April 13, 1954 G. P. McGRAW, JR 2,675,191

TENSION CONTROL FOR TRAVELING STRIP MATERIAL

Filed Sept. 24, 1951

2 Sheets-Sheet 1

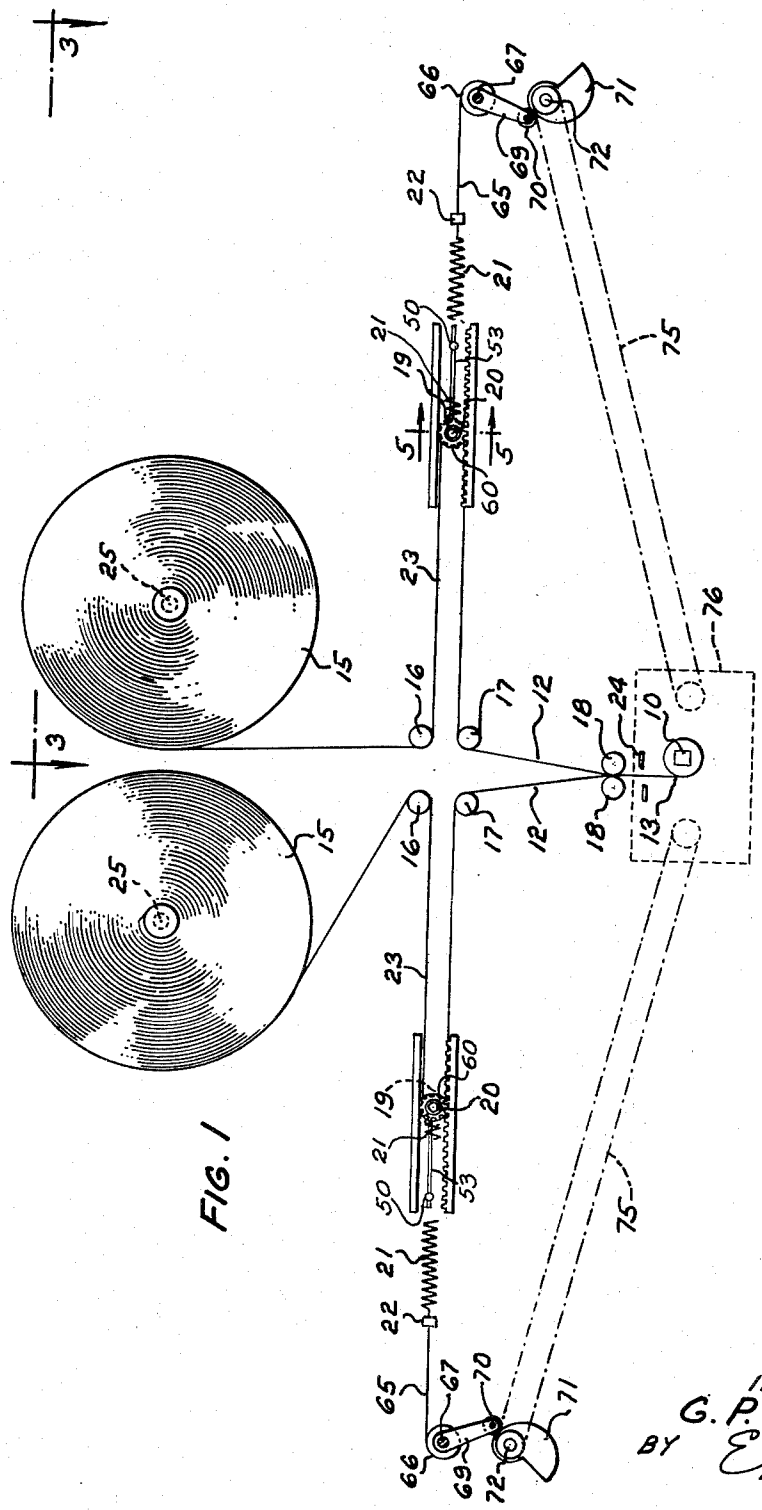

FIG. 1

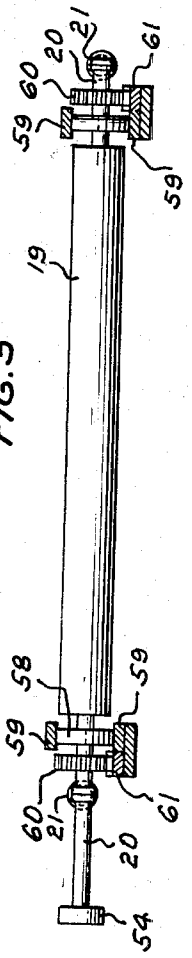

FIG. 5

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TENSION CONTROL FOR TRAVELING STRIP MATERIAL

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2 Sheets-Sheet 2

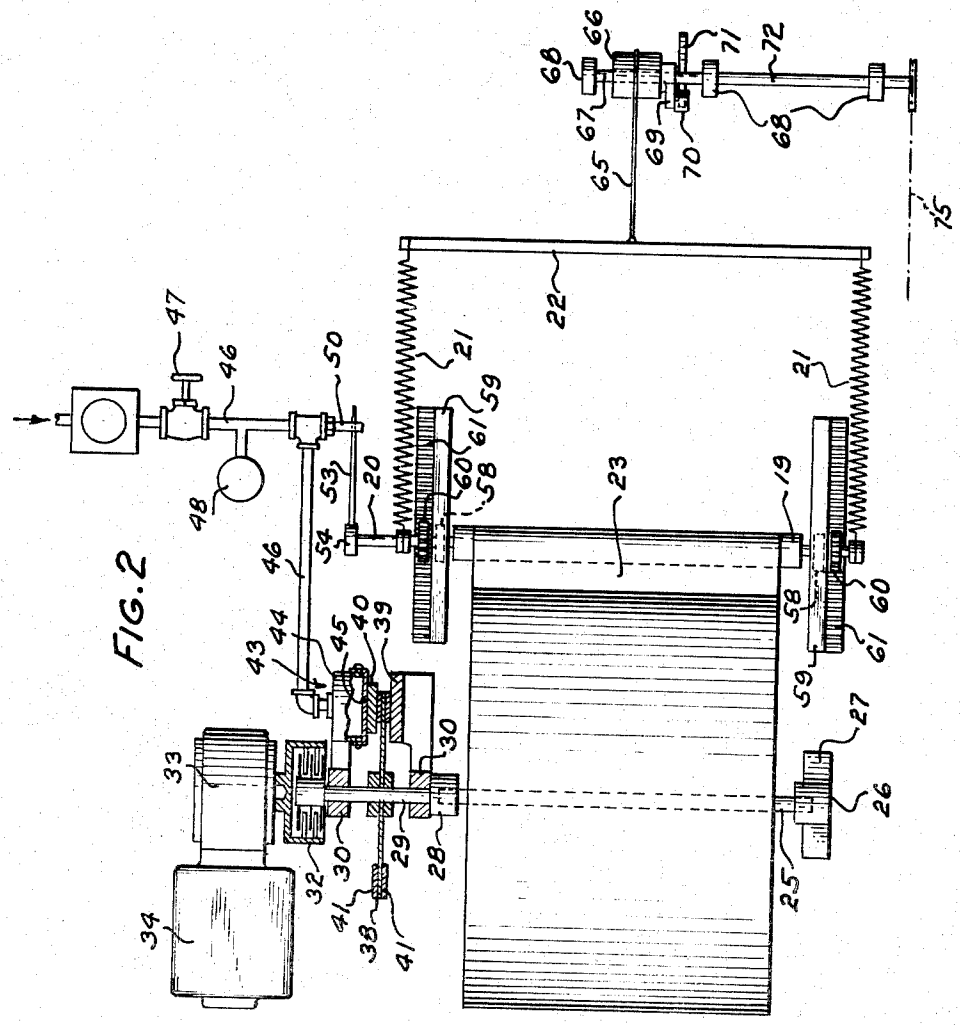

FIG. 2

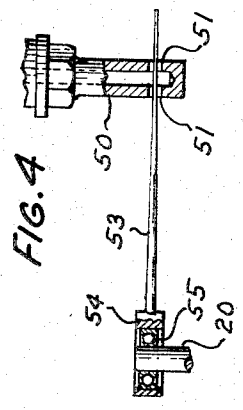

FIG. 4

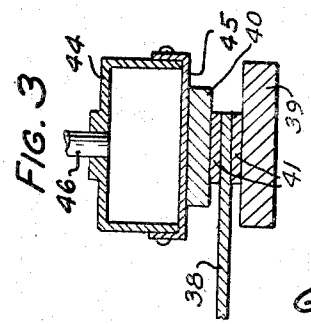

FIG. 3

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TENSION CONTROL FOR TRAVELING STRIP MATERIAL

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11 Claims. (Cl. 242—75)

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This invention relates to a tension control device and more particularly to a device for controlling the tension to strips of metallized paper as they are wound into electrical condensers.

In the art of winding condensers or the like from strip material, it is desirable to control the tension of the strips of material as they are being wound. Where the condensers are wound from supply rolls of the strip material in which the rolls are large and have considerable inertia, the frequent starting and stopping of the strip material during the winding of the condensers presents some difficulties and renders difficult the control of the tension of the strips as they are being wound.

It is an object of the present invention to provide an improved mechanism for controlling the tension of travelling strip material.

In accordance with one embodiment of the invention as applied to a condenser winding machine, a shaft is provided for supporting a supply roll of the strip material, which shaft is driven from a motor through a slip clutch to drive the supply roll. As the strip is being wound, a loop is formed therein by a dancer roller to which springs are connected for urging the roller for movement in a predetermined straight path to apply a tension to the strip. A variable braking pressure is applied to a brake disc on the shaft by a movable brake shoe actuated by compressed air from a supply line having a uniform air pressure and a control valve which is connected in the supply line and has a bleed aperture therein through which air escapes. A needle valve connected to the dancer roller for movement therewith varies the size of the bleed aperture and the amount of air bled from the supply line to control the pressure applied to the brake and the braking action on the supply roll. Thus, the movable biased dancer roller and the brake mechanism controlled by the dancer roller through the bleed valve cooperate to obtain a balanced condition to maintain a substantially uniform tension in the strip. To apply a controlled variable tension to the strip, the ends of the springs connected to the dancer roller may be connected to a mechanism for advancing or retracting the springs under control of a cam driven in timed relation to the winding of the condenser.

Other objects of the invention will become apparent by reference to the following detailed description thereof when considered in conjunction with the accompanying drawings illustrating diagrammatically a preferred embodiment thereof, in which

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Fig. 1 is a diagrammatic side elevation of a winding machine with the improved tensioning device applied thereto;

Fig. 2 is an enlarged plan sectional view of a portion of the winding and tensioning device;

Fig. 3 is an enlarged detailed view of the brake structure for retarding the rotation of the supply roll;

Fig. 4 is an enlarged detailed view of the needle valve for controlling the escape of air from the compressed air line; and

Fig. 5 is a detailed vertical sectional view showing the mechanism for mounting and guiding the dancer roller for movement.

Referring to the drawings the reference numeral 10 indicates a winding arbor of a condenser winding machine onto which a pair of composite webs or strips 12 of metallized dielectric are wound to form the condenser 13. The composite webs 12, which may be of various types, are formed from an elongated strip of paper dielectric onto one side of which a continuous film of vaporized metal has been deposited. Unwound from supply rolls 15, the webs 12 pass around guide rollers 16, 17, and 18 and dancer rollers 19, which latter are rotatably mounted on shafts 20. Each of the shafts 20 has connected thereto at opposite ends of the roller 19 one end of a pair of tension springs 21, the opposite ends of which are connected to a bar 22. The springs serve to stress the dancer rollers 19 for movement outwardly to maintain the webs 12 under tension. A loop 23 is formed in each of the webs 12 as it passes between the guide rollers 16 and 17 and around the dancer roller 19. The rollers 18 may be controlled to serve as pinch rollers to grip the webs 12 during the cutting thereof by knives 24 upon completion of the winding operation to prevent the ends of the webs 12 to be pulled back by the action of the biased dancer rollers 19.

Each of the supply rolls 15 is mounted on a supporting shaft or rod 25 which is removably and rotatably mounted in a movable bearing 26. At its other end the shaft fits into a socket member 28 on a shaft 29 and is removably connected thereto for rotation with the shaft. The shaft 29, which is rotatably supported in bearing supports 30, is driven through a slip clutch 32 and a speed reducing unit 33 from a motor 34. The slip clutch 32 applies a continuous torque to the shaft 29, which torque is sufficient to drive the supply roll of paper at a lineal speed of the web greater than that at which it is wound on the arbor. However, the effective torque applied by the shaft 29 to the roll of paper 15 is

controlled by a device for applying a variable braking or retarding force to the shaft 29.

A brake disk or drum 38 is fixed to the shaft 29 intermediate its ends and is rotatable between a fixed brake shoe 39 and a movable brake shoe 40. The brake disk 38 may be faced with brake lining 41 on opposite faces thereof if desired. The movable brake shoe 40 is actuated by any suitable actuating device 43 which is operated by air pressure. The actuating device 43 illustrated herein comprises a hollow cylinder 44 over the open end of which is secured a flexible diaphragm 45 to which the movable shoe 40 is attached. The cylinder 44 is supported against movement and is connected to a supply line 46, which in turn is connected to a source of compressed air. The air in the supply line 46 is under a predetermined constant pressure, controlled by a pressure regulating valve 47 and the pressure thereof may be indicated by a gage 48 connected to the line 46.

Means are provided to vary the amount of air supplied to the actuator 43 to vary the braking pressure applied to the brake disk 38 and to cooperate with the action of the dancer roller 19 to control the tension of the webs 12 during the winding of the condenser. For this purpose a pressure control valve 50 in the form of a bleed valve is connected into the air supply line 46 to allow a portion of the air to escape from the line. The valve 50 has a pair of diametrically opposed bleed apertures 51 therein, and a control element in the form of an elongated tapering rod or needle 53 is disposed within the apertures 51 and is movable therein to vary the size of the bleed orifices of the valve 50 to vary the amount of air escaping from the valve 50 and the supply line 46.

The tapered element or needle 53 is fixed to a ring 54 which is rotatably connected through a ball bearing 55 to the shaft 20 of the dancer roller 19. Anti-friction bearing rollers 58 (Fig. 5) mounted on each end of the shaft 20 of the dancer roller 19 ride between pairs of horizontally disposed rails 59—59 for guiding the dancer roller for movement in a straight path and a pair of gears 60 fixed to the shaft 20 on opposite ends of the dancer roller 19 mesh with racks 61 mounted parallel to the tracks 59 to impart parallel movement to the dancer roller 19 as it is carried back and forth between the pull of the web 12 and the springs 21.

It will be understood that there are two separate tension controlling units, one for each supply roll and web therefrom, which units are substantially identical in operation and in structure.

Mechanism is provided to supplement the above-described mechanism for applying a predetermined variable tension to the webs as they are being wound onto the arbor. In the embodiment disclosed herein each of the bars 22 intermediate its ends has connected thereto a cable 65 which is wound around a drum 66 mounted on a shaft 67 which is supported for rotation in suitable bearing brackets 68. A cam lever 69 secured to the shafts 67 has a cam follower 70 thereon which engages a cam 71 fixed to a cam shaft 72 suitably supported for rotation in the bearing brackets 68. The cam shafts 72 are suitably connected as by means of a sprocket and chain drive to a transmission unit 76 which is capable of being connected to the condenser winding machine for actuation in timed relation to the rotation of the winding arbor 10 and may be connected and disconnected as desired by manual actuation of a control lever (not shown).

The above-described tensioning device is capable of applying a substantially uniform tension to the webs 12 as they are wound onto the arbor or of applying a predetermined variable tension to the various portions of the webs as they are being wound. When it is desired to apply a uniform tension to the webs 12 during the winding of the condenser, the transmission 76 is disconnected from the condenser winding machine and the bars 22, to which the springs 21 are secured, remain stationary. The springs 21, which are relatively long, will thus apply a substantially uniform tension to the dancer rollers 19, tending to move the dancer rollers 19 outwardly away from the guide rolls 16 and 17. The pressure of the braking device 43, tending to govern the rotation of the shafts 29 and 25 and the feeding of the webs 12 from the supply rolls 15, cooperates with the action of the springs 21 to maintain the webs 12 under predetermined tension. With the tapered control element 53 of the valve 50 mounted for movement with the dancer roller 19 to vary the amount of air escaping from the air line 46 and thus control the braking pressure applied to the supply rolls 15, a balanced condition is achieved between the retarding or braking force applied to the supply roll and the pull of the dancer rollers 19 on the loops 23 of the webs 12 to maintain a substantially uniform tension on the webs.

Any increase in the tension on the webs 12 will result in the inward movement of the dancer rollers 19 and a corresponding movement of the tapering control element 53 resulting in the escape of more air from the bleed valve 50, thereby lessening the air pressure applied to the braking device 43 and lessening the retarding effect thereof on the rotation of the supply rolls 15 and the decreasing of the tension on the web 12 to a predetermined value. Conversely, any decrease in tension in the webs 12 during the winding of the webs results in the outward movement of the dancer rollers 19 and a corresponding movement of the tapered control elment 53 resulting in the reduction of the bleed apertures 51 and a consequent increase in pressure on the braking device 43, which results in a corresponding increased retarding effect on the rotation of the shaft 29 and the supply rolls 15, thus increasing the tension of the webs 12 to the predetermined value to which the tension device is set. The tension applied to the webs 12 may be varied to a predetermined value by adjusting the pressure regulating valve 47 to vary the air pressure in the supply line 46.

The device is capable of applying a predetermined variable tension to the webs 12 during the winding of the webs into a condenser. To accomplish this the transmission 76 is connected to the winding machine to cause the rotation of the shafts 72 and the cams 71, which actuates the drums 66 and the bars 22 in timed relation to the winding of the webs to vary the stress of the springs 21 on the dancer rollers 19 and thus vary the tension in the webs 12 as they are being wound. The cams 71 are removably secured on the shaft 72 and may be replaced by others of various designs and contours to effect the desired movement of the drums 66 and obtain the desired predetermined variable tension of the webs 12 during the winding of the webs.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the

principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A tension control device for travelling material comprising means for supporting a wound supply of material, means for withdrawing material from said supply, means for rotating said wound supply of material to unwind said material, variable brake means for retarding the rotation of said supply of material, and means for varying the effective braking force of said brake means including means engaging the material intermediate the supply and the withdrawing means and movable in response to variations in tension of said material, means connecting a source of compressed air under a uniform pressure to the brake means for conducting the compressed air to said brake means to actuate the brake means, and means in said connecting means for bleeding off a portion of the air being fed to the brake to vary the pressure of the air to said brake means in accordance with movements of the material engaging means.

2. A device for tensioning a strip of material as the strip is being wound onto an arbor comprising a shaft for supporting a roll of strip material, drive means including a yieldable connection for rotating said shaft to unwind the strip from the roll, guide rollers including a movable dancer roller for forming a loop in said strip as it advances toward said arbor and for tensioning said strip, spring means stressing said dancer roller for movement in a predetermined path to increase the size of the loop of the strip and apply a tension thereto, a brake comprising a brake member on said shaft and a brake shoe engageable with said member, a pneumatic device for actuating said brake shoe, conduit means connectible to a supply of compressed air at a predetermined constant pressure for supplying said compressed air to said pneumatic device for urging said shoe against said brake member to retard the rotation of said shaft, valve means venting a portion of said compressed air from said conduit means, and means movable with said dancer roller for controlling said valve to vary the amount of air vented thereby to vary the braking pressure of the shoe on said drum.

3. A tension control device for travelling strip material comprising means for advancing said strip, means including a shaft for supporting a roll of strip material, drive means for rotating said shaft to unwind said roll, guide means including a movable dancer roller for guiding said strip through a predetermined path and forming a loop in said strip, spring means stressing said dancer roller for movement in one direction tending to increase the size of the loop of the strip and apply tension to said strip, fluid actuated brake means connectible to a supply of fluid under a predetermined uniform pressure for applying a braking force to said shaft to retard the unwinding of said supply roll, and a valve communicating with said fluid operated brake means for releasing some of the fluid therefrom, said valve having a control element movable with said dancer roller for varying the amount of fluid released to effect a variation in the braking pressure applied to said shaft in response to variations in position of said dancer roller.

4. A strip tensioning device for use in a strip processing apparatus having means for advancing said strip, said tensioning device comprising means including a shaft for supporting a supply roll of strip material, drive means including a slip clutch for rotating said shaft to unwind the strip from said roll, guide means for guiding said strip through a predetermined path, a dancer roller, resilient means stressing said dancer roller for movement in one direction tending to move a portion of said strip transversely to the path of travel thereof and to apply tension to said strip, fluid actuated brake means connectible to a supply of fluid under a predetermined uniform pressure for applying a braking force to said shaft to retard the unwinding of said supply roll, a valve communicating with said fluid operated brake means having an orifice for releasing some of the fluid therefrom, said valve having a relatively long tapering control element disposed in said orifice for movement with said dancer roller for varying the size of the orifice and the amount of fluid released to effect a variation in the braking pressure applied to said shaft in response to variations in position of said dancer roller.

5. A strip tension device for travelling strip material comprising means for advancing said strip, means including a shaft for supporting a roll of strip material, drive means including a yieldable connection for rotating said shaft to unwind the strip from said roll, guide means including a movable dancer roller for guiding said strip through a predetermined path and forming a loop in said strip, spring means stressing said dancer roller for movement in one direction tending to increase the size of the loop of the strip and apply tension to said strip, fluid actuated brake means connectible to a supply of fluid under a predetermined uniform pressure for applying a braking force to said shaft to retard the unwinding of said supply roll, a valve communicating with said fluid operated brake means for releasing some of the fluid therefrom, said valve having a control element movable with said dancer roller for varying the amount of fluid released to effect a variation in the braking pressure applied to said shaft in response to variations in position of said dancer roller, and cam controlled means operable in timed relation to the means for advancing a strip to vary the stress of said spring means on said dancer roller for effecting a controlled variation in tension in the strip.

6. A tension control device for travelling strip material comprising means for advancing said strip, means including a shaft for supporting a roll of strip material, drive means including a slip clutch for rotating said shaft to unwind the strip from said roll, guide means including a movable dancer roller for guiding said strip through a predetermined path and forming a loop in said strip, means including a pair of springs having one end of each thereof connected to said dancer roller for stressing said dancer roller for movement in one direction tending to increase the size of the loop of the strip and apply tension to said strip, a movable supporting member connected to the other ends of said springs, a cam rotatable in timed relation to said means for advancing said strip, means actuated by said cam for moving said support to vary the stress of said springs on said dancer roller for effecting a controlled variation in tension in the strip, fluid actuated brake means connectible to a supply of fluid under a predetermined uniform pressure for applying a braking force to said shaft to retard the unwinding of said supply roll, a valve communicating with said fluid operated brake means having an orifice for releasing some of the fluid therefrom, and a relatively long

tapering control element disposed in said orifice, said tapering element being connected to the dancer roller for movement therewith to vary the size of the orifice and the amount of fluid released to effect a variation in the braking pressure applied to said shaft in response to variations in position of said dancer roller

7. A device for tensioning a strip of material as the strip is being wound onto an arbor comprising a shaft for supporting a roll of strip material, means for rotating said shaft to unwind the strip from the roll, guide rollers including a movable dancing roller for forming a loop in said strip as it advances toward said arbor and for tensioning said strip, spring means for stressing said dancing roller for movement in a predetermined path to increase the size of the loop of the strip and apply a tension thereto, cam controlled means operable in timed relation to the rotation of said arbor for varying the stress of said spring means on said dancer roller and the tension applied thereby to said strip, a brake comprising a brake member on said shaft and a brake shoe engageable with the member, a pneumatic actuator for said shoe, conduit means connectible to a supply of air compressed to a predetermined constant pressure and to said actuator for urging said shoe against said drum to retard the rotation of said shaft, valve means for bleeding a portion of said compressed air from said actuator, and means movable with said dancing roller for controlling said valve to vary the amount of air escaping therefrom and the braking pressure of the shoe on said drum.

8. A tension control device for travelling strip material comprising means for advancing said strip, a shaft for supporting a roll of strip material, drive means including a slip clutch for rotating said shaft to unwind the strip from said roll, guide rollers including a movable dancer roller for forming a loop in said strip as it advances, spring means stressing said dancer roller for movement in a predetermined path to increase the size of the loop of the strip and apply tension thereto, an air-operated braking device for applying a braking force to said shaft to retard the unwinding of said roller, means connectible to a supply of air under a predetermined uniform pressure for supplying said air to said braking device, a valve for venting some of the air supplied to said braking device, said valve having a control element for varying the amount of air vented from said valve, and means connecting said control element for movement with said dancer roller to effect a variation in the braking pressure applied to said shaft in response to variations in position of said dancer roller.

9. A tension control device for travelling strand or strip material comprising means for advancing said strip, means including a shaft for supporting a roll of strip material, drive means including a slip clutch for rotating said shaft to unwind the strip from a roll, guide rollers including a movable dancer roller for forming a loop in said strip as it advances, spring means stressing said dancer roller for movement in a predetermined path to increase the size of the loop of the strip and apply tension thereto, an air-operated braking device for applying a braking force to said shaft to retard the unwinding of said roll, means connectible to a supply of compressed air at a predetermined uniform pressure for supplying said air to the braking device, a valve for venting some of the air supplied to said braking device, said valve having a control element for varying the amount of air vented from said valve, means connecting said control element to said dancer roller for movement therewith to effect a variation in the braking pressure applied to said shaft in response to variations in position of said dancer roller, and means operable in timed relation to the means for advancing said strip to vary the stress of said spring means on said dancer roller for effecting a controlled variation in tension in the strip.

10. A tension control device for travelling strip material comprising means for advancing said strip, a shaft for supporting a roll of strip material, drive means including a yieldable element for rotating said shaft to unwind the strip from a roll, guide rollers including a movable dancer roller for moving a portion of said strip transversely of its path of travel, spring means stressing said dancer roll for movement in a predetermined path to increase the transverse movement of said portion of the strip and apply tension to the strip, air-operated brake means connectible to a supply of compressed air at a predetermined uniform pressure for applying a braking force to said shaft to retard the unwinding of said roller, a valve for venting some of the air supplied to said brake means, said valve having a control element for varying the amount of air vented from said valve, and means connecting said control element for movement with said dancer roller to effect a variation in the braking pressure applied to said shaft in response to variations in position of said dancer roller.

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