Dec. 12, 1961 G. WERNER 3,012,288

CONTROL FOR TEXTILE DRAWING FRAMES

Filed April 30, 1959 2 Sheets-Sheet 1

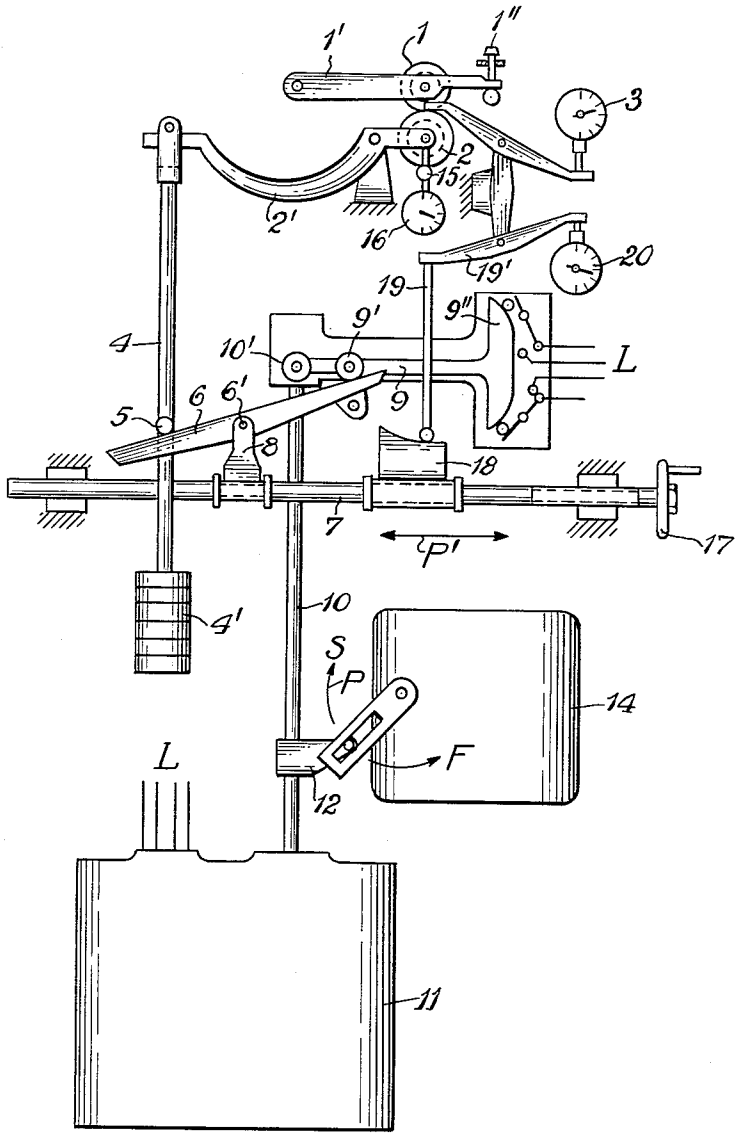

Fig. 1

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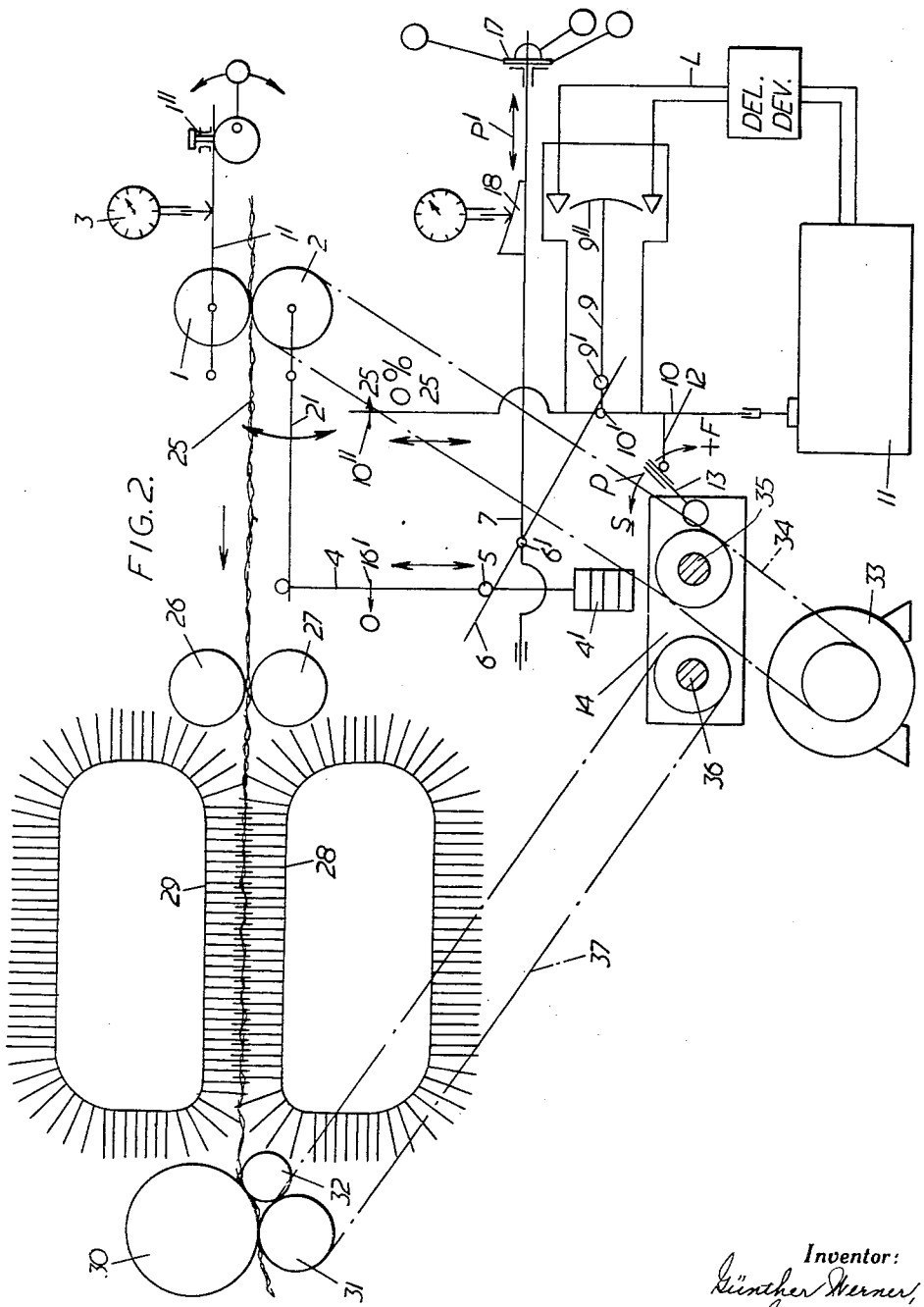

FIG. 2.

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CONTROL FOR TEXTILE DRAWING FRAMES

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16 Claims. (Cl. 19—70)

The present invention relates to improvements in textile drawing frames and particularly to a new or improved apparatus for controlling such machines.

Drawing frames are known in which a fibre sliver or lap (which may be a carding, roving, doubling or slubbing—all hereinafter referred to as a "sliver") is drawn and which operate in conjunction with an adjusting or regulating device so that changes relating to the thickness of the sliver are checked or sensed and the drawing action is so controlled according to the varying thickness of the sliver that at the exit from the drawing frame a fibre sliver of always uniform weight or density leaves the device.

In the known devices the thickness of the sliver is checked by means of two sensing rolls and possible changes in the sliver thickness are either transmitted through a lever mechanism by means of a power amplifier or servo-motor to an infinitely variable drive gear, or electrical contacts are operated which perform a change in speed of the drive motor for the purpose of correcting such changes, so that in either case the drawing of the fibre sliver is related to the checked thickness of the sliver.

These arrangements are very complicated and costly due to the use of the power amplifier or servo-motor or of the electrical components, since in all such systems a complicated mechanism must be provided for feeding back a "response" signal to the control mechanism in a closed loop system, i.e. from the regulated sliver. Moreover it is difficult with these systems to provide for an alteration in the intended standard weight handled by the sensing rollers since whatever the standard weight a given percentage change must always impart the same movement to the adjusting assembly as a whole, in order that the same change in speed is secured. With mechanical transmissions this is not obtained because with a transmission lever the amount of movement due to a given percentage change varies with the magnitude to which the percentage change refers.

The invention solves the problem of feeding back a control signal as well as the adjustment for various desired or standard thicknesses of the sliver in a simple and easily adjusted manner by the fact that the sensing rolls are operative upon the sliver entering the regulating apparatus by a transmission device adjustable from outside the apparatus in such manner that various fibre slivers of different intended or standard thicknesses can be handled and for any given value the fibre slivers are maintained at constant thickness or weight.

The apparatus according to the invention includes means for transmitting the movement of the sensing rolls resulting from changes of the sliver thickness to mechanism having a compensatory action on the drawing operations so as to maintain constant sliver thickness and for changes in the intended or desired sliver thickness the said transmitting means are adjusted or modified in such manner that the transmitted movements occur relatively to the same reference or zero position for various values of intended or desired sliver thickness.

In some cases the sensing rolls may perform their desired controlling action directly but in most cases a servo-motor or power amplifier is employed for operating an infinitely variable gear device driving the drawing or

take-off rolls of the drawing frame. However, for effective control, the various changes in the thickness of the sliver on the way from the rolls to the drawing cylinder must be allowed for since otherwise the sliver may be compensated insufficiently or too much during this period. In order to avoid this disadvantage a further feature of the invention provides that the command action for possible changes of thickness of the sliver by the checking device, e.g. the sensing rolls, is effected indirectly through the contacts of the report-back means to the power amplifier and thence through an infinitely variable gear to the feed rolls or the drawing cylinder, by means of a delay device which is conveniently adjustable.

Thereby, in the event of a change in the sliver dimensions this alteration is delayed so long by the delay device that the resulting change is not operative until the sliver section concerned has appeared in the path from the sensing roll to the drawing cylinder.

The assumption in this case is that the alteration in thickness of the sliver is held back long enough until the path from the sensing roll to the drawing cylinder is traversed. The resulting small changes over this section of the path are therefore not compensated. An important further factor is that merely local variations in the sliver are not operative upon the regulated mechanism.

It is in itself known to record, for example by means of the so-called pin disc with several pins, all the changes appearing in the sliver, according to the positions of the individual pins in such manner that the pins are displaced in their longitudinal axes. These displacements of the pins are then delivered after a certain time, for example one-half or three-quarters revolution of the disc, to a power amplifier or servo-motor. That is to say, therefore, that with these known devices in the form of pin discs, magnetic recording tapes or the like, every individual change is recorded and becomes effective on the control mechanism.

In the invention, however, retardation in the issuance of the commands is secured as well as suppression of the influence of local changes. There is no storage whatever of a magnitude factor relating to a change but virtually a signal is stored only when a predetermined magnitude alters and is transmitted later to the control mechanism providing the changed condition has not meanwhile been restored to normal. The compensation or regulation by means of a pin disc, bears in itself no similarity to the delay device according to the invention since the report-back system bridges over this delay action means while with the known pin discs there is no report-back action for the pin disc, that is the pin disc does not delay in time the individual changes but on the other hand registers the magnitudes thereof.

The various features of the present invention are shown by way of example and in diagrammatic form on the accompanying drawings in which:

FIG. 1 is a diagram showing the control mechanism according to one embodiment of the invention, and

FIG. 2 is a diagram showing the manner in which control mechanism of the general character shown in FIG. 1 is incorporated into a drawing frame, the control mechanism itself in this case representing a modified form of FIG. 1.

Referring first to the general arrangement shown on FIG. 2, it will be seen that a sliver **25** or the like of fibrous material and coming for example from a carding machine, passes between a pair of sensing rolls **1** and **2**, then passes between a pair of feed rollers **26**, **27** and enters into a combing zone where it is subjected to the action of two opposed rows of combing or gilling elements **28**, **29** which may be mounted in fallers in the manner of an intersector box and conveniently moving in an endless path as indicated in diagrammatic form on

the drawings, by which the fibrous sliver is combed out before being subjected to the action of a group of three drawing rollers 30, 31, 32.

The bottom sensing roll 2 is driven from a driving motor 33 at constant speed by a suitable transmission belt or the like indicated at 34 and the feed rollers 26, 27 are also driven at constant speed. The transmission belt 34 also actuates the intake shaft 35 of an infinitely variable change speed gear 14 the output shaft 36 of which is coupled by a transmission belt or the like 37 to one of the drawing rollers, for example the drawing roller 31, so that the portion of fibrous sliver subjected to the combing action of the elements 28, 29 is drawn out according to the speed of operation of the drawing roller assembly 30, 31, 32. Any substantial deviation of the sliver from the desired or standard thickness is compensated when the sliver reaches the combing zone where it is subjected to the action of the combing elements 28, 29, by an increased driving speed of the drawing rollers 30, 31, 32, thus ensuring that a sliver of constant thickness is obtained, and the present invention is more specifically directed to the control of the variable speed gear 14 so that it responds to changes in thickness of the incoming sliver. The variable speed gear 14 is controlled as regards its transmission ratio by an operating lever 13 which derives its movements from the sensing roll 2.

Referring now to the construction of the control mechanism shown in FIG. 1, it will be seen that the upper sensing roll 1 is arranged on a holder 1' which can be adjusted and fixed in the vertical direction by means of a fixing and adjusting screw 1'' and the adjusted value can be indicated by means of a suitable indicator 3, for example a dial indicator. The sensing roll 2 is mounted at one end of a pivoted arm 2' the other end of which is subjected to the action of a pull rod 4 loaded by means of a number of weights 4', by which the fibre sliver passing between the two sensing rollers is subjected to a uniform pressure.

The pull rod 4 is provided with a striker pin 5 which co-operates with an intermediately pivoted lever 6 supported by a holder 8 movable on a spindle 7 in such manner that the axis 6' thereof can be adjusted in the horizontal direction.

The switching arm 9 rotates about the center of roller 9' upon movement of the piston rod 10, while the roller 9' is moved upon movement of the lever 6 and thus the switching arm 9 then rotates about the center of the roller 10'.

The lever 6 also engages a bearing roller 9' on a switch arm 9 one end of which is connected at 10' to a plunger 10 comprising the output member of a mechanical amplifier or servo-motor indicated at 11. At the other end the switch arm 9 embodies a disc-shaped head 9'' which co-operates with electric contacts connected through conductors L to the power amplifier or servo-motor system 11.

The plunger 10 of the servo-motor is provided with a driver element 12 which effects the movement of the operating lever 13 for the variable speed gear 14 in the direction of the arrow P in the course of the upward and downward movement of the plunger, in such manner that the drive of the machine is effected at a slower speed in the direction S or at a higher speed in the direction F.

The method of operation of the control system for a drawing frame according to the invention is as follows:

A change in the thickness of the incoming sliver is detected by the lower sensing roll 2 and is transmitted by the lever 2' through the pull rod 4 and the striker 5 to the lever 6 which in turn actuates the switch arm 9 so that the latter operates electric contacts by means of the head portion 9'' thereof which in turn control the amplifier or servo-motor 11 in such manner that the plunger 10 moves upwardly or downwardly and thus correspondingly affects the drive of the drawing frame as already explained by means of the infinitely variable gear box 14 in the sense which maintains constant sliver thickness. Suitable indicating means, such as a dial indicator 16 in FIG. 1, is set to a zero position and indicates the movements of the sensing roll 2 as the sliver passes between the rolls 1 and 2.

If for example the upper electric contact is engaged, displacement of the plunger 10 is effected in the upward direction and thus the pivot pin 10' moves upwardly until the contact is again released, i.e. the power amplifier or servo system operates until the preset value is secured represented by the bearing point 9' of the switch arm 9.

The infinitely variable gear 14, which is so designed that on adjustment the rotary speed of the drive mechanism rises or falls linearly according to the changes in the thickness of the sliver, co-operates as already described with a power amplifier or servo-motor system 11 which in the examples shown is subjected to the influence of and is controlled by electrical contacts. These contacts can for example also be replaced by means controlling a hydraulic or mechanical power actuator system without departing from the scope of the invention, since the construction and operation of such hydraulic and mechanical systems are well known.

As already stated the apparatus described is arranged so that it can be adjusted to handle as desired different intended thicknesses of the sliver and to maintain the selected thickness constant. If different thicknesses are to be handled there will necessarily be a change in the spacing of the sensing rolls 1 and 2. In order to adjust the apparatus for the new thickness a length of sliver of the desired thickness is positioned between the sensing rolls 1 and 2 and the latter occupy new positions. The roll 1 is released by adjustment of the adjusting screw 1'' and the roll 2 is then brought to its original or zero position by adjustment of the presser system operative upon the top roll 1. This brings the top roll 1 into a new position which is represented by a change of the reading seen on the indicator 3. The adjusting screw 1'' can then be further regulated if desired.

After this adjustment the holder 1' is fixed and the leverage of the lever 6 is adjusted by means of the spindle 7 which for this purpose embodies a manually operable element 17, for example in the form of a hand wheel, and by the operation thereof both the holder 8 carrying the lever 6 and also a cam 18 arranged on the spindle are displaced horizontally in the direction of the arrow P'. The cam 18 is connected by means of a rod or linkage system 19, 19' with a control indicator 20.

This has the effect of imparting a compensatory change to the transmission ratio operative between the striker 5 and the roller 9' operating the switch arm 9. The shape of the cam 18 is such when the readings of the indicators 3 and 20 are the same the requisite compensation is secured; that is to say such that a given percentage change in the thickness of the sliver for which the apparatus is adjusted always imparts the same movement at the switch arm 9 irrespective of the desired or intended thickness for which the machine is adjusted.

A particular advantage of the device according to the invention is that besides being able to handle fibre slivers of different thicknesses, the play between the contacts executing the control can be made extremely small by reason of the comparatively long leverage of the arm 9 so that any possible changes in the sliver thicknesses are subjected immediately to a correction and on the other hand a complicated feed back or report system for the predetermined values is no longer necessary.

As already indicated it is preferable for the delay device indicated on FIG. 2 at DEL. DEV. to be incorporated in the control of the power amplifier or servo-motor 11 from the switch arm 9 or the like. In the case of the electrically controlled circuit shown on the

drawings it is sufficient for the delay device to include one or more delay action relays in the leads L as shown. On operation of the switch arm a relay is operated after a predetermined delay interval, which is preferably adjustable. On operation of this relay after the intended delay period an intermediate contact is closed which thereupon initiates operation of the power amplifier or servo-motor in the required direction. If, however, before the expiry of the delay period the switch arm **9** re-opens the contact concerned the delay means releases so that no control influence is exerted on the servo-motor **11** or on the change speed gear **14**.

Referring again to FIG. 2 of the drawings, it will be seen that many of the features shown in FIG. 1 are incorporated but that the control system is somewhat modified. The top sensing roll **1** is free to move upwardly to a limited extent from a bottom stop position determined by an eccentric stop **1''** and any deflection there may be of the arm **1'** carrying the sensing roller **1** is indicated by the dial indicator **3**. The bottom sensing roll **2** is supported by a pivoted arm **2'** carrying the pull rod **4'**. A striker roller **5** on the pull rod **4** acts on a lever **6** pivoted at **6'** to the spindle **7** and the other end of the lever **6** acts on a roller **9'** on a lever **9** pivoted to a link rod **10** connected at its lower end to the output member of the servo-motor **11**. At its other end a lever **9** carries a contact member **9''** operative upon contacts controlling the servo-motor **11** through connecting leads L and the delay device (DEL. DEV.) shown. An arm **12** on the rod **10** is operatively connected with the control lever **13** for the variable speed gear **14**. In this case the cam **18** is operative directly upon the dial indicator **20**, and is proportioned so that with the standard calibrations of the dial indicator **20**, correct adjustment of the mechanism is obtained when the indicators **3** and **20** give identical readings. The spindle **7** is adjusted axially as indicated by the arrow P' by the hand wheel **17**.

In FIG. 1 the dial indicator **16** indicates the standard or reference position of the sensing roll **2** and in the case of FIG. 2 this function is performed by means of an indicator marker or arrow **16'** on the pull rod **4** which moves over a suitably graduated scale, the zero position of which (marked on the drawing) indicates the reference or standard position of the sensing roll **2**. If desired a similar marker or arrow **10''** may be provided on the link rod **10** operated by the servo-motor **11** for the purpose of indicating the displacements from time to time of the rod **10**, controlling the variable speed gear **14** through the lever **13** as indicated by the arrows F and S representing respectively an increase or a reduction in speed and providing a compensating control for providing respectively a greater drawing action or a smaller drawing action on the sliver to compensate for deviations from the standard value and to provide an outgoing sliver of substantial uniform thickness.

What I claim is:

1. Control apparatus for a textile drawing frame comprising a pair of sensing rolls between which a sliver of fibrous material being handled in the drawing frame is passed, infinitely variable driving means for the drawing frame, power assisted means for actuating said variable means dependently on the response of the sensing rolls responsive to variations in the thickness of the sliver, control means associated with said sensing rolls to control said power assisted means and a manual control means for regulating the response of the power assisted means to the sensing rollers so that the apparatus can handle different sliver thicknesses at different settings of the manual control means while maintaining constant sliver thickness for any particular setting.

2. Control apparatus for a textile drawing frame comprising a pair of sensing rolls at the point of entry to the control apparatus and between which a sliver of fibrous material being handled in the drawing frame is caused to pass, an infinitely variable speed gear for driving the drawing frame, servo-motor means for controlling said variable speed gear dependently on the response of the sensing rolls responsive to variations in the thickness of the sliver, means operable by displacement of said sensing rolls to control said servo-motor means, and a manual control for regulating the response of the servo-motor means to the control influence exerted by the sensing rolls so that the apparatus can be regulated for different sliver thicknesses at different settings of said manual control while maintaining constant sliver thickness for any particular setting.

3. Control apparatus for a textile drawing frame comprising a pair of movable sensing rolls responsive to the thickness of a fibre sliver entering the apparatus, a weighted pull rod acting on one of said sensing rolls, striker means associated with the weighted pull rod, a control lever engageable by said striker, power controlling means operated by said lever, a servo-motor device operable by said power controlling means, said servo-motor tending to return said power controlling means to its normal position and an infinitely variable change speed gear regulated by the movement of the servo-motor, said variable speed gear driving a component part of the drawing frame so as to exert a control influence on the drawing action and thus on thickness of the sliver passing between the sensing rolls.

4. Control apparatus for a textile drawing frame comprising a pair of movable sensing rolls responsive to the thickness of a fibre sliver entering the apparatus, a first lever carrying one of said sensing rolls, a counterweight system acting on said lever, striker means associated with the counterweight system, a control lever engageable by said striker means, switch means operated by said control lever, a servo-motor device operable by said switch means, said servo-motor device tending to return said switch means to its normal position and an infinitely variable change speed gear regulated by the movement of the servo-motor, said variable speed gear driving a component part of the drawing frame so as to exert a control influence on the drawing action and thus to maintain constant thickness of the sliver passing between the sensing rolls.

5. Control apparatus according to claim 4 wherein said first lever is subjected to the action of a pull rod carrying the counterweight and striker means on the pull rod adapted to abut against said control lever, a switch arm also in engagement with the ratio lever, a linkage connection from the servo-motor to said switch arm, and contact means operable by said switch arm to control the servo-motor in such manner that the switch arm is always returned towards its inoperative position after displacement to another position.

6. Control apparatus according to claim 5 wherein said contact means is linked to a hydraulic fluid pressure device and the servo-motor is of the fluid pressure operated type.

7. Control apparatus according to claim 5 wherein said contact means comprises electrical contacts and the servo-motor is electrically driven.

8. Control apparatus according to claim 4 wherein said control lever is displaceable for variation of the operative leverage transmitted to the switch means.

9. Control apparatus according to claim 8 wherein displacement of the control lever is performed by means of a manual control spindle which further carries a cam adapted to operate a dial indicator.

10. Control apparatus according to claim 4 wherein indicating means are provided operative to indicate the position of the other sensing roll upon displacement of the first named sensing roll.

11. Control apparatus according to claim 4 wherein the other sensing roll is adapted to be fixed in position by holding means and an indicator is provided for indicating the pressure exerted by said other sensing roll on release of said holding means.

12. Control apparatus according to claim 4 wherein the other sensing roll includes a first indicator means and the sensing roll carried by the first lever is associated with position indicating means and wherein control means are provided for regulating the leverage exerated by the control lever, said control means including a cam and further indicator means operated thereby to enable the cam to be adjusted until both the first indicating means and the further indicating means are brought into balance with the said position indicating means at a zero position.

13. Control apparatus according to claim 4 wherein time delay means are provided interposed between the switch means and the servo-motor to delay the response of the drawing frame to detected changes in the sliver thickness to allow the sliver to move to a predetermined extent through the drawing frame before the control becomes operative on the drawing frame and to suppress the response to transitory changes in sliver thickness.

14. Control apparatus for a textile drawing frame comprising a pair of movable sensing rolls between which a sliver of fibrous material entering the drawing frame passes, said pair of sensing rolls being responsive to variations in the thickness of the sliver, feed rollers operative upon said sliver at one point of its travel, drawing rollers operative upon the sliver at another point, combing elements operative upon the sliver between said feed rollers and said drawing rollers, an infinitely variable ratio drive means for the drawing rollers, a lever supporting one of said sensing rollers, a weight on said lever opposite said sensing roller having a projecting striker associated therewith, a variable leverage device adapted to be manually actuated, a lever pivoted on said device adapted to be engaged by said striker, a servo-motor device operatively connected with the sensing rolls and having an output shaft, a switch member supported by said shaft for movement therewith, means associated with said shaft for controlling said infinitely variable ratio drive means and means on said switch member engaged by said lever for controlling said servo-motor, and manual control means to shift the pivot axis of said second named lever to select the effective leverage so that a given proportionate change in the sliver thickness

will impart the same control movement effected by the servo-motor device for all values of the intended sliver thickness.

15. A control apparatus according to claim 14 wherein said second named lever is physically movable to vary the effective leverage operative between the first named lever and switch means under the supervision of indicator means comprising a first indicator recording the position of the other sensing roll and a second indicator operated by the manual control rod through a cam device, said indicators being brought into coincidence for a change in intended sliver thickness, and a further position indicator associated with said first named lever to permit the zero position of the sensing roll supported thereby to be checked during operation of said manual control rod for coincidence of the first and second indicators.

16. A control apparatus according to claim 14 in which said first named lever axis can be physically moved to vary the effective leverage operative between said weighted rod and said switch means, means to fix the other sensing roll during operation and to release it during setting up operations, a first indicator recording the position of said other sensing roll during setting up, a second indicator, a cam on said variable leverage device to control said second indicator, said indiactors being brought into coincidence for a change in intended sliver thickness, and a further position indicator for showing the position of the sensing roll supported by said first named lever, the coincidence being selected so that during initial adjustment the first and second indicators are brought into coincidence with said further indicator in a zero position.

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