Oct. 30, 1962 E. W. STARNES 3,060,670

PROCESS AND APPARATUS FOR REDUCING THE BREAKING FORCES ON A BALLOONING STRAND OF YARN OR THE LIKE

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Fig. 2

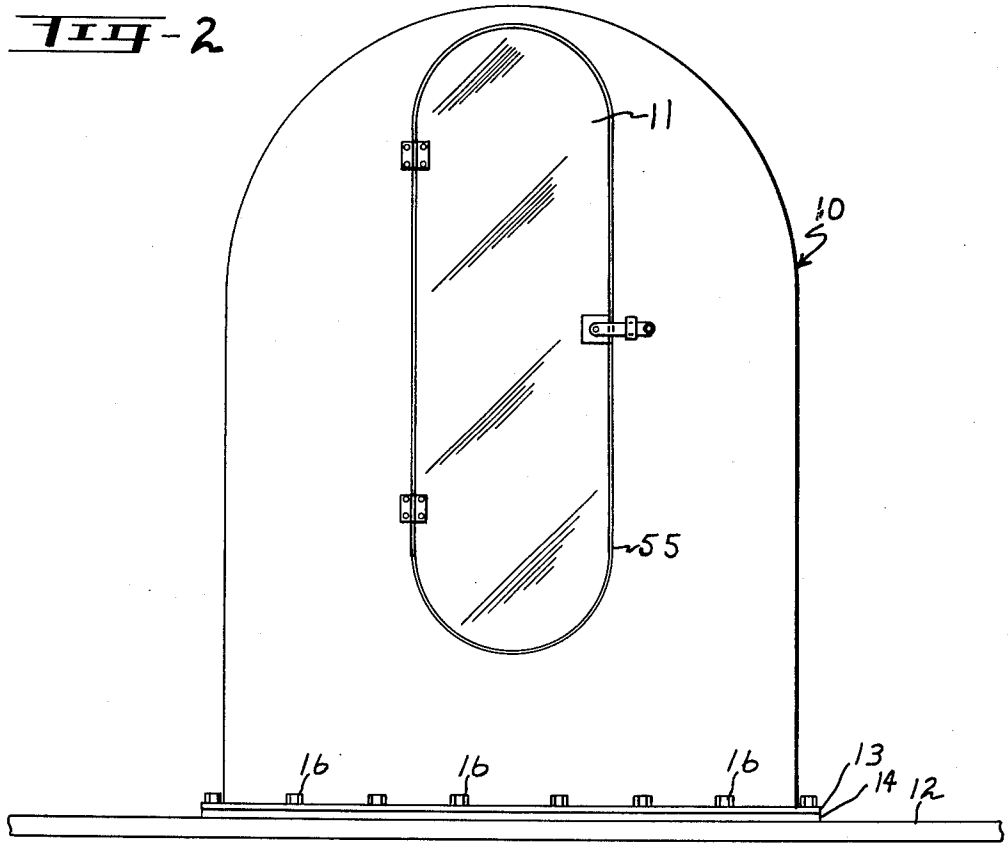


Fig. 1

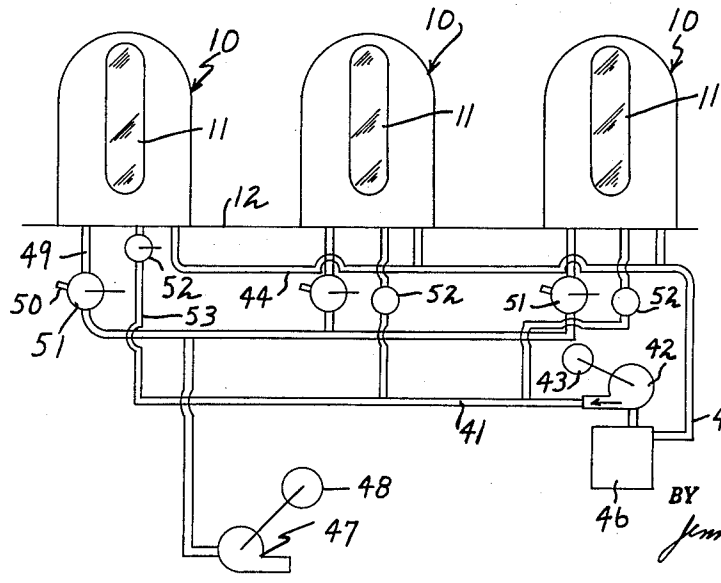
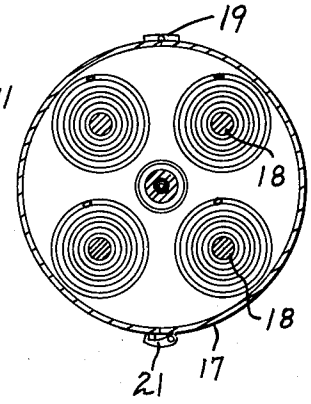


Fig. 4



INVENTOR.
Earl W. Starnes

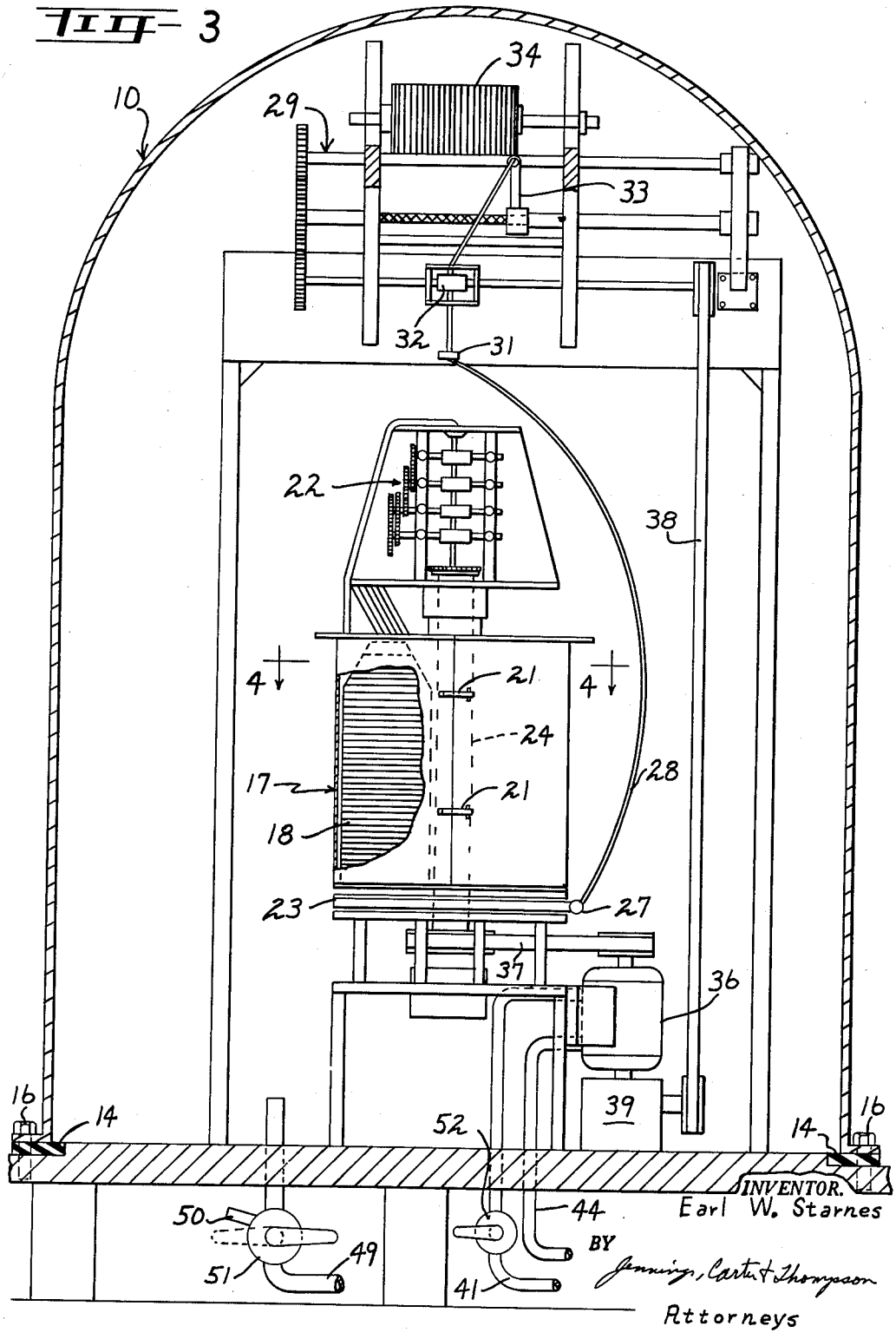
BY
Jennings, Carter & Thompson
Attorneys

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Fig. 3



INVENTOR.
Earl W. Starnes
BY
Jennings, Carter & Thompson
Attorneys

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PROCESS AND APPARATUS FOR REDUCING THE BREAKING FORCES ON A BALLOONING STRAND OF YARN OR THE LIKE

Earl W. Starnes, % Russell Manufacturing Company, Alexander City, Ala.

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2 Claims. (Cl. 57—58.83)

This invention relates to a process and apparatus for twisting fibers, and particularly to means to reduce the breaking forces on a ballooning strand of yarn.

In my prior Patent No. 2,867,967, dated January 13, 1959, I show, describe and claim apparatus for making yarn embodying attenuating apparatus wholly confined within the figure of revolution generated by the ballooning yarn. The apparatus of my prior patent has eliminated one of the principal limitations relative to high speed production of yarns and the production of very fine yarns as well as the production of the so-called "soft" yarns with low twist. That is to say, the apparatus shown in the above patent in effect eliminates the heretofore existing limitations of speed on the ordinary traveller used in the well-known types of ring spinning frames.

In further considering improvements in this field, I now believe that one of the most important, if not the only remaining barrier on unlimited speed is the breaking force exerted on the ballooning yarn due to the frictional drag of the air as the balloon rotates.

In view of the foregoing an object of my invention is to provide a process and apparatus for carrying out the same by means of which I am enabled to twist fibers to produce yarns at a high rate by reducing the breaking force due to the air drag on the ballooning yarn.

Another and important object of my invention is to provide a process and apparatus by means of which I can produce, trouble-free and at low labor cost, yarns from low strength fibers such as short staples, strips, fly, comber and damaged fibers.

Another object is to provide apparatus and process of the character designated by means of which I am enabled to produce yarns with low twist, thereby to provide the so-called "soft" yarns.

Another object is to provide a process and apparatus of the kind indicated in which the end breakage is reduced to a very minimum, thereby materially lowering the cost of the labor required to attend the machine.

A still further object is to provide an apparatus of the character designated in which the waste from the spinning or twisting operation is confined inside of an enclosure, thereby eliminating the need in the spinning or twisting room for apparatus to effect cleaning in the mill.

Briefly, my invention contemplates a process and apparatus in which the breaking forces on the ballooning length of yarn is reduced by enclosing the ballooning yarn in a space under subatmospheric pressure. Preferably, though not necessarily, I may in effect enclose the apparatus of my above mentioned Patent No. 2,867,967, together with the package builder therefor in a suitable vessel or housing in such manner that I am enabled to place the entire enclosure under sub-atmospheric pressure. I may drive the apparatus either by means of a prime mover of the electric type enclosed in the housing, or, if desired, I may provide a fluid or pneumatic motor with energy supplied to the housing from the outside. Likewise, I may drive the apparatus from an outside source through a seal surrounding the rotating shaft. Also, and as a matter of economy in equipping an entire spinning room with my improved apparatus, I prefer to have a single vacuum source and to connect a plurality of machines to that source. As an alternate, it conceivably is possible to provide each of the

enclosures with its own small, individual vacuum pump and to drive such pump directly from the motor supplying the power to the attenuating and/or twisting apparatus. The amount of sub-atmospheric pressure may be varied in accordance with the type of yarn being twisted, the type of fiber, the amount of twist, and the speed of production desired for a given size. However, with my improved process and apparatus it is practical to reduce the sub-atmospheric pressure to a degree that the only real limitation upon the speed of production becomes the capability of the several mechanical parts to withstand the strain of rotation and other movement. For instance, with the apparatus shown in my above mentioned patent and operating in the open atmosphere, in the manufacture of No. 10s yarns I have successfully twisted at the rate of 10,500 turns of twist per minute. In the atmosphere the overall tension at this speed on 10s yarn, includes the tension produced by the tensioning device and centrifugal force, as well as air drag, is on the order of five to six ounces. By reducing the atmospheric pressure surrounding the balloon to one-half atmosphere I will have reduced the total drag on the balloon to approximately three ounces. Consequently, I can increase the velocity of rotation of the twisting apparatus very substantially. Further reduction of the atmospheric pressure gives further reduction in overall drag and permits a further increase in speed, or a decrease in attention labor cost. Therefore, my improved process and apparatus lends itself very readily to the solution of the problem of air drag on the ballooning yarn, which solution embodies all of the factors heretofore mentioned. My invention likewise takes advantage of the economic factors involved in such considerations as the tightness of the cover, the thickness of the cover, the size and horsepower required for the vacuum pump, etc.

Apparatus illustrating the constructional features of my improved apparatus and which may be used to carry out my improved process is shown in the accompanying drawings, forming a part of this application, in which:

FIG. 1 is a wholly diagrammatic view illustrating a plurality of separate machines connected to a common source of vacuum and a common source of fluid under pressure for driving the same;

FIG. 2 is an enlarged front elevational view of one of the enclosed apparatus;

FIG. 3 is a still further enlarged vertical sectional view through the apparatus, certain parts being broken away and in section; and,

FIG. 4 is a detail sectional view taken generally along line 4—4 of FIG. 3.

Referring now to the drawings, and as has been before stated, I show my invention in association with the type of apparatus for making yarn shown in my Patent No. 2,867,967, dated January 13, 1959. However, as the description proceeds it will become apparent that my improved process may be carried out with other specific forms of fiber attenuating and/or twisting apparatus than the one shown in the aforementioned patent. However, for the purpose of illustration and because the apparatus shown in the above patent is peculiarly suited for inclusion in the present process and apparatus, I show the same to be substantially identical with the aforesaid patent.

Referring to FIG. 1 it will be seen that my improved apparatus comprises a plurality of housings **10** which may be of any suitable configuration and which may be provided with doors **11**. The doors **11** may be made of suitable transparent material and also provide access to the inside of the apparatus for doffing the same and for servicing it. As shown particularly in FIGS. 2 and 3, each of the housings is supported on a suitable base support **12**. The housings may be provided with flanges **13**. The flanges rest upon suitable gaskets **14** which in turn rest on the support **12**. The housing is held to the

gasket in air-tight manner by means of bolts, studs or the like **16**.

Referring now particularly to FIG. 3 of the drawings I show enclosed within each of the housings **10** the apparatus shown in Patent No. 2,867,967. That is, I show a package holder **17** in which are placed a number of the packages **18** to be attenuated or twisted. The only difference between the holder **17** and the one shown in the above mentioned patent is the fact that the holder may be in halves and hinged together at **19**. Fasteners **21** may be provided. In this manner the holder may be opened to remove the bobbins and to insert other packages **18**.

On top of the package holder **17** is the attenuating apparatus indicated generally by the numeral **22**. The flyer is in the form of a rotating plate **23** and the yarn is fed upwardly from the packages, through the attenuating apparatus **22**, downwardly through the hollow tube **24** and thence to the rotating plate **23**. The yarn passes over a tensioning device **27** and thence forms the balloon indicated at **28**.

The take-up and winding mechanism for the yarn is indicated generally by the numeral **29**. Thus, the yarn passes through an eye **31** fixed over the center of the tube **24**, under take-up rollers **32**, over a level winder **33** and thence on to the package builder indicated at **34**.

Power for driving the disc **23** is supplied preferably by a fluid pressure motor **36** located in the housing. The motor drives the disc **23** through a belt **37**. The package builder mechanism and level wind device may be driven by a belt **38**, also driven from the motor **36** through a right angle gear box **39**.

Power is supplied to the fluid motor **36** through a line **41** from a pump **42** in turn driven by a motor **43**. The fluid returns from the motor **36** through a line **44** to a reservoir **46**.

It will be understood that a plurality of the housings **10** may be connected to a single source of the fluid under pressure. Likewise, it will be apparent that the motor **36** may be an electric motor. However, in order to eliminate the accumulation of heat inside the housing **10** I prefer to use a hydraulic or air motor.

Each of the housings **10** is maintained under sub-atmospheric pressure. As illustrated in FIG. 1, I show a vacuum pump **47** driven by a motor **48**. The inside of each housing **10** is connected to the pump through branch lines **49** under control of the three-way valves **51**. A plurality of units **10** may be connected to the single pump **47** and, once the sub-atmospheric pressure is established and as will be apparent to those skilled in the art, very little additional power is required to maintain that degree of sub-atmospheric condition within the housings.

From the foregoing the method of carrying out my improved process and the constructional features of my improved apparatus may now be explained and understood. With the housings **10** in place about the twisting and attenuating apparatus and the package builder, the three-way valves **51** are opened, thus to connect the vacuum pump **47** to the housings **10**. Once the pressure is down to the degree required or desired, as hereinafter will be specifically mentioned, valves **52** in branch lines **53** leading from line **41** are opened, starting the motors **36**. This drives the attenuating apparatus **22**, the flyer disc **23** and the package builder **29**. When the entire apparatus is shut down to remove bobbins **34** or to replace package **18** the entire unit must be depressurized to allow opening of door **11**. This is accomplished by moving the handle of the three-way valve **51** to the dotted line position as shown in FIG. 3. The entire unit is then opened to the atmosphere through line **50**, allowing the door **11** to be opened.

Based upon my calculations I believe that if the pressure is reduced in the housings on the order of one-half atmosphere for a given speed and a given size yarn, the

total drag on the balloon **28** will be decreased by about **50** percent. By reducing the pressure to about one-fifth atmosphere within the housings I believe that the air drag on the balloon **28** will be decreased about 80 percent. Therefore, by operating the apparatus under sub-atmospheric pressure I am enabled greatly to increase the speed of twisting and drawing, and in fact, with low enough pressure in the housings the only real limitation is the limitation on the parts due to the speed of rotation. Stating the matter in a different way, by my invention I am enabled to operate at faster speeds without increasing the tension over what it is in open atmosphere, for a given size yarn. Obviously, as the pressure is decreased the strength of the cover or housing **10** must be increased. By providing a door **11** sufficiently large to enter the housing for servicing the machine and doffing the same, I eliminate the necessity of having to remove the housing each time it is necessary to get at the apparatus. Incidentally, and as will be understood, I provide a gasket **55** around the door to prevent leakage at that point.

As a specific example with respect to the economy of maintaining a vacuum on apparatus of the kind disclosed herein, I estimate that with reasonably attainable leak-proof connections, I could maintain reduced pressure on the order of one-half atmosphere in as many as 10,000 individual units of the kind disclosed herein with no more than a 50 h.p. motor. It is therefore apparent that insofar as power requirements to produce the sub-atmospheric pressure are concerned, and on a pier unit basis, the same is negligible.

My improved process and apparatus lends itself particularly to the production of the low grade fiber yarns and at an extremely high rate. Further, it will be apparent that with individual units of the kind shown herein the breakage of an end in any one of them will not affect any of the others. By having the vacuum lines and fluid completely independent even through they are connected pressure lines separately valved for each unit they are to single sources of vacuum and fluid under pressure.

While I have shown and described apparatus for both attenuating and twisting yarn, it will be apparent that my improved process and apparatus has equal utility in connection with twisting only. That is, if it were desired only to twist yarn it would be possible to eliminate the attenuating portion **22** and simply to run the yarns down through the tube and to the flyer plate **23**, for twisting. Likewise, while I have shown a "two-for-one" type of twister, other types may be employed with my improved process.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

I claim:

1. In apparatus for drawing and twisting a strand of fiber to form yarn, a strand supply package, a set of drawing rolls to which the strand is delivered from the supply package, a rotatable flyer positioned to receive the drawn strand directly from the drawing rolls and form a ballooning figure of revolution about the supply package and drawing rolls, yarn package building means receiving yarn from the ballooning figure and forming the yarn into a yarn package, a substantially air tight enclosure surrounding said supply package, drawing rolls, ballooning figure of revolution, and package building means, drive means within the enclosure operatively connected to the drawing and twisting apparatus and package building means for driving thereof, and means to maintain the enclosure under a substantially uniform sub-atmospheric pressure so that the fiber from the supply package to the package building means is entirely under

sub-atmospheric pressure to decrease air drag on the balloon.

2. In apparatus for drawing and twisting a strand of fiber to form yarn, a strand supply package, a set of drawing rolls to which the strand is delivered from the supply package, a rotatable flyer positioned to receive the drawn strand directly from the drawing rolls and form a ballooning figure of revolution about the supply package and drawing rolls, yarn package building means receiving yarn from the ballooning figure and forming the yarn into a yarn package, a substantially air tight enclosure surrounding said supply package, drawing rolls, ballooning figure of revolution and package building means, fluid pressure motor means in the enclosure operatively connected to the drawing and twisting apparatus and

package building means for driving thereof, means outside the enclosure to supply fluid under pressure to the motor means, and means outside the enclosure to maintain the same under sub-atmospheric pressure so that fiber from the supply package to the package building means is entirely under a substantially uniform sub-atmospheric pressure to decrease air drag.

References Cited in the file of this patent

UNITED STATES PATENTS

1,484,724	Lent	Feb. 26, 1924
2,576,936	Heffelfinger	Dec. 4, 1951
2,731,786	Klein	Jan. 24, 1956
2,856,749	Geen	Oct. 21, 1958
2,867,967	Starnes	Jan. 13, 1959