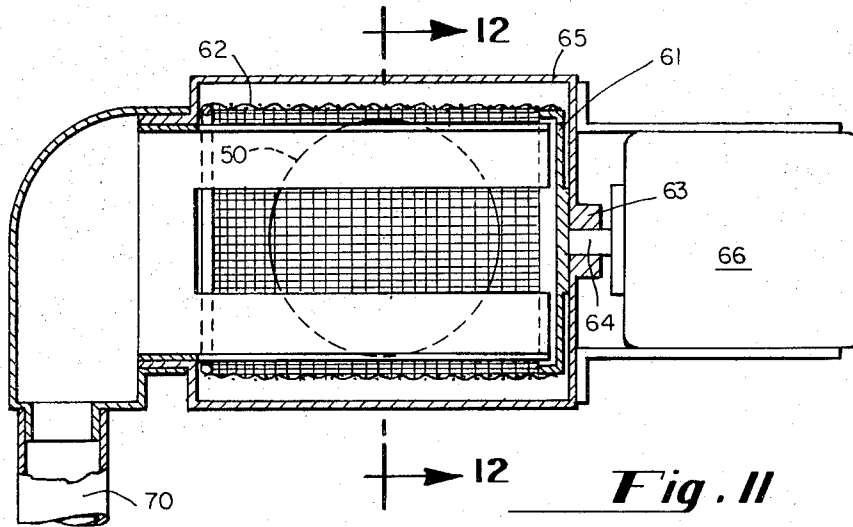


Fig. 11

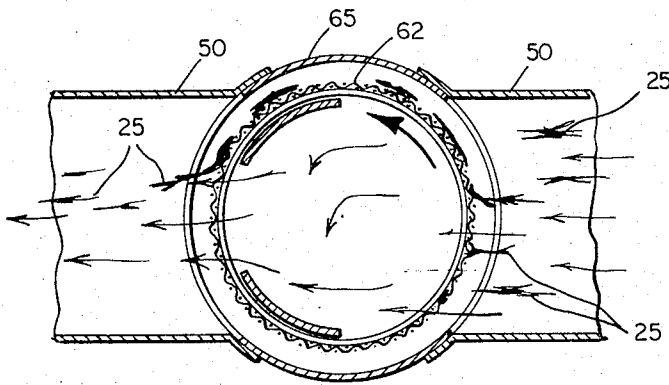


Fig. 12

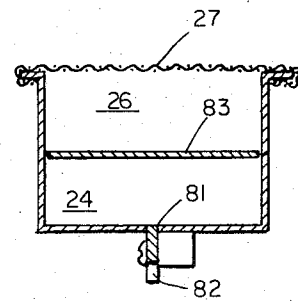


Fig. 14

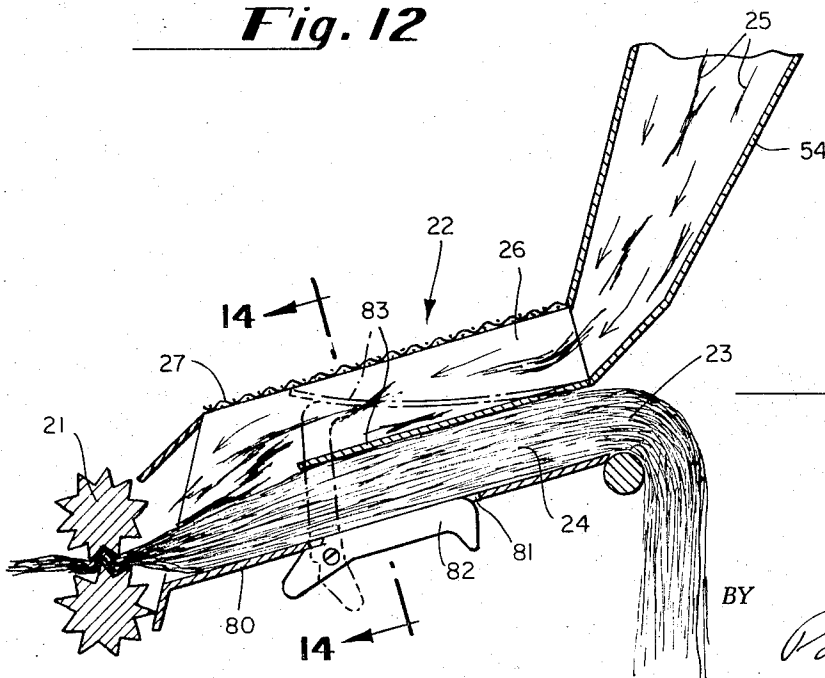


Fig. 13

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METHOD AND APPARATUS FOR KNITTING SLIVER HIGH PILE FABRICS

This invention pertains to improvements in sliver high pile fabric knitting machines, and more particularly to a new and improved pneumatic system for such machines.

Silver high pile fabric knitting machines as presently used are highly wasteful and inefficient instrumentalities because of their gross wastage of sliver fibers. At the present time, such machines are provided with air jets at each yarn feeding station which direct compressed air into the needle circle. The purpose of such air jets is to retain the pile fibers generally normal of the needle shanks as the needles take and knit the backing yarn to form the pile fabric. The air jets deliver compressed air from points external of the needles through and inwardly of the needle circle.

For a variety of reasons, such arrangement is unsatisfactory. First, the air jets usually blow a large percentage of the pile fibers off of the needle, resulting in substantial fiber wastage. Additionally, careful positioning of the air nozzles is most important, to ensure that the fibers are knit properly with the backing yarn without creating faults in the fabric. Should the air jets not be properly positioned, or should they become clogged, thereby interfering with the air flow, faults, such as "ribs" and "in-knits", are likely to occur in the fabric.

Additionally, the longer the pile fibers, the less efficient become the air jets. Because they are spaced around the needle circle, they tend to work against each other. With relatively long pile fibers, the opposing air jets tend to disturb fibers on the needles adjacent other yarn feeding stations causing faults, such as tangles.

Heretofore, fiber removal systems have been provided for sliver high pile fabric knitting machines, but with only indifferent or limited results. Such arrangements usually consist of an air suction system disposed above the needle circle, for removing loose pile fibers from within the needle circle. Because such systems are not effective below the level of the air jets spaced around the needle circle, and because the jets of compressed air create such a turbulence within the needle circle, present suction systems are of limited value in removing fibers from within the needle circle, most of which have been blown off the needles by the air jets. As a result, sliver high pile fiber knitting machines and the fabrics made thereby are relatively "dirty" in the sense that both the machines and the fabrics become littered with loose, waste pile fibers. Indeed, the problem is so severe that it frequently is necessary to remove the loose fibers from the knitted fabrics before final processing.

The primary object of this invention is to provide a new and improved pneumatic system for sliver high pile fabric knitting machines whereby the usual air jets adjacent the needle circle are eliminated, and suction is employed for retaining the sliver fibers on the needles during knitting and for removing loose sliver fibers from within the needle circle to a location remote therefrom.

A further object of the invention is to provide pneumatic means whereby loose sliver fibers removed from within the needle circle are returned to the sliver feeding means of the machine for re-delivery to the needles.

A further object is to eliminate the air jets of sliver high pile fabric knitting machines and substitute an air suction system.

A further object is to provide a pneumatic system for sliver high pile fabric knitting machines which eliminates the excessive fiber wastage which presently is characteristic of such machines.

A further object is to provide a new and improved pneumatic system for sliver high pile fabric knitting machines which enables the machines to provide fabric which is not littered with loose, waste pile fibers, and which eliminates the necessity of removing such fibers from the knitted fabric prior to final processing.

Other objects and advantages of this invention will become apparent from the following disclosure of the preferred embodiment thereof illustrated in the accompanying drawing, wherein:

FIG. 1 is a fragmentary, more or less schematic, view in elevation showing part of a sliver high pile fabric knitting machine to which the pneumatic system of this invention has been applied.

FIG. 2 is a partial section in top plan looking in the direction of the arrows 2 — 2 of FIG. 1.

FIG. 3 is an enlarged schematic view of a sliver feeding means of the machine, looking in the direction of the arrows 3 — 3 of FIG. 2.

FIG. 4 is an enlarged, fragmentary, generally schematic view looking in the direction of arrows 4 — 4 of FIG. 3, showing part of the needle circle.

FIG. 5 is an enlarged fragmentary view looking in the direction of the arrows 5 — 5 of FIG. 4, showing a needle with both pile fibers and the backing yarn within its hook.

FIG. 6 is an enlarged, fragmentary view of the suction hood shown in FIG. 1.

FIG. 7 is a fragmentary view of the bottom of the suction hood.

FIG. 8 is a fragmentary view in section looking in the direction of the arrows 8 — 8 of FIG. 6.

FIG. 9 is an enlarged fragmentary view in section looking in the direction of the arrows 9 — 9 of FIG. 6.

FIG. 10 is an enlarged fragmentary view in section looking in the direction of the arrows 10 — 10 of FIG. 6.

FIG. 11 is an enlarged view in section looking in the direction of the arrows 11 — 11 of FIG. 1.

FIG. 12 is a fragmentary view in section looking in the direction of the arrows 12 — 12 of FIG. 11.

FIG. 13 is an enlarged fragmentary view in section showing the sliver entry means for a sliver feeding means of the machine.

FIG. 14 is a view in cross section looking in the direction of the arrows 14 — 14 of FIG. 13.

In the following Specification:

The term "casting off" shall indicate the discharge of a loop of yarn from a needle as a newly drawn loop of yarn is pulled through the discharged loop to form a new stitch.

The term "cast-off level" shall indicate that level during knitting to which a needle descends to discharge a loop of yarn while a newly drawn loop of yarn is formed into a new stitch.

The term "clear level" shall indicate the level to which a needle rises, or has risen, to clear yarn from its latch.

FIG. 1 illustrates the invention applied to a conventional sliver high pile fabric knitting machine having the usual needle cylinder 10 with its complement of circularly-arranged independent latch needles 11, sinker ring 12 and ring gear 13. Uniformly spaced around the needle circle are a plurality of sliver and yarn feeding stations, each of which includes a sliver feeding means 16 and a tubular yarn guide 17 for feeding body yarn 18 to the needles. The yarn guide tubes 17 are spaced a relatively small distance from their adjacent sliver feeding means 16 in the direction of cylinder rotation, so that the needles first remove fibers from the usual doffer 19 prior to taking and knitting yarn 18.

In addition to the doffer 19, each sliver feeding means 16 includes the usual transfer cylinder 20, spaced pairs of sliver feeding rolls 21 and a sliver entry means which, in accordance to this invention, consists of a box 22 (see FIG. 3). Incoming sliver 23 passes through the lower portion 24 of sliver entry box 22 to the feed rolls 21, from which it passes via main cylinder 20 and doffer 19 to the circle of needles 11 in the usual manner.

Disposed within the circle of needles 11 is a suction hood 30, the construction details of which are illustrated in FIGS. 4-10. The upper part of suction hood 30 is of generally frusto-conical construction. Its lower portion 31 is of generally cylindrical or annular configuration having a periphery 32, a bottom 34 and a top 35. Formed in periphery 32 is a plurality of uniformly spaced arcuate openings 33. As best shown in FIGS. 3 and 8, the upper portions of openings 33 extend inwardly of the hood 30 into the top 35 of the cylindrical portion 31 of the hood. Each of the openings 33 is disposed at a sliver and yarn feeding station and is adapted to receive the lower portion of a doffer 19 in the area where it delivers sliver fibers to the needles 11 (FIG. 3).

Each arcuate portion of periphery 32 which is removed to provide the apertures 33 is bent inwardly of the periphery 32 about bend line 36 and then bent outwardly to provide right-angled internal walls 37a and 37b (FIG. 9). Each opening 33 merges into a smaller, tapered opening 40 in periphery 32 (FIGS. 4, 6), which extends in the direction of needle rotation to the point where, or just beyond where, the needles reach cast off level.

Disposed in the outer portion of floor 34 of hood 30 are a plurality of spaced notches 41 (FIG. 7), each extending arcuately from a point proximate where the needles begin to descend from clear level to proximate the point where the needles first reach cast-off level (FIGS. 4, 5). Each notched out portion 42 is bent upwardly along bend line 43 extending inwardly of floor 34 proximate the point where needles 11 reach cast-off level (FIGS. 4, 6, 7). With this arrangement, the up-turned notched out portions 42 perform as cams to aid in retaining the sliver fibers 25 in the hooks of the needles 11, generally normal to the needle shanks, as the needles descend to cast-off level, all of which is particularly well illustrated in FIG. 5.

The upper portion of suction hood 30 is connected by a conduit 48 (FIG. 1) to a blower or fan 49, or equivalent means for creating suction within conduit 48 and hood 30. By reason of the construction of openings 33 and 40 and the provision of internal walls

37a and 37b, the suction induced in hood 30 is concentrated at each sliver and yarn feeding station along an arc of the needle circle extending from a point proximate the mid-point of the doffer 19 to a point proximate where the needles reach cast-off level. With this arrangement for concentrating suction along spaced arcs of the needle circle, the pile fibers raked by the needles 11 from the doffer 19 are retained or held on the needles generally normal of the shanks thereof under a mild, but steady and uniform tension or force, as the needles pass the doffer and advance to cast-off level. The coming action of cams 42 (FIG. 5) aids in preventing the pile fibers 25 from departing from a position normal to the needles and assuming a more vertical position, as the needles descend to cast-off level (FIG. 5).

By eliminating the usual air jets spaced around the needle circle, and employing the air suction system described, far superior results are achieved in the knitting of sliver high pile fabrics. Because the air suction concentrated at each sliver feeding station gently sucks or pulls the fibers against the needles, there is far less fiber loss because of the substantial reduction in the extent to which fibers are pulled off the needles. Further, because the suction is concentrated over a fairly substantial segment of the needle circle at each feeding station, without variation, faults such as tangles, "ribs" and "in-knits" are eliminated from the knitted fabric.

By reason of the complimentary action of the concentrated suction and cams 42, a superior pile effect is achieved, because the fibers are maintained "straighter" during knitting and "stand up" substantially better in the finished fabric. The suction also serves to remove all fibers from the doffer 19, thereby preventing clogging.

The discharge side of blower 49 may lead to a collector means (not shown) for waste fibers, but preferably is connected by a conduit 50 to a cylindrical manifold 51 (FIG. 1). Preferably, the upper end 52 of conduit 50 is inserted into the lower portion of manifold 51, and extends upwardly to approximately the middle thereof, manifold 51 and conduit portion 52 being co-axial.

Formed in the bottom of manifold 51 are a plurality of uniformly spaced apertures 53, each of which opens to a downwardly extending return conduit 54. Apertures 53 are formed in a concentric ring about conduit portion 52 (FIG. 2). There is provided one aperture 53 and one conduit 54 for each sliver feeding means 16 of the machine. Each conduit 54 terminates at the entrance to the upper portion 26 of a sliver entry box 22 (FIG. 3).

Loose pile fibers within the circle of needles 11 are sucked upwardly through hood 30 and conduit 48 by blower 49, and blown upwardly through conduit 50 into manifold 51 (or to waste, if desired). Because the upper end 52 of conduit 50 is spaced from the top of manifold 51, the incoming fibers are distributed uniformly of the manifold. Since the apertures 53 are disposed concentric to conduit portion 52, the incoming fibers are divided or distributed substantially equally or uniformly among each of the several apertures. In this manner, the fibers blown into manifold 51 are distributed evenly among the several conduits 54.

for return to the respective sliver feeding means 16. Thus, manifold 51 acts as a fiber distributor or equalizer for return of the fibers to the several sliver feeding means for re-delivery to the needles. It is important, of course, that substantially equal quantities of loose fibers be distributed from manifold 51 through conduits 54 to the several sliver feeding means 16, to ensure uniform re-distribution of the returned fibers to the knitting head. Otherwise, satisfactory fabric may not be produced.

The air pressure from blower 49 transmits the substantially uniformly distributed fibers through the conduits 54 and into the upper portions 26 of each sliver entry box 22. As shown in FIG. 3, the discharge end of each conduit 54 is so arranged with the upper portion 26 of each sliver entry box to provide for the returned fibers to be delivered or blown to join the incoming sliver 23 just in advance of the first pair of sliver feed rolls 21. Thus, the recovered fibers are re-delivered to the needles 11 of the knitting machine via feed rolls 21, transfer cylinder 20 and doffer 19.

It is important that the air pressure in the conduits 54 which return the re-claimed fibers to the several sliver feeding means 16 not be too strong, or it will disrupt or tear apart the rope of sliver 23 in the boxes 22. To guard against this, the top of upper portion 26 of each sliver entry box is provided with a removeable screen or foraminous cover 27, which tends to dissipate the air pressure flowing from the lower end of the conduits 54.

Additionally, means 60 (FIG. 1) may be inserted in conduit 50, between blower 49 and manifold 51, to provide for reduction in the amount of air pressure in the upper portion of conduit 50 leading to manifold 51. The construction of such air pressure means is disclosed in detail in FIGS. 11 and 12.

More particularly, the air reduction means includes a cylinder 61 having a foraminous cylindrical wall 62 and mounted on rotatable shaft 64 within a cylindrical housing 65. Shaft 64 is supported by bearings 63. The cylinder 61 is driven at a constant rate of speed by motor 66.

As will be noted from FIG. 12, the rotatable foraminous cylinder 61 is disposed within the air stream passing through conduit 50, such that the fibers 25 entrained by the air are deposited on the foraminous wall of the rotating cylinder and carried thereby from the incoming side of housing 65 to the diametrically opposite side thereof, where they are blown from the surface of cylinder 61 into the upper portion of conduit 50. Because of the foraminous structure of the cylindrical wall 62, the air stream passing through conduit 50, which initially deposits the loose fibers on the cylinder 61, also serves to remove them from its surface as the fibers arrive at the discharge side of the housing 65.

One or more conduits 70 are connected to one end of the housing 65, and serve to divert or "bleed-off" some of the air pressure in the lower portion of conduit 50. This has the effect of reducing the air pressure in the pneumatic system down stream from air reduction means 60, without diverting any of the fibers from the system. The high pressure air thus diverted from the pneumatic system through one or more conduits 70 may be wasted or re-used for some suitable purpose, as desired.

Referring now to FIGS. 13 and 14, it will be seen that the floor 80 of lower portion 24 of sliver entry box 22 may be provided with a longitudinal slot 81 for reception of a pivotal lever 82, the distal end of which may be advanced upwardly to raise the distal end of flexible divider 83 disposed between the lower portion 24 and the upper portion 26 of sliver entry box 22. In this manner, communication between the two portions of box 22 may be closed off, so that recovered sliver fibers delivered through conduit 54 to portion 26 of entry box 22 do not pass to the feed rolls 21. Such an arrangement is used when changing the color, type or kind of sliver 23. After the old sliver is removed, and before the new sliver is fed to the machine, lever 82 is advanced to elevate divider 83, and the pneumatic system is permitted to operate until all loose fibers from the old sliver are cleaned from the machine and deposited in upper portion 26 of box 22, between screen 27 and divider 83. Thereupon, screen 27 is removed, the recovered fibers from the old sliver are removed, the screen then replaced, lever 82 returned to its normal position, and, with the machine now being clean of the old sliver fibers, knitting is ready to resume with the new sliver.

While suction systems presently are in use for removing loose sliver or pile fibers from within the needle circle, such systems are largely ineffective. Because of the use of the air jets in machines currently in use, it is not possible to create suction at the region of the needle circle, where the greatest wastage of pile fiber occurs. Rather, with the fiber recovery systems presently in use, the suction necessarily must be created at a location above the needles, where it is largely ineffective. By the elimination of the air jets, and the provision of the specially designed suction hood 30, which concentrates suction within the needle circle along spaced arcuate segments thereof, in advance of where the needles reach cast-off level, a vastly approved, highly practical and highly economical loose fiber recovery system is provided by this invention.

With the very substantial reduction in sliver fiber wastage achieved by this invention, it is possible either to obtain a denser high pile fabric, or to reduce the sliver feeding rate because of the greater percentage of sliver fibers knit into the fabric. In addition, the entire knitting machine, as a fabric producing instrumentality, is rendered cleaner and less clogged of waste sliver fibers, by reason of the improved "vacuum cleaner" effect of this invention.

The pneumatic system of this invention has been illustrated and described in the best mode presently contemplated for carrying out the invention. However, it is to be understood that the inventive concept may be carried out in a number of ways through a number of different embodiments. For example, while the preferred embodiment has been described in relation to independent needle knitting machines having latch type needles, it is to be understood that the invention is equally useful with knitting machines having fixed needles, spring heard needles, etc. This invention, therefore, is not to be limited to the precise details described, but is intended to embrace all variations and modifications falling within the scope of the claims appended hereto.

I claim:

1. In a sliver high pile fabric knitting machine having a circle of needles and a plurality of sliver and yarn feeding stations, a pneumatic system for holding fibers on the needles during knitting and for removing loose fibers from within the needle circle, said pneumatic system including:

- a. means to create suction,
- b. a suction hood within the needle circle,
- c. a plurality of spaced apertures in the hood, each aperture being disposed adjacent to a feeding station in advance of where the needles cast-off at said station,
- d. a conduit connecting the hood to the suction creating means,
- e. a manifold,
- f. a conduit connecting the suction creating means to the manifold,
- g. a plurality of return conduits extending from the manifold, each said return conduit terminating adjacent a feeding station, the number of said return conduits being equal to the number of feeding stations, and
- h. means associated with the manifold for distributing fibers entering the manifold substantially uniformly among the return conduits extending from the manifold.

2. In a sliver high pile fabric knitting machine having a circle of independent needles and means for feeding sliver and yarn to the needles, means for holding sliver fibers generally normal of the needles as the needles take and knit the yarn, said means including:

- a. a device for creating suction,
- b. a suction hood disposed internally of the needle circle,
- c. a conduit connecting the hood to the suction creating device,
- d. said suction hood terminating at the region of the needles, and having an aperture disposed adjacent the needle circle proximate to and in advance of where the needles reach cast-off level, and
- e. a cam disposed in the aperture for aiding in retaining sliver fibers generally normal of the needles as the needles descend to cast-off level.

3. A pneumatic system for a sliver high pile fabric knitting machine having a circle of needles and plural yarn and sliver feeding stations, said pneumatic system including:

- a. a hood disposed internally of the needle circle and having means for concentrating suction at each feeding station in the area where the needles descend to cast-off level,
- b. means for creating suction within the hood,
- c. a manifold for receiving and dividing uniformly loose sliver fibers,
- d. a conduit between the hood and the manifold for conveying loose sliver fibers from the hood to the manifold and
- e. conduit means for conveying loose sliver fibers from the manifold to each feeding station of the machine.

4. The invention of claim 3 wherein:

- a. the means for creating suction comprises a blower located in the conduit between the hood and the manifold and

b. the portion of the conduit between the blower and the manifold includes means to reduce air pressure in said conduit portion.

5. The invention of claim 4 wherein the air pressure reduction means includes a rotatable foraminous cylinder mounted in said conduit.

6. In a sliver high pile fabric knitting machine having a circle of needles and a plurality of yarn feeds, each yarn feed having adjacent thereto a doffer for delivering fibers to the needles,

a. means for creating suction within the needle circle,

b. means for concentrating suction at spaced intervals about the needle circle, each interval being disposed between a doffer and the point where the needles reach cast-off level and

c. cam means adjacent the needle circle to aid in retaining sliver fibers generally normal of the needles as the needles descend to cast-off level.

7. The invention of claim 6 further including:

a. a manifold,

b. a conduit for conveying loose sliver fibers from within the needle circle to the manifold and

c. conduit means for conveying loose sliver fibers from the manifold to the doffers.

8. A pneumatic fiber recovery system for high pile fabric knitting machines having a circle of needles and plural sliver feeding means, each said sliver feeding means including a doffer, which system includes:

a. a hood disposed within the needle circle and having means for concentrating suction adjacent each sliver feeding means in the area between the doffer and the point where the needles reach cast-off level,

b. means for creating suction within the hood,

c. a fiber distributor,

d. a conduit for conducting loose sliver fibers from the hood to the distributor and

e. plural return conduits extending from the distributor for conducting loose sliver fibers from the distributor to the plural sliver feeding means, each said return conduit terminating adjacent a sliver feeding means.

9. A pneumatic fiber recovery system for high pile fabric knitting machines having a circle of needles and plural sliver feeding means, which includes:

a. means for creating suction within the needle circle,

b. a fiber distributor remote from the needle circle,

c. conduit means for conducting loose sliver fibers from within the needle circle to the fiber distributor,

d. plural return conduits extending from the distributor for conducting loose fibers from the fiber distributor to the plural sliver feeding means, each said return conduit terminating adjacent a sliver feeding means,

e. a sliver entry means connecting the terminal of each return conduit and the sliver feeding means adjacent which said conduit terminates, each said sliver entry means including:

1. a first passageway for transmitting sliver to the sliver feeding means,

2. a second passageway for transmitting loose sliver fibers from the return conduit to the sliver in the first passageway and

3. means for closing off communication between the two passageways, whereby the loose sliver fibers may be trapped and collected in the second passageway preparatory to changing sliver fed to the knitting machine.

10. A method of knitting sliver high pile fabric on a knitting machine having a circle of needles and plural sliver and yarn feeding stations, which includes the steps of:

- a. feeding sliver and yarn to the needles,
- b. advancing the needles relative to the sliver and yarn feeding stations to needle cast-off level to form the sliver and yarn into fabric,
- c. creating suction within the needle circle adjacent the needles at spaced intervals about the needle circle, each interval being in advance of where the needles reach cast-off level, to retain sliver fibers fed to the needles under uniform tension generally normal of the needles as the needles approach cast-off level,
- d. removing loose sliver fibers by said suction from the region of the needles to a location remote from the needles,
- e. dividing the loose sliver fibers and
- f. conveying pneumatically the divided loose sliver fibers from said location to the sliver and yarn feeding stations to be re-fed to the needles with the

sliver.

11. The method of claim 10 wherein:

- a. the loose sliver fibers are removed from the region of the needles to a manifold,
- b. the loose sliver fibers are divided in the manifold substantially uniformly into separate groups of fibers, said groups being equal in number to the number of sliver and yarn feeding stations and
- c. each group of divided fibers is conveyed from the manifold to a sliver and yarn feeding station.

12. The method of claim 9 wherein:

- a. the suction is created by a blower, and
- b. the fibers are conveyed to the manifold and from the manifold to the sliver feeding stations by air pressure from the blower.

13. The method of claim 12 further including the step of reducing the air pressure as the fibers are conveyed to the manifold.

14. The method of claim 10 further including the step of retaining sliver fibers on the needles generally normal of the needles as the needles descend to cast-off level.

15. The method of claim 10 further including the step of retaining sliver fibers on the needles generally radially inward of the needle circle as the needles descend to cast-off level.

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