

[54] **PROCESS AND APPARATUS FOR TRANSPORTING THE YARN AT HIGH SPEED BY MEANS OF A FLUID UNDER PRESSURE**

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[51] **Int. Cl.<sup>2</sup>**..... **B65H 17/32**

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 28/1.4, 72.12; 242/47.03

[56] **References Cited**

**UNITED STATES PATENTS**

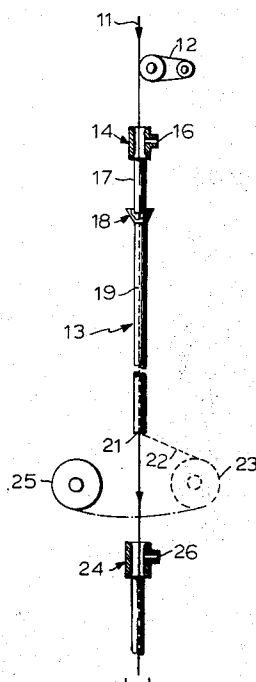
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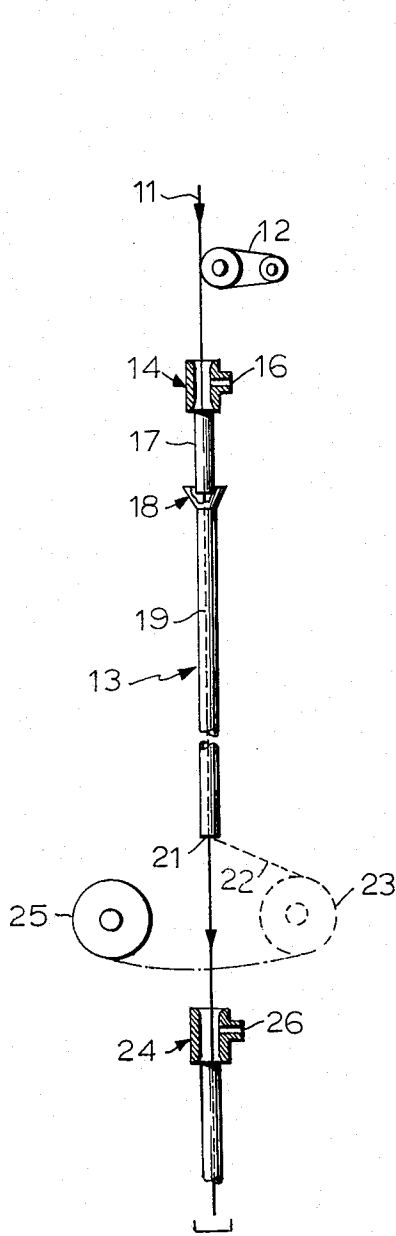
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[57] **ABSTRACT**

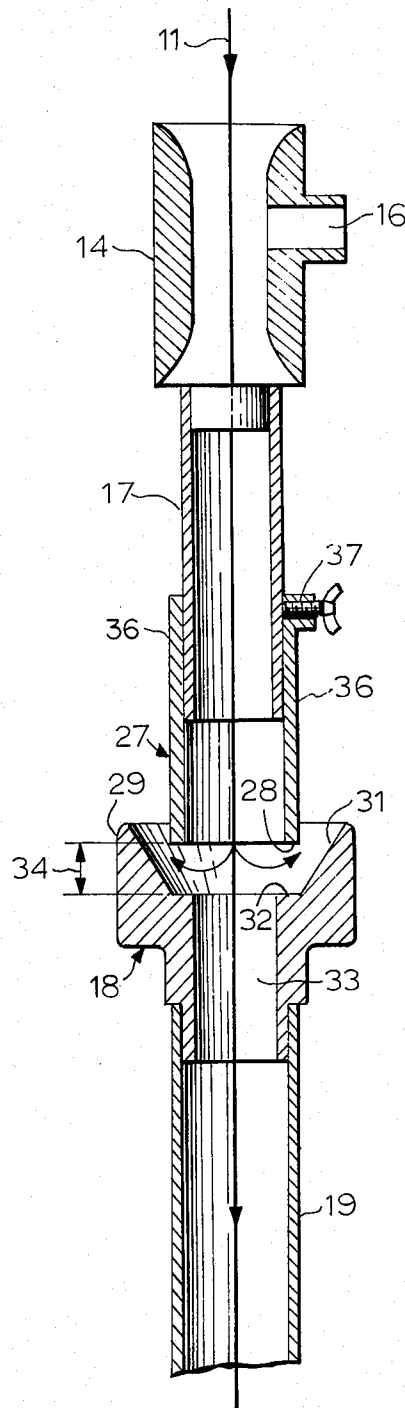
A device for transporting yarn at high speed in a stream of fluid includes a first nozzle with a tube extending therefrom. The tube has an expansion fitting disposed intermediate its ends which has a flared opening with a diameter that is greater than the diameter of the tube. When compressed air or another compressed fluid is injected into the first nozzle, it entrains a strand of yarn entering the first nozzle and accelerates the yarn down the tube. Upon reaching the expansion fitting, most of the compressed fluid escapes laterally out of the flared opening. The strand of yarn, however, continues along its initial path passing through the expansion fitting and continuing in the tube. Upon exiting from the tube, the yarn traverses a gap and is entrained in a second stream of fluid injected into a second induction nozzle positioned downstream of the gap. By allowing most of the fluid to escape through the expansion fitting, the amount of fluid necessary to capture, control and position the yarn in the second induction nozzle is reduced drastically.

**5 Claims, 2 Drawing Figures**





**FIG. 1**



**FIG. 2**

# PROCESS AND APPARATUS FOR TRANSPORTING THE YARN AT HIGH SPEED BY MEANS OF A FLUID UNDER PRESSURE

## BACKGROUND OF THE INVENTION

This invention relates to methods of and apparatus for transporting yarn in a stream of fluid. More particularly, this invention relates to methods of and apparatus for transporting yarn, wherein the yarn must traverse a gap between the outlet of one fluid transporting device and the inlet of another fluid transporting device.

In the manufacture of textiles, yarn is often transported from one station to another by means of a high speed stream of fluid which captures the yarn and carries the yarn along with it. Often it is necessary to transport the yarn to alternate stations. For example, the yarn may be transported back and forth between a winding station, where it is wound on bobbins, and a waste station.

A device which performs in this way is disclosed in copending U.S. Pat. application, Ser. No. 287,063 filed Sept. 7, 1972, by Claude Benchemoul, entitled "Apparatus for the Transport of Yarns". In this copending application, yarn is captured by a first stream of air and is accelerated by a nozzle down a tube extending from the nozzle. Upon exiting from the tube, the yarn is either received on a spinning bobbin at a winding post, or proceeds to a second induction nozzle which is spaced from the end of the tube and carries the yarn to a waste station. Through the space between the second nozzle and the tube, the yarn can be captured by a mechanical component and brought at the winding post. The mechanical component can be the support for winding up the yarn. Since the yarn is now travelling along a path which passes through the winding post it combines to be marked by the second nozzle until it is gripped by an anchoring component which describes a circular movement and the purpose of which is to start the winding as the support

In order that the yarn be gripped correctly by the anchoring component it must follow an exact path. Consequently, sufficient tension must be maintained on the yarn by the second induction nozzle to keep the yarn from becoming slack. In order to maintain sufficient tension, great quantities of compressed air must be injected into the second induction nozzle. This is because the strand of yarn is still being accelerated by a stream of fluid injected into the first induction nozzle.

The tension on the yarn between the tube and the second induction nozzle is a function, on the one hand, of the traction force generated by the second nozzle and, on the other hand, of the speed at which the yarn reaches the outlet of the tube. Accordingly, the higher this speed at the outlet, the greater the traction force necessary at the second nozzle to exert sufficient tension to accurately position the yarn for a bobbin pickup.

While in the tube, the yarn being carried by the fluid travels at the same speed as the fluid. In order to exert enough tension on the yarn to keep it from winding back on the device from which it is delivered to the first nozzle, the first nozzle must receive a high fluid delivery. Consequently, the velocity of the fluid within the tube is high. This speed remains high throughout the tube extending from the first nozzle. In order to have sufficient yarn tension upstream of the second nozzle under these conditions, it is necessary to increase the

fluid delivery of the second nozzle to an amount that results in an excessive fluid consumption. This increases the cost of operating the fluid transport system.

## OBJECTS AND BRIEF DESCRIPTION OF THE INVENTION

In view of the above-noted problem of excessive fluid consumption, the method and apparatus of the present invention were developed.

Accordingly, it is a primary object of the present invention to provide a method and apparatus for transporting yarn with minimum fluid consumption.

It is a further object of the present invention to provide a method and apparatus for transporting yarn in a stream of fluid while controlling tension on the yarn by decreasing the speed of the fluid.

It is a still further object of the present invention to provide a method and apparatus for transporting yarn in a stream of fluid by allowing a substantial portion of the fluid to escape from the stream to control the speed of the yarn.

## SUMMARY OF THE INVENTION

In accordance with these and other objects, the preferred method of the present invention includes initially capturing and accelerating a yarn in a stream of fluid along a predetermined path, discharging a substantial portion of the stream of fluid from the stream, and continuing the remainder of the fluid to carry the yarn along the predetermined path.

In general, the preferred form of apparatus of the present invention includes an induction nozzle for initially capturing and accelerating a strand of yarn with a stream of compressed fluid into a tube, and an expansion fitting located downstream of the induction nozzle to discharge a substantial portion of the stream of fluid while containing the remainder of the fluid to transport the yarn.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and advantages of the method and apparatus for practicing the present invention will become more apparent from the attached drawings, wherein:

FIG. 1 is a diagrammatic perspective view of the apparatus of the present invention in combination with a bobbin winding station; and

FIG. 2 is an enlarged view of a section of FIG. 1, which is cut away and is illustrative of the apparatus of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, there is shown a strand of yarn 11 which is being delivered by a device such as drawing train or feeder 12 of a drawing assembly (not shown). The strand of yarn 11 is coaxially aligned with a tubular fluid transport assembly designated generally by the numeral 13. As the yarn is played from the feeder 12, it enters a nozzle, designated generally by the numeral 14, which is disposed at the upstream end of fluid transport assembly 13. The nozzle 14 has a port 16 formed therein, through which a stream of compressed air is injected.

The stream of compressed air expands in the nozzle 14 to capture and entrain the strand of yarn 11, and carry the yarn into a first tubular section 17, which extends downstream from the nozzle 14 to confine the

stream and the yarn. The stream of compressed fluid and the strand of yarn 11 then pass through an expansion or discharge fitting, generally designated by the numeral 18, and into a second tubular section 19, which is coaxially aligned with the first tubular section 17. The stream of fluid and strand of yarn 11 then exit from the outlet 21 of the second tubular section 19 and enter a free space defined by a gap 22.

Upon entering the gap 22, a strand of yarn 11 can be captured by a bobbin 23 which moves through the gap, to a winding post while it is also captured by a second induction nozzle, generally designated by the numeral 24, which is positioned downstream of the gap. As disclosed in copending application, Ser. No. 287,063, the strand of yarn is then travelling along a path which passes through the winding post, and continues to be necked by the second nozzle until it is gripped by an anchoring component (not shown), the purpose of which being to start the winding on the support. In order that the yarn be gripped connectly by the anchoring component, it must follow an exact path. This is accomplished by attracting the free end of the yarn 11 into the nozzle 24 with a second stream of air, which enters the nozzle through a port 26, thereby capturing, controlling and positioning the yarn.

The amount of air which must be injected through the port 26 to maintain sufficient tension on the strand of yarn 11 depends upon the speed of the strand at the outlet 21 of the tube 19. If not enough air is injected into the port 26, the strand of yarn 11 will become slack because it is being fed from the outlet 21 of the tube 19 at a greater rate than it can be pulled through the nozzle 24 by the stream of fluid entering the port 26. If the strand of yarn 11 is slack, it will not align properly with the anchoring component and, consequently, will not wind on the bobbin properly.

In order to prevent this slack from occurring, great quantities of fluid would be required to be injected into the nozzle 24 through the port 26. This, of course, is wasteful and reduces the economic advantage of utilizing the fluid transport system. In order to reduce the amount of fluid injected into the nozzle 24, the expansion fitting 18 allows a portion of the fluid stream carrying the yarn 11 to escape. This reduces the speed of the yarn 11 at the outlet 21 of the tube 19.

This reduction in the speed of the yarn 11 at the outlet 21 is accomplished by the fluid expansion system illustrated more definitively in FIG. 2 and designated generally by the numeral 27. In the fluid expansion system 27, the expansion fitting 18 is positioned just downstream of and in overlapping relationship with the end 28 of the first tubular section 17. The expansion fitting 18 has a cup-shaped mouthpiece 29 with a sloping wall 31 that opens or flares upstream. The maximum internal diameter of the mouthpiece 29 is greater than the external diameter of the end 28 of the tube 17, so that a stream of compressed fluid travelling down the tube 17 discharges laterally between the mouthpiece 29 and the end of the tube. At the downstream end of the sloping wall 31, there is positioned a shoulder 32, which defines a cylindrical opening 33 in the mouthpiece 29 having a diameter substantially the same as the tube 17. The distance between the end 28 of the tubular section 17 and the shoulder 32 defines an aperture 34 through which a substantial portion of the stream of compressed fluid expands, while the remainder of the fluid continues down the tubular section

19 and exits from the tube at outlet 21. In practice, as much as ninety percent of the fluid delivered from the first nozzle will escape out of the aperture 34.

Since the yarn 11 is coaxially aligned with the fluid transport system 13, it is entrained by a central core of the fluid stream. Consequently, the yarn 11 will be carried through the expansion fitting 18 by the central core of the fluid stream, and will exit from the tube 19 with this central core which comprises the fluid remaining after a substantial portion of the fluid has escaped. Since a substantial portion of the fluid has escaped from the stream, the fluid in the tubular section 19 will expand at a much slower rate than it expanded in the tubular section 17. This will reduce the speed of the fluid in the tubular section 19, and will therefor reduce the speed of the yarn in the tubular section 19 and at the outlet 21. By reducing the speed of the yarn at the outlet 21, less fluid will have to be injected into the nozzle 24 in order to maintain enough tension on the strand of yarn 11 to hold the yarn taut.

In order to adjust the amount of fluid escaping from the expansion fitting 18, a tubular extension 36 may be attached to the tubular section 17. By sliding the tubular extension 36 toward and away from the expansion fitting 18, the size of the aperture 34 between the shoulder 32 and the end 28 of the tubular section 17 may be increased or decreased. As the tubular extension 36 is slid toward the shoulder 32, less compressed fluid will escape, thereby increasing the speed of the strand of yarn 11 in the downstream tubular section 19. By moving the tubular extension 36 away from the shoulder 32, more compressed fluid can escape out of the aperture 34, thereby slowing down the speed of the yarn 11 in the tubular section 19. The sliding tubular extension 36 may be secured in position on the tubular section 17 by a simple adjustment screw 37 which may be screwed in to engage the tubular section 17 to hold the tubular extension 36 in place. Ideally, there should be just enough remaining fluid expanding down the tubular section 19 to carry the strand far enough to be attracted by the nozzle 24.

#### EXAMPLE

A fluid transport assembly 13 in accordance with that shown in FIGS. 1 and 2 was designed to transport polyester yarn of a count 167 dtex delivered by the feeder 12. This device had the following dimensions:

the combined length of the tubular sections 17 and 19: 1.5 meters

the inside diameter of the tubular sections 17 and 19: 1.8 mm

the length of the gap 22: 200 mm

the height of the aperture 34: 5 - 20 mm

With a fluid transport device having the above dimensions, compressed air was fed into the port 16 at a pressure of 3 bars, and at a rate of 80 Nm<sup>3</sup>/H. Compressed air was delivered to the nozzle 24 at a feed pressure of 6 bars and at a rate of 80 Nm<sup>3</sup>/H. The yarn advanced at a rate of 3,000 meters per minute, while air pressure at the entry to tubular section 19 was maintained at 8 - 10 Nm<sup>3</sup>/H. These conditions resulted in tension on the portion of yarn 11 immediately upstream from the nozzle 24 being about 12 g, and tension on the portion of yarn upstream from the nozzle 14 being about 16 g. The resulting tension on the yarn in combination with the above conditions caused the

yarn to travel an exact path, so that it could be correctly intercepted by the anchoring element.

The apparatus of the present invention is applicable to pneumatic transport of virtually all types of yarns, both continuous and fiber yarns, comprising any type of materials, such as natural and synthetic fibers, and also yarns of virtually any count, no matter how high or low.

While the apparatus of the present invention has been illustrated by way of the foregoing drawings and embodiments, which are for the purpose of illustration only, the apparatus of the present invention is to be limited only by way of the following appended claims.

What is claimed is:

1. Apparatus for transporting a yarn downstream of a yarn drawing assembly comprising:
  - a first induction nozzle means for initially entraining the yarn in a stream of fluid to apply tension on the yarn and pull the yarn from the drawing assembly while providing an expanding fluid to carry the yarn downstream;
  - a fluid passage extending from the first induction nozzle means for containing the fluid so as to expand the fluid downstream in the direction of extent of the fluid passage and thereby carry the yarn downstream;
  - a second induction nozzle means spaced downstream of the fluid passage to define a gap between the second nozzle means and fluid passage, said second induction nozzle means receiving just enough fluid to apply sufficient tension on said yarn to hold said yarn taut in said gap;
  - winding means movable through said gap to capture

the yarn and wind the yarn thereabout while applying sufficient tension on the yarn to wind the yarn thereabout; and

lateral aperture means disposed in the fluid passage between the ends thereof, said aperture means dividing said passage into upstream and downstream portions and said aperture discharging laterally a portion of the stream of fluid while the yarn is transported solely by the remaining fluid through the downstream portion and to the second induction nozzle means, thereby reducing the amount of fluid that must be injected into the second nozzle means to hold the yarn taut when the yarn is not being wound on said winding means while allowing said first nozzle means to receive enough fluid to pull the yarn from the drawing assembly.

2. The apparatus of claim 1, wherein the upstream and downstream portions of the fluid passage are tubular sections, wherein one of the tubular sections extends from the first nozzle means and wherein the tubular sections have axially aligned ends which define said lateral aperture.

3. The apparatus of claim 2, wherein the lateral aperture is further defined by a fitting having a flared aperture which faces the end of one of the tubular sections.

4. The apparatus of claim 3, wherein the flared aperture faces upstream toward the end of the tubular section extending from the nozzle means.

5. The apparatus of claim 3, wherein the tubular section faced by the flared end is movable toward and away from the flared end to control the amount of fluid expanding through the aperture.

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