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S. F. FRENCH

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TENSIONING APPARATUS

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Fig. 1.

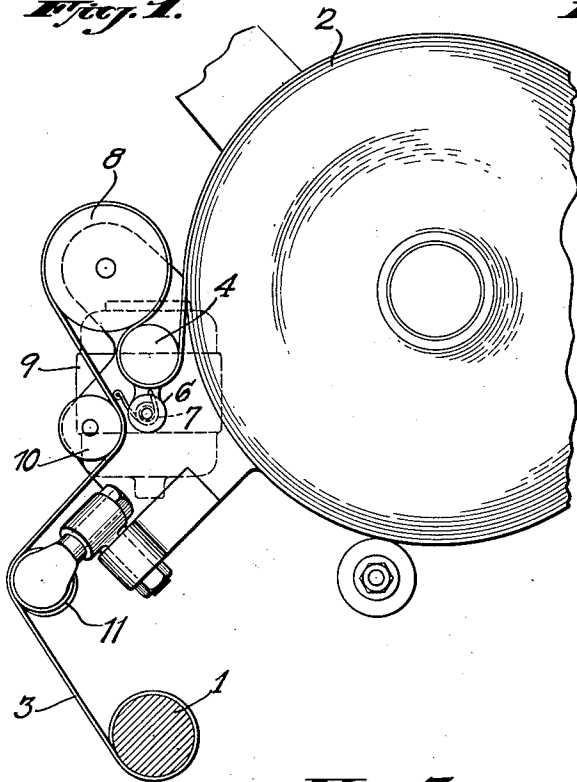


Fig. 2.

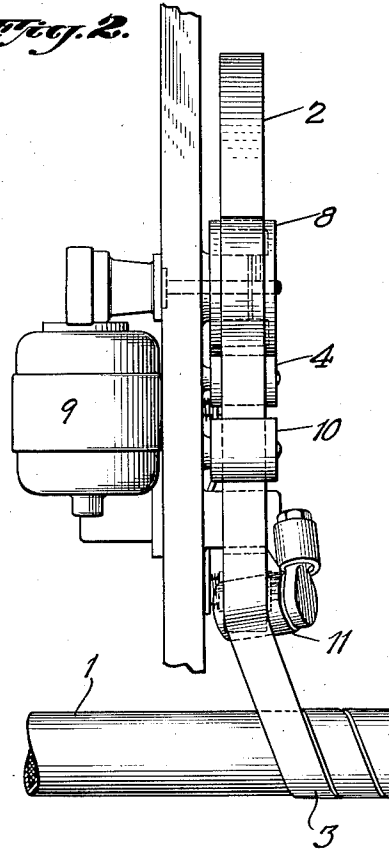
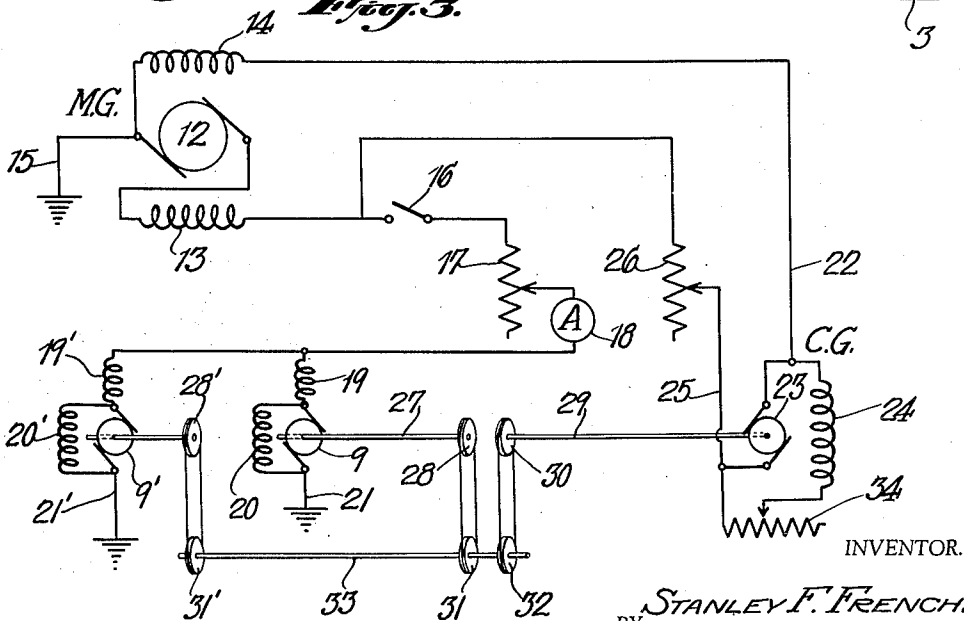


Fig. 3.



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TENSIONING APPARATUS

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9 Claims. (Cl. 271—2.3)

My present invention relates to an electric tensioning device for supplying a substantially constant tension to strip or filamentary material drawn under tension at variable speeds. The invention relates more particularly to compensating means for electric tensioning devices such as shown in my Patent No. 1,968,251 granted July 31, 1934, whereby a tension applying electric current may be varied or compensated to maintain a substantially constant torque and tension under varying speeds of the material subjected to tension.

In the apparatus of the above mentioned Patent 1,968,251 the tension and tension controlling apparatus comprises a circuit containing a motor, the armature of which is driven by the passage of the tensioned material in a direction opposite to the torque applied by the current in the circuit. The direction of the torque imposed by the electric current on the motor being opposite to the direction of movement of the tensioned material, imposes a tension on the latter directly proportional to the torque of the motor. Although the current imposes a predetermined constant torque on the motor when the armature of the latter is held stationary, this torque increases when the armature is rotated in a direction opposite to the torque and thus increases the tension as the speed of the tensioned material increases.

This increase in torque is due to the building up of an electro-motive force which has the same effect as a reduction in the resistance through the motor armature and thus permits the passage of an increased current through the motor.

In the normal operation of a motor the current through the armature is greatest, and the greatest torque is accordingly obtained, when the armature is stationary. As the armature is driven or rotated by the applied torque it builds up a reverse or back electro-motive force which opposes that of the driving circuit and thus decreases the current through the armature. When the armature is driven in a reverse direction against the torque by the passage of the tensioned material, the effect is just the reverse, inasmuch as the rotation of the armature is reversed, and an electro-motive force is generated which is additive to that of the driving circuit. The increased current in the armature caused by this additive electro-motive force increases the torque, which increases with the armature current, and thus increases the tension.

My invention provides a means whereby this increased armature current and resultant in-

crease in torque and tension may be compensated and the tension held constant or controlled and, moreover, whereby several tensioning devices may be controlled and held constant by unitary means.

The various features of my invention are illustrated, by way of example, in the accompanying drawing, in which—

Figs. 1 and 2 are side and front views, respectively, of tensioning mechanisms embodying a preferred form of the invention, and

Fig. 3 is a diagrammatic electric diagram of the tension controlling circuits and mechanisms.

In my invention I provide means controlled by the passage of the tensioned material to decrease the voltage or electro-motive force of the current supplied to the tensioning motor as the speed of passage of the tensioned material increases, and thereby to counteract the effect of the additive electro-motive force generated by the reverse rotation of the tensioning motor armature. Inasmuch as the current may be supplied to a number of tensioning motors in parallel, my control means may be applied to the simultaneous control of a number of tensioning motors supplying material at similar speeds to a common object as, for example, a number of strips for wrapping onto a core or cable, or a number of strands of textile or other material supplied to form a thread or cable.

In my circuit I provide means whereby the tension may be adjusted for any particular speed with the material at rest. I also provide means whereby the compensating effect may be adjusted so as to increase or decrease the compensation of current, and thus to tension the material in a controlled manner in a predetermined relation to its speed.

In Fig. 1 an embodiment of the invention is shown, by way of example, as applied to the tensioning mechanism shown in Patent 1,968,251 for wrapping a strip of paper or other material onto a rotating core 1 from a supply reel 2. In this embodiment there is a relative rotation of the core and the supply reel, either by rotating the supply reel about the core as described in the patent to wrap strip 3 from the reel about the core, or by holding the reel 2 stationary and rotating the core 1 so as to wind the strip about the core. For this purpose the strip 3 is drawn from the reel 2 about an idle roller 4 carried on pivoted arms 6 and held by a spring 7 tightly against the reel 2, and then passes over a tensioning roller 8 which is connected to the armature of the tensioning motor 9 either directly or

through speed change mechanism. The strip is then drawn about succeeding idler rollers 10 and 11 as described in the above mentioned patent, and wrapped on the core 1.

Current is supplied to the tensioning motor 9 from a main compound wound generator 12 having a series coil 13 and a shunt coil 14. One terminal of the main generator 12 is connected to ground through the conductor 15, and the other passes from the series coil 13 through a switch 16, variable rheostats 17 and an ammeter 18 to the tensioning motor 9. This tensioning motor preferably has a compound wound field consisting of series field coil 19 and shunt field 20. From the motor 9 the current passes to ground through the main 21.

The counter electro-motive force generated by the rotation of the motor armature by the tensioning material is compensated by decreasing the current through the main generator shunt field winding 14 in proportion to the above electro-motive force. For this purpose the circuit through the shunt field winding 14 leads through a conductor 22 to a shunt wound compensating generator 23 having a shunt field coil 24, and returns through a return conductor 25 containing a variable resistance or rheostat 26.

The armature of the compensating generator 23 is driven at a speed proportional to the speed of movement of the tensioned material and, therefore, at a speed proportional to or related to that of the motor 9. This may be accomplished by a number of different mechanisms, depending upon the particular conditions under which the apparatus may be used. For example, the armature of the compensating generator 23 may be driven by the core 1, or the means that rotate this core when a rotating core is used, and as the speed of movement of the strip 3 is proportional to the rotation of the core, the rotation of the armature 23 will be in direct relation or in proportion to the speed of rotation of the tensioning roller 8; or, if the reel 2 be rotated about the core, the armature of the compensating generator 23 may be driven directly by this rotating means or, the armature of the generator 23 may be geared or otherwise driven from the shaft of the tensioning roll 8, or of any of the idler rollers over which the strip is passed. These and other means may be employed to ensure a rotation of the armature of the compensating generator 23 at a rate proportional to the rotation of the armature of the tensioning motor 9.

These various driving means are illustrated diagrammatically in Fig. 3, in which the armature of the motor 9 drives a shaft 27 carrying a pulley 28, and the armature of the generator 23 is driven by a shaft 29 carrying a drive pulley 30. The pulleys 28 and 30 are driven from pulleys 31 and 32, respectively, rotated from a common source as, for example, a common shaft 33. Where a number of strands or strips are supplied at equal speeds or to a common winding or wrapping device, they may all be tensioned by current supplied from the generator 12 and compensated by the compensator generator 23. For this purpose it is only necessary to duplicate the motor 9 as at 9', the various field coils 19' and 20', connections 21' and the drive pulleys 28' and 31', the latter of which may be mounted on the common shaft 33.

It will be evident that the electro-motive force generated by the compensating generator 23 may be adjusted by adjusting the resistance in the

field winding 24. For this purpose an adjustable rheostat 34 is provided in this circuit. An additional or alternative control may be obtained by the variable rheostat 26.

In using the apparatus the variable resistance 17 may be adjusted to obtain a desired torque, and the current required for this torque may be read in the ammeter 18. The winding or movement of the tensioned material may then take place and the variable rheostat 34 be adjusted to maintain a constant current through the ammeter 18 and thus through the motor armature 9. This will provide a constant torque and a constant tension. If it is desired to decrease or increase the tension slightly with increases of speeds, this may be accomplished by the compensating rheostat 34.

Through the above invention, therefore, it is possible to maintain the tension constant throughout various changes in speed of the tensioned material, or to cause controlled rises or drops in the tensioned material with changes in speed.

It will be understood that the specific examples of main generator and compensating generator are given merely by way of example, and that other main generators than a compound wound generator may be employed, and other compensating generators than a shunt wound generator may be employed. These and other modifications may be made within the scope of my invention as defined in the appended claims.

What I claim is—

1. Tensioning apparatus which comprises a main compound wound electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of tensioned material to rotate said motor against the torque imposed by current from said generator, a compensating generator in the circuit of the shunt field of said main generator, and means for driving said compensating generator by said tensioning means to decrease the current in said shunt field circuit with increase in the speed of said tensioned material.

2. Tensioning apparatus which comprises a main compound wound electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of tensioned material to rotate said motor against the torque imposed by current from said generator, a compensating generator in the circuit of the shunt field of said main generator, means for driving said compensating generator by said tensioning means to decrease the current in said shunt field circuit with increase in the speed of said tensioned material, and an adjustable rheostat in the field of said compensating generator.

3. Tensioning apparatus which comprises a main compound wound electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of tensioned material to rotate said motor against the torque imposed by current from said generator, a shunt wound compensating generator in the circuit of the shunt field of said main generator, and means for driving said compensating generator by said tensioning means to decrease the current in said shunt field circuit with increase in the speed of said tensioned material.

4. Tensioning apparatus which comprises a main compound wound electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of tensioned material to rotate said motor against the torque imposed by current from said genera-

tor, a compensating generator in the circuit of the shunt field of said main generator, means for driving said compensating generator by said tensioning means to decrease the current in said shunt field circuit with increase in the speed of said tensioned material, and a tension adjusting rheostat in the circuit of said tensioning motor.

5. Tensioning apparatus which comprises a main compound wound electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of tensioned material to rotate said motor against the torque imposed by current from said generator, a compensating generator in the circuit of the shunt field of said main generator, means for driving said compensating generator by said tensioning means to decrease the current in said shunt field circuit with increase in the speed of said tensioned material, an ammeter, and a tension adjusting rheostat in the circuit of said tension motor.

6. Tensioning apparatus which comprises a main compound wound electric generator, a plurality of tensioning motors connected in parallel circuits with said generator, tensioning means actuated by the passage of tensioned material to rotate said motors against the torque imposed by current from said generator, a compensating generator in the circuit of the shunt field of said main generator, and means for driving said compensating generator by said tensioning means to decrease the current in said shunt field circuit with increase in the speed of said tensioned material.

7. Tensioning apparatus which comprises a

main electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of the tensioned material to rotate said motor against the torque imposed by current from said generator, a compensating generator, and means for driving said compensating generator by said tensioning means, said compensating generator being electrically connected to said main generator to decrease the generated electro-motive force of said main generator as the reverse rotation of said tensioning motor increases.

8. Tensioning apparatus which comprises a main electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of the tensioned material to rotate said motor against the torque imposed by the current from said main electric generator, and means driven by the passage of the tensioned material to generate a counter electro-motive force to compensate for the electro-motive force generated by said tensioning motor.

9. Tensioning apparatus which comprises a main electric generator, a tensioning motor connected in circuit with said generator, tensioning means actuated by the passage of the tensioned material to rotate said motor against the torque imposed by current from said generator, and means driven by the passage of said tensioned material to compensate for the electro-motive force generated by said motor when driven by said tensioned material.

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