

**June 23, 1970**

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**3,516,619**

## DRIVING MECHANISM FOR JIGGERS

Filed March 28, 1968

5 Sheets-Sheet 1

Fig 1.

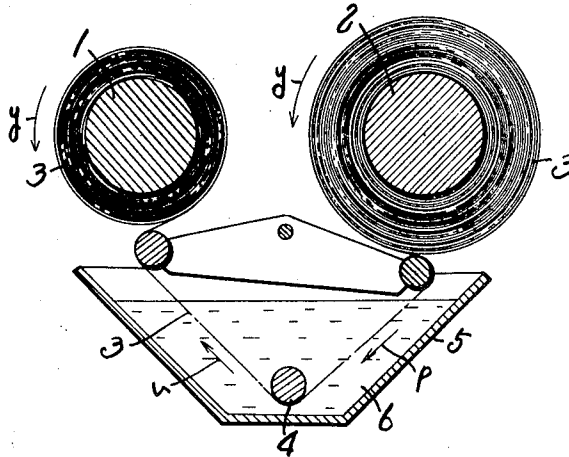
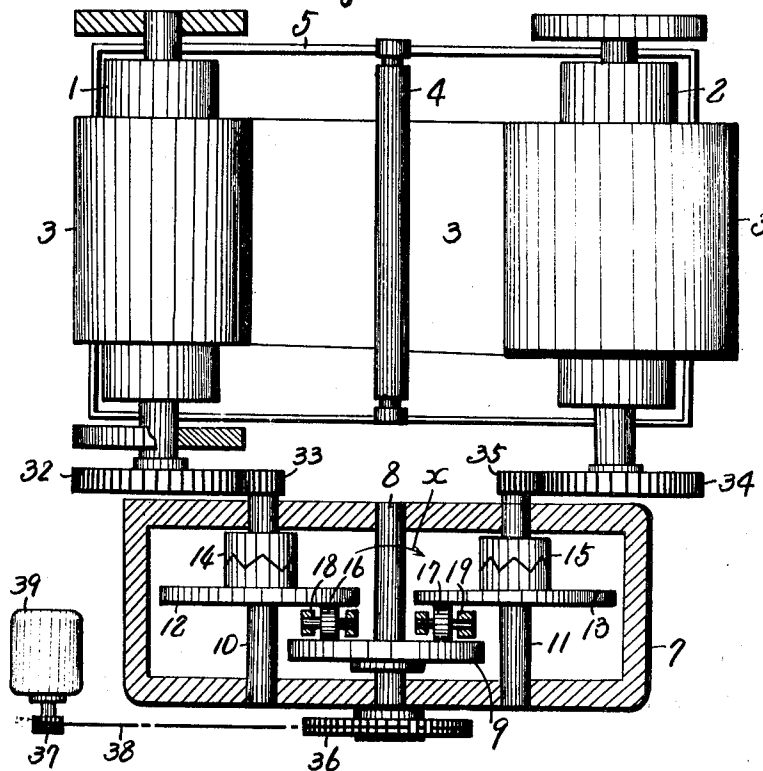


Fig 2.





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DRIVING MECHANISM FOR JIGGERS

Filed March 28, 1968

5 Sheets-Sheet 3

Fig 6

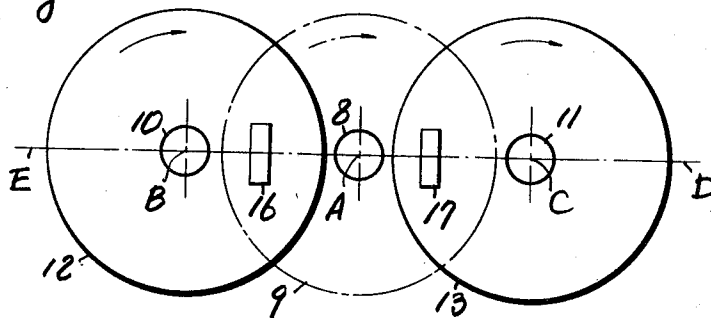


Fig 7

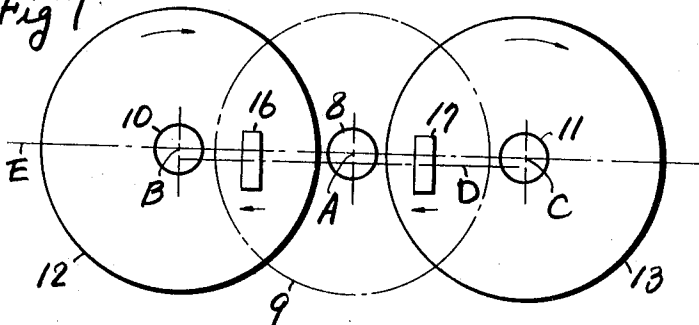
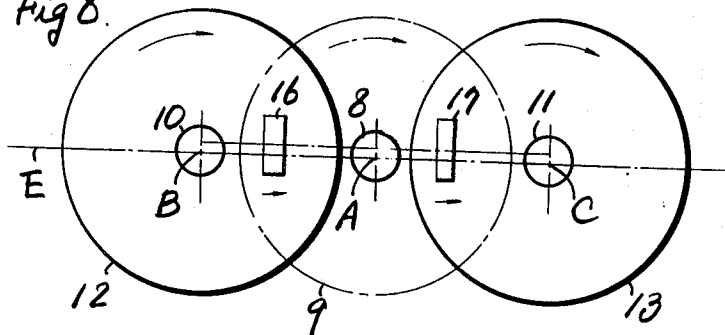


Fig 8



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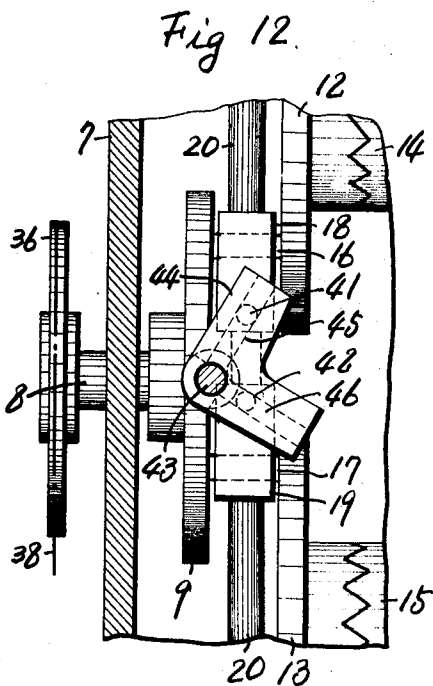
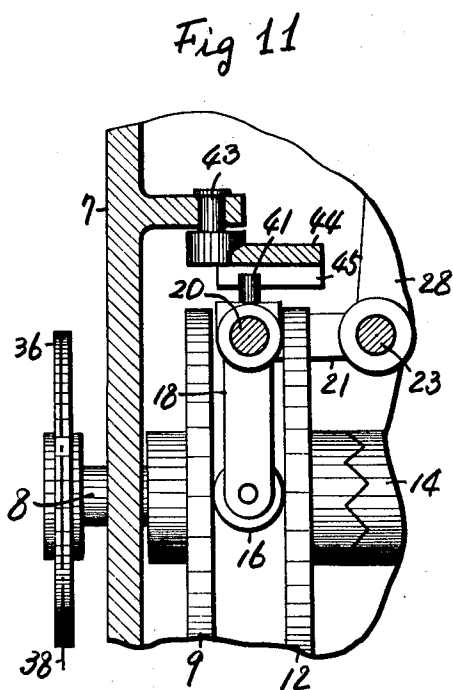
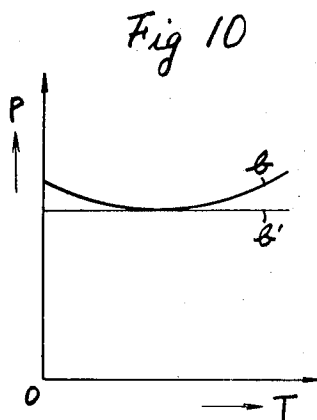
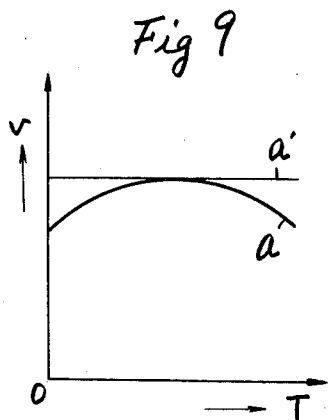
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DRIVING MECHANISM FOR JIGGERS

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5 Sheets-Sheet 4



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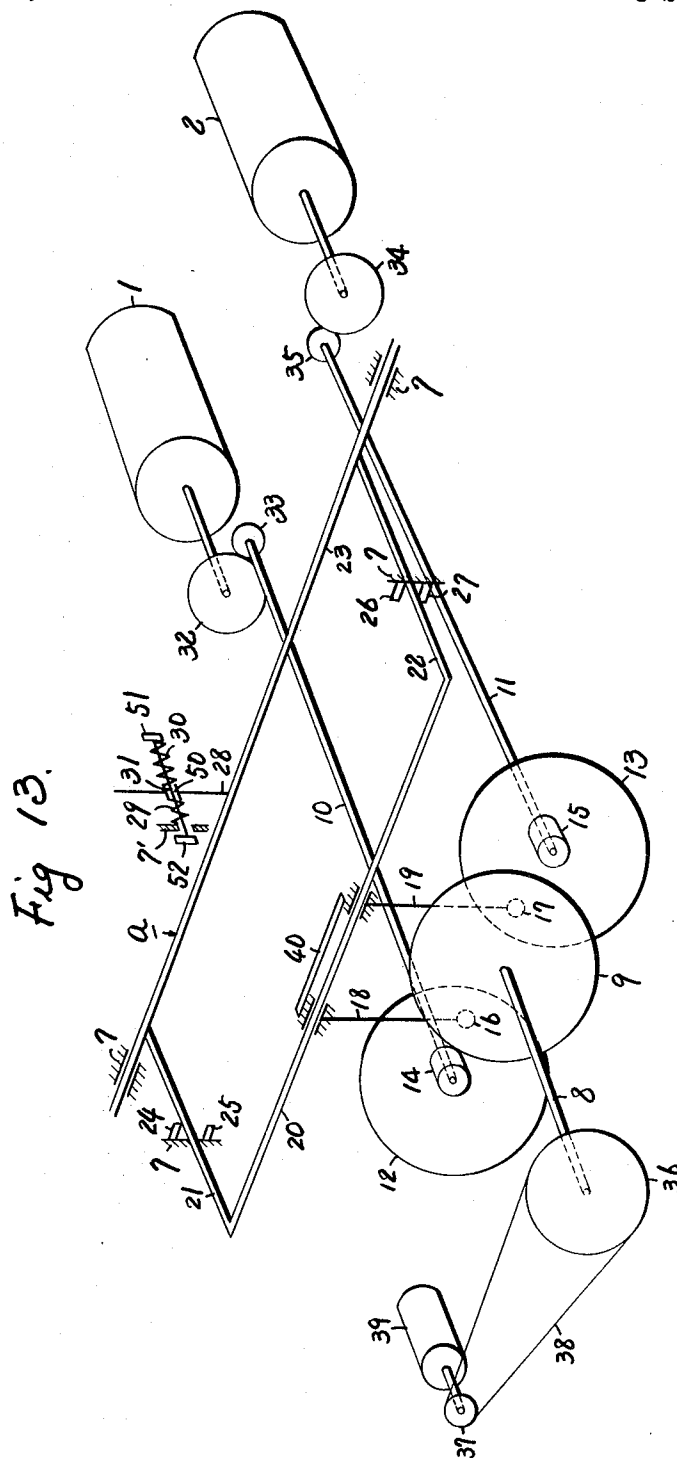
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## DRIVING MECHANISM FOR JIGGERS

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## DRIVING MECHANISM FOR JIGGERS

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10 Claims

### ABSTRACT OF THE DISCLOSURE

A driving mechanism for jigger cloth treating machines comprises means for driving the winding and unwinding rolls so as to maintain a predetermined speed and tension in the cloth between the rolls. A driving disc and driven discs bear upon friction driving wheels. These wheels are positioned between the discs so as to roll tangentially thereto in an intermediate position when a force yieldingly applied to displace the wheels from such position is balanced out by a force counter thereto, which counterforce is produced by the tension exerted on the unwinding roll by the cloth as transmitted from that roll to the associated wheel through the driven disc interconnecting the same. When the two forces do not balance, the wheels are moved out of the intermediate position and no longer track tangentially, and the resulting axial component of force moves the wheels axially to vary the drive ratios to the two rolls until the tension in the cloth is changed to again produce a balance. In a preferred embodiment, linkage means is provided to maintain more nearly constant the predetermined speed and tension of the cloth irrespective of its state of distribution between the winding and unwinding rolls.

This invention relates to a jigger dyeing machine in which the winding and unwinding of cloth under tension are effected between a pair of rollers to apply physical and chemical treatments to the cloth, and the object of the invention is to automatically keep constant both the ravelling speed of and tension on the cloth in such dyeing machine.

As for drive means for jigger dyeing machines, use has heretofore been made of various types of drive means, such as differential gear type, friction type, and D.C. motor type. With these types, however, it is generally difficult to attain constant fabric speeds and tensions, and particularly at low speeds it is extremely difficult to attain constant tensions and if this is to be attained at any rate, complicated and expensive control means must be additionally employed, thus involving a disadvantage in that such dyeing machines become very expensive.

This invention achieves the aforesaid object by a very simple mechanism without using complicated and expensive means, thereby eliminating said disadvantages.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a front view, in longitudinal section, of a jigger dyeing machine according to the invention;

FIG. 2 is a plan view, in cross-section, of the machine;

FIG. 3 is a side elevational view, in longitudinal section, of a drive box;

FIG. 4 is a side elevational view in longitudinal section taken along line 4—4 in FIG. 3;

FIG. 5 is a sketch explanatory of the direction of force on a slide rotary wheel;

FIGS. 6—8 are views explanatory of automatic speed change actions;

FIG. 9 is a characteristic diagram showing changes in cloth speed during operation;

FIG. 10 is a characteristic diagram showing changes in cloth tension during operation;

FIG. 11 is a side elevational view in longitudinal section, showing an instance in which cam means is provided for correcting speed change and cloth tension;

FIG. 12 is a plan view thereof; and

FIG. 13 is an outline view of the principal portion of the mechanism of the invention.

In FIG. 1, which shows the outline of a jigger dyeing machine, cloth 3 to be processed is wound on two rollers 1 and 2 with an intermediate portion of the cloth passing around guide rollers 4 journaled within a liquid bath 5.

The liquid bath 5 is filled with a processing liquid 6. A drive box 7 (FIG. 2) is provided laterally of the liquid bath 5 for driving the rollers 1 and 2. Journaled centrally of the drive box 7 is a main drive shaft 8, on both sides of which driven shafts 10 and 11 are journaled. The main drive shaft 8 has a drive disc 9 secured thereto, and the driven shafts 10 and 11 have driven discs 12 and 13 respectively keyed thereto through thrust means 14 and 15. Between the drive disc 9 and the driven discs 12 and 13, slide rotary wheels 16 and 17 are arranged under pressure in a movable state, as shown in FIG. 2. The slide rotary wheels 16 and 17 are rotatably supported at the lower ends of support levers 18 and 19, respectively, as shown in FIG. 3. The upper ends of the support levers 18 and 19 are slidably and rotatably fitted on a swing shaft 20. The opposite ends of the swing shaft 20 are fixedly supported at the front ends of arm levers 21 and 22 so that the swing shaft 20 lies horizontal. The base portions of the arm levers 21 and 22 are both secured to a pivot shaft 23 horizontally and rotatably supported by the drive box 7, in such a manner that the arm levers 21 and 22 are vertically cycloidally moved in accordance with the pivotal motion of the pivot shaft 23. Thus, the swing shaft 20, arm levers 21, 22 and pivot shaft 23 form a frame *a*, which is so mounted that it may swing around the axis of the pivot shaft 23 within the drive box 7. Further, the range of the cycloidal motion of the arm levers 21, 22 is limited to a small extent by respective pairs of stop means 24, 25, and 26, 27.

A pressure-receiving lever 28 is attached to the central part of the pivot shaft 23 and is associated with two springs 29 and 30 acting on the upper end thereof. The upper end of the pressure-receiving lever 28 is bored with an opening 50 through which extends an adjusting lever 31 screwed into a lateral wall 7' of the drive box 7, and the springs 29 and 30 are interposed in a compressed state between the lateral wall 7' and the pressure-receiving lever 28 and between the pressure-receiving lever 28 and the front end of a flange 51, respectively. The spring 29 counteracts the gravitational force due to the weight of the members such as the slide rotary wheels 16, 17 and support levers 18, 19, and thereby serves to compensate for unbalance resulting from such force. The spring 30 imparts a downwardly directed external support force *Q* (FIG. 5) to the swing shaft 20 through the pressure-receiving lever 28, pivot shaft 23 and arm levers 21, 22. The resilience of the spring 30 may be adjusted by rotating the adjusting lever 31 by manipulating a knob 52 attached to the outer end thereof. The support levers 18, 19 are interconnected by a connecting lever 40 and are loosely fitted on the swing shaft 20 in such a manner that it may be moved right and left on the swing shaft 20 and maintained in a vertical state. As a result, the slide rotary wheels 16 and 17 can be moved in the same direction and are freely supported in such a manner that their axial centerline *D* (FIG. 3) may undergo a slight displacement so as to vertically move above or below a plane *E* including the drive shaft centerline *A* and driven shaft centerlines *B* and *C* with said plane *E* as center.

The rollers 1 and 2 are associated with the driven shafts 10 and 11 through gear wheels 32, 33, and 34, 35, respectively (FIG. 2).

The drive shaft 8 is driven by an electric motor 39 through a pulley 37, belt 38 and pulley 36.

Automatic speed change action and automatic tension control action achieved by the invention will now be described with reference to the drawings.

If the drive shaft 8 is rotated in the direction of arrow  $x$ , namely in a clockwise direction, then the rollers 1 and 2 are both rotated counterclockwise so that the cloth 3 is wound in the direction of arrow  $y$  in FIG. 1.

In this mechanism if a tension  $P$  acts on the cloth 3, the roller 2 is pulled by the cloth 3 so that the tension becomes an unwinding brake torque. Such unwinding brake torque is imparted to the driving disc 9 from the roller 2 through the gear wheels 34, 35, shaft 11, thrust means 15, driven disc 13 and slide rotary wheel 17 frictionally engaged with the disc 13 and disc 9, and acts to drive the driving disc 9.

Further, when the mechanism is driven, the following forces are exerted on the slide rotary wheels 16 and 17. That is, when the roller 1 operates as winding side, upwardly directed tangential forces  $F_k$  and  $F_l$  always act at points of contact K and L between the slide rotary wheel 16 and the driving disc 9 and between the slide rotary wheel 16 and the driven disc 12, respectively, as shown in FIG. 5. In this case, the other roller 2 operates as unwinding side, and when this unwinding side is driven by the driving disc 9, that is, when a tension  $P$  on the cloth is less than the predetermined or set tension, downwardly directed tangential drive forces  $F_m'$  and  $F_n'$  are exerted at points of contact M and N between the slide rotary wheel 17 and the driving disc 9 and between the slide rotary wheel 17 and the driven disc 13, respectively. However, when the tension  $P$  is exerted, upwardly directed tangential drive forces  $F_m$  and  $F_n$  corresponding to said tension  $P$  are exerted at the points of contact M and N, respectively. In addition, these tangential drive forces vary in proportion to the tension  $P$  on the cloth 3. These slide rotary wheels 16 and 17 are rotatably supported at the front ends of the support levers 18 and 19 suspended from the swing shaft 20 of the frame  $a$ . A resilient force from the spring 30 acts on said frame  $a$ , so that a downwardly directed external support force  $Q$  is imparted to the slide rotary wheels 16 and 17 through the frame  $a$ .

In this way, the downwardly directed external support force  $Q$  counteracts the sum  $F$  of said tangential drive forces. And, setting is so made that if force  $Q$  equals force  $F$ , the axial centerline  $D$  of the slide rotary wheels 16 and 17 coincides with the plane  $E$  defined by the axial centerlines of the shafts 8, 10 and 11.

In addition, it is so arranged that the slide rotary wheels 16, 17 do not slip between the discs 9, 12 and 13, in whatever condition they may be.

An explanation will now be made of an instance in which, in the aforesaid arrangement, the roller 1 operates as a winding roller while the roller 2 operates as an unwinding roller and the motor 39 is started with the slide rotary wheels 16 and 17 positioned in the central region of the swing shaft 20.

Before start, the axial centerline  $D$  of the slide rotary wheels 16 and 17 is positioned below the plane  $E$  by reason of the external support force  $Q$  exerted by the spring 30. When the motor is started, the rollers 1 and 2 begin to rotate at the same speed, because they are positioned equidistantly from the axis of the shaft 8. At this time, since the torque required to rotate the roller 2 is greater than that required to rotate the roller 1, the total tangential drive force  $F$  is downwardly directed, and since the wound amount is greater than the unwound amount, tension  $P$  does not exist, with the result that the axial centerline  $D$  of the slide rotary wheels 16, 17 is positioned below the plane  $E$ .

When the axial centerline  $D$  of the slide rotary wheels is positioned below the plane  $E$ , a sliding frictional force

directed to the left is exerted at the points of contact between the wheels 16, 17 and the discs 9, 12, 13 owing to the rotation of the slide rotary wheels 16 and 17, as shown in FIG. 7, with the result that the slide rotary wheels 16 and 17 are moved to the left. When the slide rotary wheels are thus moved to the left, the point of contact K between the slide rotary wheel 16 and the driving disc 9 moves toward the outer periphery of the disc 9, while the point of contact L between the slide rotary wheel 16 and the driving disc 12 moves toward the center of the driven disc 12. Therefore, the rotative speed of the winding roller 1 becomes faster. As for the other slide rotary wheel 17, driving disc 9 and driven disc 13, the points of contact M and N move in a direction to decelerate the unwinding roller 2. That is, the wound amount becomes equal to the unwound amount, and the slide rotary wheels 16 and 17 continue moving to the left until the required tension  $P$  results. And, the sum  $F$  of the tangential drive forces approaches the force  $Q$  and the axial centerline  $D$  of the slide rotary wheels 16 and 17 approaches the plane  $E$ . Thereafter, whenever the force  $F$  is equal to the force  $Q$ , the external support force  $Q$  due to the spring 30 is balanced with the sum  $F$  of the tangential drive forces so that the axial centerline  $D$  of the slide rotary wheels is in its neutral position lying in the plane  $E$  (FIG. 6). At this time, there is no sliding frictional force in speed change direction exerted at the points of contact K, L and M, N of the slide rotary wheels 16 and 17, so that the operation is in a balanced condition with no lateral movement of the slide rotary wheels 16 and 17.

As the winding of the cloth 3 proceeds, the diameter of the roller 1 becomes correspondingly larger while that of the roller 2 becomes smaller. That is, the wound amount tends to become larger than the unwound amount. As a result, the unwinding brake torque due to tension  $P$  is increased, which is attended with an increase in the total force  $F$  acting on each point of contact of each slide rotary wheel 16 and 17, so that the axial centerline  $D$  of the slide rotary wheels 16 and 17 makes a slight upward displacement (FIG. 8). And, on the same principles as mentioned above, sliding frictional forces directed to the right are exerted at the points of contact K, L and M, N, so that the slide rotary wheels are moved to the right. Therefore, the winding speed of the roller 1 becomes slower, while the unwinding speed of the roller 2 becomes faster, so that the tension  $P$  is decreased.

Conversely, if the tension  $P$  on the cloth 3 becomes smaller for one reason or another during operation so that the sum  $F$  of the tangential drive forces at the points of contact of the slide rotary wheels becomes smaller than the external support force  $Q$  exerted by the spring 30, the axial centerline  $D$  of the slide rotary wheels 16 and 17 deviates from the plane  $E$  downwardly to make a slight displacement so that it no longer aligns with the driving shaft centerline  $A$  and the driven shaft centerlines  $B$ ,  $C$ . That is, a condition shown in FIG. 7 is established, wherein at the points of contact K, L and M, N the direction of the tangential path on the driving side deviates from the direction of the tangential path on the driven side by a slight angle. Therefore, as mentioned above, a sliding frictional force directed to the left is exerted at any point of contact, whereby the sliding rotary wheels 16 and 17, which are capable of changing speed, are moved to the left. As a result, the winding speed of the roller 1 becomes faster, while the unwinding speed of the roller 2 becomes slower, so that the tension  $P$  is increased.

In practice, it is usual for the tension  $P$  to have variations of small wave form inclusive of external vibrations and the slide rotary wheels 16 and 17 are caused to repeat a slight vertical displacement in a swing manner. Thus, microscopically, a wave form of speed increasing and decreasing movement is repeated, but macroscopically, the tension  $P$  is stabilized on an average so that the operation continues smoothly.

5

As is apparent from the above explanation, the tension P acts on the cloth at a value which is in accord with the external support force Q, and any desired value for the tension P may be selected by manipulating the adjusting lever 31 to vary the external support force Q.

In the above-described embodiment, the support levers 18 and 19 are shown as connected directly to the connecting lever 40, and the cloth speed V and tension P will not remain constant from beginning to end, and some variations cannot be avoided, as graphically shown in FIGS. 10 and 11, in which the cloth speed V is represented by a curve *a*, and the tension P by a curve *b*.

Correcting means for making the speed V and tension P as constant as possible will now be described.

In the preceding embodiment, the distance between the slide rotary wheels is constant, which is responsible for the fact that the cloth speed V is maximum in intermediate stage and at same diameter and is minimum at the beginning and end of winding.

Therefore, in order to make the cloth speed V constant, it is necessary to correct and change the distance between the slide rotary wheels 16 and 17.

In this case, it is necessary that the amount of the movement of the slide rotary wheels 16 and 17 be greater on the higher speed side than on the lower speed side.

FIGS. 11 and 12 show an embodiment thereof, wherein the slide rotary wheels 16 and 17 are interconnected by linkage means for performing the aforesaid function, in which the lower surface of a cam 44 pivotally mounted on a pivot shaft 43 is provided with U-shaped guide grooves 45 and 46 intersecting each other at the axis. The top ends of pins 41 and 42 provided on the slide rotary wheels 16 and 17 are received in the U-shaped guide grooves 41 and 42, respectively. The position of the shaft 43 for the cam 44 is set in such a manner as to enable the slide rotary wheels 16 and 17 to maintain their suitable positions. With this arrangement, the cloth speed V is corrected to be constant from beginning to end and the tension P becomes nearly constant. Thus, in FIGS. 9 and 10, curve *a'* indicates the cloth speed and curve *b'* the tension.

Merits of the present invention are enumerated below.

Constant cloth speed and constant cloth tension of high accuracy can be obtained substantially over the entire range of winding and unwinding. Particularly, stability of high accuracy in a lower tension region cannot be obtained with conventional drive systems such as differential gear system and electric system.

Since tension is determined by the relationship of balance between the external support force and the tangential drive forces acting on the slide rotary wheels and the automatic speed change action is brought about by the utilization of sliding frictional force exerted at the points of contact of the slide rotary wheels 16 and 17, there is no need of providing means for detecting tension and means for detecting cloth speed. Further, there is no need of providing auxiliary power means (such as hydraulic, pneumatic and electric means) for controlling tension and cloth speed.

Since it is unnecessary to the brake means required by a differential gear system, the structure is simple and compact.

Since the power for winding is fed back as a brake force to the driving shaft, power consumption is small and very economical.

Cloth speed and tension can be independently set without any interference therebetween (setting of graduation is possible).

What is claimed is:

1. A driving mechanism for jigger cloth treating machines of the type having a pair of parallel winding and unwinding rolls for the cloth, said mechanism comprising:

(a) driven shafts operatively connected to said rolls, respectively

6

(b) a driving shaft, and

(c) means for operatively connecting said driving and driven shafts so as to maintain substantially a predetermined speed and tension in the cloth between said rolls, said means comprising:

(1) a driving disc carried by said driving shaft, (2) driven discs carried by said driven shafts in spaced partially overlapping relation to said driving disc,

(3) friction drive wheels interposed between said driving disc and said driven discs, respectively, and frictionally engaged therewith,

(4) movable means on which said friction drive wheels are mounted for rotation and axial sliding movement,

(5) said friction drive wheels having their axes positioned to align, in an intermediate position of said movable means, with lines connecting the axes of said driving and driven discs, respectively, so that they then bear tangentially against said driving and driven discs,

(6) said drive wheels and movable means being displaceable in first and second directions from said intermediate position resulting, when displaced in said first direction, in axial sliding movements of said drive wheels that increase the speed of drive of the winding roll and decrease the speed of drive of the unwinding roll and, when displaced in said second direction, in axial sliding movements of said drive wheels that decrease the speed of drive of the winding roll and increase the speed of drive of the unwinding roll,

(7) means connected to said movable means for yieldably applying a first force thereto in said first direction,

(8) the tension of the cloth on the unwinding roll, transmitted during operation through the drive shaft and driven disc connected thereto and the drive wheel bearing thereagainst, applying a second force to said movable means in said second direction,

(9) whereby, when the forces referred to in clauses (c)(7) and (c)(8) are unequal, the resultant thereof produces movement of said movable means toward or from said intermediate position in the direction of said resultant.

2. A driving mechanism according to claim 1, wherein the means of clause (c)(7) is adjustable to yieldingly apply a selected first force to said movable means for selecting the tension to be developed in the cloth.

3. A driving mechanism according to claim 1, wherein the axes of the driving and driven shafts of clauses (a) and (b) are parallel to one another and lie in a common plane, and wherein the drive wheels of clause (c)(5) are rotatable about and laterally slidable along a common axis which in said intermediate position lies in said common plane, and which is displaceable from said common plane as set forth in clauses (c)(6) and (c)(9).

4. A driving mechanism according to claim 3, wherein the movable means of clause (c)(4) comprises a swing shaft and a pair of support levers rotatable and axially slidable thereon and rotatably supporting said drive wheels.

5. A driving mechanism according to claim 4, in which said pair of support levers are interconnected to slidably move as a unit.

6. A driving mechanism according to claim 4, in which said pair of support levers are interconnected by linkage means for varying the relative movements of the drive wheels produced by the displacement of their axes from said aligned position for maintaining more nearly constant the speed and tension of the cloth irrespective of its state of distribution between the winding and unwinding rolls.

7

7. A driving mechanism according to claim 6, wherein said linkage comprises a pair of pins, respectively carried by said supporting levers, and a pivotally mounted cam having cam grooves angularly disposed thereon in which said pins are slidably engaged.

8. A driving mechanism according to claim 7, wherein said pins are movable along a common line parallel to the axis of said swing shaft, the cam grooves are arranged at right angles to each other, and the cam is pivotally mounted on an axis laterally displaced from said common line.

9. A driving mechanism according to claim 4, wherein said movable means of clause (c)(4) further comprises a horizontally supported rotatable pivot shaft having a pair of arms secured thereto and also having a pressure receiving arm secured thereto, said pair of arms supporting said swing shaft at their free ends, and the adjustable means of clause (c)(7) being connected to said pressure receiving arm for yieldingly applying said first force thereto.

8

10. A driving mechanism according to claim 1, wherein the driven shaft of clause (a) comprise thrust means (14, 15) for applying torque developed therein to press said driven discs toward said driving disc.

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U.S. Cl. X.R.

242—75.5