May 19, 1970 H. BURR 3,512,241

APPARATUS FOR FEEDING A WIRE COVERING TO A WIRE WITHIN A HEATABLE FORMING DIE

Filed March 13, 1968

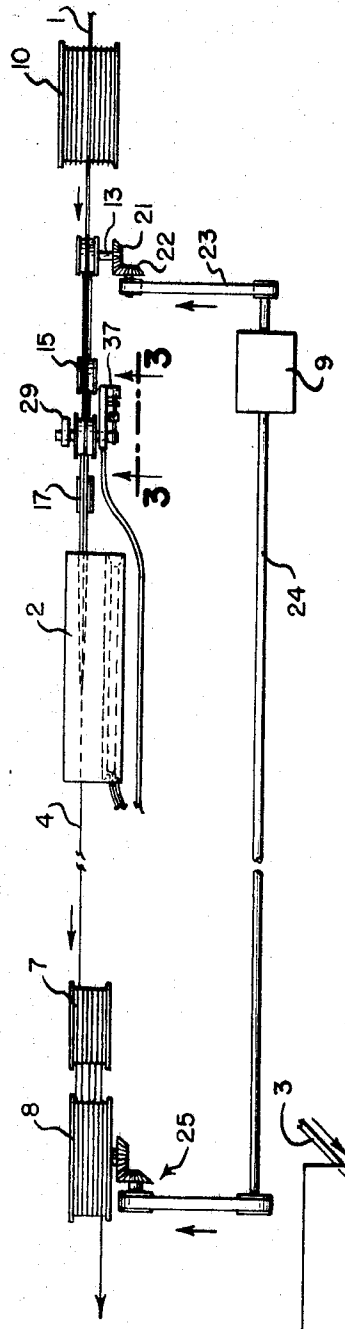


FIG. 1

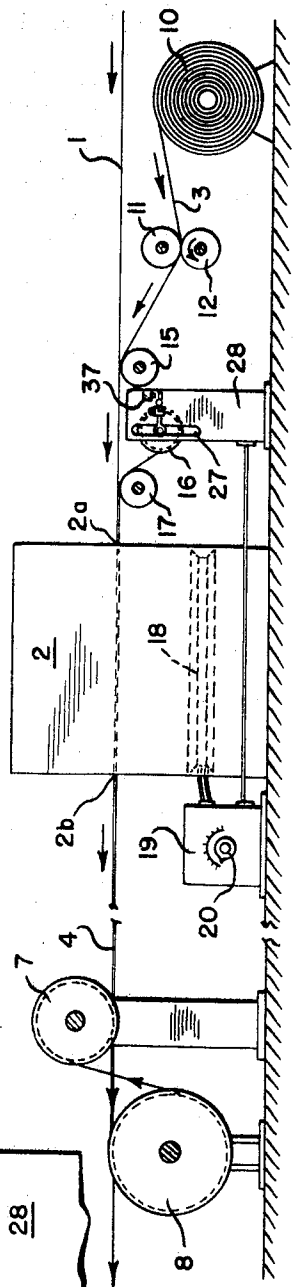


FIG. 2

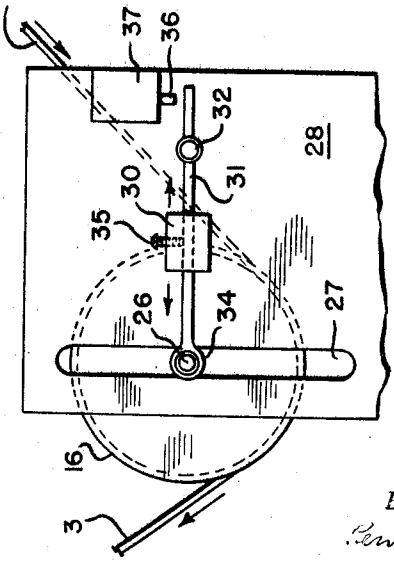


FIG. 3

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United States Patent Office 3,512,241
Patented May 19, 1970

3,512,241

APPARATUS FOR FEEDING A WIRE COVERING TO A WIRE WITHIN A HEATABLE FORMING DIE

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Filed Mar. 13, 1968, Ser. No. 712,841
Int. Cl. B23p 19/04
U.S. Cl. 29—202.5 6 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to apparatus for feeding strips of extensible material to a forming die which wraps the material around a moving wire to form an insulation covering. A tension roll arrangement senses extension of the strip due to temperature and tension and actuates a heater which varies the temperature of the strip to control the rate of feed of the strip to the wire.

BACKGROUND OF THE INVENTION

Prior use of spun-bonded polyethylene and other materials suitable for insulating wires has demonstrated that long thin strips of such materials are extensible and elongate depending on the tension induced therein and the temperature of the material. In particular, it has been found that where dies are heated to sufficient temperatures to permit wrapping and formation of the insulation covering, variations in the amount of extension and elongation in the strip have caused difficulty in accomplishing proper wrapping of the insulation.

The stretching and elongation of the strip varies with the type of insulation material used and also varies with the width and thickness of the strip fed to the die. Spun-bonded polyethylene stretches readily when narrow strips of material are fed to forming dies at high speeds. The use of heated dies in wrapping polyethylene insulation has increased the problem of controlling the rate of feed of the material to the die to compensate for such stretching and elongating of the strip.

SUMMARY OF THE INVENTION

It has been found that by measuring and controlling the tension of the strip prior to its entrance into the die that the rate of feed of strip to the strand within the die can be regulated to accomplish proper insulation of the conductor.

Broadly, the present invention comprises a die, heating means for controllably heating the die, feeding means for continuously feeding a wire into the die at a controlled rate, supplying means for supplying continuously a tensioned strip of insulation to the die, tension indicating means for indicating the tension of the strip prior to its entry into the die and control means actuated by the indicating means to control the die heating means.

It is a feature of the invention that elongation and extension of the strip is sensed by measuring the tension in the strip prior to its entrance into the die.

It is also a feature of the invention that a tension sensing means is used to control the die heating means so that when the rate of elongation of the tensioned strip is outside the desired range, the temperature of the die heater is varied to change the strip temperature and rate of strip elongation.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, FIG. 1 is a plan view of the apparatus, FIG. 2 is an elevation view of the apparatus, and FIG. 3 is an enlarged partial elevational view of the tension and strip elongation sensing means.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the strand or wire **1** is continuously conveyed through the forming die unit **2** by conventional strand handling reels including guide roll **7** and a strand supply reel (not shown). Die unit **2** has a die entrance **2***a* into which wire **1** and strip **3** are fed with their longitudinal axes substantially parallel to one another. The shape and configuration of die unit **2** causes the narrow strip **3** to wrap around the wire forming an insulation covering. After the insulation wrapping has been accomplished in the die unit **2**, the insulated wire **4** passes out through exit **2***b* and is carried around guide reel **7** to capstan **8**. Guide or idler reel **7** has grooves in it to separate and prevent entanglement of the wire. A second insulated wire or strand, which has preferably been wrapped in a similar manner, may be conveyed together with wire **4** to a twinner or other apparatus (not shown).

Strip **3** is removed from supply roll **10** by operation of upper pinch roll **11** and lower pinch roll **12**. Lower pinch roll **12** rotates about shaft **13** and is driven counterclockwise, as viewed in FIG. 2, and upper pinch roll **11** is permitted to rotate in a clockwise direction. Alternatively, upper roll **11** may be driven from shaft **13** in such a manner that it rotates at the same surface speed as roll **12**. The pinch rolls perform the function of providing a predetermined and controlled rate of linear feed of the strip at a point after it has been removed from the supply roll **10** and before it enters the die unit. Shaft **13** of lower pinch roll **12** has bevel gear **21** secured to it which is driven by bevel gear **22** which in turn is driven from main drive shaft **24** by belt **23**. Capstan **8** is also driven by drive shaft **24** through drive arrangement **25**. A variable speed gear unit **9** is positioned between sections of shaft **24** to permit the speed of the insulating strip **3** and the wire speed to be varied with respect to one another depending on wire gauge and other variables.

The speed at which the insulated wire **4** is drawn through the machine is determined by the linear speed of the surface of capstan **8**, and the speed of strip **3** as it leaves the pinch rolls is determined by the surface speed of driven roll **12**. The surface speed of roll **12** is set to be less than the surface speed of capstan **8** to cause during normal operating conditions a desired amount of tensioning and elongation of the strip. The amount of elongation is determined by the relationship between the two surface speeds. This relationship is determined by the setting of the variable speed gear **9** and any desired percentage of elongation of the strip can thus be obtained by adjustment of the variable speed gear **9**. However, the amount of elongation which the strip can tolerate without fracture is determined principally by the temperature to which it has been brought by the heated die **2**. If the temperature is too low, the tension in the strip between the pinch rolls and the die will increase and the strip will break before the desired amount of elongation as set by the variable speed gear **9** has been reached. If the temperature is too high, the tension in the strip will reduce and the elongation will be higher than desired. This will cause the pinch rolls to feed a greater length of strip than the length being drawn through by the capstan **8**, and the strip will then accumulate in an uncontrolled manner between the pinch rolls and the die.

Strip **3** passes from the pinch rolls over idler roll **15**, under tension roll **16** and over second idler roll **17** where it is fed through entrance **2***a* of forming die unit **2**. Forming die unit **2** causes the strip **3** which is positioned just below wire **1** to be wrapped around the wire to form an insulation covering around the wire. Preferably a longitudinal wrapping die, as disclosed in my U.S. Pat. No.

3,337,386 issued Aug. 22, 1967, is used to perform the strip wrapping function.

Die unit **2** is heated by an electrical heater **18** which is controlled by control unit **19** which includes a switch for turning the heater on and off and includes a rheostat **20** for varying the electrical current to the heater **18**. Die unit **2** is made of metal or other heat conductive material thus permitting heat to flow through from heater **18** to the strip. The strip is preferably a spunbonded polyethylene inulation material, a polypropylene material or other plastic material. Such materials provide satisfactory insulation characteristics and a narrow strip of such materials is controllably extensible when heated and tensioned. For example, a strip of polyethylene material only 3/16" wide and 1.5 thousandths inch thick is used to wrap a No. 26 A.W.G. wire. The die is heated is facilitate formation of the strip wrapping and its formation as an insulation covering. Heat permits some material to bind to itself after it has been wrapped around the wire thereby forming an insulation covering that resists winding or fraying.

The tension in the strip **3** between pinch rolls **11, 12** and guide or idler reel **7** is caused to vary by reason of variations in elongation and extension of the strip depending on the surface speeds of the pinch rolls and the capstan and depending on the temperature of the strip. It is desired that the rate of feed of the strip to the position where it wraps around the wire be controlled to provide proper wrapping of the insulation in the die. Since variation in elongation of the strip varies the feed rate, the temperature of die is automatically controlled to maintain strip elongation within a desired range. The tension in the strip is measured, indicated and controlled by tension roll **16** and control unit **19** which turns the electric heater on and off in response to signals produced by the tension roll movement. Control unit **19** also has a rheostat **20** which may be manually operated to vary the amount of heat transferred to the strip when the heater is turned on.

Tension roll **16** rotates freely about tension roll shaft **26**; however, if desired, the roll **16** and shaft **26** may be fixed together permitting the roll to slide on the moving strip. The ends of shaft **26** are positioned in vertical guide slots **27** of front and back stands **28** and **29**, respectively. Tension roll **16** is lowered when tension decreases and is raised when tension increases.

Turning to FIG. 3, tensioning roll **16** is shown positioned for rotation about shaft **26** which shaft has its front end portion in guide slot **27** of front vertically-positioned stand **28**. The position of the the apparatus in FIG. 3 illustrates the condition in which heater **18** is turned on and is heating the strip **3**. A weight **30** is positioned on pivotable arm **31** to tension strip **3** in such a manner as to hold the tension roll **16** in approximately the position shown. Weight **30** is slidable positioned to accommodate for variations in the width, cross-sectional area and tensile strength of the strip being handled. Arm **31** is pivoted about axis **32** with one of its ends having a bearing **34** freely rotatable about the front end of shaft **26**. Weight **30** is slidable along a portion of arm **31** and has screw **35** to seize it to the arm at selected positions.

As the strip **3** is heated it will increase its rate of elongation thus reducing tension in the strip and permitting roll **16** to move downwardly causing arm **31** to rotate counterclockwise until the arm contacts and pushes spring-loaded element **36** of switch **37**. Switch **37** is in turn actuated to deenergize heater **18** as element **36** moves upwardly against a spring (not shown). As strip **3** cools and reduces its rate of elongation roll **16** will move upward permitting element **36** to be returned by the spring to a lower position whereby switch **37** will turn the heater on again. Switch **37** may be of conventional construction to accomplish opening and closing of an electric circuit when element **36** is urged upward or permitted to return to the position shown in FIG. 3. Heater **18** is turned on and off in response to roll **16** movement as described to maintain a constant tension in strip **3** as it is fed to die **2**. Roll **16** moves up and down or remains steady to indicate the amount of tension in strip **3**.

In the operation of the invention, it has been found that spunbonded polyethylene has little strength where a die temperature of about 250° F. is maintained for a substantial length of time. A strip temperature range of 175° F. to 200° F. was found satisfactory for spunbonded polyethylene but since the material is a poor conductor of heat a higher die temperature is required to start up within a reasonable length of time. As strip temperatures increases, tension is decreased and the heater is turned off by the control unit. An operator may adjust the position of the weight and the rheostat of the control unit when different strips are being handled or where such adjustments are desirable during a particular run.

I claim:

1. An apparatus for controlling the rate of movement of a strip of extensible material within a forming die as the strip is formed around a continuously moving wire comprising

(a) conveying means for conveying the wire to be insulated to the die and for conveying the insulated wire from the die,

(b) supply means for continuously supplying the extensible strip to the die,

(c) heating means capable of selectedly supplying heat to the die for heating the strip to cause it to extend in length,

(d) strip extension indicating means positioned between the supply means and the die for indicating extension of the strip prior to its entry into the die, and

(e) control means operably connected to the extension indicating means to control the heating means,

whereby heat is selectedly supplied to the die as the extension of the strip varies.

2. The apparatus of claim **1** in which the conveying means conveys the wire at a predetermined rate and in which the strip supply means includes strip feeding means for controlling the rate of feed of the strip prior to the entry of the strip into the die.

3. The apparatus of claim **1** having variable drive means for driving both the conveying means and the strip feeding means to coordinate the feed rates of the wire and the strip such that the linear speed of wire conveyed by the conveying means is greater than the linear speed of the strip prior to the entry of the strip into the die.

4. An apparatus for controlling the feeding of a strip of a readily elongated insulation material to a forming die having an entrance and an exit comprising

(a) conveying means for conveying under tension a conductive wire into the forming die entrance,

(b) supply means for supplying the strip into said entrance with its longitudinal axis substantially parallel to the longitudinal axis of the wire,

(c) electrical heating means for heating the die and the contained wire and strip,

(d) tension indicating means positioned remotely from the die to indicate tension in the strip as it travels toward the die, said tension indicating means in turn comprising

(i) two guide rolls for supporting the strip as it travels toward the die,

(ii) a tension member positioned between said guide rolls and supported by the moving strip such that the member moves as the tension in the strip varies,

(iii) a pivotable member connected to the ten-

sion member and pivotable by the tension member when the tension member moves in response to tension in the insulation material; and

(e) control means connected to the tension indicating means for controlling the electrical heating means, the control means in turn comprising

(i) a switch actuated by the pivotable member, and

(ii) electrical circuit means for energizing the electrical heater when the switch is activated.

5. The apparatus of claim 4 in which the strip supply means includes a pair of pinch rolls which regulate the rate of movement of the strip at a point remote from the entrance of the die,

6. The apparatus of claim 4 having drive means for driving the conveying means and the pinch rolls of the strip supply means at predetermined speeds.

References Cited

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U.S. Cl. X.R.

29—203; 156—588, 590; 219—388