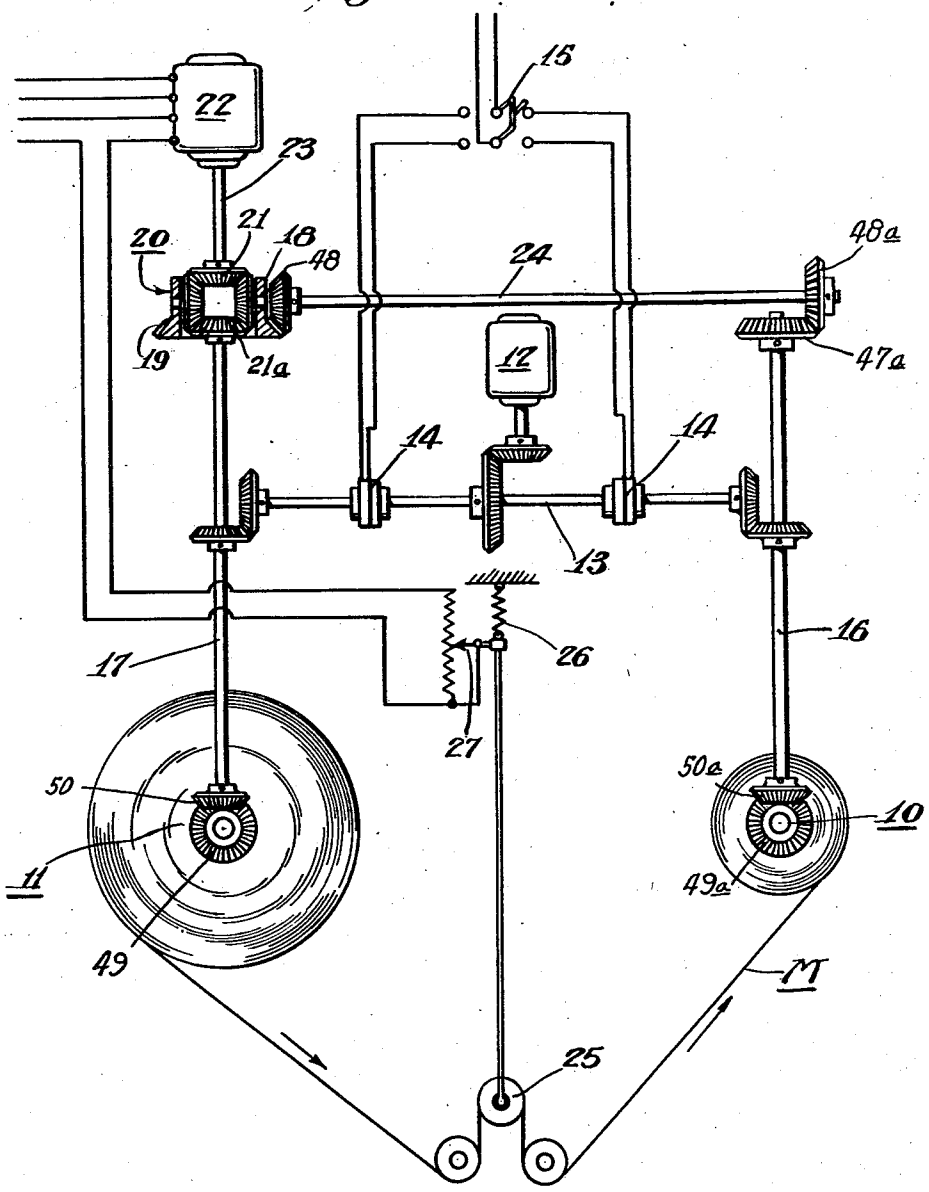
Nov. 13, 1945. W. B. HEINZ 2,389,047

TENSION REGULATING MECHANISM

Filed July 3, 1943 2 Sheets-Sheet 1

Fig. 1.



Inventor:
Winfield B. Heinz
by his Attorneys
Howson & Howson

Nov. 13, 1945. W. B. HEINZ 2,389,047

TENSION REGULATING MECHANISM

Filed July 3, 1943 2 Sheets-Sheet 2

Fig. 2.

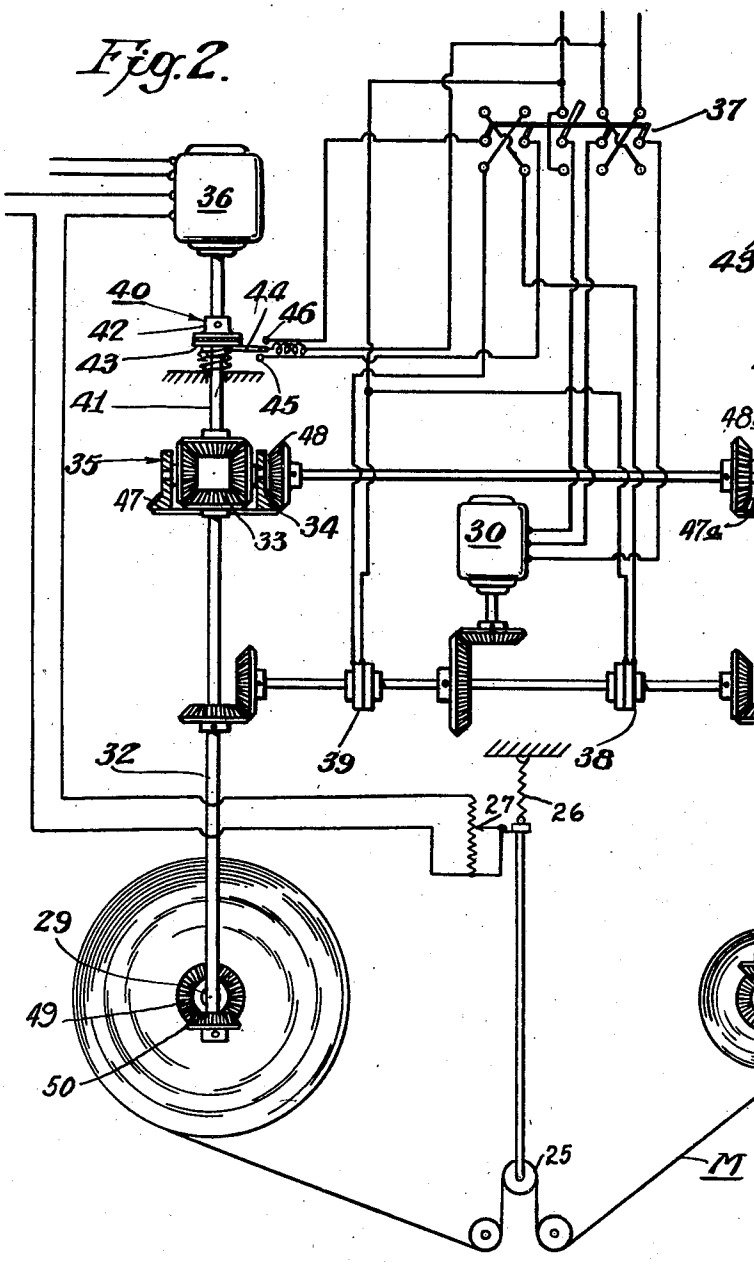
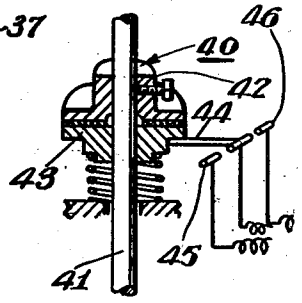


Fig. 3.



Inventor:—
Winfield B. Heinz
by his Attorneys
Howson & Howson

Patented Nov. 13, 1945 2,389,047

UNITED STATES PATENT OFFICE

2,389,047

TENSION REGULATING MECHANISM

Winfield B. Heinz, Bound Brook, N. J.

Application July 3, 1943, Serial No. 493,457

6 Claims. (Cl. 242—75)

This invention relates to winding machines and more particularly to that type of winding machine in which a strip is wound from one to another of a pair of rolls. A typical machine of this character is the ordinary dyeing jig in which the material is alternately wound from one to another of a pair of rolls and during its passage to the other roll is submerged in dyeing or liquid treating baths. Obviously, in driving such a machine, it is difficult to maintain the material under anything approximating a uniform tension, this difficulty arising principally from the constantly varying diameters of the winding rolls, due to which there is a constant variation in the rotative speed of the rolls and in the linear speed of the strip passing from one to the other thereof.

An important object of the present invention is the provision of an attachment for machines of this character which may be readily applied to existing machines or incorporated in such machines without any substantial variation in the present structure and which will enable maintenance of a substantially constant tension throughout the entire transfer operation regardless of the direction of the movement of the strip.

A further and more specific object of the invention is the utilization of the characteristics of the common differential in maintenance of such constant tension.

A still further object of the invention is the provision of means for automatically controlling the drive to such rolls in a manner such that the roll having the smaller diameter is always driven, thereby maintaining a much more nearly uniform strip speed than is possible where the drive is constantly applied to one of the rolls.

These and other objects I attain by the construction shown in the accompanying drawings, wherein for the purpose of illustration, I have shown a preferred embodiment of my invention and wherein:

Figure 1 is a diagrammatic view illustrating the application of my invention to the dyeing jig;

Figure 2 is a diagrammatic illustration of a modified form of my invention in which means are provided for automatically transferring the drive from one to another of the rolls of the machine; and

Figure 3 is a semi-diagrammatic perspective partially in section illustrating a type of switch which may be utilized in the control of Figure 2.

Referring now to the drawings and more particularly to Figure 1 thereof, numerals 10 and 11 designate winding rolls and 12 a driving motor therefor. This motor drives a shaft 13, which, through magnetic clutches 14 controlled by a selector switch 15, may be connected to the drive shafts 16 and 17 propelling the rolls 10 and 11 respectively. In accordance with my invention, the drive shafts 16 and 17 are extended and connected respectively to the cage 18 and one gear 19 of a differential gear 20. The second gear 21 is driven by a torque motor 22 supplying constant torque to the gear. This torque motor is for convenience of illustration shown as an electrical motor, but may obviously be substituted for by any of the well-known mechanical forms. It will be noted that while the differential gear employed is mechanically identical with the differential as utilized in an automobile, the applied power of motor 22 is not connected to the cage, but to one of the gears. Continuing the parallel to an automotive drive, the shaft 23 of motor 22 corresponds to one of the wheel axles while shaft 17 corresponds to the second wheel axle and shaft 24, which is connected to the drive shaft 16, corresponds to the drive shaft of an automobile. With this connection of motor 22, the motor constantly tends to turn shafts 16 and 17 in opposite directions and in winding directions and the motor accordingly tends to constantly attempt to wind material on both winding rolls thus maintaining a continuous tension in the material M without regard to the direction in which this material may be traveling. This torque will be constantly that applied by motor 22 and accordingly will remain constant during the entire pass of material M from one to the other of the rolls. It is essential that the gearing be so arranged that shaft 23 will stand still when the two rolls 10 and 11 are equal in size and the shafts 16 and 17 are turning at identical speeds. Although the exact values and combinations of shaft speeds and gear ratios are matters of mechanical design, the assembly which is schematically illustrated in Fig. 1 will operate correctly if the speeds and gear ratios are as follows:

Speed of roll 10 when rolls are equal in size	R. P. M.— 50
Speed ratio between gears 49a:50a	1:1
Speed of shaft 16	R. P. M.— 50
Speed ratio between gears 47a:48a	1:1
Speed of shaft 24	R. P. M.— 50
Speed ratio between gears 48:19	2:1
Speed of gear 19	R. P.M.— 25
Speed ratio between gears 19:21a (when gear 21 is standing still)	1:2
Speed of gear 21a and shaft 17	R. P. M.— 50
Speed ratio between gears 50:49	1:1
Speed of roll 11	R. P. M.— 50

Although the scheme of connection to the differential as shown in the figures is desirable from the standpoint of mechanical convenience, it should be recognized that with suitable alterna-

tive arrangements of external gearing, the differential would serve equally well if the two roll drive shafts were connected to the two differential gears, with the torque motor connected to the cage. In other words, any of the three elements of the differential may be connected to any of the torque motor or rolls, the mode of connection to be used in any given case being merely a matter of design practicability.

The torque applied by motor 22 may be regulated as desired. In the present illustration of an electrical torque device, this may be accomplished by engaging the material M with a tension roller 25 operating against a spring 26. Movements of this roller due to variations in tension may be utilized to control a rheostat 27 controlling the output of motor 22. In mechanical torque motors the movement of roller 25 may be utilized to operate a pressure regulator or other means for varying the output of the motor.

In the operation of the apparatus, the motor 12 operates at a constant speed and always in one direction. One or the other of the clutches 14 is energized through switch 15 resulting in the driving of the corresponding winding roll 10 or 11. At the end of a pass the switch 15 is reversed to cause winding upon the other of the winding rolls. Throughout this operation, the motor 22 exerts a continual torque, always in one direction, which tends to rotate the winding rolls in opposite directions, thus exerting a continual tension in the material M regardless of its direction of travel. Since the motor 12 is a constant speed motor, the speed of motor 22 will automatically adjust itself to compensate for the difference in the instantaneous speeds of winding rolls 10 and 11. When winding roll 10 turns faster than the roll 11, the motor 22 will rotate in one direction; when winding rolls 10 and 11 are of equal size and rotate at identical speeds, the motor 22 stands still and when the effective diameter of the winding roll 11 is less than that of the winding roll 10, the direction of rotation of the motor 22 will be reversed. Regardless of its speed or direction of rotation, the motor 22 has been exerting a uniform tension on the material.

In the form of invention shown in Figures 2 and 3, the winding rolls 28 and 29 are driven by a reversible motor 30. The driving connections are such that the rolls are driven in the same direction, a reversal of direction of travel of the material M being obtained by reversing the direction of operation of the motor 30. As in the construction of Figure 1, the drive shafts 31 and 32 of winding rolls 28 and 29 are extended and connected to a gear 33 and a cage 34 of a differential 35 and the torque motor 36 is connected to the second gear of the differential. The reversing switch 37 controlling the direction of operation of motor 30 serves in reversal of motor 36 to likewise reverse connections to magnetic clutches 38 and 39, determining which of rolls 28 and 29 is driven by the motor 30. The circuits of clutches 38 and 39 include a reversing switch 40 controlled by the direction of rotation of shaft 41 of motor 36. A suitable switch for this purpose is semi-diagrammatically illustrated in Figure 3 and comprises a disc 42 secured to shaft 41, a spring-pressed disc 43 confronting the disc 42 and having frictional engagement therewith, and a contact arm 44 carried by the disc 43 and coacting with contacts 45 and 46. During the rotation of shaft 41 in one direction, the contact arm 44 will be pressed against the contact 45 and thus maintain a circuit to one of the clutches 38 and 39. When the direction of rotation of shaft 41 is reversed, the contact arm will move to the contact 46, thereby opening the circuit of the previously energized magnetic clutch and closing the circuit of the other thereof, thus transferring the drive of motor 30 from one to the other of the winding rolls 28 and 29.

It will be recalled from the description of operation in connection with the form of invention shown in Figure 1, that when a pass is started the shaft of the torque motor will rotate in one direction and will continue to do so until the effective diameters of the winding rolls are equal. At this time, the rotation of the torque motor shaft ceases and subsequently reverses in the direction of operation. This reversal takes place as the initially driven winding roll 28 or 29 attains a somewhat larger diameter than that of the undriven roll. At this time, the switch 40 becomes effective and disconnects the drive of motor 30 from that roll which was originally driven and transfers it to the roll having the smaller diameter.

In order that shaft 41 stand still when shafts 31 and 32 are turning at identical speeds, the gear should be proportioned as already described in connection with Fig. 1.

It will be seen that in this form of the invention, the torque motor drive serves not only to maintain a constant tension in the material M, but likewise serves as a means for maintaining the drive of motor 30 to the roll having the smaller diameter. The fluctuation in linear speed in material M will accordingly amount to substantially one-half that normal occurring during the pass from one to the other of the rolls. The tension control 25, 26, 27, hereinbefore described in connection with Fig. 1, may obviously be utilized to control the output of the motor 36. Since the constructions herein illustrated are obviously capable of modification without departing from the spirit of my invention, I do not wish to be understood as limiting myself thereto, except as hereinafter claimed.

I claim:

1. The combination in a winding machine of a pair of rolls, means to selectively drive said rolls in the same direction to cause material to be wound from one upon the other thereof, means controlled by the relative rotative speeds of the rolls for automatically transferring the drive from one to the other thereof, a differential having one of its three elements in driving relation to one of the rolls and another of its elements in driving relation to the other of said rolls, means to exert a unidirectional torque on the third element of the differential, and means to control the degree of effort exerted by the last-named means from the tension of the material between the rolls.

2. The combination in a winding machine of a pair of rolls, means to selectively drive said rolls to cause material to be wound from one upon the other thereof, means controlled by the rotative speed of one roll with relation to the rotative speed of the other roll for transferring the drive from one to the other thereof, a torque motor having driving connection with said rolls constantly tending to rotate the rolls in a direction to wind material on both thereof, and means to control the degree of effort exerted by the last-named means from the tension of the material between the rolls.

3. In a machine for winding material from one to another of a pair of rolls, means to selectively drive said rolls in the same direction, a differential having one of its elements in driving relation to one roll and a second element in driving relation to the other roll, and means controlled by the direction of rotation of the third element of the differential for automatically transferring the drive from one to the other of said rolls.

4. In a machine for winding material from one to another of a pair of rolls, means to selectively drive said rolls in the same direction, a differential having one of its elements in driving relation to one roll and a second element in driving relation to the other roll, means controlled by the direction of rotation of the third element of the differential for automatically transferring the drive from one to the other of said rolls, and a torque motor constantly tending to drive the last-named element of the differential in one direction.

5. In a machine for winding material from one to another of a pair of rolls, means to selectively drive said rolls in the same direction, and means controlled by the relative rotative speeds of the rolls for automatically transferring the drive from one to the other of said rolls.

6. The combination in a winding machine of a pair of rolls, means to selectively drive said rolls to cause material to be wound from one upon the other thereof, means to automatically maintain said drive in engagement with the more rapidly rotating roll of said pair, a differential having one of its elements in driving relation to one of the rolls and a second element in driving relation to the other of said rolls, torque means to exert a unidirectional rotative effort on the third element of the differential, and means to control the degree of rotative effort of said torque means by the tension of the material between the rolls.

WINFIELD B. HEINZ.