May 9, 1950 W. D. KELLOGG ET AL 2,506,645

WARP KNITTING MACHINE AND METHOD OF OPERATION

Filed Jan. 11, 1945 2 Sheets-Sheet 1

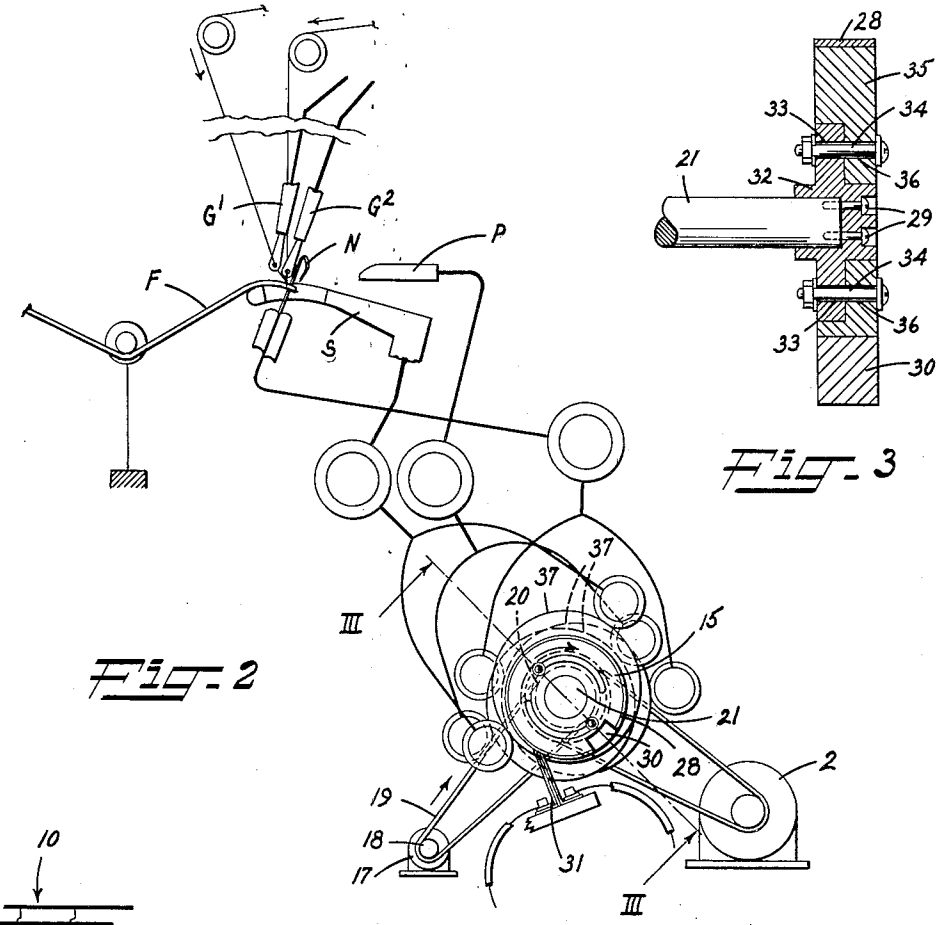


Fig. 2

Fig. 3

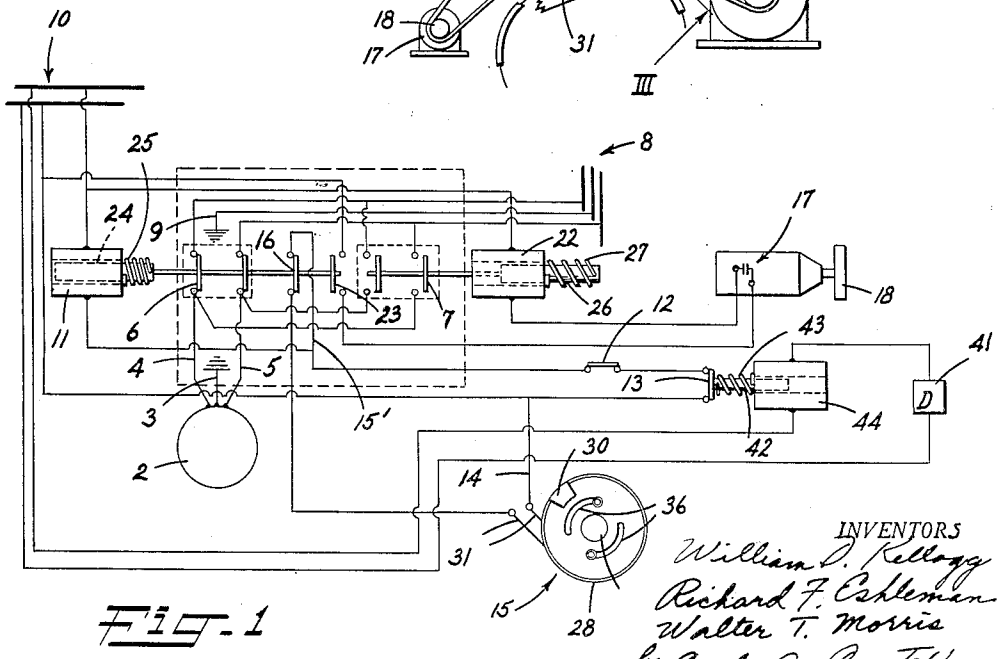


Fig. 1

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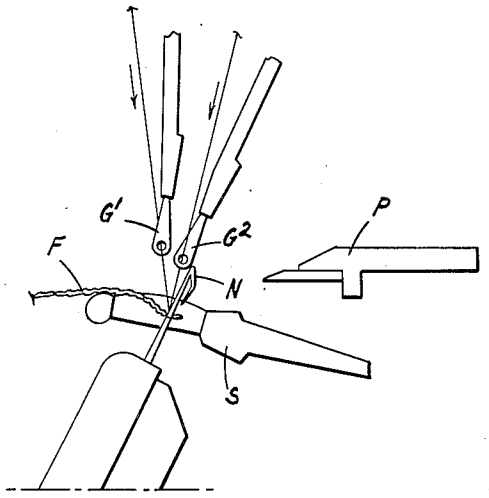


Fig. 4

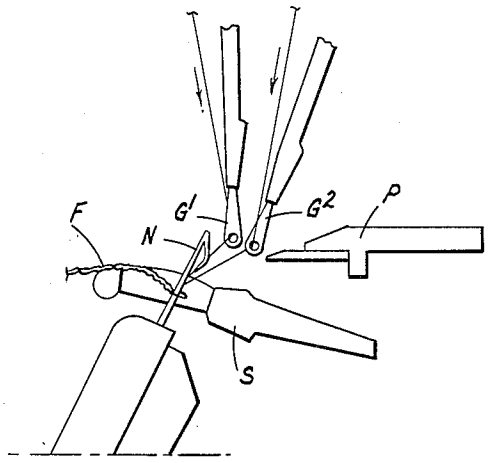


Fig. 5

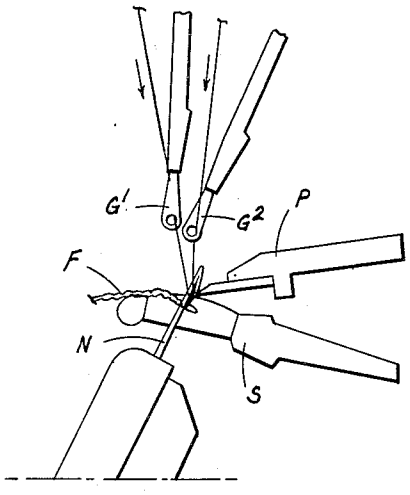


Fig. 6

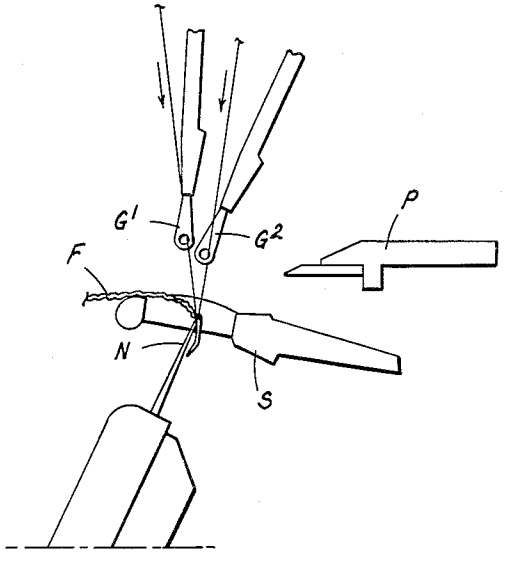


Fig. 7

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UNITED STATES PATENT OFFICE

2,506,645

WARP KNITTING MACHINE AND METHOD OF OPERATION

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Application January 11, 1945, Serial No. 572,366

9 Claims. (Cl. 66—157)

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This invention relates to warp or tricot knitting machines, and it is particularly concerned with a method and arrangement for elinmating stop and start marks or so reducing such marks that they completely disappear during the normal after-treatment of the fabrics, such as de-sizing, bleaching, dyeing and the like.

In accordance with the present invention, when the machine is stopped for any purpose whatsoever, it is stopped as quickly as possible and in re-starting the machine, it is brought to full speed as quickly as possible. The quick stopping and starting may be accomplished by various means such as the provision of a constant speed motor, which has a high starting torque and rapidly comes up to speed, along with an arrangement for "plugging" the motor (i.e., reversing the current through the windings of the motor) to effect stoppage thereof. Alternatively, a powerful braking system may be arranged instead of plugging the motor. Again, both a braking system and a motor plugging system may be associated together. The initiation of operation of the stopping means is caused to take place in timed relationship to the knitting cycle, or what is the equivalent, in timed relationship to the rotation of the cam shaft, so that stopping is initiated in a predetermined portion of the knitting cycle and is completed in less than a complete knitting cycle. Preferably, this initiation is so controlled as to occur during the motion of the needles from their pressing position where their beards are closed to their low position, that is, during the drawing of the new loops through the previously formed loops, and the entire operation of stopping is preferably accomplished by the time that the needles have returned to the vicinity of their lowest position and in no event later than their arrival in their next lapping position in preparation for the formation of the next loops thereabout. Besides reducing the stop and start marks, stopping at this phase of the knitting cycle assures that the guides always come to rest in their forward position where they are accessible for threading, threading individual threads, and for replacing broken or defective needles. Heretofore, after stopping to correct any of these troubles it has generally been necessary for the operator to drive the machine by hand until the guides were brought forward and this hand operation caused serious marks akin to the stop and start marks.

In accordance with the present invention, the initiation of the stopping of the machine is thus controlled, regardless of the cause of stopping, whether for the purpose of making adjustments in the operation of the machine, or for servicing

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the knitting elements (known as the "insides" to the tricot trade and consisting of needles, sinkers and guides) for threading the machine, replacing broken needles, tying in broken threads, etc., and is also thus controlled regardless of whether the stopping is initiated manually or automatically by detectors for breakage or slack tension in the yarns.

The invention is illustrated in a specific embodiment in the accompanying drawings, in which:

Figure 1 shows the electrical connections (in conventional symbols) for functionally correlating the parts in a preferred embodiment of the invention,

Figure 2 illustrates the relationship of certain parts shown in Figure 1 to the cam shaft and knitting elements of a warp knitting machine;

Figure 3 is a cross-section of the timing wheel taken on line III—III of Figure 2; and

Figures 4 to 7 illustrate the knitting cycle.

In a warp knitting machine, the knitting cycle comprises generally the following sequence of steps taken by the knitting elements referring to the relationships shown in Figure 4 as the starting position. In Figure 4, the guides G_1 and G_2 are in their forward position in front of the needles N which are in their "lapping" position of intermediate height with their shanks extending through the most recently formed loops of the fabric F. As shown in Figure 5, the guides move back of the needles and then move laterally to lap their threads around the needles. Then the guides return to their forward positions to complete the loops around the needles, at which time the needles rise to their uppermost position to place the new loops under their beards. As the needles start downwardly, the presser bar P moves forward to close the beards of the needles over these loops and the sinkers S move back somewhat so that the relative positions of Figure 6 are reached. Then the needles continue to move downwardly to draw the new loops within the closed beards through the previously formed loops surrounding the shanks of the needles, thereby reaching the position shown in Figure 7. From this position, the needles rise to lapping position as shown in Figure 4.

With reference to the illustrative embodiment of the invention shown in Figures 1 and 2, a three-phase constant speed A. C. motor 2 has one lead 3 grounded and the other two, 4 and 5, connected in parallel to one side of the switches 6 and 7. For normal operation of the motor, power is transmitted to the motor 2 from the line 8 through the switch 6. It will be noted that

the line 8 is connected to the line side of switch 7, so that the current will take the reverse direction through the motor, as compared to that taken when the line 8 is connected to the motor through switch 6, thereby providing for plugging of the motor to stop it. One phase of the three-phase power line is grounded as shown at 9 to complete the three-phase circuit to the motor in both normal and plugging operations.

A control circuit, provided with current from an auxiliary line 10 supplying A. C. current in a one-phase system (or, if desired, connected instead to the line 8 so that it derives its current therefrom) comprises a solenoid 11, a switch 12 for manually stopping and starting, and a switch 13 for automatically stopping the machine, said three members 11, 12 and 13 being in series. Shunted across the switches 12 and 13 is a timing circuit comprising the leads 14 and 15 through the timing device 15 and the switch 16 in series. For controlling the duration of the action of the plugging circuit, there is provided a switch 17, which is responsive to rotative speed and is held in closed condition when the machine is in operation by virtue of the pulley 18 connected by belt 19 and pulley 20 to the cam shaft 21 (see Figure 2) and is, on the other hand, opened upon stopping of the cam shaft. The switch 17 is in series with a solenoid 22 and a switch 23, and derives current from the auxiliary line 10. For the plugging switch 17, any form of centrifugal switch may be used. An example of an equivalent form of switch which may be used as the switch 17 is a type made by the General Electric Company, Schenectady, N. Y., known as the G. E. plugging switch CR–2962, and described in the circular GEA–3571 published by that company.

A core 24 is associated with solenoid 11, so that energization of solenoid 11 causes closing of switches 6 and 16 and opening of switch 23, whereas a spring 25 opens switches 6 and 16 and closes 23 upon de-energization of solenoid 11. A core 26 is associated with solenoid 22 and is so connected to switch 7 that energization of the solenoid 22 closes switch 7, a spring 27 opening switch 7 upon de-energization of the coil.

The timing device 15 merely comprises a conductive band 28 carried upon a wheel structure secured for rotation with cam shaft 21 by cap screws 29 (see Figure 3). The band 28 does not completely encircle the wheel, but is interrupted by an insulating segment 30. Two contact elements 31 bear upon the exposed surface of the band on the wheel, so that current through this branch of the circuit is interrupted periodically by the segment 30. The wheel structure, as shown in Figure 3, is preferably adjustable angularly with respect to the cam shaft 21. For this purpose, it may comprise a central hub portion 32 having bores 33 for receiving the bolts 34. A rotatable slidable section 35 of the wheel is provided with slots 36 to receive the bolts 34, whereby the segment 30 carried by the outer section 35 can be clamped in any angular relationship to the cam shaft 21 desired. The relationship of the segment 30 can thus be adjusted at will with respect to the cams 37 on the cam shaft 21 (see Figure 2) so that stoppage is initiated at some point during the movement of the needles from their pressing position shown in Figure 6 to their next low position as shown in Figure 7.

The automatic stopping switch 13 may be controlled by any conventional electric, mechanical or photo-electric device for detecting breakage in yarns or development of excessive slack therein. This detecting device is shown as a capital D in a block and referred to by reference character 41 in Figure 1, and may take the form of any conventional detector and relay, such as shown in Quick 2,010,928, Stanley 2,290,257, Hayes 2,330,212 and Hayes 2,345,599. As shown, the detector may operate the switch 13 by means of the relay comprising a core 42 carried by switch 13, which is normally held in closed position by the spring 43 and solenoid 44 connected in series with the detecting device 41 and the line 10.

The operation of the circuit may be described as follows: When the machine is in operation, switches 12, 13, 6 and 16 are closed, current flowing from the auxiliary line 10 through the solenoid 11 to hold switches 6 and 16 closed and switch 23 open, so that the normal driving current passes through the switch 6 to the three-phase motor 2 and the cam shaft 21 rotates, causing the switch 17 to be closed by virtue of the centrifugal force. Upon opening either switch 12 manually or switch 13 automatically, it will be seen that the current through solenoid 11 will be cut off when the contacts 31 strike insulating segment 30 of the timing device 15. Because of the timing device, the opening of switch 12 or 13 cannot initiate stopping of the motor, but really presets the stopping system in condition for actuation when the predetermined portion of the knitting cycle mentioned above has been reached as controlled by the insulating segment 30. De-energization of coil 11 opens switches 6 and 16 and closes switch 23. Closure of switch 23 energizes coil 22, thus closing the switch 7 and plugging the motor 2. However, when the motor has been stopped, switch 17 opens by virtue of loss of centrifugal force, so that coil 22 is de-energized and switch 7 is opened to prevent rotation of the motor in the opposite direction beyond stopping position.

While the invention has been illustrated with the use of an A. C. motor, a direct current motor may be used instead and a modified system, such as that provided in a Thymatrol, can be used for plugging it. As stated above, a braking system may also be initiated to assist the plugging action of the motor, or a braking system may be supplied instead of the system for plugging the motor.

By controlling the quick stopping of the warp knitting machine so that it occurs only during that portion of the cycle beginning with the pressing position shown in Figure 6 and ending with the next lapping position shown in Figure 4, and then quickly starting the machine, it has been found that stop and start marks can be substantially entirely eliminated. By so controlling the quick stopping that the knitting elements of the machine come to rest with the needles in the vicinity of their low position, the marks are eliminated and the machine presents the most favorable condition for the servicing of the elements. In either case, the machine can be serviced without turning it over by hand, thereby avoiding additional marks occasioned by this operation.

It is to be understood that the description herein is illustrative only, and that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. In combination with a warp knitting machine having knitting needles, a cam shaft for controlling the cycle of operation, an electric motor for driving the cam shaft, means for stop-

ping the machine comprising an auxiliary control circuit having an electromagnetic means for holding closed the circuit to the motor, said control circuit having two branches in parallel, one of the branches comprising a device operated in timed relation to the knitting cycle for intermittently interrupting the current therethrough and the other branch comprising a switch adapted to be opened to preset the stopping means in condition for initiation when the next interruption in the current is effected by the device in the first branch.

2. In combination with a warp knitting machine having knitting needles, a cam shaft for controlling the cycle of operation, an electric motor for driving the cam shaft, and means for stopping the machine comprising an auxiliary control circuit having an electromagnetic means for holding closed the circuit to the motor, said control circuit having two branches in parallel, one of the branches comprising a device operated in timed relation to the knitting cycle for intermittently interrupting the current therethrough and the other branch comprising a switch adapted to be opened to preset the stopping means in condition for initiation when the next interruption in the current is effected by the device in the first branch, additional electromagnetic means for connecting the motor to a reversed current circuit, a control circuit comprising a switch arranged to be closed by the first-mentioned electromagnetic means upon deenergization thereof and a switch in series therewith adapted to be opened and closed in response to decrease and increase in rotative speed respectively, said switch being arranged to be diven by the cam shaft.

3. In combination with a warp knitting machine having knitting needles and a cam shaft for controlling the cycle of operation, electrical means for stopping the machine, means comprising a timing switch element carried by and rotated by the cam shaft for controlling the initiation of the stopping means so that initiation thereof occurs at a predetermined position of the knitting cycle, and a movable switch member connected in parallel with the timing switch element for presetting the stopping means in condition for actuation.

4. In combination with a warp knitting machine having knitting needles, a cam shaft for controlling the cycle of operation, an electric motor for driving the cam shaft, a motor circuit, a control circuit having electromagnetic means for holding closed the motor circuit, means for stopping the machine comprising switch means in the control circuit, and means for controlling the actuation of the switch means to interrupt the control circuit so that initiation of the stopping means occurs during a predetermined portion of the knitting cycle.

5. In combination with a warp knitting machine having knitting needles, a cam shaft for controlling the cycle of operation, an electric motor for driving the cam shaft, a motor circuit, a control circuit having electromagnetic means for holding closed the motor circuit, means for stopping the machine comprising switch means in the control circuit, means for controlling the actuation of the switch means to interrupt the control circuit so that initiation of the stopping means occurs during a predetermined portion of the knitting cycle, means for plugging the motor, and centrifugal means driven by the motor for initiating operation of the plugging means when the speed of the motor falls below a predetermined limit.

6. The method of controlling the operation of a power-driven warp knitting machine comprising quickly stopping the machine from normal operating speed within less than the period of a complete knitting cycle so that the entire operation of stopping is completed during that period of the knitting cycle in which the needles move from their pressing position to their next looping position, servicing the machine and subsequently quickly starting the machine without manually changing the positional relationship of the elements from that existing when the machine first comes to rest at the conclusion of said stopping.

7. The method of substantially eliminating stop marks in warp knit fabrics comprising the step of completely stopping a power-driven warp knitting machine from normal operating speed during that period of the knitting cycle between the time of pressing the beards of the needles closed to the approximate time when the needles next reach their lowest position, servicing the machine and subsequently quickly starting the machine without manually changing the positional relationship of the elements from that existing when the machine first comes to rest at the conclusion of said stopping.

8. The method of servicing the knitting elements of a power-driven warp knitting machine during operation thereof without detrimentally affecting the fabric loop formation comprising stopping the machine from normal operating speed within less than the period of a complete knitting cycle so that it comes to rest at a predetermined portion of the knitting cycle in which the guides are in a forward position in front of the needles, and servicing and subsequently starting the knitting elements without changing the positional relationship of the elements from that existing when the machine first comes to rest at the conclusion of said stopping.

9. The method of servicing the knitting elements of a power-driven warp knitting machine during operation thereof without detrimentally affecting the fabric loop formation comprising stopping the machine from normal operating speed within less than the period of a complete knitting cycle so that it comes to rest at a predetermined portion of the knitting cycle in which the guides are in a forward position in front of the needles and the needles are in the vicinity of their lowest position, and servicing and subsequently starting the knitting elements without changing the positional relationship of the elements from that existing when the machine first comes to rest at the conclusion of said stopping.

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