United States Patent [19]

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[11] **3,852,141**

[45] **Dec. 3, 1974**

[54] **STRAND CLAMPING APPARATUS FOR AUTOMATIC KNOCK OFF SYSTEM**

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[73] Assignee: **PPG Industries, Inc.**, Pittsburgh, Pa.

[22] Filed: **Dec. 11, 1972**

[21] Appl. No.: **313,911**

[52] **U.S. Cl.**..... **156/351,** 57/7, 57/19, 57/81, 118/6, 156/352, 156/361, 156/441, 242/37 R, 242/49

[51] **Int. Cl.**.. **B23b 31/00,** B65h 63/02, B05c 11/00

[58] **Field of Search** ..... 156/161, 162, 166, 167, 156/352, 361–362, 368, 441; 65/2, 3, 4; 57/7, 19, 58.7, 78, 80, 81, 83, 90, 157 R, 164; 242/37, 49; 118/4, 10, 6, 420

[56] **References Cited**

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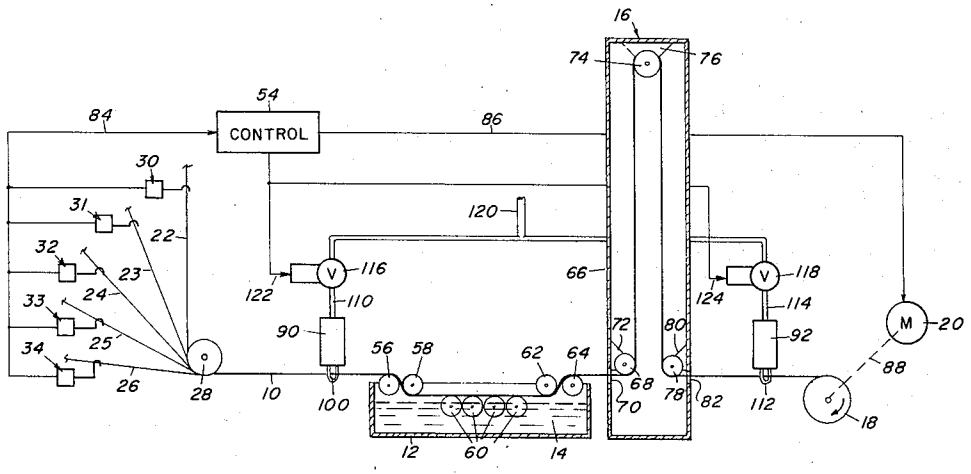
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Primary Examiner—Douglas J. Drummond
Assistant Examiner—David A. Simmons
Attorney, Agent, or Firm—John E. Curley

[57] **ABSTRACT**

An automatic knock-off system for use in a fiber glass filament coating process to stop and hold a strand, made up of a plurality of filaments, whenever a single filament breaks, or when the package being wound becomes full. The system includes a sensor element responsive to the end of a filament or to its breakage for operating a strand holding mechanism and for shutting down the strand winder.

11 Claims, 4 Drawing Figures



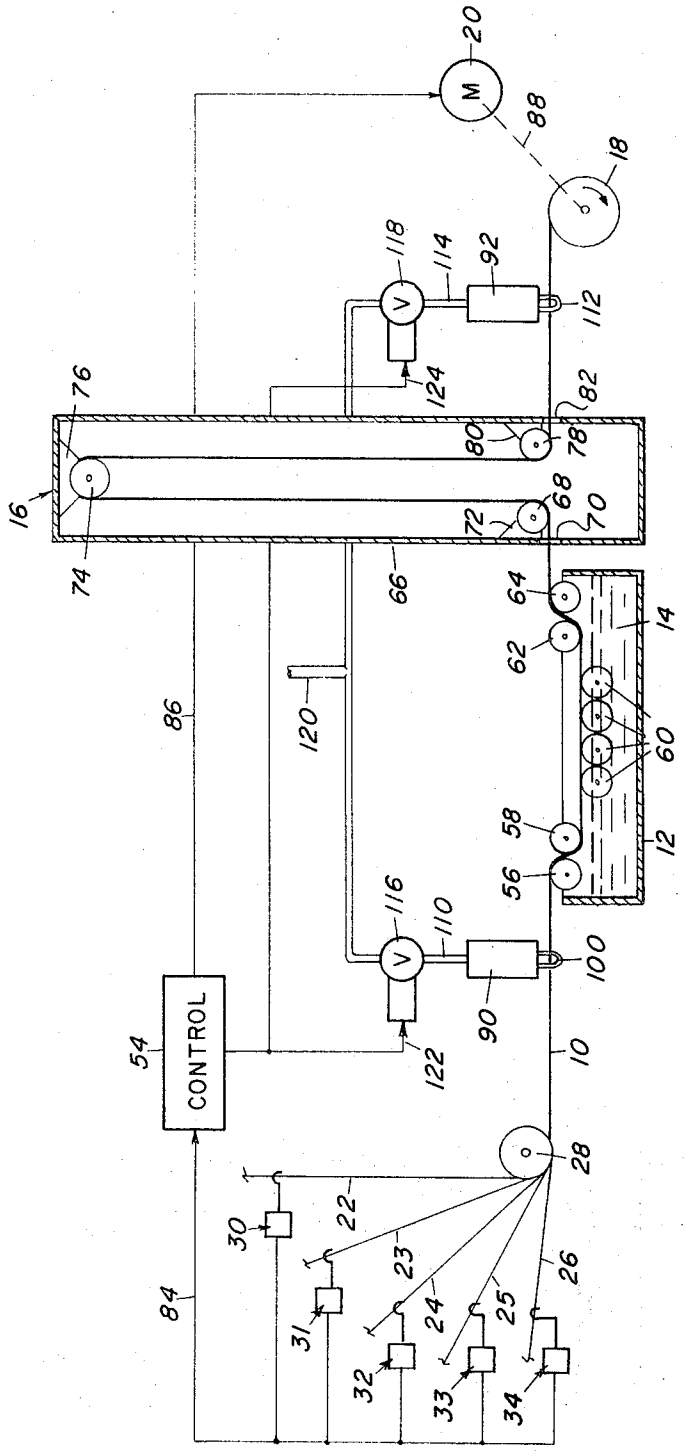

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FIG. 1

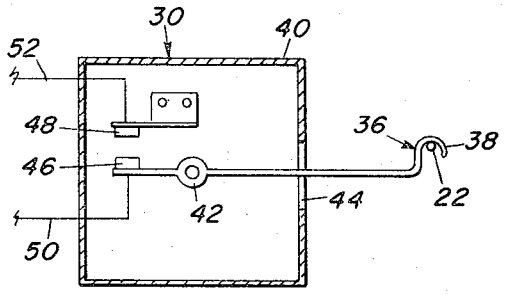


FIG. 2

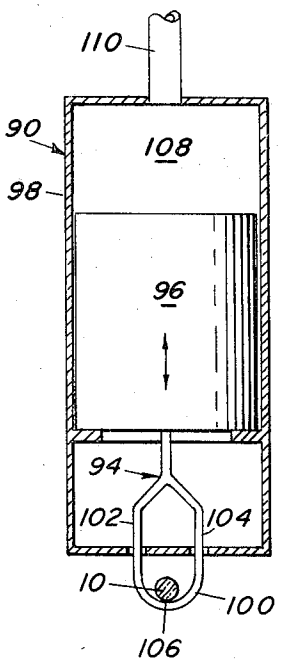


FIG. 3

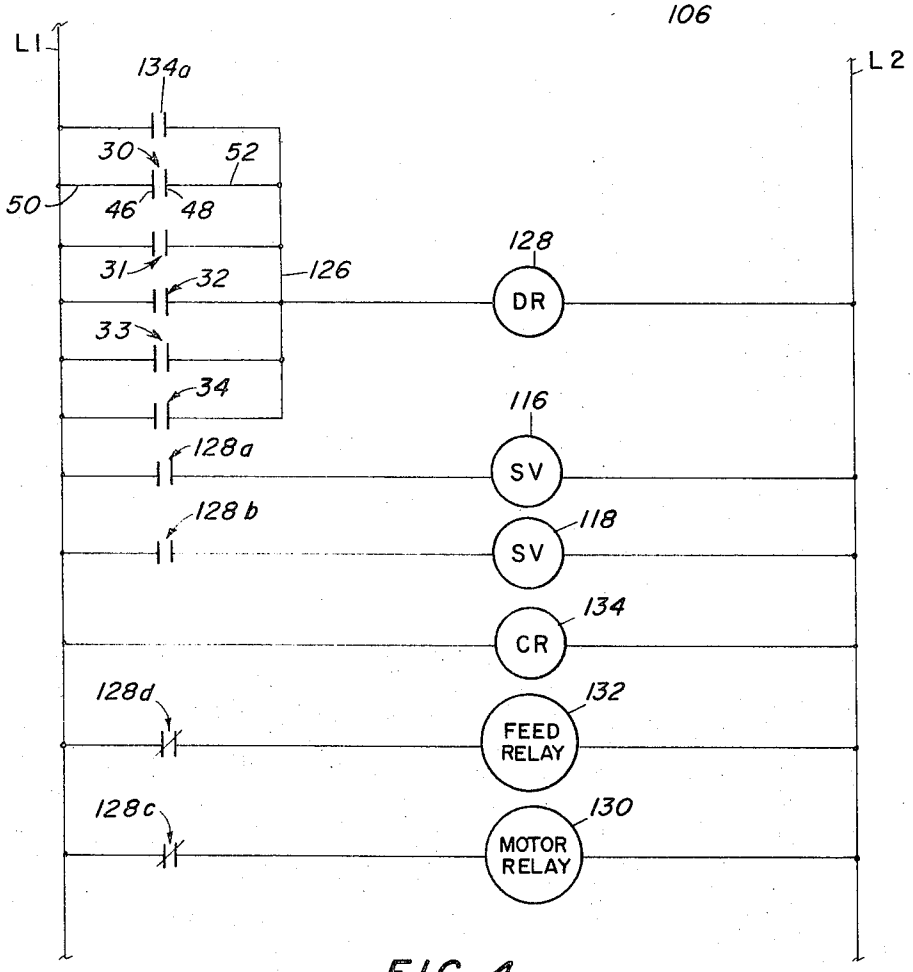


FIG. 4

STRAND CLAMPING APPARATUS FOR AUTOMATIC KNOCK OFF SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates, in general, to a glass fiber coating system, and more particularly to a mechanism for stopping a coating operation and grasping the ends of the strand at each side of the coating appartaus when the end of one of the filaments making up the strand is sensed.

In a glass fiber coating process, a strand of fibers is made up from a plurality of individual filaments which are then fed into a coating tank where, for example, a latex coating is placed on the strand. The strand is fed into an oven for curing the latex, and is then wound on a mandrel. It is important that the strand be of high quality throughout its length in order to insure a commercially saleable product, and this means that the strand must have a full count when it is wound on the mandrel. If some of the fibers are missing for a part of the run, the package of coated strand is not of acceptable quality, and must be discarded.

Accordingly, to insure a high quality end product, the present invention contemplates the provision of a sensing means which is responsive to filament or strand breakage to stop the winding mandrel, and thereby prevent the broken end from being pulled onto the package. However, merely stopping the winding mandrel in a coating apparatus of the present type creates other problems, for in such systems the coated filaments are fed through a drying oven by way of a of pulleys. These pulleys guide the strand into and through the oven, following vertical paths within the oven to assure thorough curing of the coating. If the breakage of a filament in the strand merely causes the mandrel to stop, the strand then is left hanging loosley within the oven, where it can get tangled in the pulleys or brush against electrical heating elements to cause a short circuit, and such problems can necessitate shutting down the oven and halting production on all of the strands being cured in parallel adjacent paths through the oven. Simularly, the loosened strands can get tangled in the coating rollers which serve to apply the latex to the strands prior to their entry into the oven.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide means for sensing glass fiber strand breakage in a strand coating appartaus.

It is another object of the invention to provide means for sensing the breakage of a fiber glass strand, and for quickly and accurately halting the movement of the strand through a coating apparatus in order to prevent tangling of the strand in the coating apparatus and to maintain a high quality strand.

It is still another object of the invention to provide means responsive to the sensing of a broken filament or strand to grasp and hold the strand on each side of the oven and coating tank assembly, whereby the strand is held taut, and arcing within the oven and tangling of the strand in the guide pulleys and coating rollers is avoided.

Briefly, the knock off system of the present invention comprises a plurality of sensors adapted to detect any breakage in one or more of the filaments that make up the strand that is to be fed through the coating apparatus and the drying oven. The sensor may take many forms, but in the illustrated embodiment of the present invention comprises a mechanically operated microswitch having a lever arm which contacts the filament as it is fed into the strand. The presence of the filament holds the arm up and keeps the switch open. When the filament breaks or ends, the lever arm for the sensor falls, and closes the microswitch, activating a control mechanism for the filament handling system.

The control for the system of the present invention includes, in addition to the usual controls for fiber coating, drying and winding systems, at least two solenoid-operated strand holders, means for turning off the mandrel, or winder, motor, and means for disabling the filament feed mechanism which feeds the filaments to the coating apparatus. The solenoid strand holders are located on opposite sides of the coating and drying apparatus, and are activated by closure of the sensor microswitch to immediately grasp and hold the strand so that it remains taut in the coating and drying apparatus, and will not present problem of tangling or short-circuiting. In the preferred embodiment disclosed herein, each strand holder comprises a pneumatically operated mechanical gripping mechanism which, when activated, pulls the strand up against the holder housing to secure it against movement. One such holder is located prior to the coating dip tank, and the other located after the drying oven along the path of the strand.

Although the strand holders are primarily designed to prevent tangling and short circuit problems and to prevent a short filament count in the strand being wound on a package when a filament breaks, they are also useful in preventing similar problems when a package is full and the mandrel must be stopped to permit doffing of the package. Thus the holder solenoids may also be sensitive to a count relay which is activated when a preselected length of strand has been wrapped on the package. Similarly, the holders may be activated by other sensing mechanisms, if desired, to stop the strand in response to various selected conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and additional objects, features, and advantages of the present invention will become evident from a consideration of the following detailed description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a diagrammatic illustration of the automatic knock off system of the present invention;

FIG. **2** is a sectional view of a sensor switch suitable for use in the system of FIG. **1**;

FIG. **3** is a sectional view of a strand holder suitable for use in the system of FIG. **1**; and

FIG. **4** is a partial schematic diagram of the control circuitry for the system of FIG. **1**.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the diagrammatic illustration of the present invention set forth in FIG. **1**, there is shown a strand **10** being fed through a conventional coating apparatus which may include a dip tank **12** for applying a liquid coating of a latex material **14** to the strand and a drying oven **16** for curing the latex or other coating. The strand is fed from the oven to a suitable package forming device

such as a collect or mandrel **18** driven by a winder motor **20.**

Strand **10** is formed, conventionally, from a plurality of filaments; in this case five filaments **22 – 26** are illustrated as being fed to a common guide roll **28** which combines the filaments and directs the resulting single, unitary strand **10** into the coating apparatus. The filaments **22 – 26** may be unwound from corresponding packages of filaments, may be pulled directly from a glass fiber forming bushing, or, as is preferred here, may themselves be formed from the combination of a plurality of fibers. In a preferred strand construction, each of the five filaments **22 – 26** is made up of at least five fibers drawn from a fiber-forming bushing, so that strand **10** is comprised of 25 fibers.

The filaments **22 – 26** are drawn through the coating apparatus under a controlled amount of tension, but because of that tension, and other reasons known in the art, are subject to breakage. When a break occurs in one of the filaments, the fiber count in strand **10** is substantially reduced, and such a strand is not commercially acceptable. If such a breakage goes undetected, the reduced count strand is coated and wound on the package. It then becomes difficult to determine exactly how much of the package is made up of a low-count strand, and it often becomes necessary to discard the package.

To avoid this problem, the present invention utilizes a plurality of sensors **30 – 34** each of which is responsive to the breakage of a corresponding one of the filaments **22 – 26.** It will be apparent that these sensors are responsive to any ending of filament continuity, not only breakage, and thus will also operate, for example, when the filament is being unwound from a package and the package has been depleted.

An example of such a filament sensor is illustrated in FIG. **2,** wherein sensor **30** is shown to have a sensing lever arm **36** in contact with and lightly resting on filament **22.** The filament is pulled through a hook or loop portion **38** of the lever arm, and holds the arm in an up position which allows the strand to be coated and wound in the normal manner. Any break in the continuity of the filament, however, causes the lever arm to fall to its down position to activate the knock-off system controls and to prevent the strand from being pulled through the coating apparatus. The up position of the lever arm may thus be considered to be an enabling position of the switch, while the down position of the lever arm provides a disabling signal.

For purposes of illustration, level arm **36** is shown to be pivotally mounted to the sensor housing **40** by means of pivot **42,** the lever arm extending through an opening **44** in the housing. The lever arm extends beyond pivot point **42** and carries within the housing a movable contact **46** which is adapted to make electrical connection with a second, fixed contact **48** secured to the housing when the lever arm is moved. The contacts **46** and **48** may be the contacts of a conventional microswitch, and are responsive to the motion of lever arm **36** to open or close an electrical circuit which includes leads **50** and **52,** respectively. In the illustration, the switch contacts are shown as being open when the lever arm is in the up position, thus enabling the strand **10** to be pulled through coater **12** and oven **16,** and as being closed when the lever arm drops down to signal a break in the filament, thereby disabling the strand winding mechanism. It will be apparent, however, that the operation of these contacts may be reversed, if desired, so that the contacts are closed when the lever arm **36** is being held up by filament **22** and are opened when the arm falls, such variations being within the skill of the art.

Each of the sensors **31 – 34** are similar to sensor **30,** with all being electrically connected to a control circuit **54** diagrammatically illustrated in FIG. **1.** This control circuit, which will be further explained hereinbelow, responds to the condition of the sensors to regulate the motion of the strand through the coating apparatus. When all of the sensors are in their enabling condition, drive motor **20** is operable to draw the strand through the system by winding it on the package carried by mandrel **18.**

The strand **10** is guided into the coating dip tank **12** by means of a pair of guide rollers **56** and **58** which serve to carry the strand down into the tank and into contact with the upper surfaces of a plurality of coating rollers **60.** These rollers serve as wipers, and are mounted in the tank in such a manner that the bottom portion of each roller dips into the liquid coating material **14,** and are rotatably driven so as to carry a film of the coating to the top of the roller where the coating material is transferred to the filament as it is drawn along the tops of the rollers. At the end of the coating process the strand is fed out of the tank by way of guide rollers **62** and **64,** and thence to oven **16.**

The oven is of conventional construction, having a housing **66** in which is mounted a first lower guide roller **68** positioned to guide the strand **10** into the interior of the oven housing through inlet opening **70.** The pulley may be mounted within the housing in any suitable manner, as by means of a bearing block **72** secured to the interior surface of the oven. In similar manner an upper guide pulley **74** is secured in the upper portion of the oven by means of bearing block **76** and a second lower guide pully **78** is secured in the housing by means of bearing block **80** near the exit opening **82.** The strand thus passes into the oven through inlet **70,** is fed around guide pulley **72** and upwardly in a first vertical run to guide pulley **74,** and passes downwardly from pulley **74** in a second vertical run to guide pulley **78,** from which it is fed out of the oven by way of outlet **82.** The coating placed on strand **10** by the coating tank **12** is cured in the oven by means, for example, of electrical heating elements.

As alluded to earlier, the actuation of any one of the sensor switches **30 – 34** by a discontinuity in a corresponding one of filaments **22 – 26** will close the sensor switch contacts, providing a control signal which is applied by way of line **84** to the controller **54.** The controller then provides a control signal through line **86** (FIG. **1**) to motor **20,** shutting down the motor and stopping winder **18,** which may be connected to the motor by way of a shaft or other mechanical drive **88.**

The deenergization of motor **20** by control **54** prevents further winding of the strand, and thus prevents the winder from pulling a short-count strand through the coating and drying apparatus. However, as has been explained, this stopping of the winder motor **20** can create other problems in the system, for the loose end of strand, or of one of the filaments making up the strand, can be pulled into the driven rollers **60,** where it can become tangled in the rollers, or it can cause arcing in oven **16.** To overcome this problem, first and sec-

ond strand holders, or clamps, indicated at **90** and **92** in FIG. **1**, are provided, the first being located between guide roller **28** and dip tank **12**, and the second being located between the outlet from oven **16** and the package on the mandrel **18**.

A typical strand clamp **90** is illustrated in FIG. **3**, wherein it is shown as having a clamp arm **94** secured at one end to the bottom of a piston **96** movable within housing **98**. The strand clamp arm **94** includes a strand gripping loop **100** having two vertical arms **102** and **104** extending out of corresponding openings in housing **98**, and a generally horizontal arm **106** extending between arms **102** and **104** to close the loop and to receive the strand in such a way as normally to insure its free lengthwise movement. The upper end of housing **98** forms a vacuum chamber **108** to which is connected a vacuum line **110** so controlled as to draw a vacuum when piston **96** is to be pulled up toward the top of chamber **108**. It will be apparent that when a vacuum is applied to chamber **108**, piston **96** is drawn up, pulling the clamp arm **94** and gripping loop **100** up into the lower part of housing **98** until the arm **106** strikes the bottom wall **112** of the housing. When strand **10** has been threaded through the loop, this motion will clamp the strand between the loop and the housing wall and grip it tightly until the vacuum is released.

It will be understood that strand holder **92** is constructed in a manner similar to holder **90**, and thus is provided with a strand loop **112** which is adapted to receive strand **10**, and to draw the strand up against the bottom wall of the holder housing upon application of a vacuum to the holder by way of vacuum line **114**.

The operation of strand holders **90** and **92** is regulated by solenoid-controlled valves **116** and **118** located in vacuum lines **110** and **114**, respectively. These valves are normally biased closed to cut off lines **110** and **114** from a source of vacuum such as line **120**, whereby strand clamp loops **100** and **112** normally permit the strand **10** to move freely through the coating and drying apparatus. The solenoid valves, however, are operated by the control **54** which upon occurrence of a disable signal from any one of the sensors **30 – 34** will be energized to turn off motor **20**, as explained above, and also to apply a control signal by way of lines **122** and **124** to open both of the solenoid valves **116** and **118**. This immediately pulls up the loops **100** and **112**, clamping the strand at both ends of the coating apparatus and insuring that the strand will remain taut within this apparatus even during a shut-down condition, thereby avoiding the problems created by a loose strand or filament, as set out above.

The manner in which the control circuit operates is illustrated in part in FIG. **4**, it being understood that the illustrated circuitry shows only that portion of the full control network for a coating apparatus which relates to the automatic knock off mechanism of the present invention. As shown, power is supplied to the control circuitry by way of lines L1 and L2. The several filament sensors **30 – 34** have their electrical contacts connected in parallel with eachother between line L1 and a common line **126**, with a relay coil **128** being connected between line **126** and power supply line L2. The relay coil thus is connected to be energized by closure of one of the sensor switches and thus performs the main control function of the automatic knock off system. Coil **128** thus may be referred to as a disabling relay since it responds to a signal from any one of the sensors to disable the motor **20** and activate the strand clamps. As illustrated in FIG. **4**, those functions may be accomplished by means of suitable relay contacts in the control lines of the motor and strand clamps. Thus, relay **128** has a normally open contact **128*a*** connected in series with the solenoid coil of solenoid valve **116** and a normally open contact **128*b*** in series with the coil of solenoid valve **118**, these two valves and their respective contacts being connected across lines L1 and L2.

A normally closed contact **128*c*** is connected in series with a motor relay coil **130** across lines L1 and L2, the motor relay being normally energized to permit operation of motor **20**. Upon energization of coil **128**, relay contact **128*c*** open to disable the motor relay **130** and thus motor **20**. In similar manner, contacts **128*d*** may be connected in series with a feed mechanism relay **132** across lines L1 and L2, where such a relay is appropriate to effect control of a filament feeder. Such a feeder may be provided to drive the guide roller **28**, the coating rollers **60**, or the like, if desired; the relay contacts **128*d*** serve to disable this feeder.

As has been noted, it is desirable to operate the strand holders and stop motor **20** not only when a filament breaks, but in response to other selected conditions as well. The manner in which such control can be effected is illustrated by a counter relay **134** connected across lines L1 and L2 and responsive to, for example, the number of rotations of the package winding mandrel **18**. Since it is known how many turns of strand are to be wrapped on the mandrel to form a full package, a counter relay can be utilized to operate a corresponding contact **134*a*** when the package is full. This contact may be connected in series with disabling relay **128**, and is parallel with the sensors **30 – 34**, to operate the disabling relay upon occurence of a full package, thereby stopping the winder motor **20** and pulling up the strand clamps **90** and **92**. Additional controls and appropriate signal lights may be provided in accordance with known procedures.

Thus there has been provided an automatic system for knocking off a package winder and clamping the strand ends in a strand coating apparatus upon occurrence of a predetermined condition; i.e., upon occurrence of a discontunity in one of the filaments making up the strand or upon occurrence of a full package. Although the present invention has been illustrated in terms of a preferred embodiment thereof it will be apparent that numerous modifications can be made without departing from the basic concept disclosed herein. For example, it will be understood that although a single strand is shown passing through the coating and drying apparatus, it should be understood that in reality a large number of strands may be similarly treated and controlled at spaced stations along the length of an elongated coating tank and a corresponding curing oven. Each station will be individually controlled in the manner described hereinabove, so that the breakage of a single strand or the completion of a single package will not require shutting down of all the stations in the installation. It will also be understood that the operations of the various sensors and switches can be modified so that switches shown as normally open are normally closed, and vice-versa, with appropriate circuit modifications, and that the vacuum-operated strand clamp may be operated instead by air pressure. Further, the strand clamp may be operated directly by

means of solenoids, if desired, instead of by air pressure or vacuum. These and other changes may be made by those skilled in the art without departing from the time spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. In an automatic knock-off system for use with a fiber glass coating apparatus,

a source of supply for a plurality of glass filaments,

means for forming said plurality of filaments into a single strand,

means for feeding said single strand through said coating apparatus,

motor driven winder means for wrapping said single strand onto a package after the single strand has been coated,

clamp means responsive to a discontinuity in any one of said plurality of filaments for grasping said single strand on both sides of said coating apparatus to thereby hold said single strand taut in said apparatus, said clamp means including first and second strand holders, said strand holders being actuable sustantially simultaneously to grasp said strand and each including therein mechanically movable strand gripping means around said single strand and biased to allow free movement of said single strand and actuator means for said clamp means for moving each said strand gripping means into contact with said single strand to grasp and hold said strand.

2. The system of claim **1,** wherein said strand gripping means includes a loop passing around said strand.

3. The system of claim **1,** wherein said actuator means comprises a pneumatic cylinder having a movable piston, said strand gripping means being connected to said piston for movement therewith.

4. The system of claim **3,** wherein said actuator means further comprises pneumatic means for moving said piston in said pneumatic cylinder, and valve means for regulating said pneumatic means.

5. The system of claim **4,** wherein said valve means is a solenoid-operated valve operable in response to a discontinuity in any one of said filaments

6. The system of claim **5,** further including sensor means for each said filament, each said sensor means being responsive to a discontinuity in a corresponding filament to actuate said solenoid-operated valve.

7. The system of claim **6,** further including control means responsive to all of said sensors, said control means including first electrical switch means for energizing said solenoid-operated valve.

8. The system of claim **7,** wherein said control means further includes means for stopping said motor-driven winder whenever said clamp means is actuated.

9. The system of claim **8,** wherein said control means includes relay means energizable in response to operation of each of said sensors to operate said first electrical switch means.

10. The system of claim **9,** wherein said control means incudes second electrical switch means responsive to said relay means for operating said motor-driven winder.

11. The system of claim **10** wherein said first strand holder is located on said single strand prior to said coating apparatus, and said second strand holder is located on said single strand following said coating apparatus.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,852,141 Dated December 3, 1974

Inventor(s) Christopher G. Cross

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

Column 1, line 32, after "by way of a" insert --plurality--

Column 2, line 22, "problem" should be --problems--

Column 2, line 28, after "other" insert --is--

Column 3, line 50, "level" should be --lever--

Column7, line 23, "sustantially" should be --substantially--

Signed and sealed this 18th day of February 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

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