

Nov. 17, 1970

KOZO SUSAMI ET AL

3,540,201

METHOD AND APPARATUS FOR MANUFACTURING YARN FROM TEXTILE FIBERS

Filed Nov. 1, 1967

6 Sheets-Sheet 1

Fig. 1

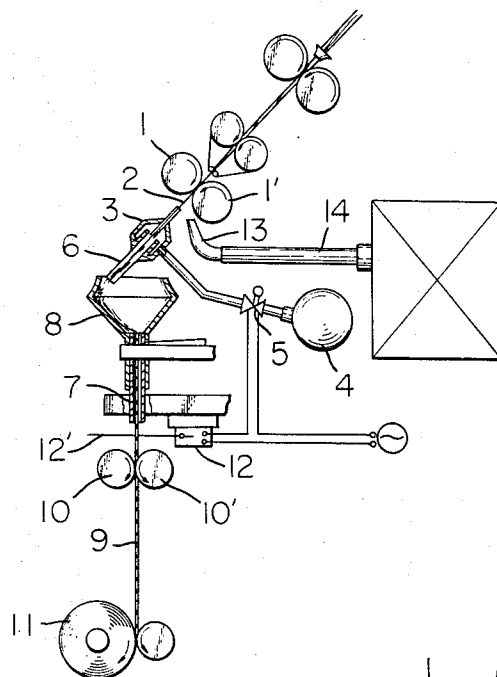
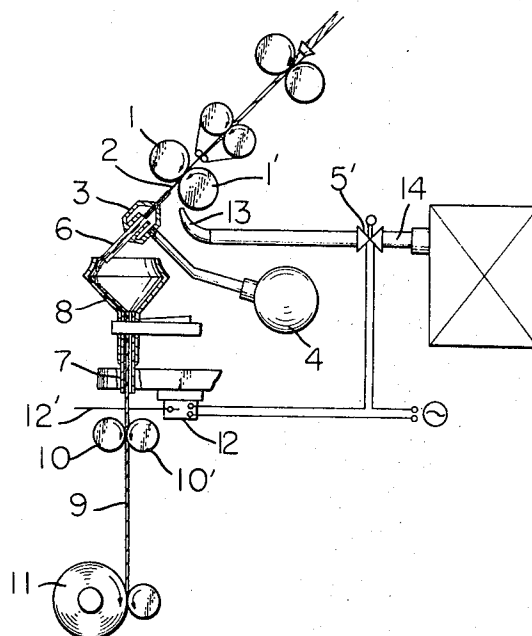


Fig. 2



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Fig. 3

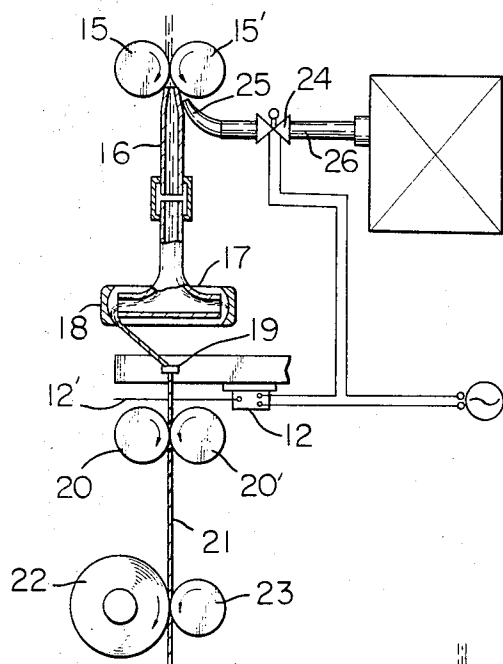
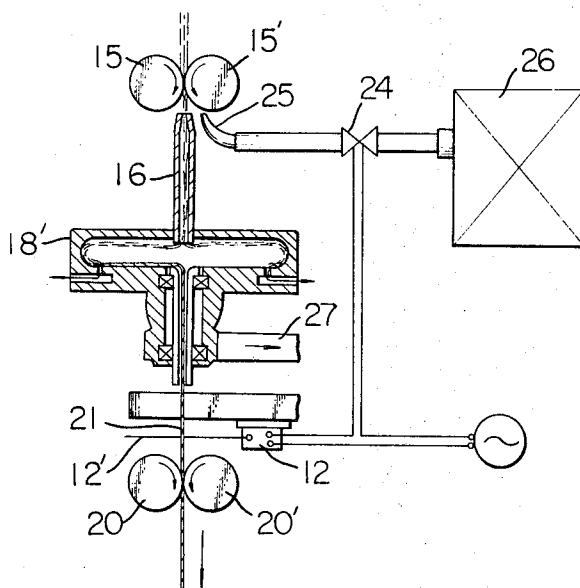


Fig. 4



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Fig. 5

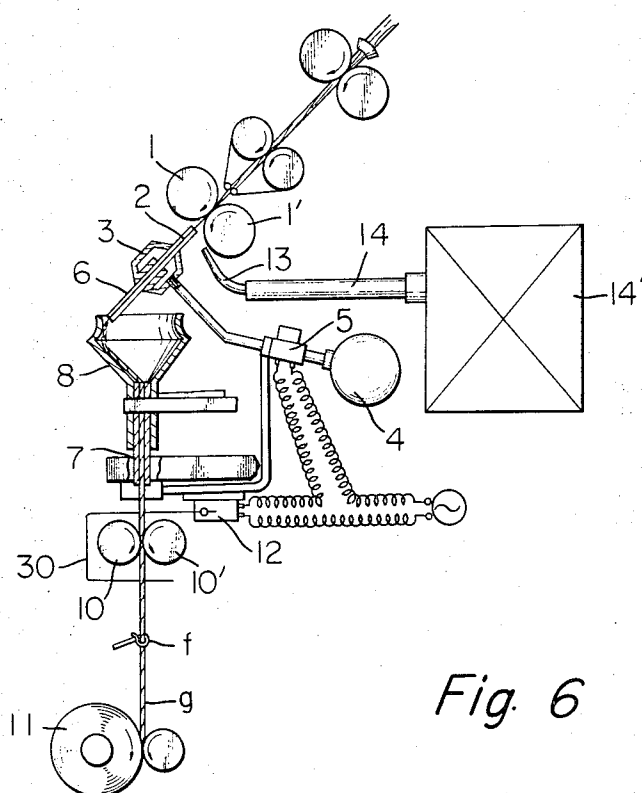
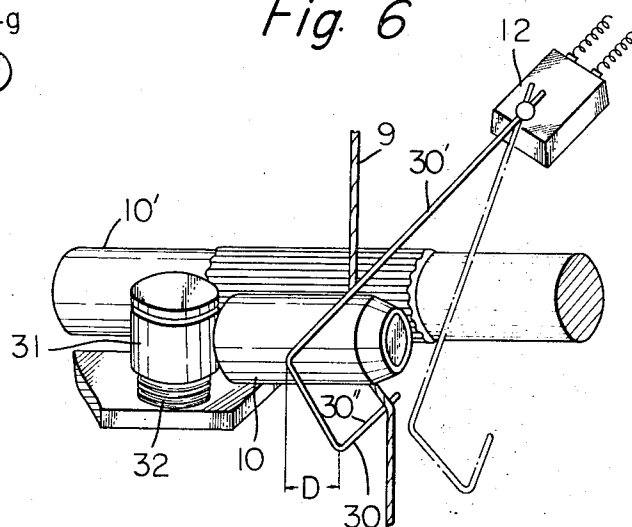


Fig. 6



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Fig. 7

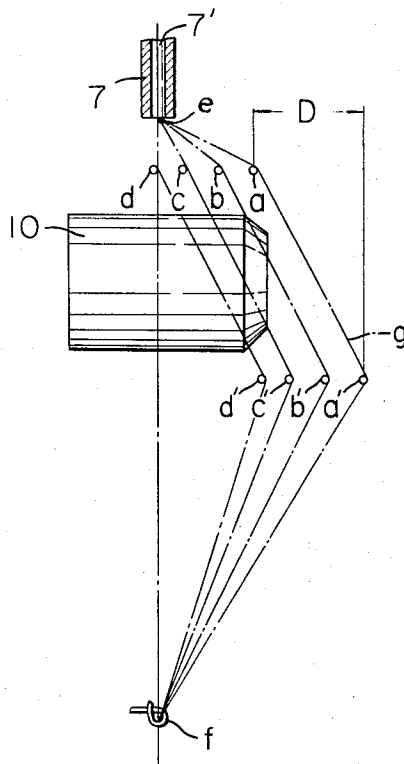
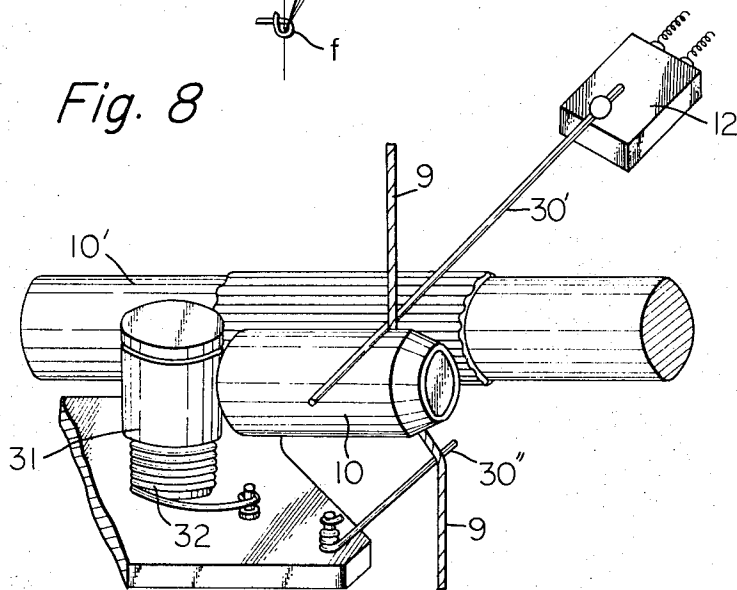


Fig. 8



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Fig. 9

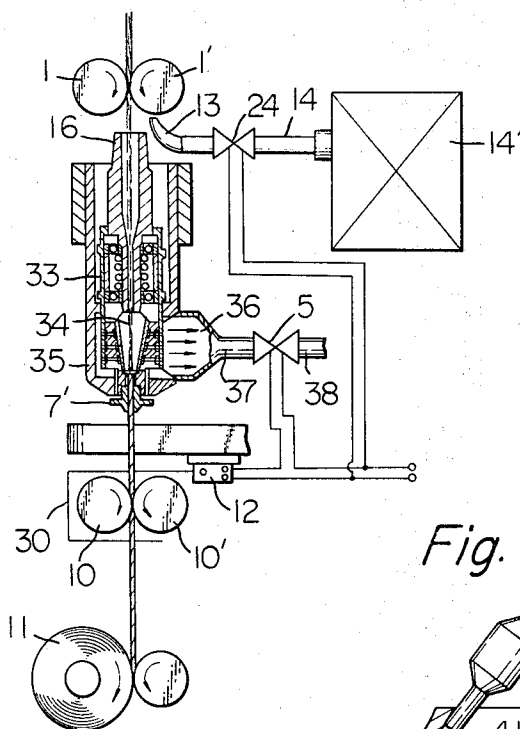


Fig. 10A

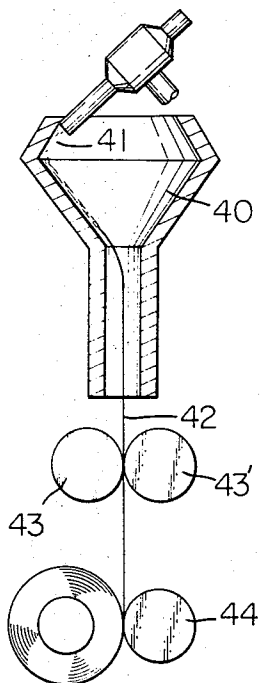
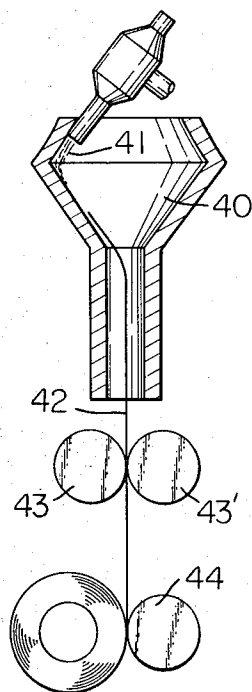


Fig. 10B



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Fig. 11

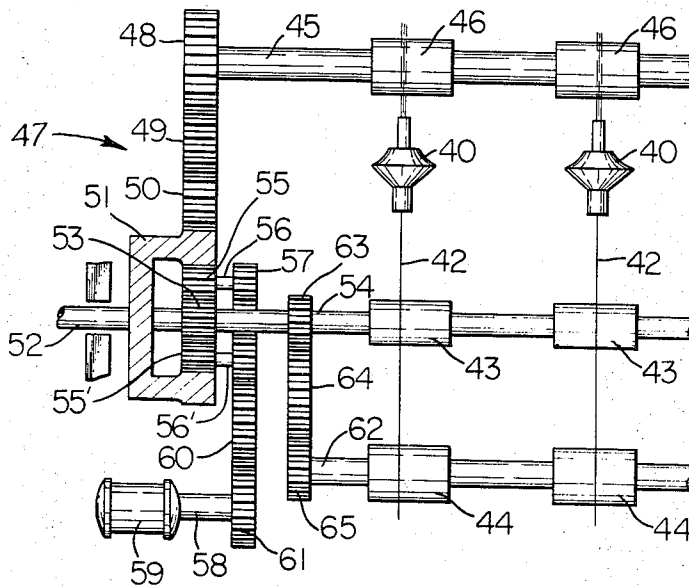


Fig. 12A

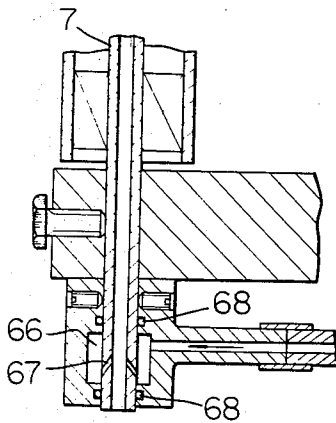


Fig. 12B

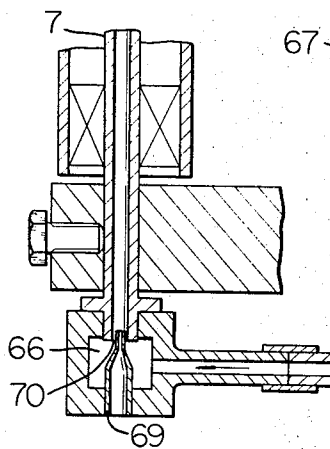
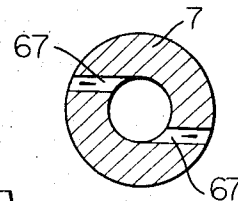


Fig. 13



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METHOD AND APPARATUS FOR MANUFACTURING YARN FROM TEXTILE FIBERS

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Claims priority, application Japan, Nov. 4, 1966, 41/101,499; Apr. 27, 1967, 42/26,577; May 8, 1967, 42/28,687

Int. Cl. D01h 1/12, 13/16

U.S. Cl. 57—80

17 Claims

ABSTRACT OF THE DISCLOSURE

An improved method and apparatus for manufacturing yarn from textile fibers by a spinning system utilizing pneumatic and centrifugal forces. The supply of the material fibers into the system and the delivery of produced yarn out of the system is automatically controlled by starting and/or stopping at least one of the pneumatic sucking actions of the twisting equipment of the spinning system and/or of the suction means for conducting the supplied material fibers from the system. This eliminates such troubles as yarn breakage which were often observed when starting the spinning machine in the conventional spinning system.

The present invention relates to an improved method and apparatus for manufacturing yarn from textile fibers, more particularly relates to an improved method and apparatus for manufacturing yarn from textile fibers while eliminating troubles which usually occur at time of yarn breakage or starting and stopping of the spinning machine.

As a method for eliminating drawbacks encountered in the conventional ring and traveller type spinning system, the so-called open end spinning system has been proposed which is characterized by separating the twisting and the taking-up operation by utilizing pneumatic and centrifugal forces. However, the application of the open end spinning system in mass-production is very limited practically on account of the fact that the open end spinning system encounters more operative troubles at the time of yarn breakage or the starting and stopping of the spinning machine as compared with the conventional ring and traveller type spinning system.

The principal object of the present invention is to provide an improved method and apparatus for manufacturing yarn from textile fibers with higher operation efficiency in the open end spinning system.

The other object of the present invention is to provide an improved method and apparatus for eliminating operative troubles which usually occur at the time of starting and stopping of the spinning machine in the open end spinning system.

Further object of the present invention is to provide an improved method and apparatus for eliminating operative troubles usually encountered at the time of yarn breakage in open end spinning system.

Further features and advantages of the present invention will be apparent from the ensuing description with reference to the accompanying drawings to which, however, the scope of the invention is in no way limited.

FIG. 1 is an explanatory skeleton sketch of an embodiment of the apparatus of the present invention applied to the open end spinning system utilizing pneumatic and centrifugal forces,

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FIG. 2 is an explanatory sketch skeleton of another embodiment of the apparatus of the present invention applied to an open end spinning system the same as that shown in FIG. 1,

FIGS. 3 and 4 are explanatory sketch skeletons of the embodiment the same as that shown in FIG. 2 which is applied to another type of open end spinning system,

FIG. 5 is an explanatory sketch skeleton for showing a practical arrangement of the apparatus shown in FIG. 1,

FIG. 6 is an enlarged perspective view of an embodiment of the detection device of the present invention for detecting the absence of yarn tension,

FIG. 7 is an explanatory drawing for showing the yarn retrieving operation using the detection device shown in FIG. 6,

FIG. 8 is an enlarged perspective view of another embodiment of the detection device of the present invention for detecting the absence of yarn tension,

FIG. 9 is an explanatory skeleton sketch of an embodiment the same as that shown in FIG. 2 which is applied to still other type of open end spinning system,

FIGS. 10A and 10B are explanatory skeleton sketches for showing the condition of fibers within the spinning rotor while the machine is driven and stopped, respectively,

FIG. 11 is a gearing diagram of the mechanism for positively feeding back the spinning yarn into the spinning rotor before restarting the machine,

FIGS. 12A and 12B are sectional side views of embodiments of the device for positively ejecting compressed air into the vertical cylindrical axis of the open end spinning equipment,

FIG. 13 is a cross-sectional view of the cylindrical axis used in the embodiment shown in FIG. 12A.

As already described, the success in the application of the open end spinning system in a practical mass-production depends on whether the uniting operation of the broken yarns can be performed quickly without fail, and whether the restarting of the spinning machine can be performed without any yarn breakage. The method and apparatus of the present invention can be favorably applied to a variety of open end spinning systems satisfying the requirements for manufacturing yarn from textile fibers at high production efficiency in a simple way.

An embodiment of the present invention applied to an open end spinning system utilizing pneumatics and centrifugal forces is shown in FIG. 1, wherein the open end spinning apparatus comprises a feeding device for successively transferring the fed bundle of fibers in a separated condition to a spinning rotor by utilizing pneumatics, a spinning rotor disposed close to the feeding device for converting the shredded or separated fibers into a spinning yarn, and a device for taking-up the spinning yarn from the spinning rotor. In the above-described arrangement of the open end spinning apparatus, the apparatus of the present invention comprises a means for detecting the breakage of the spinning yarn disposed at the position under the spinning rotor, an electromagnetically actuated valve disposed adjacent to the air conduit for supplying air flow to the feeding device and controlled by the operation of the means for detecting the breakage of the spinning yarn, and a suction means for sucking the broken end of the bundle of fibers disposed between the feeding source of fibers and the feeding device.

Referring to FIG. 1, a bundle of fibers 2 is fed from the conventional type of draft equipment to the inlet of a feeding device 3 by means of a pair of front rollers 1 and 1'. A compressed air flow is supplied into a feeding device 3 from a pneumatic source 4 through an electromagnetic valve 5 in such a manner that the supplied air

flow creates a negative pressure within the feeding device 3, and the supplied air flow is ejected in the direction along the passageway of the bundle of fibers through the device 3. By the pneumatic operation of the air flow supplied to the device 3, all fibers contained in the fed bundle of fibers become separated and are transferred into a delivery pipe 6 floating in the air flow. The outlet portion of the delivery pipe 6 should point toward the inside wall of the spinning rotor 8 which is rotatably supported by a vertical cylindrical axis 7 and rotated at a high rotating speed by a suitable driving means. As already described, the shredded fibers are ejected against the inside wall of the spinning rotor 8, deposited successively upon it by centrifugal force, and rotated at a high rotating speed together with the spinning rotor 8 while cohering on its inside wall. Then the separated or shredded fibers are collected to form a bundle of fibers and twisted in the form of a complete spinning yarn 9 and taken up into a cheese 11 by a pair of take-up rollers 10 and 10'.

A microswitch 12 provided with a detecting wire 12' is disposed between the bottom outlet of the vertical cylindrical axis 7 and the pair of take-up rollers 10 and 10' for the purpose of detecting a malfunction occurring in the spinning rotor 8, such as the breakage of the spinning yarn 9, or a malfunction of the spinning rotor 8 itself, such as slowing down or speeding up of the rotor which would affect the yarn tension. Microswitch 12 breaks the electric circuit connected to the electromagnetic valve 5 when the tension loaded on the detection wire 12' by the ballooning of the spinning yarn 9 is eliminated on account of yarn breakage or the absence of the yarn tension.

A suction nozzle 13 is disposed between the pair of front rollers 1 and 1' and the inlet portion of the feeding device 3 in such a manner that the front end portion of the nozzle 13 is positioned adjacent to the passageway of the bundle of fibers 2. The sucking action of the nozzle 13 is provided by a pneumatic fan (not shown) through the duct 14 in such a manner that the sucking force of the nozzle 13 is not strong enough to disturb normal pneumatic introduction of the bundle of fibers 2 into the feeding device.

When the spinning yarn 9 is broken indicating a malfunction occurring in the spinning rotor 8, the microswitch 12 breaks the electric circuit as described above. Then the electromagnetic valve 5 is closed and the supply of compressed air flow into the feeding device 3 through the valve 5 is stopped, resulting in the absence of negative pressure within the feeding device 3. On account of this absence of sucking action on the bundle 2 by the device 3 the feeding device 3 is rendered ineffective and the bundle of fibers 2 is placed in a slacked condition at a position near the nozzle 13 for a moment, sucked into the nozzle 13 by its sucking action, and conducted outside of the apparatus through the duct 14. By taking-up the broken end of the bundle of fibers, such troubles as diversion of fibers or sticking of fibers onto rollers are effectively eliminated in the present invention.

Retrieving of the yarn breakage is carried out according to the following steps. After stopping the taking-up action of the take-up rollers 10 and 10', the broken yarn end is drawn out from the cheese, the yarn end is passed upward through the vertical cylindrical axis 7, and the spinning rotor 8 is started. Then the yarn is again placed under tension brought about by the centrifugal ballooning of the yarn with the rotation of the spinning rotor and as the rotation of the spinning rotor reaches the normal driving condition, a tension is created on the yarn which is sufficient to load the detection wire 12', and the microswitch 12 closes the electric circuit connected to the electromagnetic valve 5. The pneumatic supply from the pneumatic source 4 thus resumed begins to create a negative pressure again within the feeding device. When the sucking force caused by this negative pressure becomes stronger than that provided by the suction nozzle 13, the

bundle of fibers 2 is sucked again into the inlet portion of the feeding device 3 automatically on account of the sucking force which corresponds to the subtracted effect between the sucking action by the feeding device 3 and the sucking action by the suction nozzle 13. When the broken yarn end which has been introduced into the spinning rotor 8 from the cheese 11, as already described, is connected with the layer of fibers deposited upon the inside wall of the rotor 8, the take-up rollers 10 and 10' are started again for taking up the yarn thus retrieved into a cheese 11.

Another embodiment of the present invention applied to the same open end spinning system as that shown in FIG. 1, is illustrated in FIG. 2, wherein the arrangement of the apparatus is the same as that of the embodiment shown in FIG. 1 with the exception that the microswitch 12 is connected to an electromagnetic valve 5' disposed in the duct 14 by an electric circuit.

In this arrangement, the sucking action of the nozzle 13 is performed only when the spinning yarn is broken and the sucking force of the nozzle 13 must be designed so as to overcome the sucking force of the feeding device 3. When the spinning yarn 9 is broken, the microswitch 12 sends an electric signal to the electromagnetic valve 5' so as to open it thereby rendering the feeding device 3 ineffective, and the bundle of fibers is sucked by the suction nozzle 13 on account of the sucking force which corresponds to the subtracted effect between the sucking action by the feeding device 3 and the sucking action by the suction nozzle 13.

While in the above described embodiments an electric system is used for detection and retrieving of yarn breakage, it is also possible to use a mechanical system in accordance with the user's preference without decreasing the effect of the present invention.

There has also been proposed another type of open end spinning system wherein the sucking of the bundle of fibers into the feeding device is performed only by the high speed rotation of the spinning rotor, that is, no pneumatic suction mechanism is therein utilized.

The method and apparatus of the present invention can also be very well applied to this type of open end spinning system as shown in FIGS. 3 and 4, wherein the apparatus shown in FIGS. 1 and 2 are applied without too much modifications.

In the embodiment shown in FIG. 3, the bundle of fibers is fed from the conventional type of draft equipment to the supply pipe 16 by a pair of front rollers 15 and 15', and then fibers in the bundle of fibers are ejected onto the inside wall of the spinning rotor 18 in a separated or shredded condition through a rotating distribution tube 17. The shredded fibers are deposited successively upon the inside wall of the spinning rotor 18 by the vortical air flow created inside the spinning rotor 18 by the rotation of the distribution tube 17 and the spinning rotor 18, and rotated at a high rotating speed together with the spinning rotor 18 while cohering on its inside wall. Then the shredded fibers are collected again to form a bundle of fibers and twisted in a form of a complete spinning yarn 21 and taken up into a cheese 22 through the yarn guide member 19 by a pair of take-up rollers 20, 20' and a drum 23 rotating in a contacting condition with the cheese 22. In case of the present embodiment, the sucking action of the bundle of fibers into the supply pipe 16 is performed only by rotating the distribution tube 17 together with the spinning rotor 18 without applying pneumatic suction system.

In this arrangement, a suction nozzle 25 is disposed between the pair of front rollers 15 and 15' and the inlet portion of the supply pipe 16 in such a manner that the front end portion of the nozzle 25 is positioned to the passageway of the bundle of fibers.

The sucking action of the nozzle 25 is provided by a pneumatic fan (not shown) through the duct 26. A microswitch 12 is disposed at the same position as in the

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embodiment shown in FIGS. 1 and 2, but is connected to an electromagnetic valve 24 disposed in the duct 26 by means of an electric circuit. When the spinning yarn 21 is broken indicating a malfunction occurring in the spinning rotor 18 or the absence of fibers being fed to the spinning rotor, the microswitch 12 detects the absence of the yarn tension by the detection wire 12' and breaks the electric circuit connected to the electromagnetic valve 24 which is accordingly opened. The bundle of fibers is sucked into the nozzle 25 by its pneumatic sucking action and conducted outside of the apparatus through the duct 26. By thus taking up the broken end of the bundle of fibers, such troubles as diversion of fibers or sticking of fibers onto rollers are effectively eliminated in this embodiment also. Retrieving of the yarn breakage can be carried out in the same manner as in the preceding example.

The arrangement of the embodiment shown in FIG. 4 is the same as that shown in FIG. 3 with the exception that the supply tube 16 is stationary and its lower end portion is inserted into the spinning rotor 18' which is rotated at a high rotating speed by a driving belt 27 at its lower end portion. The sucking action by the apparatus of the present invention is performed in the same manner as that in the embodiment shown in FIG. 3.

A practical example embodying the technique of the present invention and which can be effectively utilized in practical mass-production of an open end spinning system in a simple manner and with simple mechanical construction is illustrated in FIG. 5. In the drawing the microswitch 12 is provided with a detection lever 30 for detecting the absence of yarn tension. The microswitch 12 controls the operation of the electromagnetic valve 5 in such a manner that it breaks the electric circuit connected to the electromagnetic valve 5 when an absence of yarn tension takes place while it closes the circuit during normal spinning operation. When the circuit is closed, the electromagnetic valve 5 is opened to supply air flow to the feeding device while it stops the air supply when the circuit is broken.

The detailed construction of the detection part is shown in FIG. 6, wherein the take-up roller 10' is disposed to the spinning machine in such a manner that it extends laterally along the row of spinning units, while the other take-up roller 10 is disposed individually to the respective spinning unit. The take-up roller 10 is supported by a supporting shaft 31 at one of its end portion and is pressed against the take-up roller 10' by a helical spring 32 disposed adjacent to the shaft 31, while the other end of the roller 10 is converged toward the outside as shown in the drawing. The circular surface of the roller 10 is covered by an elastic material such as rubber for firmly nipping the spinning yarn 9 by cooperating with the take-up roller 10'. The detection lever 30 consists of a pair of detecting wires 30' and 30'' and an intervening portion for connecting the pair of detecting wires in an approximately parallel condition, and is turnably disposed to the microswitch 12 in such a manner that the detecting wire 30' is positioned at the yarn inlet side of the take-up rollers 10, 10' and the other detecting wire 30'' is positioned at the other side of the rollers 10, 10'. It is still preferable to position the outlet side detecting wire 30'' away from the position of the inlet side detecting wire 30' with a distance of D toward the converged end of the take-up roller 10.

In FIG. 7, the letters *a*, *b*, *c* and *d* designate the positions of the inlet side detecting wire 30', while the letters *a'*, *b'*, *c'* and *d'* designate the corresponding positions of the outlet side detecting wire 30''. When the broken spinning yarn is retrieved, the broken yarn end is first picked out from the cheese, passed through a pigtail guide *f*, further conducted through the detection lever 30 toward the lower outlet portion of the vertical cylindrical axis 7 and finally upward into the spinning rotor 8. Before starting the rotation of the spinning rotor 8, the spinning yarn

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9 is not nipped as yet by the take-up rollers 10, 10' forming yarn passage defined by *f*, *a'*, *a* and *e*. As the spinning rotor 8 begins to rotate, the spinning yarn 9 is placed under tension on account of the centrifugal force bestowed thereon within the spinning rotor 8. Then the spinning yarn 9 gradually changes its passage from that defined by *a'*, *a* to that defined by *d'*, *d* turning the detection lever 30 against the force provided by a spring disposed to the microswitch 12.

The microswitch 12 is set in such a manner that it breaks the electric circuit when the spinning yarn 9 forms a passage defined by *a'*, *a* while it closes the circuit when the spinning yarn 9 forms the passage defined by *b*, *b'*, *c*, *c'* and *d*, *d'*. Thus, the electromagnetic valve 5 closes and stops the supply of air flow from the pneumatic source to the feeding device 3 when the spinning yarn 9 is forming a passage defined by *a*, *a'*, no sucking action on the bundle of fibers 2 is presented by the feeding device 3, and the bundle of fibers 2 is sucked into the suction nozzle 13 and conducted outside of the apparatus through the conduit 14 and the duct 14'. The electromagnetic valve 5 opens and permits the supply of air flow from the pneumatic source to the feeding device 3 when the yarn forms a passage defined by *b*, *b'* on account of the revived yarn tension. The spinning yarn 9 is not taken up as yet by the take-up rollers before it forms a passage defined by *c*, *c'* and nipped between the pair of take-up rollers 10 and 10'. When the spinning yarn 9 forms a passage defined by *e*, *d* and *d'*, the cheese 11 begins to rotate and take up the spinning yarn 9 thereon, by which the yarn retrieving operation is completed. It will be apparent from the above description that the length of time between the start of the sucking action by the feeding device 3 and the start of the normal taking-up action by the take-up devices differs and the longer the distance D the longer is the above described time. Thus, it is possible to adjust the length of time in accordance with preference in practical use by changing the length of the distance D.

Another embodiment of the detection part is illustrated in FIG. 8, wherein the mechanical arrangement is almost the same as that in the embodiment shown in FIG. 6 with the exception that the outlet side detecting wire 30'' is separated from the inlet side detecting wire 30' and secured to the machine frame at one of its end portions as shown in the drawing. The spinning yarn 9 passes through the detection part in the same manner as in the preceding embodiment, and the microswitch 12 turns the electromagnetic valve on and off in accordance with the change in yarn tension as already described.

While the above described examples are applications only in the open end spinning system of the type shown in FIG. 1, it is also possible to apply them in the open end spinning system of the type such as shown in FIGS. 2, 3 and 4 without departing from the object of the present invention.

Another type of open end spinning system such as is disclosed in Czechoslovakian Pat. No. 91,208, issued on Aug. 15, 1959 is illustrated in FIG. 9, wherein the sucking of the bundle of fibers into the supply pipe 16 is carried out by sucking air from the spinning rotor 34 positively, while in case of the preceding type of open end spinning system, it is carried out by supplying pneumatic air flow into the feeding device positively. In this apparatus a spinning member 33 rotating at a high rotating speed is disposed within the casing 35, and a spinning rotor 34, which is provided with a plurality of air holes radially drilled through its wall, is also disposed within the casing 35 below the spinning member 33. The supply pipe 16 is secured firmly to the casing 35 and its lower end portion is inserted into the upper opening of the spinning rotor 34. A vertical cylindrical axis 7' is disposed at the bottom opening of the spinning rotor 34 to avoid inflow of air from cavity 36. The bundle of fibers is fed to the apparatus by a pair of front rollers and sucked into the supply pipe 16. As the fibers are conducted into the spinning rotor 34

through the supply pipe 16 in a shredded condition, the shredded fibers are rotated together with the spinning rotor 34 while cohering onto its inside wall by the centrifugal force due to the high speed rotation of the spinning rotor 34 and the sucking action due to the sucking operation of the cavity 36, collected again to form a bundle of fibers, twisted in the form of a complete spinning yarn and delivered out of the apparatus through the vertical cylindrical axis 7'. The mechanical arrangement of the detection part is almost the same as that in the embodiments already described with the exception that the electromagnetic valve 5 is disposed to the air suction conduit 37 and 38, and the operation of the detection part is almost the same as that already described.

A further preferable embodiment of the present invention is presented by positively feeding back the spinning yarn into the spinning rotor just before restarting the machine. During normal spinning operation, fibers are deposited within the spinning rotor 40 in a shredded condition while cohering onto its inside wall, and are continuously collected, twisted and converted into a spinning yarn 42 as shown in FIG. 10A. When the machine is stopped, the connection between the bundle of fibers 41 fed to the spinning rotor 40 and the spinning yarn 42 is broken as shown in FIG. 10B. Therefore, if the machine is restarted with the yarn in this broken condition, it is apparent that yarn breakage will take place instantly. This kind of yarn breakage can be avoided by feeding back the spinning yarn 42 positively by turning the take-up rollers 43 and 43' and the drum 44 in a reverse direction just before restarting the machine and starting the rotation of the spinning rotor 40, thereby making the slacked upper end portion of the fed back spinning yarn 42 connect with the lower end portion of the bundle of fibers 41 within the spinning rotor 40, both of which are sucked gradually into the spinning rotor 40 by the sucking action due to the rotation of the spinning rotor 40. The length of the spinning yarn fed back into the spinning rotor should be determined according to the type of the spinning rotor, which is preferably in the range of 40 to 60 mm.

A practical example of the present embodiment is illustrated in FIG. 11, wherein the rotation of the shaft 45 of front rollers 46 is transmitted to the epicyclic gearing mechanism 47 by means of a gear 48 secured to one end of the shaft 45 and a gear train composed of intervening gears 49 and 50. The epicyclic gearing mechanism 47 comprises, an outer gear 51 meshing with the gear 50 of the above-described gear train and secured to a shaft 52 rotatably disposed to the machine frame, an inner gear 53 secured to the shaft 54 of take-up rollers 43, a pair of epicyclic gears 55 and 55' intervening between the outer gear 51 and the inner gear 53 in a meshing condition with them and mounted rotatably on shafts 56 and 56', respectively, extending from one side surface of the gear 57. The gear 57 is connected to the driving shaft 58 of a brake motor 59 by a gear train composed of gears 60 and 61. Usually the gear 57 is maintained in a stationary condition on account of the braking action of the brake motor 59. The rotation of the shaft 54 is transmitted to the shaft 62 of the drum 44 for taking up the spinning yarn 42 onto a cheese by a gear 63 mounted firmly on the shaft 54 and a gear train composed of gears 64 and 65.

In the above described mechanism, the rotation of the shaft 45 during normal spinning operation is transmitted to the outer gear 51 of the epicyclic gearing mechanism 47 by means of the gear train 48, 49 and 50. During normal spinning operation, revolution of the epicyclic gears 55 and 55' is restricted due to the braking action of the brake motor 59 as already described while rotating in a meshing condition between the outer gear 51 and the inner gear 53. Thus, the transmitted rotation of the outer gear 51 is further transmitted to the shaft 54 by means of the epicyclic gears 55 and 55' and the inner gear 53 so as to actuate the rotation of the shaft 54, and still further to the shaft 62, both in the direction for

taking up the spinning yarn 42. In the case the machine is restarted, the brake motor 59 is started slightly before the starting of the rotation of front rollers 46, and this rotation of the driving shaft 58 connected to the brake motor 59 is transmitted to the gear 57 so as to rotate it. However, the outer gear 51 is still maintained stationary because this outer gear 51 is connected to the shaft 45 of front rollers 46 which has not started as yet at this stage. Thus, the epicyclic gears 55 and 55' are revolved and travel around the inner gear 53 supported by the gear 57, and this revolution of the epicyclic gears 55 and 55' actuates the rotation of the inner gear 53 in the direction opposite to that during normal spinning operation because the outer gear 51 is maintained stationary as already described. This reverse rotation of the inner gear 53 results in the rotation of the takeup rollers 43 and the drums 44 in the direction for feeding back the spinning yarn towards the spinning rotors 40. The spinning rotor 40 begins to rotate simultaneously. After the predetermined length of the spinning yarn 42 is fed back into the spinning rotor 40, the brake motor 59 is stopped and the reverse rotation of the take-up rollers 43 and the drums 44 are also stopped accordingly. Then the rotation of the front rollers 46 is started so as to perform the normal spinning operation, and both the take-up rollers 43 and the drums 44 are also started to rotate into normal direction in a manner as already described.

The length of the spinning yarn 42 fed back into the spinning rotor 40 can be predetermined by suitably setting the length of time wherein the brake motor 59 is rotated before the starting of the rotation of the front rollers 46. By positively feeding back the spinning yarn into the spinning rotor slightly before restarting the spinning machine as already described, such troubles as yarn breakage which is often observed when restarting the machine can be effectively eliminated.

As already described, the yarn retrieving operation is first started by drawing out the broken yarn end from the cheese and passing the yarn end upward into the spinning rotor rotating at a high rotating speed through the vertical cylindrical axis manually. But usually this operation is very difficult to perform manually even when something like a yarn guide wire is used.

An example of an attempt to practice this operation easily is illustrated in FIG. 12A, wherein the apparatus of the present invention is described in conjunction with the open end spinning equipment shown in FIG. 1, for the sake of explanation. In the embodiment shown in FIG. 12A, a compressed air cavity 66 is disposed at the bottom end portion of the vertical cylindrical axis 7 with a seal ring 68 for preventing the leakage of the compressed air and a pair of apertures 67 are formed through the vertical cylindrical axis 7 in such a manner that the compressed air is ejected upward into the central bore of the vertical cylindrical axis 7 from the air cavity 66. Compressed air is supplied into the cavity 66 from a pneumatic source (not shown) so as to create a sucking force near the bottom inside portion of the vertical cylindrical axis 7. Retrieving of the spinning yarn is performed in the above-described arrangement by starting the rotation of the spinning rotor 8, drawing out the broken yarn end from the cheese 11, and inserting the drawn-out yarn end into the bottom end portion of the vertical cylindrical axis 7. Then the inserted yarn end is sucked into the cylindrical axis 7 and further into the spinning rotor 8 by the sucking action due to the compressed air ejected from the air cavity 66, rotated together with the spinning rotor 8 while cohering onto its inside wall and reunited with the bundle of fibers as already described. When the rotation of the spinning rotor 8 reaches its normal driving condition, a tension will be created again on the spinning yarn 42 which is sufficient to load the detection wire 12', and the microswitch 12 breaks the electric circuit connected to the electromagnetic valve (not shown) disposed adjacent to the pneumatic conduit for supplying compressed

air into the air cavity 66 so as to stop the air supply. Simultaneously, the microswitch 12 closes the electric circuit connected to the electromagnetic valve 5 so as to make the pneumatic source 4 start producing a negative pressure again within the feeding device 3. When the sucking force caused by the negative pressure becomes stronger than that provided by the suction nozzle 13, the bundle of fibers 2 is again sucked into the inlet portion of the feeding device 3 automatically. As the broken yarn end is connected with the layer of fibers deposited upon the inside wall of the rotor 8, the take-up rollers 10 and 10' are started again for the taking up the yarn 42 thus retrieved into a cheese 11.

A further modification of the embodiment shown in FIG. 12A is illustrated in FIG. 12B, wherein an aspirator-type guide member 69 is disposed vertically through the air cavity 66 in such a manner that the upper end portion of the aspirator-type guide member 69 is inserted into the bore of the vertical cylindrical axis 7 while the bottom end portion thereof forms an opening to deliver the spinning yarn 42 therefrom. A cylindrical aperture 70 is formed around the upper end portion of the aspirator-type guide member 69 inserted into the cylindrical axis 7 in such a manner that the compressed air is ejected upwardly into the central bore of the cylindrical axis 7 from the air cavity 66. The operation and the effect of this embodiment is almost the same as the embodiment shown in FIG. 12A.

Even when the machine is stopped without yarn breakage, restarting the machine can be performed smoothly by positively ejecting compressed air into the vertical cylindrical axis 7 as described above. This is another great advantage of the present invention. When the machine is once stopped in any type of the open end spinning system, the sucking action on the bundle of fibers is stopped also. Therefore, the fibers deposited upon the inside wall of the spinning rotor in a shredded condition have a tendency to fall down towards the bottom portion of the spinning rotor on account of their dead weight, and the layer of fibers cohering onto the inside wall of the spinning rotor are disturbed often resulting in such troubles as yarn breakage when restarting the machine.

In the case of the present invention, the fibers are maintained in a floating condition while cohering onto the inside wall of the spinning rotor without disturbing the layer formed thereon by an upward force which corresponds to the subtracted force between the dead weight of the fibers and buoyancy provided by the compressed air ejected upwardly into the spinning rotor as already described while the machine is stopped. Thus the bundle of fibers and the spinning yarn are maintained in a connected condition within the spinning rotor even when the machine is stopped. Consequently, restarting of the machine can be performed smoothly without such troubles as yarn breakage which was often observed in the conventional open end spinning method.

A further preferable embodiment of the present invention is shown in FIG. 13, wherein the pair of apertures 67 are offset with respect to the central bore of the vertical cylindrical axis 7 in such a manner that the compressed air is fed tangentially into the bore and creates a vortical air stream upward through the cylindrical axis 7. By the application of this kind of vortical air stream, the so-called false-twist action is applied to the bundle of fibers passing through the cylindrical axis 7. When the vortical direction of the ejected air stream is the same as that of the twists already imparted into the spinning yarn while passing through the spinning rotor, additional twists can be imparted to the spinning yarn while passing through the cylindrical axis 7, resulting in an increased production speed of the machine. On the other hand, when the vortical direction of the ejected air stream is opposite to that of the twists imparted into the spinning yarn while passing through the spinning rotor, it is pos-

sible to produce a loosely twisted yarn. This is a further advantage of the present invention.

While the invention has been described in conjunction with certain embodiments thereof, it is to be understood that various modifications and changes may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. An improved method of altering the path of a bundle of fibers fed to a spinning zone when a malfunction occurs in the spinning zone, comprising; entraining a bundle of fibers in a first stream of negatively pressurized fluid and advancing said bundle of fibers to a spinning zone, spinning said bundle of fibers into yarn in said spinning zone and delivering said yarn therefrom, detecting a condition of the yarn as it is delivered from said spinning zone indicative of a malfunction occurring in said spinning zone and generating a signal representative of said malfunction, bypassing said bundle of fibers around said spinning zone in response to said signal by entraining them in a second stream of negatively pressurized fluid, and rendering said first stream ineffective by means of said second stream during the bypassing of said bundle of fibers by said second stream.

2. A method according to claim 1, further including developing said second stream in response to said signal, and maintaining said second stream of negatively pressurized fluid more negative than said first stream of negatively pressurized fluid to allow said fibers to become entrained in said second stream and bypass said spinning zone when a malfunction is detected.

3. A method according to claim 2, further including the step of extinguishing said second stream when said malfunction has been corrected, whereby said bundle of fibers is transferred from said second stream back into said first stream.

4. A method according to claim 1, wherein said step of detecting a condition of the yarn comprises detecting the tension of the yarn as it is delivered from said spinning zone.

5. An improved method of altering the path of a bundle of fibers fed to a spinning zone when a malfunction occurs in the spinning zone, comprising; entraining a bundle of fibers in a first stream of negatively pressurized fluid and advancing said bundle of fibers to a spinning zone, spinning said bundle of fibers into yarn in said spinning zone and delivering said yarn therefrom, detecting a condition of the yarn as it is delivered from said spinning zone indicative of a malfunction occurring in said spinning zone and generating a signal representative of said malfunction, bypassing said bundle of fibers around said spinning zone by entraining them in a second stream of negatively pressurized fluid, maintaining said first stream of negatively pressurized fluid more negative than said second stream of negatively pressurized fluid to allow said bundle of fibers to be advanced to said spinning zone by said first stream despite the tendency of said second stream to bypass said bundle of fibers around said spinning zone, and rendering said first stream ineffective in response to said signal to allow said bundle of fibers to become entrained in said second stream and bypass said spinning zone.

6. A method according to claim 5, wherein said step of rendering said first stream ineffective comprises extinguishing said first stream in response to said signal.

7. A method according to claim 6, further including the step of redeveloping said first stream after said malfunction has been corrected, whereby said bundle of fibers is transferred from said second stream back into said first stream.

8. An improved method of reuniting a parted yarn end with its associated fiber bundle when a break occurs during a spinning operation, comprising: advancing a fiber bundle by a fluid stream to a spinning zone, stopping both the spinning operation in said spinning zone and

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said advancement of the fiber bundle when a yarn is parted from its associated fiber bundle, entraining the parted yarn end in a positively pressurized fluid stream independent from said first-mentioned fluid stream and returning said yarn end to said spinning zone, accelerating the speed of said spinning operation until normal spinning operation speed is reached to reunite said parted yarn end with its associated fiber bundle, and resuming the advancing of the fiber bundle by said first-mentioned fluid stream when the tension of said reunited yarn reaches a predetermined value.

9. An apparatus for producing yarn from a bundle of fibers, comprising: spinning means for spinning yarn from a bundle of fibers and delivering said yarn therefrom; feeding means for entraining a bundle of fibers in a first stream of negatively pressurized fluid and feeding said entrained bundle of fibers to said spinning means, said feeding means comprising an aspirator having a fiber inlet and a fiber outlet, and a first conduit connected to said aspirator for supplying positively pressurized fluid thereto; detecting means for detecting a condition of the yarn as it is delivered from said spinning means indicative of a malfunction occurring in said spinning means and generating a signal representative of said malfunction; bypass means for entraining said bundle of fibers in a second stream of pressurized fluid and bypassing said bundle of fibers around said spinning means, said bypass means including a suction nozzle disposed adjacent said feeding means, and a second conduit connected to said nozzle for supplying negatively pressurized fluid thereto; and valve means disposed in one of said first or second conduits actuatable in response to said signal for rendering said bypass means effective; whereby said bundle of fibers is bypassed around said spinning means in response to said signal.

10. An apparatus for producing yarn from a bundle of fibers, comprising: spinning means for spinning yarn from a bundle of fibers and delivering said yarn therefrom; feeding means for entraining a bundle of fibers in a first stream of negatively pressurized fluid and feeding said entrained bundle of fibers to said spinning means; detecting means for detecting a condition of said yarn as it is delivered from said spinning means indicative of a malfunction occurring in said spinning means and generating a signal representative of said malfunction; bypass means for entraining said bundle of fibers in a second stream of negatively pressurized fluid and bypassing said bundle of fibers around said spinning means; means for maintaining said first stream of negatively pressurized fluid more negative than said second stream of negatively pressurized fluid to allow said bundle of fibers to be fed to said spinning means during the absence of a malfunction; and means responsive to said signal for rendering said first stream ineffective, whereby said bundle of fibers are bypassed around said spinning means when a malfunction is detected.

11. An apparatus according to claim 10, wherein said bypass means comprises a suction nozzle and means providing in use of the apparatus communication between said suction nozzle and a source of negatively pressurized fluid; said feeding means comprises an aspirator having a fiber inlet and a fiber outlet, and a conduit connected to said aspirator for supplying positively pressurized fluid thereto; and said means responsive to said signal for rendering said first stream ineffective includes valve means disposed in said conduit actuatable in response to said signal for preventing said positively pressurized fluid from flowing to said aspirator, whereby said aspirator is rendered ineffective in response to the said signal.

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12. An apparatus according to claim 11, wherein said valve means comprises an electromagnetically actuated valve; and said detecting means comprises means for detecting the tension of said yarn as it is delivered from said spinning means, and means for generating an electric signal to actuate said valve when the tension of said yarn falls below a predetermined value.

13. An apparatus according to claim 12, wherein said means for detecting the tension of said yarn includes a U-shaped member disposed downstream from said spinning means and mounted for movement in response to changes in the tension of said yarn.

14. A apparatus for producing yarn from a bundle of fibers, comprising: spinning means for spinning yarn from a bundle of fibers and delivering said yarn therefrom; feeding means for entraining a bundle of fibers in a first stream of negatively pressurized fluid and feeding said bundle of entrained fibers to said spinning means; detecting means for detecting condition of said yarn as it is delivered from said spinning means indicative of a malfunction occurring in said spinning means and generating a signal representative of said malfunction; bypass means for entraining said bundle of fibers in a second stream of negatively pressurized fluid and bypassing said bundle of fibers around said spinning means; and means including said bypass means responsive to said signal for rendering said first stream ineffective by means of said second stream; whereby said bundle of fibers are bypassed around said spinning means when a malfunction occurs.

15. An apparatus according to claim 14, wherein said bypass means comprises a suction nozzle and a conduit connected to said nozzle for supplying said second stream of negatively pressurized fluid thereto; and said means responsive to said signal for rendering said first stream ineffective includes valve means disposed in said conduit actuatable in response to said signal for allowing said second stream to flow through said conduit; whereby said bundle of fibers are entrained in said second stream in response to said signal.

16. An apparatus according to claim 15, wherein said valve means comprises an electromagnetically actuated valve; and said detecting means comprises means for detecting the tension of said yarn as it is delivered from said spinning means, and means for generating an electric signal to actuate said valve when the tension of said yarn falls below a predetermined value.

17. An apparatus according to claim 16, wherein said means for detecting the tension of said yarn includes a U-shaped member disposed downstream from said spinning means and mounted for movement in response to changes in the tension of said yarn.

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