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MATERIAL HANDLING APPARATUS

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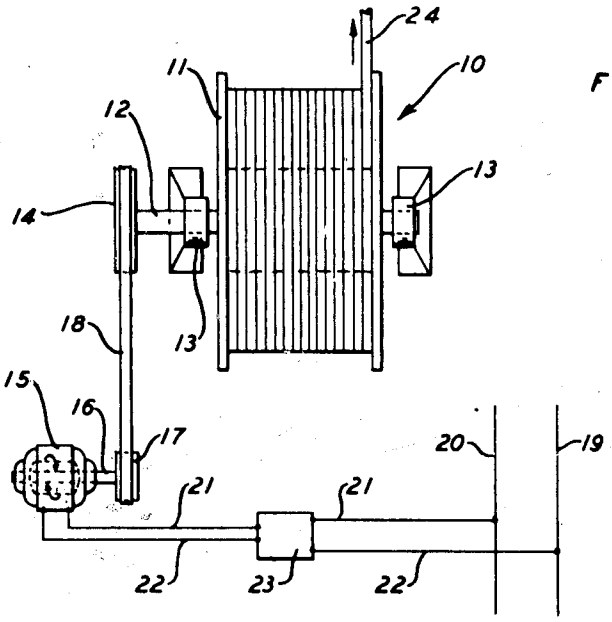



FIG. 1.

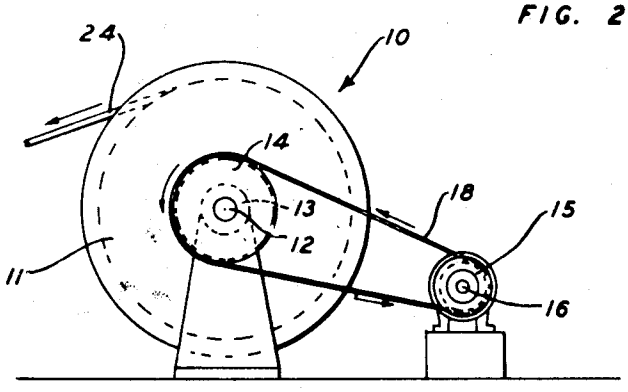



FIG. 2.

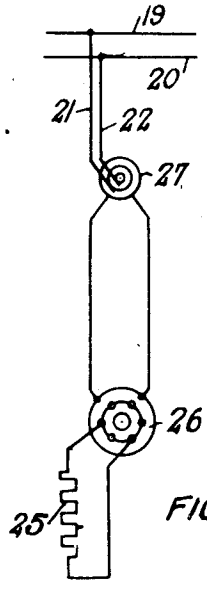
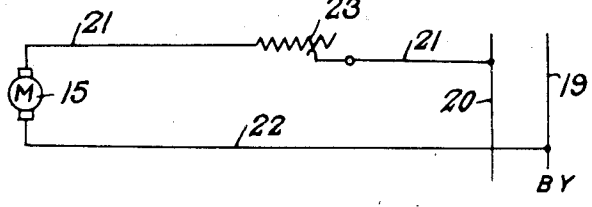



FIG. 4.

FIG. 3.




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## MATERIAL HANDLING APPARATUS

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5 Claims. (Cl. 242—45)

This invention relates to material handling apparatus and more particularly to such strand handling apparatus as is provided with a supply reel which is rotated by the withdrawal of a strand therefrom, and in which it is desirable to provide means to regulate and maintain constant the tension in the strand while being withdrawn from the reel.

An object of the invention is to provide simple and reliable means for maintaining constant tension in a strand or band of material being withdrawn from the supply of a material handling apparatus, as well as to adjustably predetermine the amount of the tension.

One embodiment of the invention contemplates the provision of an electric motor connected to the rotatable supply reel of a strand handling apparatus in such a way as to be driven thereby in a direction contrary to the normal direction of rotation of the motor when a strand is being withdrawn from and thereby driving the reel. The motor is so designed and constructed that its torque will diminish with increasing speed in its backward direction, since the rotary speed of the reel will increase as the diameter of the body of strand wound thereon diminishes, and the effective lever arm of the strand on the reel will simultaneously decrease. The motor is at all times during operation of the apparatus, supplied with current from a source of substantially constant effective potential so that even during periods of temporary stoppage the motor exerts a reverse torque upon the reel of constant amount. By altering some characteristic of the current supplied to the motor the amount of the reverse torque may be variably adjusted to variably fix the constant tension against which the strand is withdrawn.

Other objects and characteristic features of the invention will appear from the following detailed description of one embodiment of the invention taken in connection with the accompanying drawing in which the same reference numbers are used to designate identical parts, and in which

Fig. 1 is a diagrammatic plan view of a supply reel and appurtenant parts including a direct current motor for a strand handling apparatus embodying the invention;

Fig. 2 is a similar view thereof in left hand end elevation,

Fig. 3 is a diagram of the electrical connections in Fig. 1 when direct current is used, and

Fig. 4 is a similar diagram when alternating current is used.

In the embodiment of the invention herein disclosed in Figs. 1, 2 and 3, the reference numeral 10 indicates generally a strand supply reel which may be thought of as pertaining to any kind of a strand treating apparatus, not shown, which has means to withdraw the strand from the reel. The reel comprises a spool member 11 upon which the strand is wound, and which is rigidly mounted on a shaft 12 journalled in bearings 13 suitably supported. On the shaft 12 is further mounted a pulley 14 rigidly attached thereto for rotation therewith.

A direct current electric motor 15 having a shaft 16 with a driving pulley 17 thereon is coupled to the shaft 12 of the reel 10 by means of a belt 18. The motor 15 is connected to a supply circuit 19, 20 by a circuit 21, 22 including a control device 23.

The motor 15 is so wound and electrically connected to the supply 19, 20 and mechanically connected to the reel 10, that when the reel 10 is rotated counterclockwise (Fig. 2) by the withdrawal of strand therefrom, the belt 18 will drive the motor 15 backwards, i. e., in the contrary direction to that in which it would otherwise rotate as actuated by power from the supply 19, 20, the torque exerted by the motor being substantially less than the torque due to the pull on the strand 24 at the shaft 12.

The strand is withdrawn from the spool 11 with constant average longitudinal speed and thus exerts a torque at the shaft 12 which varies directly as the product of the tangential pull of the strand at the surface of the substantially cylindrical mass of strand remaining on the spool and the radius of this cylinder. Thus as the strand is withdrawn two variations of importance arise. Since the strand is withdrawn at substantially constant linear velocity, and since the diameter of the mass of strand on the spool diminishes the rotational velocity of the spool will increase. At the same time, as noted above, the torque exerted by the strand at the shaft 12 will decrease at the same rate.

It is desirable, usually, that the linear tensile stress in the strand as it is withdrawn remain substantially constant. Hence means are required to offer an adjustable resistance to the rotation of the spool by the strand which shall diminish as the diameter of the strand mass decreases.

The present invention provides to this end, a motor 15 so wound and with its parts so proportioned that when it is supplied through the circuit 21, 22 with electric current at constant potential and is furthermore overhauled by externally applied mechanical force so as to rotate backwards, then the torque of the motor at its

shaft 16 (and hence at the shaft 12 also) will diminish as its velocity of backward rotation increases. Hence the arrangement will tend to maintain from full spool to empty spool a substantially constant longitudinal tensile stress in the strand 24. Furthermore, if the operation of the apparatus to which the reel 10 pertains is temporarily stopped for one reason or another, the current supply to the motor 15 being left uninterrupted, the natural torque of the motor will prevent any over-running of the spool 11 and will maintain the strand 24 taut under approximately the predetermined, desired stress.

A regulating device 23 of any approved construction (rheostat, resistance, etc.) is connected in the supply circuit 21, 22 to adjustably vary the substantially constant torque of the motor 15 at the shaft 12, for example to suit varying types or weights of strands being withdrawn.

The precise nature and details of the motor 15 will of course vary with the current supply available, with the mass and volume of strand and spool involved, and with the speed and tensile stress desired in withdrawing the strand. It may, however, be noted that in one instance a direct current motor for a 115° volt circuit rated at ¼ H. P. and commercially described as a separately excited, compound wound direct current motor proved to possess the required characteristics.

Although, as heretofore disclosed, a direct current motor is used to provide the tensioning means, an alternating motor of suitable type and characteristics may evidently be used equally well. In such case, however, the tension adjustment control 23 will comprise a frequency changing device.

The use of alternating current requires certain precautions in handling the heavy counter currents which arise, but an alternating current motor of the peculiar type known as a rotary induction frequency converter, when made with a wide air gap between the stator and rotor windings, with the rotor windings heavy enough to handle a 200% overload safely, and with a large auxiliary resistance in series with the rotor windings through the slip rings to dissipate the braking energy as heat, presents familiar apparatus well adapted to the uses of the invention, as an illustration of an application of alternating current. A wound rotor induction motor might also be used provided that slip rings be added and connected to an external ventilated resistance to dissipate the heavy counter currents produced. Such an arrangement is illustrated diagrammatically in Fig. 4 which corresponds to Fig. 3 except that element 27 is a frequency changer and element 25 is a resistance connected through slip rings to the rotor windings of the alternating current motor 26.

The embodiment of the invention herein disclosed is evidently merely illustrative and may be varied and departed from in many ways without departing from the spirit and scope of the variable means to regulate the torque of the motor.

What is claimed is:

1. In a material handling apparatus the combination with a rotatable supply means of means to maintain a constant tension in material being withdrawn therefrom comprising an electric motor coupled thereto to be driven backwards thereby, the motor having such characteristics that over the operating range its torque varies substantially inversely with its backward speed.

2. In a material handling apparatus the combination with a rotatable supply means of means to maintain a constant tension in material being withdrawn therefrom comprising an electric motor coupled thereto to be driven backwards thereby, the motor having such characteristics that over the operating range its torque varies substantially inversely with its backward speed, and variable means to regulate the torque of the motor.

3. In a strand handling apparatus, a supply means rotated by the withdrawal of strand therefrom, and an electric motor coupled to the means to be driven backwards thereby, the motor having such characteristics that over the operating range its torque varies substantially inversely with its backward speed.

4. In a strand handling apparatus, a supply means rotated by the withdrawal of strand therefrom, a direct current electric motor coupled to the means to be driven backwards thereby, and a potential regulating device associated with the motor to adjustably vary the torque thereof, the motor having such characteristics that over the operating range its torque varies substantially inversely with its backward speed.

5. In a strand handling apparatus, a supply means rotated by the withdrawal of strand therefrom, an alternating current motor coupled to the means to be driven backwards thereby, and a device associated with the motor to adjustably vary the torque thereof, the motor having such characteristics that over the operating range its torque varies substantially inversely with its backward speed.

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