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Eichmanns et al.

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[54] **PROCESS AND DEVICES FOR THE WINDING OF CONTINUOUS FIBERS-PARTICULARLY GLASS FIBERS—IN THE FORM OF BOBBINS**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **242/18 R,** 242/18 G, 242/43

[51] **Int. Cl.** **B65h 54/02,** B65h 54/28

[58] **Field of Search** ..... 242/18 R, 18 G, 43

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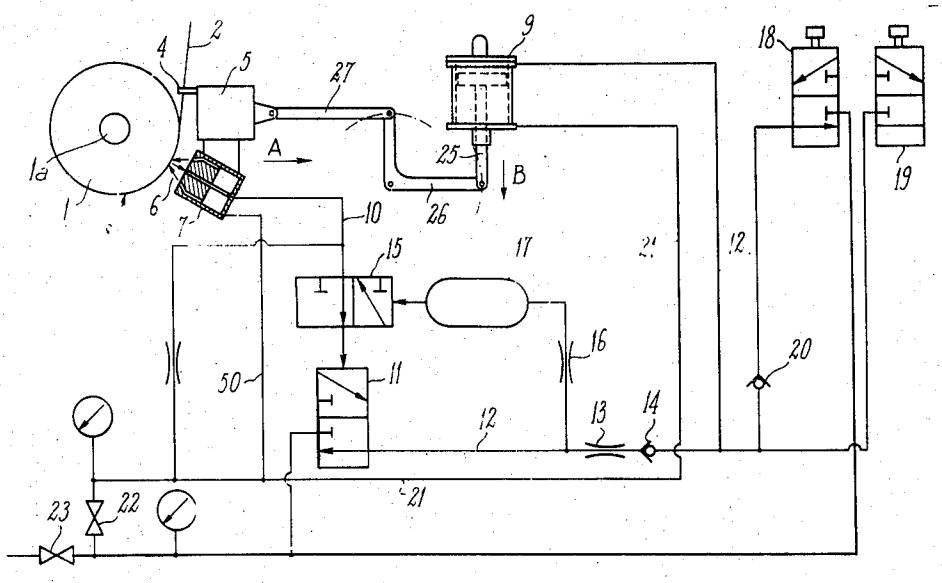
[57] **ABSTRACT**

Bobbin winding system with thread guide mounted for traverse motion and for radial motion toward and away from the surface of the bobbin being wound. The radial motion is controlled by directing a fluid jet against the surface of the bobbin being wound and by sensing the strength of reflected jet fluid.

10 Claims, 5 Drawing Figures



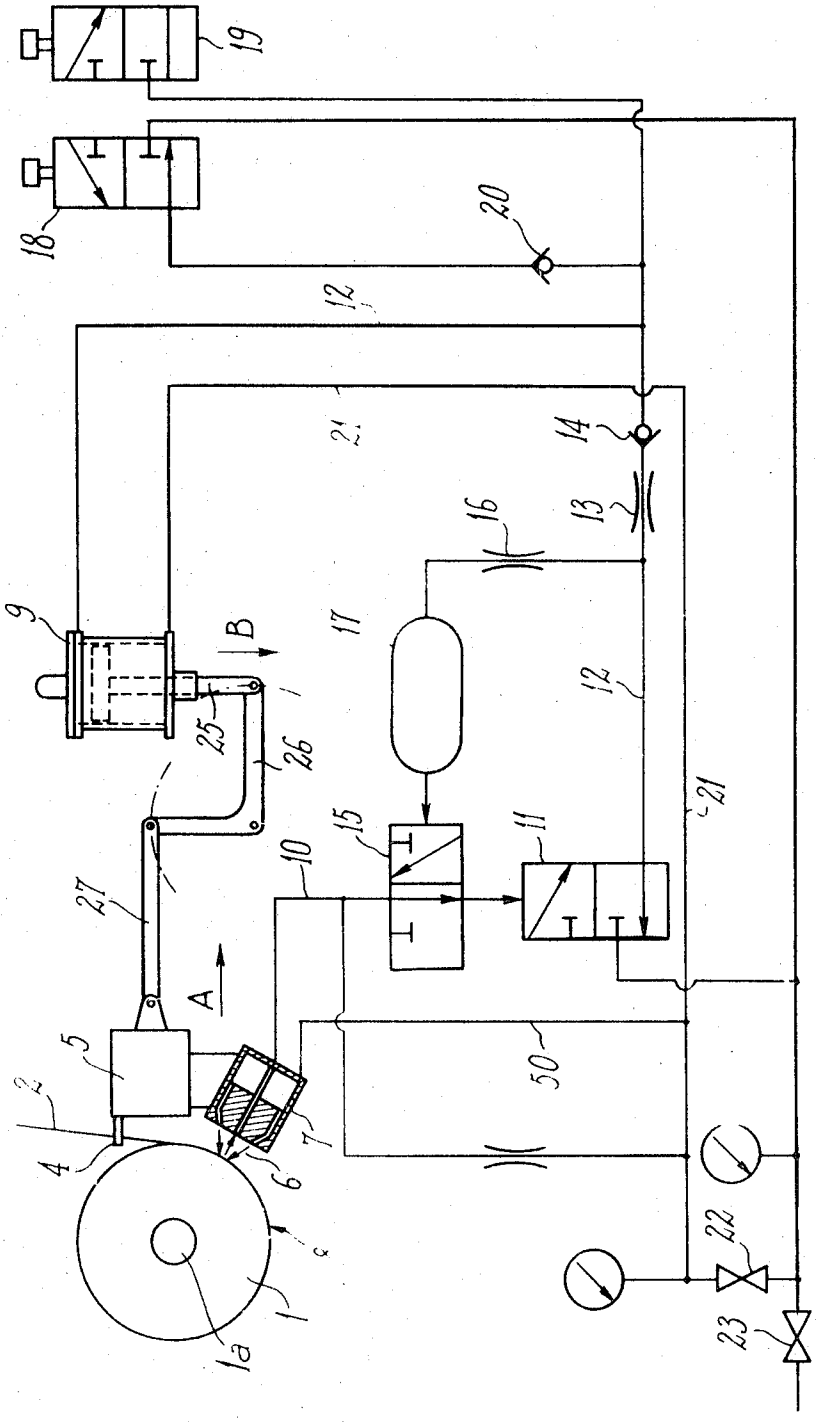

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FIG. 1

Fig. 2

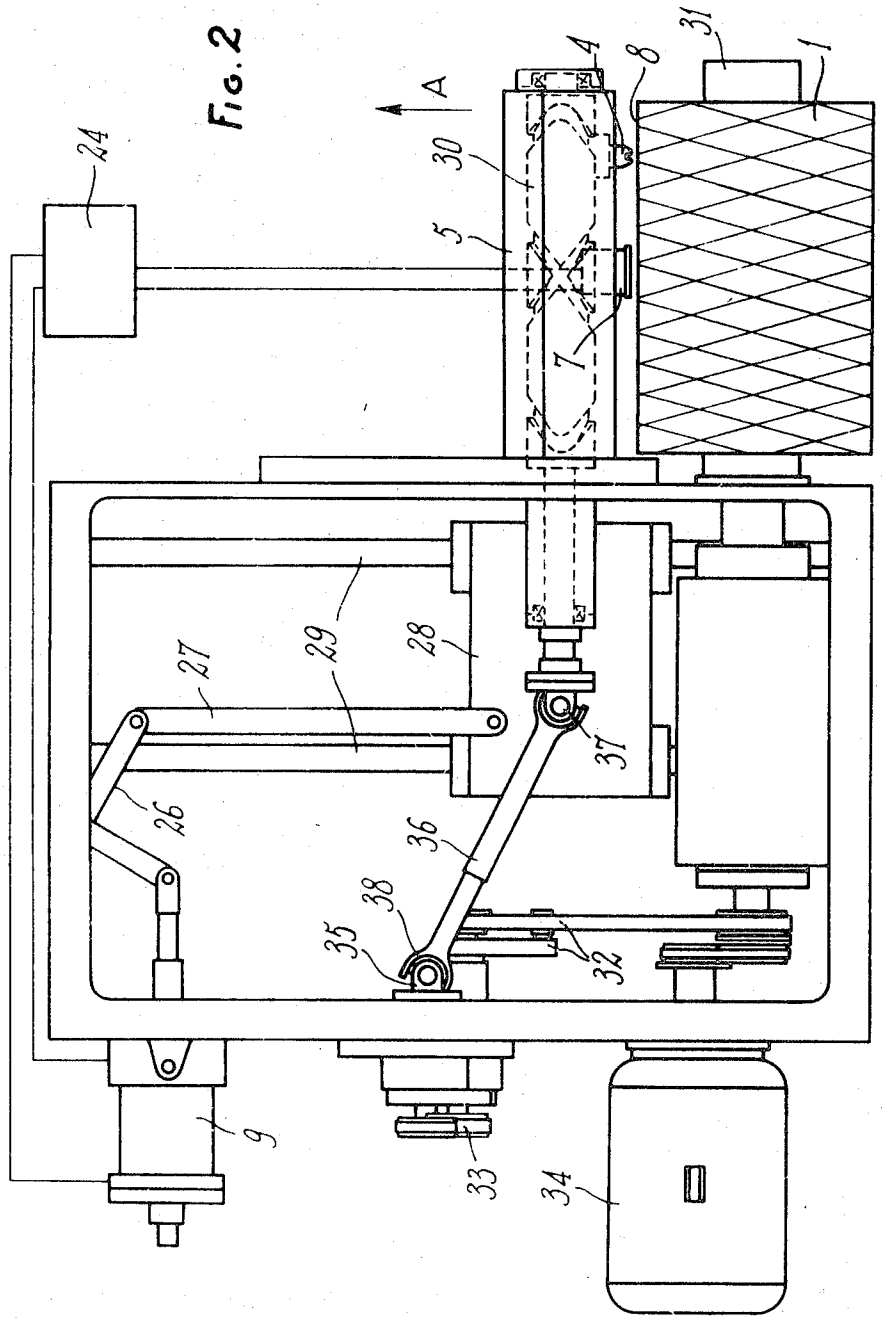


FIG. 3

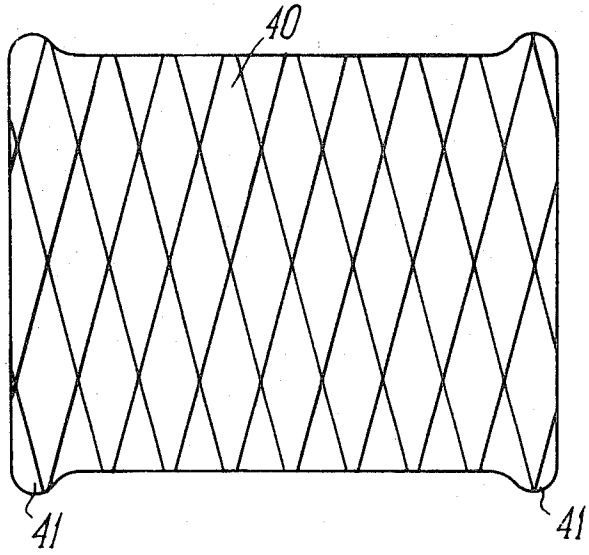
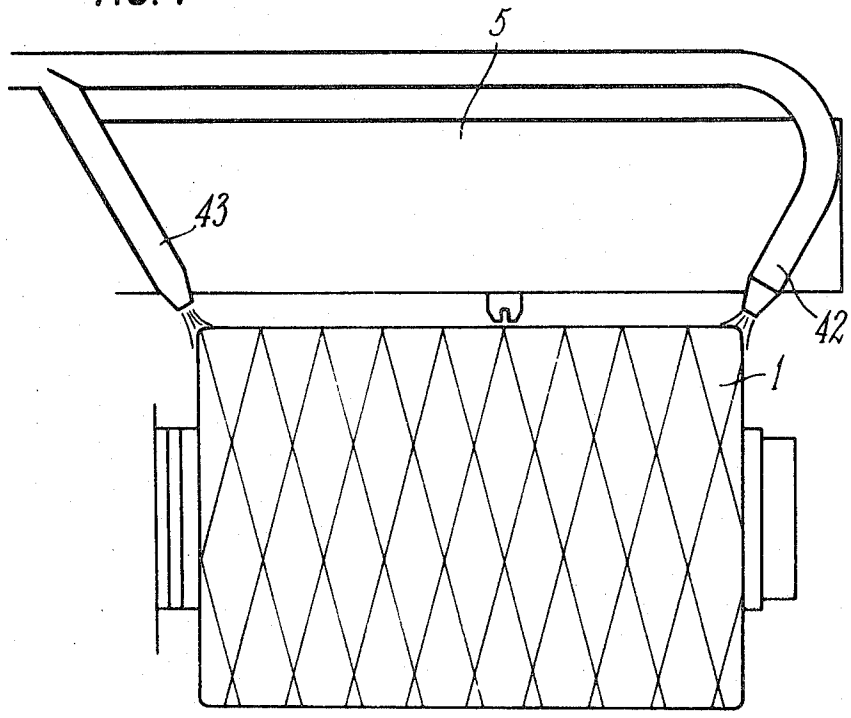


FIG. 4



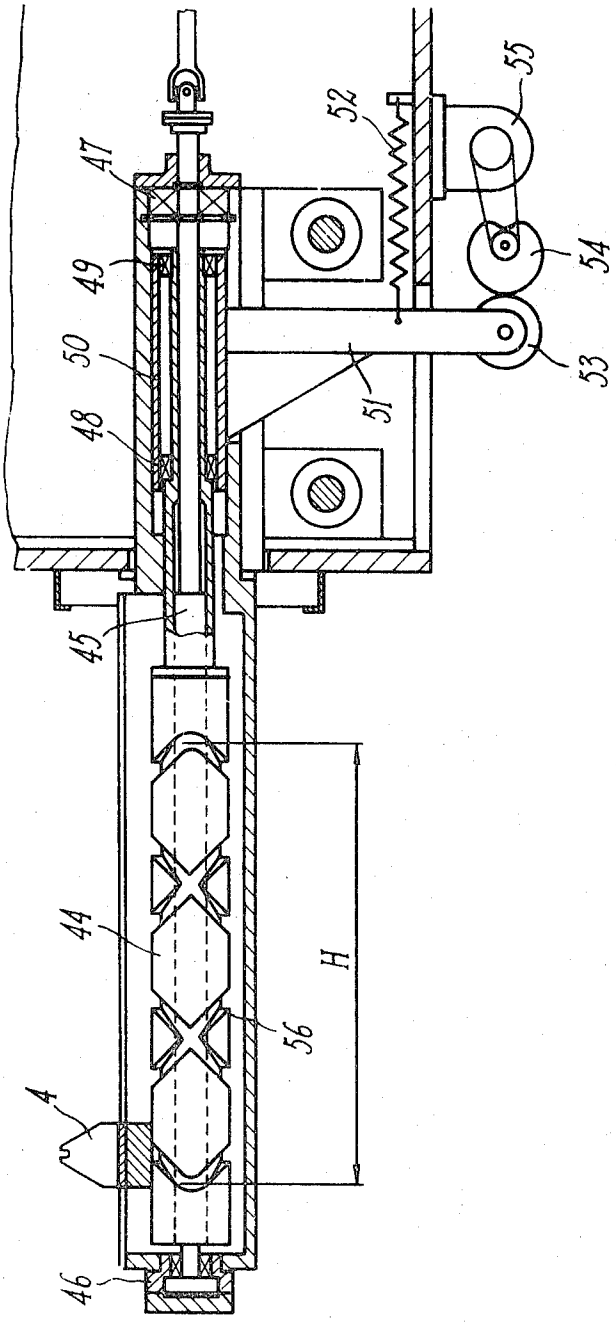


FIG. 5

PROCESS AND DEVICES FOR THE WINDING OF CONTINUOUS FIBERS-PARTICULARLY GLASS FIBERS—IN THE FORM OF BOBBINS

The present invention refers to processes for manufacturing bobbins by the winding of continuous fibers, particularly multi-filament glass strands, on a rotating sleeve, the strand being directed by means of a thread guide activated simultaneously by a traverse motion parallel to the axis of the sleeve and by a radial motion with respect to the sleeve in order to maintain constant the distance between the wound mass or bobbin and the thread guide.

In the known processes and devices, the radial motion imparted to the thread guide with respect to the surface of the wound mass is obtained by means of a mechanical device in contact with the said surface. This mechanical device generally consists of a presser or follower roller rotating with the bobbin, which gives the bobbin the desired shape at the same time that it maintains a constant distance between the thread guide and the surface of the bobbin or package.

A process is also known in which a thread guide is used which exerts a pressure on the edge of the package, thereby serving the same function as the presser roller referred to.

Although the second arrangement represents an improvement in design, the same disadvantage is found in both of the prior arrangements, because of the physical or direct contact of the follower elements with the surface of the package. This contact damages the filaments which, particularly in the case of fibers with low resistance to friction, such as mineral fibers, leads to rupturing of the unit filaments of which the strand or thread is formed, thus causing a reduction in the strength, as well as the formation of wads.

A high pressure is created between the roller and the bobbin particularly towards the sides of the latter regions where an accumulation of material is produced due to the winding process that is ordinarily used. Such a pressure causes breakage of the filaments as well as deformations thereof, so that inferior quality bobbins are obtained.

On the other hand, the high winding speeds as well as the starting up and braking of the winder leads to differences in speeds between the bobbin and the roller and to consequent friction, which causes the fibers to deteriorate.

The invention is concerned with eliminating these disadvantages.

It has as its object a process according to which a fluid stream from a pressure gauge mounted to move with the thread guide is directed towards the surface of the winding. Furthermore, by means of a fluid stream reflected from the surface of the winding, mechanism is activated to effect movement of the thread guide support, in a manner to maintain constant the distance between the surface of the winding being formed and the thread guide.

According to one feature of an arrangement for the application of this process, the stream entering the pressure gauge, after reflection from the surface of the winding, is applied to a fluid circuit controlling a fluid pressure device activating the support for the fiber-guide.

This circuit may contain in particular an amplifier, which advantageously may be of the diaphragm type, the signals leaving this amplifier being sent to the fluid pressure device activating the support for the fiber-guide.

During the functioning of the apparatus, in order to prevent the support for the fiber-guide from moving too far away from the winding surface, due to the relatively large differences between the engaging and disengaging pressures of the amplifier, the invention provides for imparting stepwise movements to the support for the thread guide.

According to one particularly advantageous type of embodiment, these stepwise movements are obtained by providing a relay valve upstream from the amplifier. This relay valve is activated by the air pressure at the outlet of the amplifier but with the intervention of a delaying circuit. This circuit may contain a throttle valve and an accumulator.

In the case where winding is accompanied by a tendency to make the ends of the winding bulge, according to another feature of the invention, provision is made for directing the jets of air onto these ends. This eliminates the bulges, the above-mentioned jets of air being produced by nozzles mounted on the support for the thread guide.

The invention also provides for accomplishing the winding operation in such a way that the winding is in the form of a honeycomb. This is especially important in eliminating the formation of bulges.

Other features and advantages of the invention will become evident from the description which follows, related to types of embodiments given by way of example.

This description is given in reference to the attached drawings in which:

FIG. 1 is a diagram of the device for activating the fiber-guide support from the pressure gauge or sensor device;

FIG. 2 is a view of the winding apparatus;

FIG. 3 is a view of a bobbin with bulges at the end;

FIG. 4 is a view of the apparatus containing jets for preventing the formation of these bulges;

FIG. 5 is a view of an alternative apparatus for driving the thread guide.

As is represented in FIG. 1, strand 2 is wound by means of a movable thread guide 4 in order to form a bobbin or reel or package 1. This thread guide is activated by a mechanism shown at 5, which contains a rotating helicoidal cam with reverse pitch cam grooves imparting a traverse motion to the thread guide. The guide moves in a path parallel to the axis of sleeve 1a on which the reel is formed. Furthermore, the mechanism for thread guide includes means providing for radial movement with respect to the bobbin as it is increasing in size during winding, this movement taking place in the direction of arrow A.

In accordance with the invention, the apparatus includes a pressure gauge 7 or sensor device supplied with pressurized air by a duct 50, having a plurality of outlet tubes directed towards surface 8 of the winding. When, due to the effect of an increase in the diameter of the winding, the surface of the winding approaches the outlet tubes, an increase in pressure is produced in the reflected jet and consequently in duct 10 which is connected to an amplifier device 11, for example of the diaphragm type. Amplifier device 11 is only diagrammatically shown as the details of its construction form no part of the present invention per se, but as is known

such devices embody a diaphragm or membrane biased in one direction but subject to the control pressure and serving to actuate the amplifier valve. Such devices are readily available commercially with appropriate threshold or operating pressure characteristics so that the duct **12** will be disconnected from the pressure supply (as shown in FIG. 1) when the reflection pressure in the sensor **7**, as delivered through the line **10** and valve **15**, drops below the shut-off threshold pressure of the amplifier. When the reflection pressure reaches the threshold value for opening the valve of the amplifier device, the supply pressure is delivered to the duct **12**. By means of a throttle valve **13** and a check valve **14**, the supply pressure is supplied to a fluid pressure device such as the compressed air cylinder **9**. Throttle valve **13** serves to regulate the flow of air so that cylinder **9** is not driven too fast.

If the signal in duct **10** is not interrupted, cylinder **9** operates to move supporting mechanism **5** for the fiberguide and pressure gauge **7**, in a direction away from surface **8** of the bobbin as indicated by arrow A, by moving rod **25** in the direction of arrow B and by means of bellcrank **26** and rod **27** attached to mechanism **5**. This movement continues until the pressure in duct **10**, due to a reduction in the air pressure reflected into the gauge **7**, reaches a value lower than that corresponding to the operating threshold of amplifier device **11**. The latter thus interrupts the supply of operating air to cylinder **9**. This causes the cylinder to stop and consequently stops the radial movement of the thread guide and of the gauge **7**.

Because of the relatively large difference between the engaging pressure and the disengaging pressure of the amplifier device, the pressure gauge and the thread guide would tend to move too far away from surface **8** of the reel after the apparatus had been operating for a while. Provision is consequently made to give the radial movement of mechanism **5** of the thread guide a stepwise motion by interrupting the signal in duct **10** by means of a relay valve **15**. The latter valve is connected to duct **12** by a delay circuit consisting of a choke or throttle valve **16** and an accumulator **17**. This circuit introduces a delayed action which may be, for example, 1 second — i.e., the action of the pressure in cylinder **9** is delayed for this interval of one second. Cylinder **9** thus only moves the mechanism for the thread guide and pressure gauge away from surface **8** of the bobbin, by one step or increment. After disengaging amplifier **11** by means of valve **15**, the operating pressure in duct **12** and thus in the accumulator is exhausted through the amplifier **11**, and as a result valve **15** being biased to open position is opened once again. Since pressure gauge **7** is moved away by one step from surface **8** of the bobbin, the pressure in duct **10** is reduced due to the decreased reflection of the air into the gauge and this in turn affects the amplifier device **11**. The latter is only reactivated when surface **8** of the bobbin again approaches gauge **7**, the apparatus functioning as just described in order to cause the drive mechanism of the thread guide and pressure gauge unit to move again by another step.

It is possible to quickly make the thread guide support **5** move from or towards bobbin **1** with the aid of two valves **18** and **19** actuated manually.

By actuating valve **18**, air from the pressure supply is brought into cylinder **9** through a check valve **20**, which has the effect of making support **5** move away from bobbin **1** at a high speed.

By actuating valve **19**, the compressed air in the upper end of cylinder **9** is discharged to atmosphere and the permanently existing pressure in duct **21** brings the piston of the cylinder back into the high position, consequently causing support **5** to draw close to bobbin **1** at a high speed.

Valves **22** and **23** serve to regulate the air pressures introduced into the system.

FIG. **2** shows one embodiment of a winder for obtaining precision crossed bobbin winding in which the support for thread guide moves radially away from spindle **31** as the thickness of the winding increases by means of the device just described. Device **24** receives a signal from pressure gauge **7** if surface **8** of the bobbin is approaching the gauge. Device **24** thus activates cylinder **9** which, by means of bellcrank **26** and rod **27**, moves the thread guide support **5** in direction A. The support **5** for the thread guide is mounted on a carriage **28** which may slide on two guide bars **29**.

The support for the thread guide contains a rotating helicoidal cam **30** with reverse pitch cam grooves which provide the traverse motion of thread guide **4**, the strand being distributed in turns on the sleeve mounted on spindle **31**. This distribution is determined by the transmission ratio provided by belts **32** and gears **33** between motor **34** and drive shaft **35** of spindle **31**. A telescopic shaft **36**, mounted by means of universal joints **37** and **38**, makes it possible to transmit movement to the support for the thread guide despite the radial movements of the fiberguide support.

The apparatus for driving the support for the thread guide may be set up — by using a suitable transmission ratio — in such a way as to obtain bobbins wound in a honeycomb fashion, i.e., providing channels extending more or less radially through the body of the bobbins as a result of the traverse guide applying spaced turns of fibers in each layer applied as the bobbins are built up during the winding operation.

Examples related to the obtaining of honeycomb type windings, using strands of different diameters, are given below.

TABLE I

Strand	I-68 tex	II-300 tex	III-600 tex	IV-2400 tex
Drawing speed in m/sec	31	25	25	20
Intercrossing ratio	1:8.46	1:8.38	1:8.44	1:8.36
Dimensions of the bobbin in mm				
diameter of the full bobbin *D*	205	245	245	245
diameter of the spindle *d*	144	144	144	144
length of the bobbin *L*	340	340	340	340
Traverse at the beginning of the winding per min.	483	398	392	317

TABLE I—Continued

Strand	I-68 tex	II-300 tex	III-600 tex	IV-2400 tex
Curved channels deviation	5.8°	11.7°	11.7°	11.7°
Dimensions of the channels (width of the strand = 0)				
On the spindle	1.6 × 9.0	2.8 × 15.6	3.2 × 18.1	5.8 × 32.3
At the surface	1.6 × 12.9	2.8 × 26.6	3.2 × 30.8	5.8 × 55.0
Width of the strand (mm)	1	2	3	4.5
Dimensions of the channels				
On the spindle	0.65 × 3.2	0.75 × 5.1	0.25 × 1.3	1.2 × 6.7
At the surface	0.65 × 4.8	0.75 × 7.6	0.25 × 2.2	1.2 × 12.5

FIG. 3 illustrates a bobbin **40** which has bulges **41** at the ends. These bulges appear if so-called "open-point diamond" or "closed-point diamond" windings are wound without using a presser roller. When choosing the honeycomb type winding, these bulges do not exist even when working without a presser roller.

In the case where the winding apparatus tends to produce bobbins containing bulges, the formation of these bulges can be avoided by blowing air onto the ends (FIG. 4). The air flows from nozzles **42** and **43** onto the ends of bobbin **1** and compresses the wound material. The air pressure must be adjusted to the material making up the fibers or strands to be wound. The two nozzles **42** and **43** are mounted on the thread guide support in a manner to follow its radial movements when the diameter of bobbin **1** increases. The distance of nozzles **42** and **43** from the ends of reel **1** thus remains constant.

FIG. **5** shows an alternative apparatus giving thread guide **4** an additional course or motion. This additional course of **1** to **10** mm, according to the nature of the material making up the fibers to be wound, also prevents the creation of bulges at the ends of the bobbin, without the need for a presser roller. FIG. **5** illustrates the mechanism in an inverted position as compared with FIG. **2.**

A helicoidal cam **44** with reverse pitch cam grooves is mounted on shaft **45** by any suitable known means providing for axial movement on shaft **45,** but without rotating around this shaft. Shaft **45** turns in bearings **46** and **47.** Bearings **48** and **49** are mounted on the helicoidal cam **44.** These bearings support box **50** to which arm **51** is attached. A tension spring **52** urges roller **53** - mounted in a rotating fashion on arm **51** - against eccentric **54.** This eccentric is driven at a slow speed by motor and gear reducer **55** and gives a traverse movement to the helicoidal cam **44** on shaft **45.** The thread guide thus has an additional motion corresponding to the motion of the eccentric, this motion being added to motion H of helicoidal groove **56** of the helicoidal cam **44.**

We claim:

1. Apparatus for winding continuous fibers, especially glass fibers, on a rotating sleeve, comprising a thread guide having a support and means providing for traverse motion of the guide in a direction parallel to the axis of the sleeve, the guide support being mounted for motion in a direction toward and away from the surface of the winding being applied to the sleeve, and mechanism for effecting such motion of the support and thus of the thread guide toward and away from the surface of the winding including a fluid pressure operable device, a fluid pressure gauge mounted to move with the support and having means for directing a fluid jet against the surface of the winding of the sleeve and means for sensing jet fluid reflected from the surface of the winding, and fluid pressure means responsive to reflected jet fluid as sensed by said gauge for delivering actuating fluid to said device to effect motion of the fiber guide support.

2. Apparatus according to claim **2,** characterized by the fact that the mechanism for effecting motion of the fiberguide support includes means for imparting stepwise motion to the support.

3. Apparatus according to claim **2,** characterized by the fact the means providing stepwise motion of the fiberguide support includes a relay valve upstream from the amplifier activated by a fluid pressure circuit responsive to the air pressure at the outlet of the amplifier, and a time delay device in said circuit.

4. Apparatus according to claim **3,** characterized by the fact that the time delay device consists of a check valve and an accumulator.

5. Device according to claim **1,** and further including air jets nozzles mounted on the thread guide support and directed against the end portions of the winding being built up.

6. Apparatus according to claim **1,** characterized by the fact that the mechanism for effecting traverse motion of the fiber guide includes a helicoidal cam with reverse pitch cam grooves.

7. Apparatus for winding continuous fibers, especially glass fibers, on a rotating sleeve, comprising a thread guide having a support and means providing for traverse motion of the guide in a direction parallel to the axis of the sleeve, the guide support being mounted for motion in a direction toward and away from the sleeve, and mechanism for effecting such motion of the support and thus of the fiber guide toward and away from the sleeve including means for directing a fluid jet against the surface of the windings and providing for reflection of jet fluid from said surface, a fluid sensitive sensor device positioned to receive reflected jet fluid, and means activated by the reflected jet fluid as sensed by said sensor device for moving the thread guide support and thus the thread guide in a direction away from the sleeve.

8. In the operation of winding continuous, especially glass fibers, on a rotating sleeve by means of a traverse guide providing for build up of a bobbin having a multiplicity of layers of wound turns, the method which comprises the steps of directing a fluid jet against the layers of turns of the bobbin to provide for reflection of a stream of jet fluid from said layers, sensing the strength of the reflected stream, and shifting the position of the traverse guide in a radial direction with respect to the rotating sleeve in accordance with variations of the strength of said reflected stream of jet fluid.

9. A method according to claim **8** in which the shifting of the guide is effected stepwise periodically in accordance with said variations of the reflected stream of jet fluid.

10. Apparatus according to claim **1** in which the fluid pressure means comprises a fluid pressure amplifier with its input connected with the means for measuring the reflected jet fluid and with its output connected with the fluid pressure operable device of the mechanism for effecting motions of the guide support.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,845,912 Dated November 5, 1974

Inventor(s) Winifried Paul Eichmanns et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 6, Line 14, after "claim" change "2" to --1--.

Signed and sealed this 11th day of March 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks