PULLER SLIP ALARM AND SAFETY DEVICE
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Filed Mar. 10, 1967, Ser. No. 622,257
Int. Cl. B29g 2/00; F16p 7/02
U.S. Cl. 18—4

9 Claims

ABSTRACT OF THE DISCLOSURE

First and second spaced apart counter rotating hubs are actuated respectively by a wheel engaging the article and another wheel engaging the article extracting mechanism of a filament winding machine. A sprocket wheel disposed between the counter rotating hubs supports a plurality of balls, restrained by opposed grooves in the hubs, whereby the sprocket wheel is stationary as long as the hubs counter rotate at the same speed. When one hub rotates faster than the other because of slippage between the extracting mechanism and the article, the sprocket wheel then rotates. A microswitch engaging the sprocket wheel is then actuated, whereupon an alarm signal is activated.

Background of the invention

This invention relates to equipment for producing filament reinforced resin articles and, more particularly, to an alarm and safety control device for such equipment.

Apparatus and a method for making continuous lengths of elongate filament reinforced thermostetting plastic articles, such as pipe, rods, or angularly shaped structural members, are disclosed in my prior Patent 3,235,429. The method of the patent involves basically, pulling on the finished continuous elongate product to advance elementary resin-impregnated filamentary materials through the die wherein the product is formed. It is apparent that the production of continuous, uniform, elongate articles depends upon the coordinated operation of all elements of the apparatus. That is, the rate at which raw material is fed into the apparatus depends upon, and is carefully coordinated with, the rate of extraction of the finished product from the exit end of the apparatus.

The preferred puller mechanism, for extracting the finished product, is of the crawler-tread type, described more fully in my Patent 3,151,354. In this puller mechanism there are matching pairs of tread shoes, comprising matching blocks, which are shaped to fit and engage a portion of the surface of the elongate article being made. Each pair of matching shoes is capable of developing substantial frictional force over a particular area of the article being engaged and, cumulatively, all of the shoes engaging the article at one time create enough frictional force to extract the article from the die portion of the apparatus.

However, whenever due to wear of the mechanical parts, or wear of the die surfaces, or for other reasons, slippage occurs between the puller tread shoes and the finished article, serious consequences may obtain unless corrective measures are promptly taken. For example, if the apparatus is making continuous lengths of pipe having a wall thickness that must be maintained within certain tolerances and if the puller extracts the finished pipe at less speed than the calibrated speed of the winding mechanism because of wear of the tread shoes, it is clear that the winding mechanism will add more material per unit of length than is desired or is required, and a build-up in wall thickness of the pipe obtains. Generally, this build-up occurs gradually as the slippage is almost imperceptible at first, in which case, only when the finished product is inspected is it learned that slippage of the puller mechanism has caused a build-up in wall thickness. A large build-up of material can mean also that the pipe will not pass through the die, or the pipe structure will break because the build-up portion is too large to pass through the die.

The present invention is directed to apparatus adapted to warn operating personnel of such a material building-up condition and to automatically stop the machine if this should occur.

Summary of the invention

In apparatus for making a continuous filament reinforced resin article, using a forming die and a powered article-extracting mechanism, according to the invention a first element frictionally engages the article at a location intermediate the die and the extracting mechanism. A second element is mounted adjacent to and frictionally engages the extracting mechanism. The first and second elements are each connected to spaced apart counter rotating hubs between which a wheel is maintained stationary as long as the counter rotating hubs rotate at the same speed.

Whenever slippage occurs between the article and the extracting mechanism, the first hub rotates at a speed less than the speed of the second counter rotating hub, and then the intermediate wheel rotates. A microswitch, having an extension that normally rides in a stationary position on protrusions on the periphery of the intermediate wheel, is thereby actuated, and current flows in an alarm circuit actuating an alarm that alerts operating personnel.

For a further understanding of the invention and for advantages and features thereof, reference may be made to the following detailed description taken in conjunction with the drawings which show, for the purpose of exemplification, a preferred embodiment of the invention.

Brief description of the drawing

In the drawings:

FIG. 1 is a schematic elevational view of a portion of equipment for producing filament reinforced resin articles, incorporating an embodiment of the invention;

FIG. 2 is an elevational view along line II—II of FIG. 1 showing one portion of the apparatus of the invention;

FIG. 3 is a sectional view along line III—III of FIG. 1;

FIG. 4 is a sectional view along line IV—IV of FIG. 1 showing the other portion of the apparatus of the invention;

FIG. 5 is a detailed view in section of a portion of the apparatus of FIG. 3;

FIG. 6 is a view along line VI—VI of FIG. 5;

FIG. 7 is a schematic electrical wiring diagram involving a portion of the apparatus, in one aspect of the invention; and

FIG. 8 is a schematic electrical wiring diagram involving...
ing a portion of the apparatus, in another aspect of the invention.

**Detailed description**

The general arrangement of the apparatus of the invention is illustrated in FIG. 1 from which it will be seen that the apparatus comprises a product-slip first indicator 11 and a puller-slip second indicator 13, which are interconnected by means of a flexible drive shaft 15. The product-slip first indicator 11 is shown in FIG. 1 in relation to a material forming die 17 which is arranged and fixed in vertical alignment with the puller blocks 43 of a crawler-tread type puller mechanism 19.

The forming die 17 is similar to that described in Patent 3,235,429 mentioned previously. Filaments 21, leading downward from storage reels (not shown) through a resin-filled reservoir 23, enter the forming die 17 at the top thereof. The forming die 17 has an upper section 25 wherein cooling water enters and discharges through conduits 27, 27a, to maintain the resin at a temperature below polymerization temperature; a middle section 29 wherein heated fluid such as hot oil enters and discharges through conduits 31, 31a, to polymerize the resin in the article; and a lower section 33 wherein cooling water enters and discharges through conduits 37, 37a to cool the product somewhat before it enters the ambient air and before it enters the puller mechanism 19.

The finished product leaves the cooled lower end portion 33 of the die 17 and spans a relatively short distance between the die 17 and the entrance upper end of the puller mechanism 19. The product, for purposes of this description only, is assumed to be a circular tubular member 37 (FIG. 2).

The crawler type puller mechanism 19 is described in my Patent 3,151,354 and comprises generally two opposed endless crawler treads 39, 41 having each a plurality of tread shoes 43 that are shaped to engage and fit a portion (FIG. 3) of the peripheral surface of the article being manufactured, in this instance the pipe 37. Regardless of the size and shape of the product 37 being extracted from the forming die 17, it is desirable that there be a plurality of pairs of tread shoes of proper size and shape in engagement with the product 37 to draw the product through the forming die 17. Each tread shoe 43 is desirably provided with a rubber or other friction type liner 45 so that it is capable of maintaining good frictional contact with the product 37. The crawler treads 39, 41 are moved toward the product 37 and toward each other by means of two pneumatic cylinders 47, 49 and a link mechanism 51, as disclosed in aforementioned Patent 3,151,354.

Those skilled in the art will recognize that after a period of time, normal wear and tear of the tread shoes 43 will result in slippage between the tread shoes 43 and the article or product 37. Such slippage usually is very slight at first and is hardly perceptible; but, as wear continues, the slippage continues to grow until it is great enough to cause serious damage to the filament winding machine if it is not corrected in time. Particularly, the slippage results in a buildup of filamentary material in the forming zone of the machine and it may be impossible to extract over-size material through the die; the die could then be damaged or the product could break under the extracting force.

Apparatus 11, 13, 15, combined with the puller mechanism 19 and the product 37, effectively detects such slippage and either aborts the operating personnel to a dangerous situation, or automatically stops the machine to prevent serious damage to the die or other parts thereof.

The product of article-slip first indicator 11, shown in FIG. 4, comprises a wheel 53 mounted on a shaft 55 that is journaled mounted to one end of a strap or arm 57. Preferably, the strap or arm 57 is pivotally mounted at 59 to any suitable support 61 that is fixed adjacent to, or a fixed portion of the winding mechanism. The periphery of the wheel 53 supports an O-ring 62 that is disposed to frictionally engage the periphery of the product 37 and thereby rotate the wheel 53 as the product moves downward. The wheel 53 may pivot into the engaging position by gravity, or it may be resiliently biased into such position if preferred.

The flexible drive shaft 15 is joined at the end to the shaft 55 and at the other end to a stub shaft 63 projecting out of the puller slip indicator 13 (FIG. 3). Suitable couplings 65 are provided at each end of the flexible drive shaft 15 to effect a driving connection to the shafts 55 and 63.

The puller-slip second indicator 13 is mounted to one of the pair of side plates or frame members of the puller mechanism 19, which are adapted to carry the travelling tread shoes 43; each tread shoe 43 being mounted to a pair of spaced apart roller mounted links 69, 71, which ride on the peripheral edge of the fixed frame member 67.

The puller-slip second indicator 13 is supported by brackets 73 (FIG. 5) that are secured as by bolts 75 to both the fixed puller frame member 67 and to the puller-slip indicator casing 77. The puller-slip indicator casing 77 is a hollow receptacle having a bossing 79 projecting from one side thereof, which supports spaced apart bearings 81. The bearings 81, in turn, support both a sleeve 83 and the shaft 63 which is journaled neatly within the sleeve 83 (FIG. 5). To the end of the sleeve 83, which projects to the left of the bossing 79 as viewed in FIG. 5, there is mounted another wheel 85 that is secured to the sleeve 83 by means of a set screw 87. In the periphery of the wheel 85 there are two spaced apart parallel grooves 89 in which are supported O-rings 91 that are similar to the O-ring 62. Preferably, the grooves 89 and the O-rings 91 are spaced apart the same distance that the link 69, 71 are spaced apart, for a purpose that will be apparent hereinafter.

At the right-hand end of the sleeve 83 there is mounted a first hub 93 by means of a set screw 95, and to the right-hand end of the shaft 63 there is mounted, as by set screw 97, a similar facing second hub 99. Each hub 93, 99 has a concentric V-shaped groove 101 in a respective broad face 100 and both such concentric V-shaped grooves 101 match since they are located at the same radial distance from the center line axis of the shaft 63.

Between the faces 100 of the hubs 93, 99, there is disposed an annular wheel or sprocket 103 having a scalloped perimeter formed by a plurality of protrusions 104, and which has a plurality of apertures 105 regularly spaced along the circumference of a pitch circle 106 (FIG. 6), located at the same radial distance from the concentric grooves 101. In each aperture there is a single bearing ball 107 which is of such a size that it mates with both of the V-shaped grooves 101 and is freely rotatable within its respective aperture 105.

The right-hand end of the shaft 63 (FIG. 5) is bored to slidably receive a thrust pin 109 having a head 111 that restrains a compression type spring 113 between it and the end of the shaft 63. The head portion 111 is rounded and engages a cover 115 that is bolted, as at 117, to the puller-slip indicator casing 77. When the cover 115 is bolted in place, the hub 93 bears against one of the bearings 81, and the other hub 99 is maintained in proper relation to the hub 93 under the influence of the spring 113 as it is compressed between the head 111 and shaft 63.

The puller-slip indicator casing 77 is perforated at 118 to mount a push-pull type microswitch 119 having an actuating shaft extension 121 with mounted wheel 123 that contacts the protrusions 104 on the sprocket 103, as shown in FIGS. 5 and 6.

In operation of the winding machine, the O-ring 62 of the product-slip first indicator 11 engages the surface of the product 37, as indicated in FIG. 4, and the respective O-rings 91 of the puller-slip second indicator 13 engage the links 69, 71 of the crawler tread 39. The flexible drive shaft 15 mechanically links the product-slip first indicator 11 to the shaft 63 of the puller-slip second indi-
cator 13. Particularly, the flexible drive shaft 15 causes the shaft 63 and hub 99 to rotate in a direction opposite to the direction the O-rings 91 rotate the hub 93.

Now, as long as the hubs 93, 99 counter rotate at the same speed, there will be no movement of the sprocket or wheel 103 since, in this instance, it merely serves as a race to hold and support the bearing balls 107 since both hubs rotate at the same speed relative to the stationary spocket 103. However, if there is slippage in the puller mechanism 19 whereby the hub 93 rotates faster than the hub 99, then the spocket or wheel 103 will also rotate in the direction of the faster rotating hub 93.

As shown in Fig. 6, when the spocket 103 is stationary, the wheel contact 123 of the microswitch 119 rests on a crest 125 of the spocket, and, in such position, the microswitch 119 remains open; that is, no current flows through the microswitch.

Referring to Fig. 7, the visual signal lamp 129 and audible signal alarm bell 131, a relay 133, and a motor 135 that schematically designates a source of power that drives the puller mechanism and the winding mechanism.

Referring to Fig. 7, the visual signal lamp 129 and an audible signal alarm bell 131 are connected in one side of a circuit that includes the microswitch 119, the manual switch 127 and electrical lead wires 137 that are connected to the source of power (not shown). As shown in Fig. 7, no current flows in the circuit because both the microswitch and the manual switch are open. This is a situation corresponding to the position of the wheel 123 on the spocket 103, as shown in Fig. 6, and is normal for operation of the puller and winding mechanism when there is no slippage.

However, if slippage occurs between the tread shoes 43 and the article 37, the spocket 103 then moves, as mentioned before, and the wheel 123 moves off the crest 125 of the spocket, thereby opening the microswitch. This is the equivalent of moving contact arms 139 of the microswitch 119 (Fig. 7) through an angle of 90° in a counterclockwise direction. Then, current will flow through the circuit; the visual signal lamp 129 lights up and the alarm bell 131 sounds an audible signal alerting the operating personnel that the machine is malfunctioning. The operating personnel can then take proper and necessary steps to correct the situation.

The circuit of Fig. 8 is similar to the circuit of Fig. 7 except that, when the microswitch 119 operates, as mentioned previously and when the visual and audible alarms become active, the relay 139 is also activated and current, flowing to the drive motor 135, is interrupted whereby the entire winding mechanism stops.

Of course, operating personnel may use the manual switch 127 in either case to stop and to start the winding mechanism whenever desired, and especially in case of any other observed malfunctioning of the apparatus.

From the foregoing, several features and advantages are apparent. For one thing, the present invention provides a simple apparatus for detecting slippage in filament winding machines of the character described herein such slippage causes serious harm to the apparatus. Further, the apparatus of the invention, in one aspect, acts positively to shut down such a filament winding machine before serious damage occurs whenever slippage between product and extracting mechanism occurs. Furthermore, the present invention comprises a safety device in that it prevents serious damage to the filament winding machine which could injure operating personnel and do irreparable damage to property.

Although the invention has been described herein with a certain degree of particularity, it is understood that the present disclosure has been made only as an example and that the scope of the invention is defined by what is hereinafter claimed.

What is claimed is:

1. Apparatus for making a continuous filament reinforced resin article including a powered mechanism that extracts said article from a forming die, wherein the improvement comprises:
   (a) a first element engaging said article and actutable as said article advances from said die;
   (b) a second element engaging said article-extracting mechanism and actutable as said mechanism extracts said article from said die;
   (c) means linking said first and second elements and movable in response to a difference in speed of advance of said first and second elements; and
   (d) an alarm operable in response to movement of said linking means.

2. The invention of claim 1 including:
   (a) a first component driven by said first element; and
   (b) a second component driven by said second element and disposed in spaced apart relation to said first component;
   (c) with said linking means disposed between said first and second components and actutable when slippage occurs between said article and said article advancing mechanism whereby said apparatus is deactivated.

3. The invention of claim 2 wherein:
   (a) said first element is a first wheel;
   (b) said first component is a first hub;
   (c) said second element is a second wheel;
   (d) said second component is a second hub; and
   (e) said linking means is a third wheel supporting a plurality of bearing balls that rollably engage both hubs whereby said third wheel remains stationary as long as the speed of advance of said article is the same as the speed of advance of said article extracting mechanism and no slippage occurs.

4. The invention of claim 3 including:
   (a) an alarm that is electrically operative; and
   (b) switch means engaging said third wheel and connected to said alarm whereby when slippage occurs and said third wheel moves said alarm is activated.

5. The invention of claim 4 wherein:
   (a) said apparatus is electrically powered; and
   (b) said alarm is electrically connected in the power circuit of said apparatus whereby when slippage occurs and said alarm is activated, the power to said apparatus is interrupted and said apparatus stops.

Apparatus for making a continuous filament reinforced resin article including a powered mechanism that extracts said article from a forming die, wherein the improvement comprises:

(a) a source of power driving said apparatus;
(b) a first wheel engaging said article at a location intermediate said die and said extracting mechanism;
(c) a second wheel engaging the extracting mechanism and rotatable as said mechanism advances said article;
(d) a sleeve mounting a first hub and said second wheel thereon, said hub rotating as said second wheel rotates in a first direction;
(e) a shaft journaled in said sleeve and mounting a second hub in spaced apart relation to said first hub;
(f) drive means connecting said first wheel and said shaft whereby said second hub and said first wheel rotate simultaneously at the same speed in an opposite direction;
(g) a third wheel disposed between said first and second hubs, said third wheel being stationary when no slippage occurs between said extracting mechanism and said article; and
(h) switch means connected to said power source and contacting said third wheel whereby when said slippage occurs and said third wheel rotates, said switch means is actuated to interrupt the supply of power to said apparatus and the same stops.

7. The invention of claim 6 including:
   (a) a friction developing element on said first wheel that engages said article whereby said first wheel rotates as said article advances.
8. The invention of claim 7 including:
(a) a friction developing element on said second wheel that engages said extracting mechanism whereby said second wheel rotates as said extracting mechanism engages and advances said article.
9. The invention of claim 6 wherein:
(a) the drive means includes a flexible drive shaft;
(b) said third wheel has on the perimeter thereof a plurality of protrusions; and
(c) said switch means engages one said protrusion when said third wheel is stationary.