Jan. 19, 1954 T. T. BUNCH 2,666,289

BRAKE FOR STRAND HANDLING APPARATUS

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FIG. 2

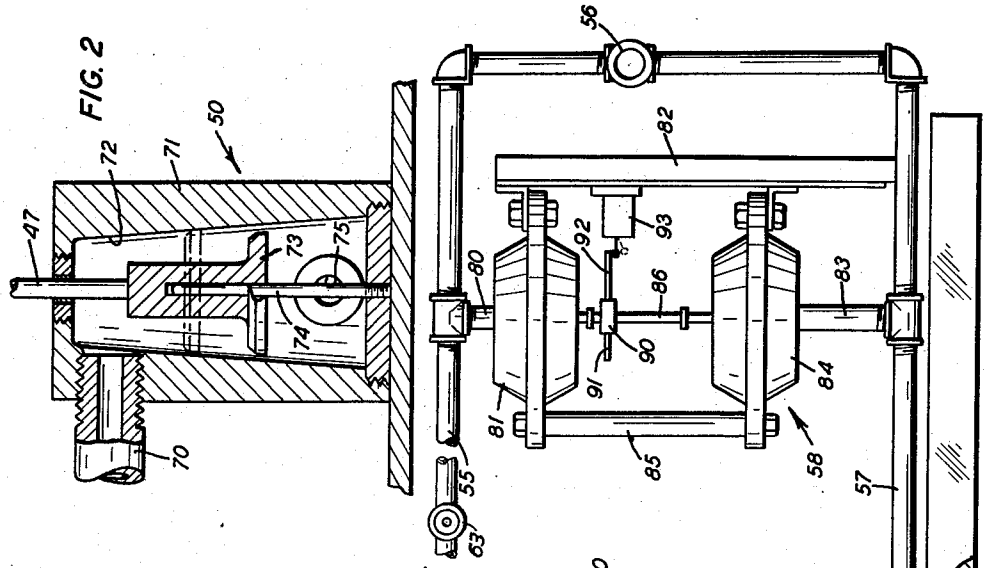
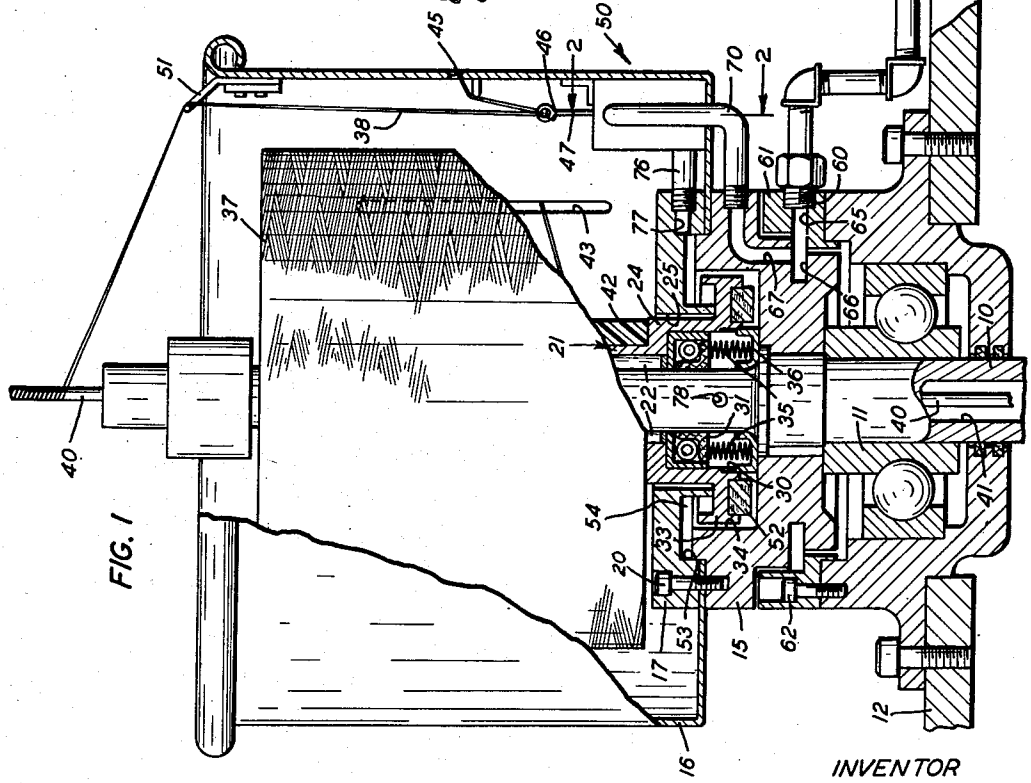


FIG. 1



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BRAKE FOR STRAND HANDLING APPARATUS

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15 Claims. (Cl. 57—19)

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This invention relates to brakes for strand handling apparatus, and more particularly to brakes for maintaining uniform tension on strands being withdrawn from supply cops and for stopping the withdrawal of such strands.

In the manufacture of electrical conductors for use in the communications art, certain types of conductors are advanced through an apparatus arranged to withdraw a strand material from one or more supply cops and serve it spirally around the advancing core to form a covering on the conductor. The withdrawal of the strand from the supply cop causes the cop to rotate with respect to the strand withdrawing means, whereby it usually is necessary to retard the relative rotation of the cop with a braking force sufficient to maintain uniform tension on the strand as it is expended from a full cop to an empty cop.

Due to the fact that the unwinding diameter of the cop is constantly decreasing as the strand material is expended from a full cop to an empty cop, the braking force must constantly decrease in order to maintain a uniform tension on the strand. An accurate control of the strand tension may be obtained by regulating the braking force retarding the rotation of the cop by the tension in the strand itself, whereby any changes in the strand tension adjusts the braking means directly so as to maintain the required tension on the strand. It is further desirable to use the braking means to stop the cop and the means withdrawing the strand from the cop when the strand being withdrawn therefrom breaks in order to prevent overrunning of the cop and excessive tangling of the strand.

An object of the invention is to provide new and improved brakes for strand handling apparatus.

Another object of the invention is to provide new and improved brakes for maintaining uniform tension on a strand being withdrawn from supply cops and served around a continuously advancing filamentary core and for stopping the withdrawal of such strands upon the breakage of a strand being withdrawn from the cop.

A brake for strand handling apparatus which embodies certain features of the invention, comprises a rotatable spindle designed to receive a strand supply cop, means for withdrawing the strand from the cop at a predetermined rate and causing rotation of the cop, means for retarding the rotation of the spindle to tension the strand, and means responsive to the tension on the strand for selectively controlling the spindle retarding means so as to maintain uniform tension on the strand as it is withdrawn from the cop.

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A clear understanding of the invention will be had from the following detailed description of a specific embodiment thereof, when read in conjunction with the appended drawings in which like numerals designate identical parts throughout the several views, and, in which:

Fig. 1 is an enlarged, fragmentary, sectional view of a strand serving apparatus embodying certain features of the invention, and

Fig. 2 is an enlarged, vertical, sectional view taken along line 2—2 of Fig. 1.

Referring now to the drawings and more particularly to Fig. 1, there is shown a concentric type strand serving machine of a type generally used in applying a textile or similar covering around an insulated or jacketed conductor. Only that portion of such a serving machine to which the invention is directly related is shown in Fig. 1, and, as shown, comprises an elongated shaft 10 suitably journalled in a bearing cartridge 11 which is rigidly secured to the base of the serving machine, a portion of which is indicated by the numeral 12. A flange 15 is keyed to the portion of the shaft 10 adjacent to the bearing 11 and has a thin metal cup 16 secured thereto by means of an annular cap 17 secured to the flange 15 by a plurality of bolts one of which is shown in Fig. 1, and indicated by the numeral 20.

It is to be understood that the shaft 10 is connected to a suitable power means (not shown) which is arranged to rotate the shaft and the cup 16 attached thereto at a predetermined speed. The arrangement of the driving mechanism for the shaft is described fully in my copending application Serial No. 102,664, filed on or about July 1, 1949, hence, a detailed description of this mechanism is not given here.

The portion of the shaft 10 extending beyond the flange 15 is reduced in diameter to receive a tubular spindle 21 which is rotatably mounted on this portion of the shaft 10 by a plurality of needle bearings 22—22. The end of the spindle adjacent to the bottom of the cup 16 is provided with a hub 24 which fits neatly in a central bore 25, provided in the cap 17. The hub portion 24 is provided with a counterbore 30 for receiving a grease retainer ring 31 which fits neatly between the counterbore and the shaft 10 to retain the lubricant provided on the needle bearings 22—22.

The hub 24 extends beyond the cap 17 and is provided with a flange 33 which rotates within a counterbore 34 provided in the flange 15. A plurality of springs 35—35 are positioned between the ring 31 and a cup-shaped ring 36 resting on the bottom of the counterbore 34 and

keyed for rotation with the spindle 21. The spindle 21 is designed to rotatably support a cop 37 having a supply of strand material 38 wound thereon in a fashion which permits it to be readily withdrawn therefrom and served around a core 40 being advanced through a central bore 41 provided in the shaft 10 by suitable advancing means (not shown).

The cop 37 usually is wound on a cop tube 42 which is arranged to be keyed for rotation with the spindle 21 in any suitable manner, such as a plurality of longitudinal splines equally spaced about the periphery of the tubular spindle 21 and complementary ribs provided along the internal bore of the cop tube. The strand 38 is withdrawn from the cop 37 and passes through a slot 43 provided in the cup and around the outside surface of the cup to an eye 45 through which the strand passes to an eye 46 provided on a piston rod 47 forming part of an air flow control poppet valve indicated generally at 50 which is mounted inside the cup. The strand passes through the eye 46 and then upwardly as seen in Fig. 1 to a guide 51 secured at the lip of the cup and then moves angularly toward the core 40 passing through the central bore 41 of the shaft 10.

Rotation of the cup 16 at a predetermined rate of speed, withdraws the strand from the cop 37 and serves it spirally around the advancing core 40 to form a suitable covering thereon. The withdrawal of the strand causes the cop to rotate at a rate of speed greater than the speed of the cup due to the diameter of the cop with respect to the orbit of the rotating guide 51 attached to the cup 16.

The flange 33 forming part of the spindle 21 is provided with a brake ring 52 of suitable friction material. The needle bearings 22—22 permit the spindle 21 to move axially on the shaft 10 so that the brake ring 52 may engage the bottom of the counterbore 34. The springs 35—35 are designed to hold the spindle in its uppermost position so that normally the brake ring does not touch the bottom of the counterbore 34. When the ring 52 engages the bottom of the counterbore 34, the friction between the ring 52 and the surface of the counterbore 34 retards the rotation of the spindle 21 and the cop 37 carried thereby and tensions the strand 38 as it is withdrawn from the cop by the cup 16. The tension on the strand 38 must be maintained at a predetermined value as the strand is expended from a full cop to an empty cop to obtain a uniform covering on the core 40. However, as the diameter of the cop constantly decreases, the torque required to rotate the cop must decrease proportionately to maintain uniform tension on the strand throughout a serving operation from a full cop to an empty cop.

The cap 17 is provided with a counterbore 53 adjacent to the flange 33 of the spindle 21 so as to form an annular chamber 54 between the upper side of the flange 33 and the bottom of the counterbore 53. Air under pressure from a suitable supply source (not shown) is admitted to the annular chamber 54, in a manner hereinafter to be described, to press the brake ring 52 against the bottom of the counterbore 34 with a force corresponding to the diameter of the cop, and thereby maintains a constant tension on the strand as it is withdrawn from the cop.

Air under pressure from a suitable supply source passes through an adjustable valve 63, an inlet pipe 55, a valve 56 having an adjustable orifice therein and an outlet pipe 57 forming part of an air flow switch indicated generally at 58. The pipe 57 is connected to a threaded bore 60 provided in a ring 61 which is rigidly secured to the bearing 11 by a plurality of bolts, one of which is indicated generally by the numeral 62. The air passes through the bore 60 to an annular groove provided in the ring 61 and into an annular groove 66 provided in the flange 15 secured to the shaft 10. The air under pressure completely fills the grooves 65 and 66 and passes from the groove 66 through a bore 67 to a pipe 70 which transmits the air to an inlet port provided in the upper end of a body 71 of the poppet valve 50.

The air under pressure enters a tapered bore 72 provided in the body 71 and passes downwardly around an annular clearance formed between the tapered bore 72 and a piston 73 secured to the piston rod 47 and slidably mounted on a guide rod 74 secured to the base of the body 71. Air escaping through the annular clearance between the piston and the tapered bore 72 passes through an outlet port 75 and through a pipe 76 to a bore 77 provided in the cap 17. The bore 77 communicates with the counterbore 53 provided in the cap, whereby the air from the poppet valve 50 enters the annular chamber 54.

The presence of air under pressure in the annular chamber 54 exerts a pressure against the flange 33 provided on the spindle 21, and thereby forces the brake ring 52 against the bottom of the counterbore 34. This pressure exerts a braking force on the spindle in accordance with the pressure of the air maintained in the annular chamber. Since the spindle is rotating with respect to the cap 17, the bore 25 in the cap 17 provides a running clearance between the spindle and the cap which permits a predetermined leakage of air from the annular chamber into the cup 16, and, hence, into the atmosphere. Air also escapes around the clearance provided between the periphery of the flange 33 and the counterbore 34 and leaks under the friction ring 52 into the clearance between the counterbore 30 and the upper portion of the shaft 10. To prevent air pressure from building up in the counterbore 30, a plurality of holes 78—78 are provided in the shaft to permit the air which leaks into the counterbore 30 to escape through the central bore 41 of the shaft into the atmosphere. Due to the clearances between the bore 25 and the hub 24, and between the periphery of the flange 33 and the counterbore 34, the air from the supply source flows through an air flow switch 58 at a rate determined by the leakage of air through these annular clearances. The air at the supply source is maintained at pressure sufficient to maintain a substantial working pressure in the poppet valve 50 and the annular chamber 54 in conjunction with the loss of air through the clearances in the chamber 54.

Air under pressure from the pipe 55 passes through a pipe 80 into an air-actuated diaphragm apparatus 81 of the air flow switch 58 which may be mounted on a support 82 suitably secured to the frame 12 of the serving machine. Air under pressure from the pipe 57 passes through a pipe 83 into an air-actuated diaphragm apparatus 84 also secured to the support 82 so as to be directly in line with the diaphragm apparatus 81.

A post 85 is positioned between the diaphragm apparatus 81 and 84 to maintain a predetermined spacing between the apparatus. The dia-

phragms of the apparatus 81 and 84 are joined together by a rod 86 so that changes in the pressure of the air admitted to the diaphragms causes a vertical movement of the rod 86. A collar 90 is adjustably secured to the rod 86 by a set screw 91 and has a finger 92 extending therefrom to operate a sensitive switch 93 mounted on the support 82. The switch 93 preferably is provided with a normally closed contact (not shown) which is connected in series with the control circuit of the motor driving the shaft 10 and the cup 16, so that a predetermined downward movement of the rod 86 opens the contact of the switch 93 to deenergize the motor and terminate the rotation of the cup 16.

Operation

Let it be assumed that the cop 37 is positioned on the spindle 21, and that the strand 38 is threaded through the slot 43 and the eyes 45 and 46, the guide 51 and attached to the core 40 which has been threaded through the bore 41 of the shaft 10. Air under pressure from a suitable supply source (not shown) passes through the pipe 55, the valve 56 and the pipe 57 of the air flow switch 58 to the grooves 65 and 66. The groove 66 is completely filled with air under pressure and the air passes therefrom through an opening 67 and a pipe 70 to the inlet port provided in the body 71 of the valve 50. The air passes through the annular clearance provided in the piston 73 and the tapered bore 72 to an outlet port 75 in the body 71, and from the outlet port through a pipe 76 and a bore 77 to the chamber 54. The air pressure in the valve 50 positions the piston 73 in its lowermost position within the tapered bore 72 of the body 71. In this position, the piston permits the maximum escape of air around the annular clearance between the piston and the tapered bore and, hence, a maximum air pressure in the annular chamber 54. This air pressure working against the upper side of the flange 33 moves the spindle axially on the shaft against the actions of the springs 35—35 and presses the brake ring 52 against the bottom of the counterbore 34 with maximum force.

The motor driving the shaft 10 and the core advancing means (not shown) is energized to rotate the cup 16 and advance the core. The rotation of the cup withdraws the strand from the cop and serves it spirally around the core. As the cup starts to withdraw the strand 38 from the cop 37, it rotates the spindle against the pressure on the brake ring and produces a braking force in excess of that which is required to create the required tension on the strand 38 as it is served on the core 10. This excessive tension on the strand immediately moves the piston 73 in the tapered bore 72 against the pressure of the air admitted to the body 71 so as to decrease the annular clearance between the piston and the tapered bore 72. This movement of the piston reduces the air pressure admitted to the annular chamber 54 to such an extent that the resulting force applied on the brake ring 52 produces a braking force on the spindle which is sufficient to create the required predetermined tension on the strand 38. This predetermined tension on the strand holds the piston 73 at an intermediate point in the tapered bore 72 where the tension on the strand, plus the air pressure in the annular chamber 54, is equal to the pressure of the air in the pipe 70. The pressure of the air admitted to the pipe 55 may be adjusted by any conventional pressure regulating means, such as valve 63, to obtain from the supply source, any desired tension on the strand within reasonable limits.

Due to the annular clearance provided between the bore 25 and the hub 24 of the spindle 21 and between the flange 33 and the counterbore 34, a slight air leakage occurs from the annular chamber 54 into the atmosphere. This air leakage creates a normal flow of air through the pipe 55, the valve 56 and the pipe 57 of the air flow switch 58 and through the grooves 65 and 66 and the valve 50 to the chamber 54. This air flow through the air flow switch 58 results in an air pressure in the diaphragm apparatus 81 substantially equal to the air pressure in the pipe 55. An air pressure substantially equal to that in the diaphragm apparatus 81 also occurs in the diaphragm apparatus 84 since the velocity of the air flow through the switch 58 is relatively low.

The differential between the air pressure acting on the diaphragm 81 and the air pressure acting on the diaphragm 84 holds the finger 92 of the collar 90 at a predetermined position. The switch 93 is positioned on the support 82 so that its operating lever is adjacent to the finger 92, whereby its contact remains in its normally closed position. With this normal air flow through the switch 58, the valve 56 in the pipe line 57 does not disturb the pressure differential between the diaphragm apparatus 81 and 84. As a result, the switch 93 is not actuated by the finger 92 secured to the rod 86.

As the cup 16 continues to withdraw the strand from the cop and serve it spirally around the core, the unwinding diameter of the cop 37 constantly decreases. As the unwinding diameter of the cop decreases, the length of the lever arm from the tangential point where the strand leaves the cop to the center of rotation of the spindle constantly decreases. This decreasing length of the lever arm requires a corresponding decrease in the braking force applied on the spindle 21 in order to maintain a uniform tension on the strand 38 throughout the unwinding operation from a full cop to an empty cop. The effective braking radius of the brake ring 52 is fixed; therefore, the braking force on the spindle must be decreased by continually decreasing the pressure of the air in the annular chamber 54 as the diameter of the cop 37 decreases to obtain uniform tension on the strand.

It has been stated hereinabove, that when the cup 16 is withdrawing the strand from the cop, the tension on the strand is approximately equal to the difference between the air pressure in the pipe 55 and the air pressure in the chamber 54. Therefore, the increased tension in the strand resulting from the decrease in the unwinding diameter of the cop together with the back pressure in the valve 50 overcomes the pressure of the air supplied to the valve 50 and moves the piston 73 toward a portion of the tapered bore having a smaller diameter. This movement of the piston reduces the annular clearance and permits less air to escape from the upper portion of the valve to the outlet port 75, and thereby reduces the pressure of the air admitted to the annular chamber 54. This reduced air pressure in the chamber 54 reduces the braking force applied on the spindle, and, consequently, reduces the tension on the strand to its predetermined value.

This adjustment of the piston 73 by the strand tension takes place in very small increments be-

cause the change in the tension on the strand increases in very small amounts for very short periods of time. It is believed to be obvious from the above description, that as the unwinding diameter of the cop decreases, the strand operates the piston 73 in accordance with each decrease in the unwinding diameter of the cop so as to constantly decrease the air pressure admitted to the chamber 54 and thereby effect a corresponding decrease in the braking force on the spindle 21. In this way the valve 50 serves to maintain substantially uniform tension on the strand 38 as it is expended from a full cop to an empty cop by the cup 16 which serves it around the core 40.

The valve 50 controls the braking force applied on the spindle in the manner described so long as the strand 38 does not break during the serving operation. Let is be assumed that during the serving operation, the strand 38 suddenly breaks, in which case, the parted strand allows the piston 73 to drop to its lowermost position. The piston in this position permits a maximum escape of air from the tapered bore 72 to the outlet port 75 and results in a substantial increase in the air pressure in the chamber 54. The increased air pressure within the chamber 54 immediately stops the rotation of the cop and the spindle 21 with respect to the cup 16 driven by the shaft 10. But the rotation of the cup 16 must be terminated substantially simultaneously with the cop 37 to prevent the strand from unwinding from the cop and becoming entangled within the cup.

The sudden movement of the piston 73 to its lowermost position in the tapered bore of the valve 50, also creates a sudden increase in the velocity of the air flow in the pipe 57 due to the sudden release of the air from the pipe 57 into the chamber 54. The valve 56 positioned between the diaphragm 81 and the diaphragm 84 provides a variable orifice in the air flow switch 58 which prevents the sudden release of the air from the pipe 57 a corresponding drop in its pressure from being restored immediately to the normal pressure differential between the diaphragms 81 and 84 by the air supply source. Therefore, the sudden increase in the velocity of the air flow through the pipe 57 substantially reduces the pressure of the air acting on the diaphragm 84. This allows the diaphragm 81 to move the rod 86 so as to cause the finger 92 to actuate the switch 93 to open its contact and disconnect the motor (not shown) which is driving the shaft 10 from its power supply, whereupon the rotation of the cup 16 is terminated substantially simultaneously with the cop and spindle. Thus, when the strand 38 breaks during the serving operation, the release of the piston to its lowermost position effects an immediate stoppage of the spindle 21, the cop 37 and the cup 16.

When a sufficient quantity of air passes through the valve 56 to bring the air pressure in the pipe 57 up to air pressure in the pipe 55, the normal pressure differential between the diaphragms 81 and 84 is restored and the finger returns to its normal position with respect to the switch 93. This causes the switch 93 to resume its normal operating positon, but the motor driving the shaft 10 must be reenergized to place the apparatus in operation when the broken strand has been repaired.

While it has been shown that variations occur in the tension on the strand 38 as the diameter of the cop constantly decreases layer by layer, it should be understood that the strand tension

varies throughout the unwinding of each layer due to the fact that the unwinding point of the strand traverses the length of the cop as it is withdrawn therefrom. This traversing of the unwinding point of the strand varies the angle of the strand with respect to the eye 45, and, consequently, the tension on the strand 38. The strand tension also varies due to mutual adhesion of the strand 38 when the convolutions of one layer are imbedded in between the convolutions of the adjacent layer. All variations in the tension of the strand 38 operate the valve 50 in the manner described to vary the braking force on the spindle 21 in accordance with the change in tension so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop.

While the above-described apparatus is particularly well adapted to maintain uniform tension on a strand being withdrawn from a strand supply cop during a serving operation, it may be readily modified to maintain uniform tension on various kinds of filamentary material employed in the manufacture of filamentary articles without departing from the spirit and scope of the invention.

What is claimed is:

1. A brake for tensioning strands withdrawn from a supply cop provided on strand handling apparatus, which comprises a support, a shaft positioned on the support, a spindle rotatably mounted on the shaft and designed to carry a cop containing a supply of strand material, means for withdrawing the strand from the cop and causing rotation of the cop by the paying off of the material therefrom, a brake element positioned between one end of the spindle and the support, said spindle being free to move axially on the shaft, means for moving the spindle axially on the shaft and press the brake element against the support with a force sufficient to retard the rotation of the spindle and tension the strand being withdrawn from the cop, and means responsive to the tension in the strand for selectively controlling the means urging the brake element against the support so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop.

2. A brake for tensioning strand material being withdrawn from a supply cop provided on strand handling apparatus, which comprises a shaft, a spindle rotatably mounted on the shaft and designed to carry a cop containing a supply of strand material, means rotatable about the axis of the cop for withdrawing the strand material from the cop and causing rotation of the cop by the paying off of the material therefrom, a brake element mounted on the end of the spindle adjacent to a surface of the strand withdrawing means, said spindle being provided with a predetermined axial movement on the shaft, resilient means for holding the brake element out of engagement with the strand withdrawing means, means for moving the spindle on the shaft against the action of the resilient means and causing the brake element to engage the strand withdrawing means with a force sufficient to retard the relative rotation of the spindle against the withdrawal of the strand and thereby tension the strand, and means responsive to the tension in the strand for selectively controlling the means urging the brake element against the strand withdrawing means so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop.

3. A brake for tensioning strands withdrawn

from strand handling apparatus, which comprises a support, a shaft positioned on the support, a spindle rotatably positioned on the free end of the shaft and designed to carry a cop containing a supply of strand material, said spindle having a surface in close proximity to a surface of the support, means for withdrawing the strand from the cop and causing rotation of the spindle, fluid pressure actuated means for causing the surfaces to engage each other with a force sufficient to retard the rotation of the spindle and tension the strand being withdrawn from the cop, and means responsive to the tension on the strand for selectively controlling the fluid pressure actuated means so as to maintain uniform tension on the strand as it is withdrawn from the cop.

4. A brake for strand handling apparatus, which comprises a rotatable spindle designed to carry a cop containing a supply of strand material on the free end thereof, means for withdrawing the strand from the cop and causing rotation of the cop by the paying off of the strand material therefrom, a brake element mounted on the strand withdrawing means adjacent to one end of the spindle, means for causing air under pressure to urge the spindle into engagement with the brake element with a force sufficient to retard the tension in the strand as it is withdrawn from the cop, and a valve provided in the air supply means for regulating the pressure of the air causing the spindle to engage the brake element, said valve being responsive to the tension in the strand so as to regulate the air pressure acting on the spindle so that it maintains a uniform tension on the strand as it is expended from a full cop to an empty cop.

5. A brake for tensioning strand material withdrawn from a supply cop provided on strand handling apparatus, which comprises a support, a shaft vertically positioned on the support, a spindle rotatably mounted on the free end of the shaft and designed to carry a cop containing a supply of strand material, means for withdrawing the strand from the cop and causing rotation of the cop by the paying off of the strand therefrom, an annular brake element secured on the spindle adjacent to the support, said spindle being free to move axially on the shaft so that the brake element may engage the support, means for causing a fluid under pressure to move the spindle on the shaft so that it presses the brake element against the support with a force sufficient to retard the rotation of the spindle and tension the strand being withdrawn from the cop, and a valve provided in the fluid pressure system and arranged to be operated by the strand for selectively controlling the fluid pressure acting on the spindle so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop.

6. A brake for tensioning strand material withdrawn from a supply cop provided on a strand handling apparatus, which comprises a support, a shaft positioned on the support, a spindle rotatably mounted on the free end of the shaft and designed to carry a cop containing a supply of strand material, means for withdrawing the strand material from the cop and causing rotation of the cop, an annular chamber formed at the base of the shaft supporting the spindle, said spindle having a flange secured thereon for rotation within the annular chamber, a brake element provided on the annular flange of the spindle, said spindle having sufficient axial movement on the shaft to permit the brake element to engage the bottom of the annular chamber, means for admitting air under pressure into the annular chamber to cause the brake element to engage the bottom of the chamber with a force sufficient to retard the rotation of the spindle with respect to the support and create a tension in the strand, and a valve provided in the air pressure supply means and arranged to be responsive to the tension in the strand for selectively controlling the pressure of the air admitted to the annular chamber so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop.

7. A brake for tensioning strand material being withdrawn from a supply cop provided on a strand handling apparatus, which comprises a shaft, a spindle rotatably mounted on the free end of the shaft and designed to carry a cop containing a supply of strand material, means rotatable about the cop for withdrawing the strand from the cop and causing rotation of the cop by the paying off of the strand therefrom, a brake element mounted on one end of the rotatable spindle adjacent to the strand withdrawing means, said spindle having a predetermined axial movement on the shaft, means for causing air under pressure to move the spindle axially of the shaft so that the brake element engages the strand withdrawing means with a force sufficient to retard the relative rotation of the spindle and tension the strand being withdrawn from the cop, and a valve provided in the air supply means having a piston slidably positioned therein for regulating the pressure of the air causing the brake element to engage the strand withdrawing means, the movement of the piston being controlled by the tension in the strand being withdrawn from the cop so as to regulate the pressure of the air applied to the brake element so that it maintains uniform tension on the strand as it is expended from a full cop to an empty cop.

8. A brake for tensioning strand material being withdrawn from a supply cop provided on strand handling apparatus, which comprises a shaft, a spindle rotatably mounted on the free end of the shaft and designed to carry the cop containing a supply of strand material, means rotatable about the axis of the cop for withdrawing the strand material from the cop and causing rotation thereof by the paying off of the strand therefrom, a brake element positioned at the end of the spindle adjacent to the strand withdrawing means, said spindle having a predetermined axial movement on the shaft, means for moving the spindle axially on the shaft thereby urging the brake element into engagement with the strand withdrawing means to retard the relative rotation of the spindle with a braking force sufficient to tension the strand being withdrawn from the cop, and means responsive to the tension on the strand for selectively controlling the braking force applied on the spindle so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop, said controlling means responsive to the tension of the strand being so arranged that if the strand breaks as it is withdrawn from the cop the controlling means is rendered inoperative, whereby the urging means increases the braking force applied to the spindle to stop the cop immediately and prevent overrunning of the cop.

9. A brake for strand handling apparatus, which comprises a shaft, a spindle rotatably mounted on the free end of the shaft and designed to carry a cop containing a supply of

strand material, means rotatable about the axis of the cop for withdrawing the strand from the cop and causing rotation of the cop, a brake element positioned on the end of the spindle adjacent to the strand withdrawing means, said spindle being capable of axial movement on the shaft, means for moving the spindle axially on said shaft thereby causing the brake element to engage the strand withdrawing means and retard the relative rotation of the spindle with a braking force sufficient to tension the strand being withdrawn from the cop, means responsive to the tension on the strand for selectively controlling the means for moving the spindle axially on the shaft so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop, said tension controlling means being arranged to cause the brake element to substantially increase the braking force on the spindle and stop the rotation of the cop when the strand being withdrawn from the cop breaks, and means arranged to be operable when the strand tensioning means applies greater than a predetermined braking force on the spindle for stopping the strand withdrawing means simultaneously with the cop to prevent overrunning of the cop with respect to the strand withdrawing means.

10. A brake for tensioning strand material being withdrawn from a supply cop provided on strand handling apparatus, which comprises a shaft, a spindle rotatably mounted on the shaft and designed to carry a cop containing a given supply of strand material, means rotatable about the axis of the cop for withdrawing the strand material therefrom and causing rotation of the cop by the paying off of the material therefrom, a brake element mounted on the end of the spindle adjacent to the strand withdrawing means having sufficient axial movement on the shaft so that the brake element engages the strand withdrawing means, means for causing a fluid under pressure to move the spindle axially of the shaft and causing the brake element to engage the strand withdrawing means and retard the relative rotation of the spindle with a force sufficient to tension the strand, means responsive to the tension in the strand for continuously regulating the rate of flow of the fluid acting on the spindle so as to vary the braking force thereon in accordance with the constantly decreasing diameter of the cop and thereby maintain uniform tension on the strand as it is withdrawn from a full cop to an empty cop, and means responsive to a predetermined change of a rate of flow of the fluid acting on the spindle for terminating the rotation of the strand withdrawing means.

11. A brake for tensioning strand material being withdrawn from a supply cop provided on the strand handling apparatus, which comprises a rotatable shaft, a tubular spindle rotatably mounted on the free end of the shaft and designed to carry a cop containing a supply of strand material, a member secured for rotation with the shaft for withdrawing the material from the cop and causing rotation of the cop, a brake element positioned on the end of the spindle adjacent to the strand withdrawing member, said spindle being free to move axially on the shaft, means for causing air under pressure to move the spindle axially of the shaft and press the brake element against the strand withdrawing member so that it retards the rotation of the cop with a braking force sufficient to tension the strand being withdrawn from the cop, a valve responsive to the tension in the strand for regulating the rate of flow of the air under pressure acting on the spindle to vary the braking force applied thereon in accordance with the constantly decreasing diameter of the cop and thereby maintain uniform tension on the strand as it is expended from a full cop to an empty cop, said valve being arranged to substantially increase the pressure of the air acting on the spindle when the strand breaks so as to prevent overrunning of the spindle, an air flow switch provided in the air supply means so as to be actuated by a predetermined change in the rate of flow of the air acting on the brake element, and means arranged to be actuated by the air flow switch for terminating the rotation of the strand withdrawing member when a strand breaks to prevent overrunning of the cop with respect to the strand withdrawing member.

12. A brake for tensioning strand material withdrawn from a supply cop provided on strand handling apparatus, which comprises a rotatable shaft, a spindle rotatably mounted on the free end of the shaft and designed to carry a cop containing a supply of strand material, a member secured for rotation with the shaft for withdrawing the strand from the cop and causing rotation of the cop, a brake element mounted on the end of the spindle adjacent to the withdrawing means, said spindle having sufficient axial movement on the shaft so that the brake element may engage the strand withdrawing member, a supply of air under pressure, means for conducting air under pressure from the supply source to cause the spindle to move axially on the shaft so that the brake element retards the relative rotation of the spindle with a braking force sufficient to tension the strand being withdrawn from the cop by the withdrawing means, a valve positioned in the air conducting means and responsive to the tension in the strand being withdrawn from the cop for continuously regulating the pressure of the air acting on the spindle so as to vary the braking force on the spindle in accordance with the constantly decreasing diameter of the cop and maintain uniform tension on the strand as it is expended from a full cop to an empty cop, and an air flow switch including a pair of air-actuated diaphragms connected together so as to be subject to the pressure of the air in the conducting means ahead of the valve operated by the strand tension, said arrangement of the air diaphragms producing a normal operating pressure differential between the diaphragms, an orifice positioned between the diaphragms to restrict the rate of flow of air through the conducting means joining the diaphragms, and means arranged to be actuated by the air flow switch when the pressure differential between the diaphragms is not normal to terminate the rotation of the strand withdrawing means, said valve controlled by the strand tension being arranged to substantially increase the rate of flow and the pressure of the air acting on the spindle when the strand breaks to stop the cop immediately, said operation of the valve due to the breakage of the strand substantially increasing the rate of flow of air between one of the diaphragms and the valve and changing their normal pressure differential sufficiently to operate the switch and terminate the operation of the strand withdrawing means simultaneously with the stoppage of the cop.

13. A brake for tensioning strand material withdrawn from a supply cop on a strand handling apparatus, which comprises a rotatable

shaft, a spindle rotatably mounted on the free end of the shaft designed to carry a cop containing a supply of strand material, a member secured to the shaft for rotation therewith for withdrawing the strand from the cop and causing rotation of the cop, said spindle having a flange secured on one end thereof, a brake element secured on the annular flange of the spindle, an annular chamber formed in the strand serving member to receive the flange on the spindle and the brake element, said spindle having sufficient axial movement on the shaft so that the brake element may engage the bottom of the annular chamber, a supply of air under pressure, means for conducting the air under pressure from the supply source to the annular chamber, said air pressure in the annular chamber acting on the flange and moving the spindle so that the brake element engages the bottom of the chamber and retards the rotation of the spindle with a braking force sufficient to tension the strand being withdrawn from the cop, a valve positioned on the strand serving member and actuated by the tension in the strand for regulating the pressure of the air in the annular chamber so as to maintain uniform tension on the strand as it is expended from a full cop to an empty cop, said annular chamber having a leakage path between the strand serving member and the spindle whereby a predetermined flow of air occurs throughout the air conducting means, an air flow switch comprising a pair of air-actuated diaphragms positioned in the air conducting means so that each diaphragm is subject to the air pressure in the conducting means, a variable orifice provided in the air conducting means between the diaphragms, said valve being arranged to substantially increase the rate of flow of air through the air conducting means when the strand breaks to stop the rotation of the cop, means arranged to be actuated by the air switch for terminating the rotation of the strand serving member, said variable orifice serving to maintain an unbalanced air pressure in the air diaphragms for a period of time sufficient to permit the air flow switch to operate the switch and terminate the rotation of the strand withdrawing member when the strand breaks to prevent overrunning of the cop with respect to the strand withdrawing member.

14. A brake for tensioning strands withdrawn from a supply cop provided on strand handling apparatus, which comprises a support, a shaft positioned on the support, a spindle rotatably mounted on the shaft and designed to carry a cop containing a supply of strand material, means for withdrawing the strand from the cop and causing rotation of the cop by the paying off of the material therefrom, a brake element positioned between one end of the spindle and the support, said spindle being free to move axially on the shaft, means for moving the spindle axially on the shaft and press the brake element against the support with a force sufficient to retard the rotation of the spindle and tension the strand being withdrawn from the cop, means responsive to the tension in the strand for controlling the means urging the brake element against the support so as to maintain uniform predetermined tension on the strand as it is expended from a full cop to an empty cop, and means for selectively adjusting the value of the predetermined tension on the strand while the strand handling apparatus is in operation.

15. A brake for tensioning strands withdrawn from strand handling apparatus, which comprises a support, a shaft positioned on the support, a spindle rotatably positioned on the free end of the shaft and designed to carry a cop containing a supply of strand material, said spindle having a surface in close proximity to a surface of the support, means for withdrawing the strand from the cop and causing rotation of the spindle, fluid pressure actuated means for causing the surfaces to engage each other with a force sufficient to retard the rotation of the spindle and to tension the strand being withdrawn from the cop, means responsive to the tension on the strand for controlling the fluid pressure actuated means so as to maintain uniform predetermined tension on the strand as it is withdrawn from the cop, and means for selectively adjusting the value of the predetermined tension on the strand while the strand handling apparatus is in operation.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
859,216	Hadley	July 9, 1907
2,098,422	Keen et al.	Nov. 9, 1937
2,134,561	Keyes	Oct. 25, 1938
2,253,740	Van Hook	Aug. 26, 1941
2,332,655	Miles	Oct. 26, 1943
2,353,727	Howard	July 18, 1944
2,388,982	Leithiser	Nov. 13, 1945
2,430,358	Merwin et al.	Nov. 4, 1947

FOREIGN PATENTS

Number	Country	Date
411,994	Great Britain	June 21, 1934