June 12, 1956 E. H. McANGUS 2,749,573

FEED CONTROL MEANS FOR DRAWING APPARATUS

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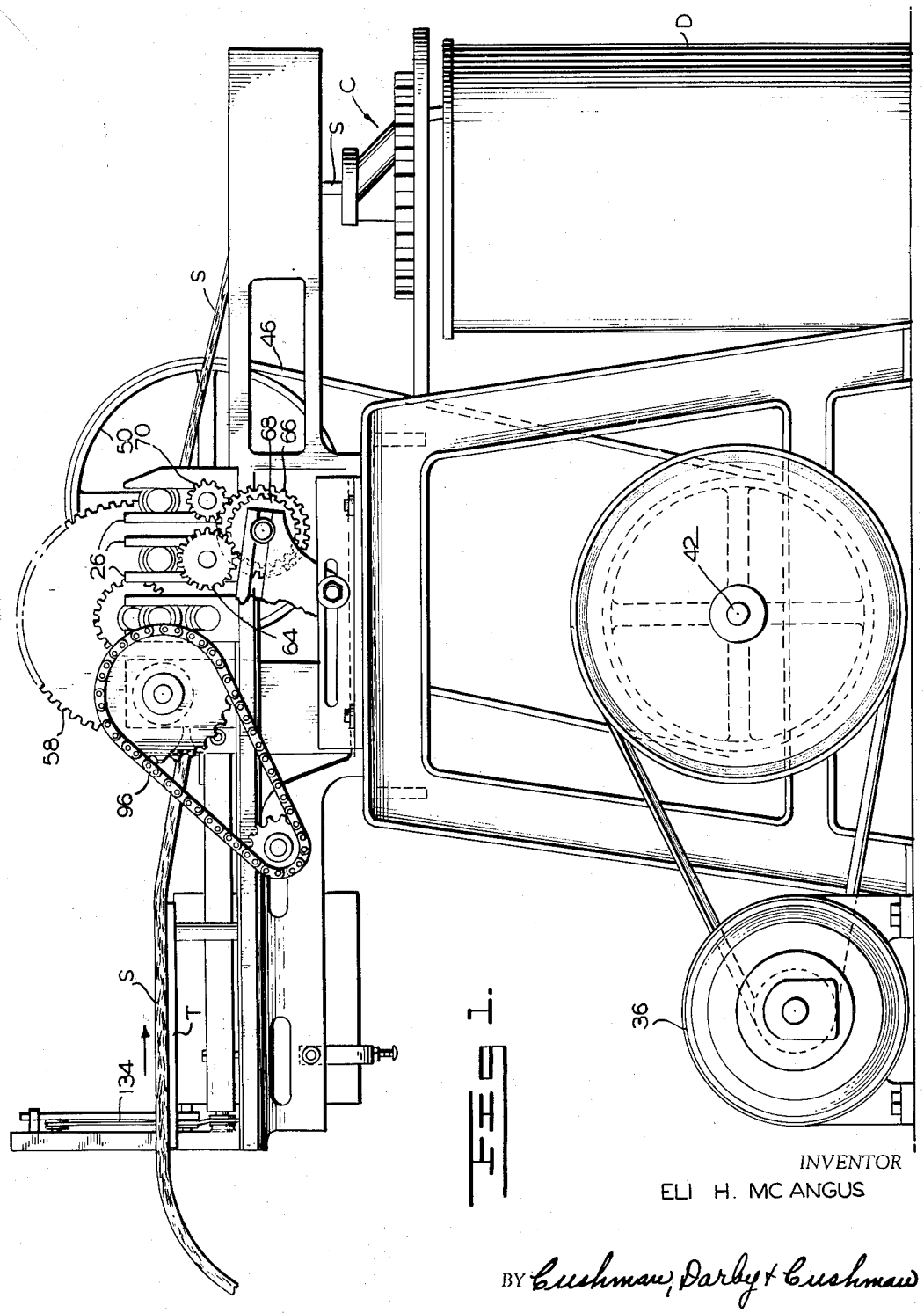


Fig. 1.

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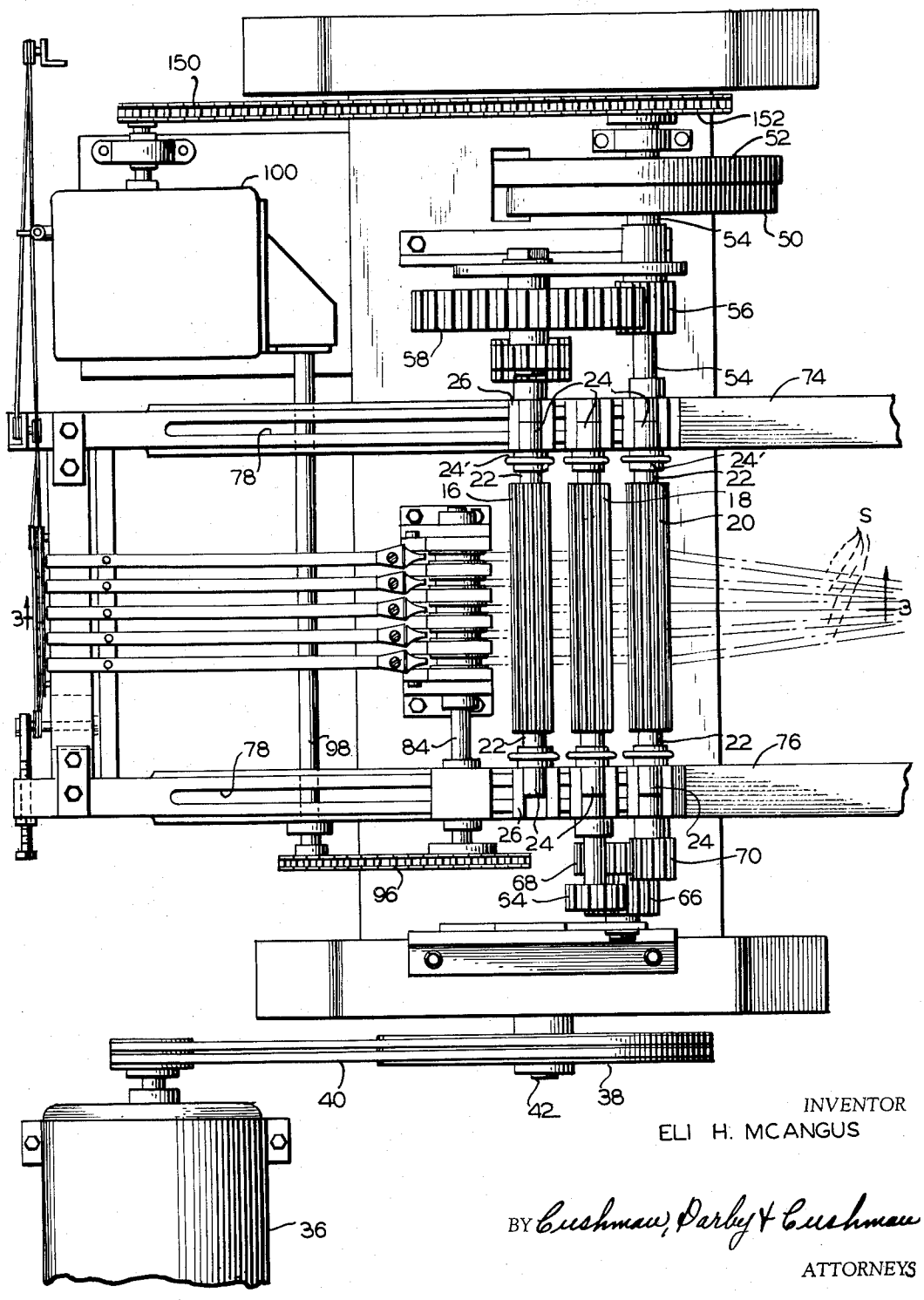
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FEED CONTROL MEANS FOR DRAWING APPARATUS

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Fig 2.



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FEED CONTROL MEANS FOR DRAWING APPARATUS

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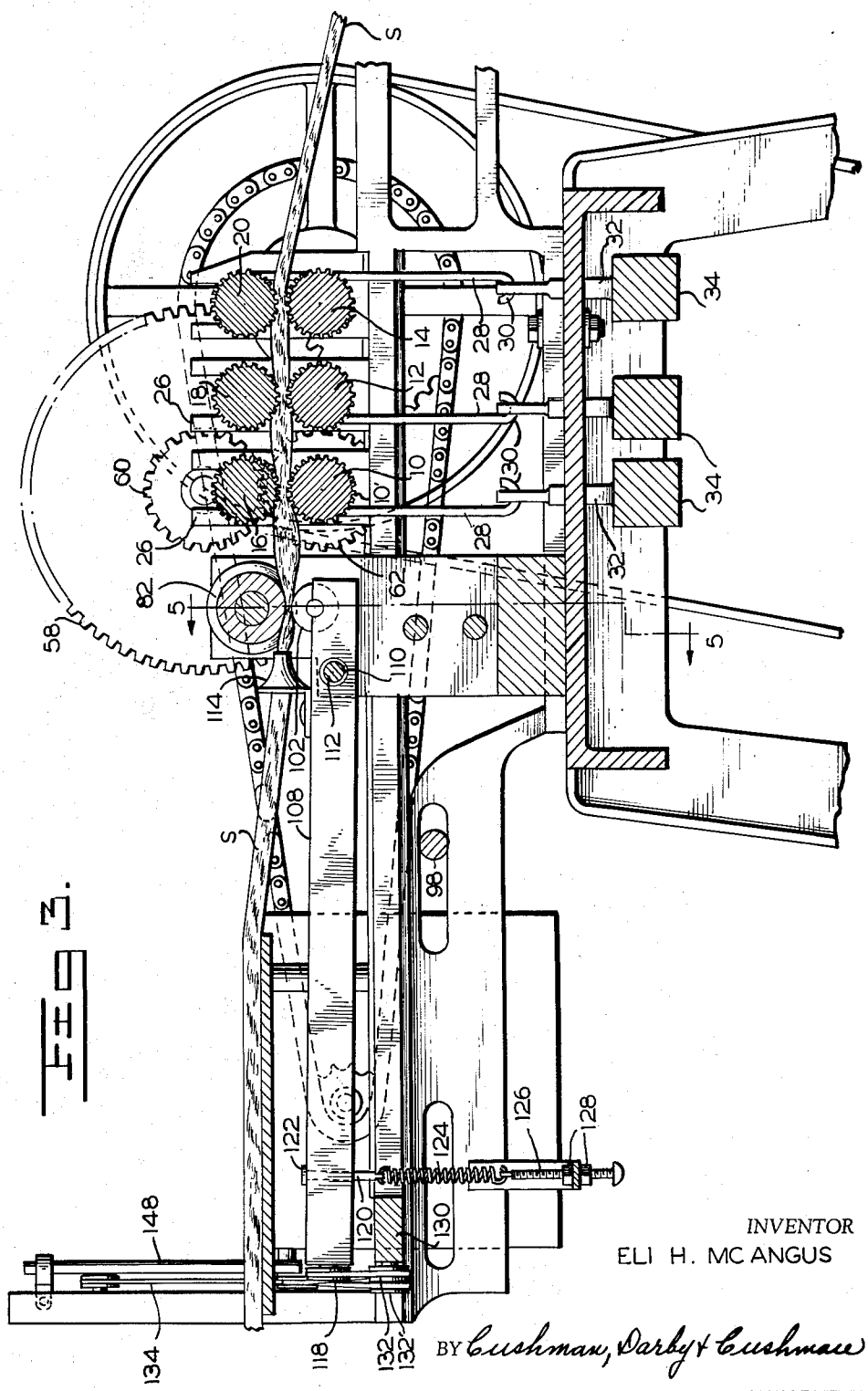


Fig. 3

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FEED CONTROL MEANS FOR DRAWING APPARATUS

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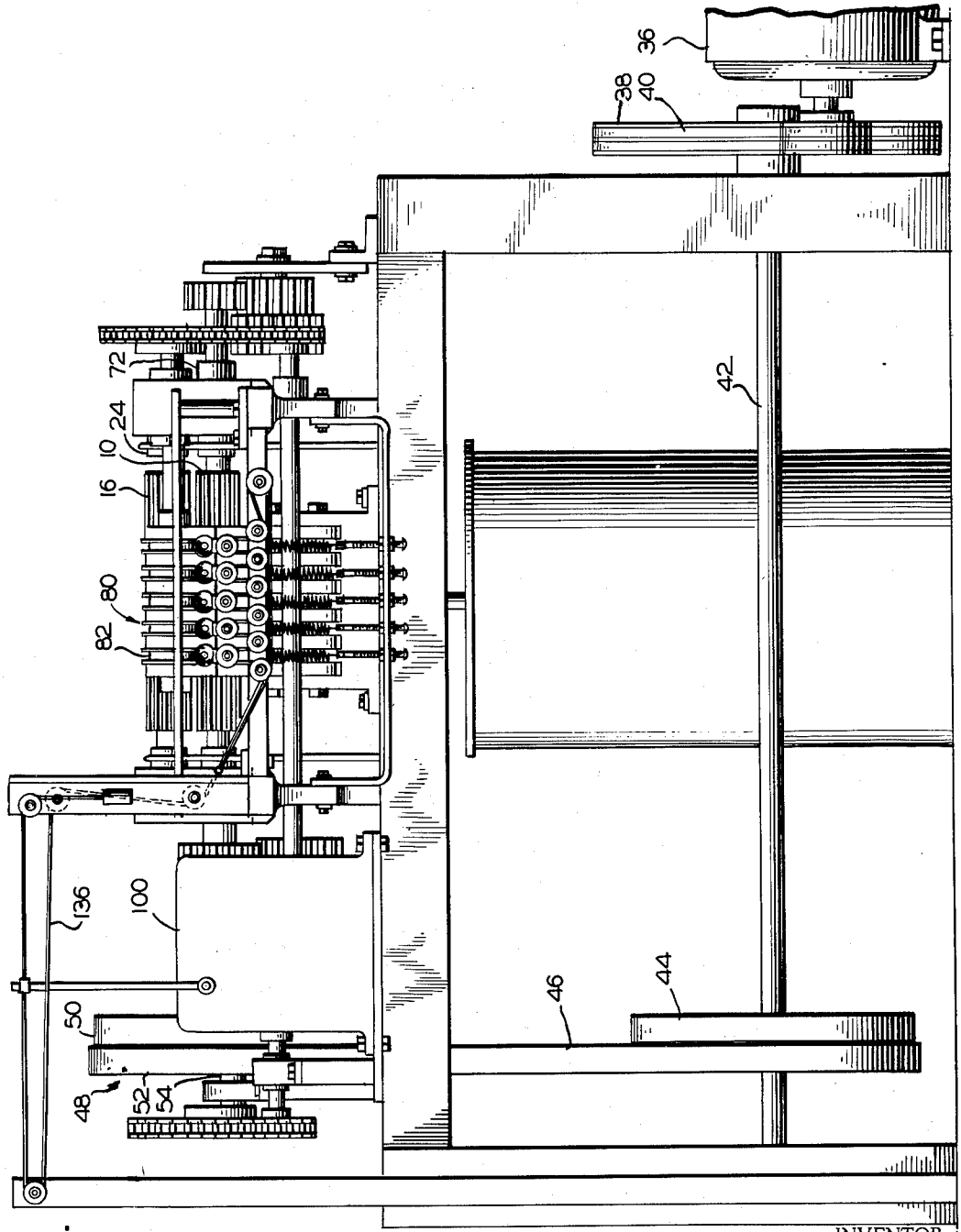


Fig. 4.

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FEED CONTROL MEANS FOR DRAWING APPARATUS

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Fig 5.

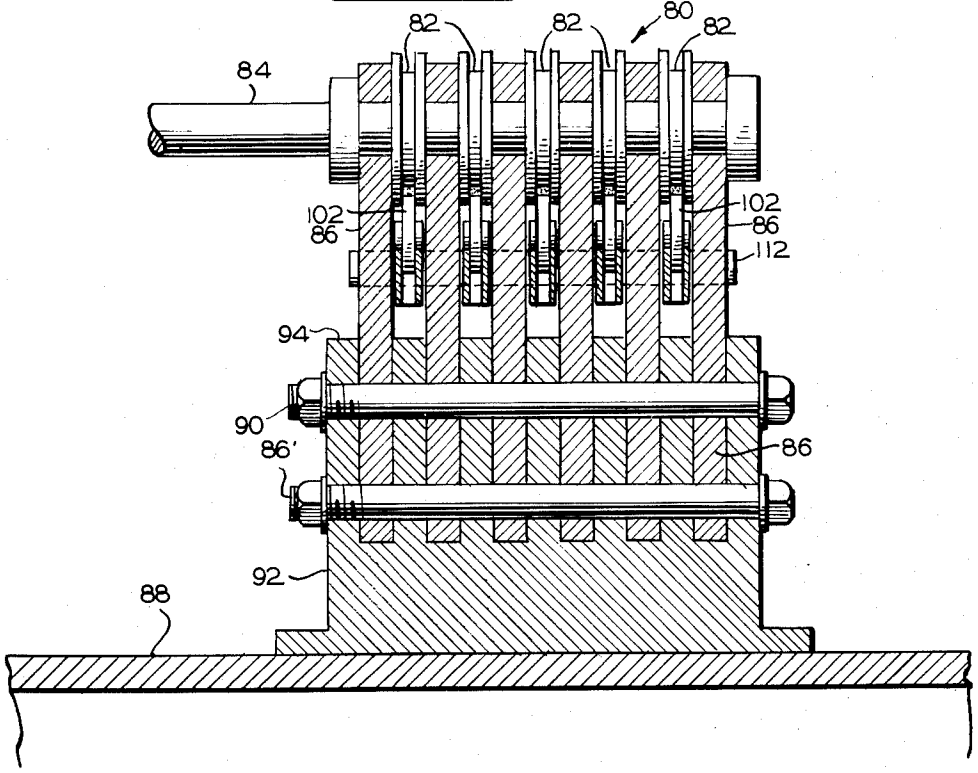
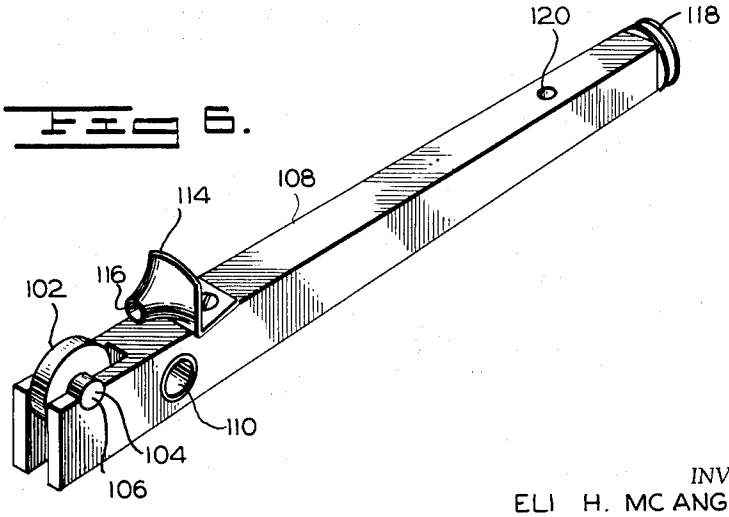


Fig 6.



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FEED CONTROL MEANS FOR DRAWING APPARATUS

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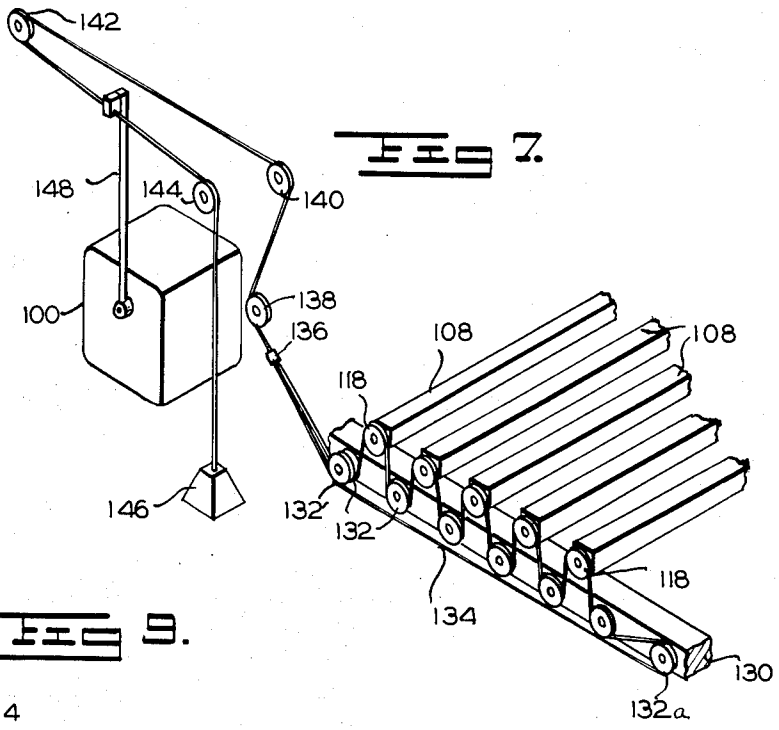


Fig 7.

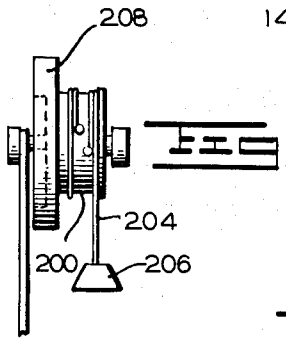


Fig 9.

Fig 8.

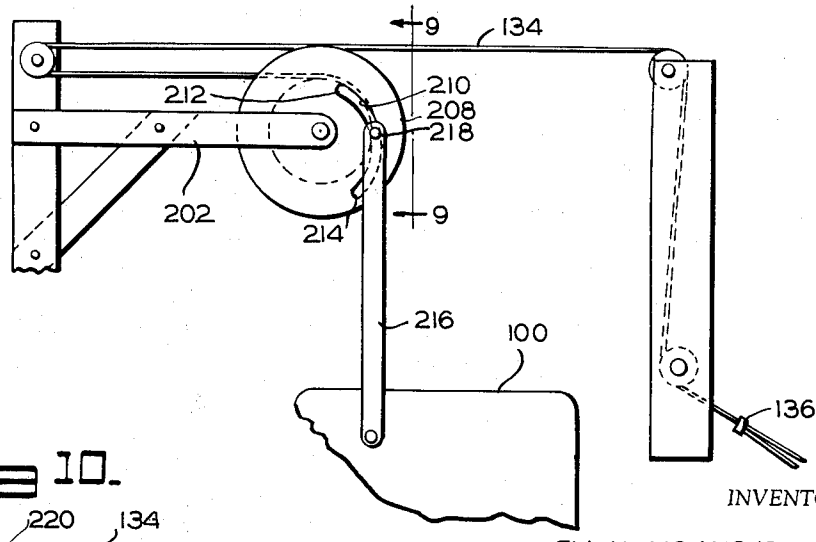
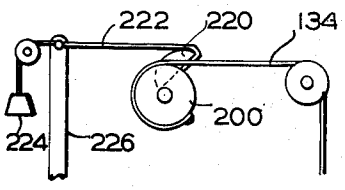


Fig 10.



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United States Patent Office 2,749,573 Patented June 12, 1956

2,749,573

FEED CONTROL MEANS FOR DRAWING APPARATUS

Eli Hugh McAngus, Shawmut, Ala., assignor to West Point Manufacturing Company, West Point, Ga., a corporation of Alabama

Application May 9, 1952, Serial No. 286,879

2 Claims. (Cl. 19—70)

This invention relates to drawing frames and particularly to such devices embodying automatic means for evening slivers drawn therethrough.

It has been known in the drawing frame art to independently regulate the speed of one drawing roll relative to other drawing rolls and a feed roll to compensate for the average unevenness of slivers. An early example of such prior art is disclosed in United States Patent No. 786,242 to Westcott et al. A later example of similar art is the apparatus disclosed in the patent to Lewis No. 2,361,217. However, in the type of drawing frame shown in the Westcott patent the feed roll and the first two drawing rolls are linked together so that the relative speeds of these rolls remain constant. The average thickness or weight of the slivers is determined at the feed roll and mechanism responsive to changes in the weight and thickness automatically changes the speed of the final drawing roll relative to the feed roll and first two drawing rolls, so that a thinning or thickening of the sliver is produced between the second and the final or speed adjusted drawing roll. In the apparatus of the Lewis patent the sliver is first drawn by passing three drawing rolls positively interrelated in speed. The thickness or density of the sliver is then tested by photoelectric means and the final roll is adjusted in speed to compensate for detected variations.

Use of the prior art devices of the above type has proved somewhat unsatisfactory, and room for improvement has been manifest, because of the strict requirements of many purchasers of woven material, for absolute minimum standards of weight content. That is, some users demand that the weight or thickness of thread should not go below a set standard. This means that any unavoidable range of deviations must occur above the lower limit, rather than range above and below the limit. If even a short length of substandard weight should be sensed, a section of material several hundred feet in length may be rejected. The present invention has been found to satisfy this situation by reducing the range of deviation to a very low value, thus cutting down markedly in the unnecessary material previously consumed in guaranteeing that the minimum limits were met.

In distinction to the prior art as just described the basic improvement of the present apparatus according to this invention is that the slivers or like material is tested for weight or thickness at the drawing roll as in the Westcott patent above cited, but the thickness determination is applied to automatically adjust the speed of the feed roll itself. Briefly stated, it has been found that far superior results are obtained by measuring the sliver thickness at the feed roll and adjusting this roll relative to the other drawing rolls, with the latter rolls being positively interrelated.

Further, the present invention makes use of a novel cable type average thickness sensing arrangement and also makes use, in a preferred embodiment, of a closely adjustable hydraulic speed change device for automatically

changing the speed of the feed roll relative to the drawing rolls. In addition, a corrective device may be introduced between the thickness sensing apparatus and the speed control unit for more accurately changing speed in response to detected variations in thickness of the sliver.

Accordingly, it is a primary object of this invention to provide improved drawing frames equipped to automatically even the slivers drawn therethrough.

It is a further object of the invention to provide a novel cable arrangement for detecting average thickness of the slivers.

It is a still further object of this invention to provide hydraulic speed change devices in combination with automatic drawing frame apparatus of the type described.

It is a still further object of the invention to provide a corrective device between the thickness sensing apparatus and the speed change control apparatus for introducing necessary corrections in the relative speeds between the feed roll and drawing rolls of drawing frames.

It may be further stated that the provision of a corrective device between the thickness measuring apparatus and speed control apparatus of the drawing frame is not necessarily limited to the type of drawing frame otherwise described in this application in which the final drawing rolls are all regulated relative to the feed roll. That is, the corrective device may be applied to the earlier drawing frames to provide beneficial results, and this is a still further object of this invention.

Further objects and the entire scope of the invention will become apparent from the following description and the appended claims.

Exemplary embodiments of the apparatus will be described below in detail, but without limitation thereto.

The exemplary embodiments may be best understood with reference to the accompanying drawings, in which:

Figure 1 shows a side elevational view of apparatus according to the invention.

Figure 2 shows a top plan view of the apparatus shown in Figure 1.

Figure 3 shows a sectional view taken substantially along the line 3—3 of Figure 2.

Figure 4 shows an elevational view from the left-hand end of the apparatus as shown in Figure 1.

Figure 5 shows a partial sectional view taken along the line 5—5 of Figure 3.

Figure 6 shows an isometric view of a thickness measuring arm employed in apparatus according to the described exemplary embodiments of the invention.

Figure 7 shows an isometric view of a cable arrangement for sensing the average thickness of sliver according to the invention.

Figure 8 shows a first embodiment of a corrective device according to the invention.

Figure 9 is a view taken substantially along the line 9—9 of Figure 8, and

Figure 10 shows a second embodiment of a corrective device according to the invention.

The basic drawing frame is characterized by first, second and third driven drawing rolls designated **10**, **12** and **14**, respectively. In cooperation with these rolls and placed immediately thereabove are idler drawing rolls designated **16**, **18** and **20**. Each of the rolls **10** through **20** is fluted, as for example at **10'** on roll **10**, so that sliver designated S may be gripped between the vertically arranged pairs of rolls **10—16**, **12—18** and **14—20**. The upper or idler drawing rolls **16**, **18** and **20** are characterized by stub shafts **22** extending from the ends thereof into bearing blocks **24** arranged to slide between vertical guides **26** mounted upon the general framework of the apparatus. As may be understood from Figures 2 and 3, rods **28** are hooked over the bearing blocks **24** as at **24'** in Figure 2 and extend to other hooks **30** at their lower ends

to pass through apertures in arms 32 extending upwardly from transverse bar weights 34. Thus, the weights 34 exert a downward force on the rolls 16, 18 and 20 to urge these rolls downwardly toward the driven rolls 10, 12 and 14, the separation of the rolls depending upon the amount of sliver S passing therebetween. In other words, when sliver is introduced between the pairs of rolls 10—16, etc., the upper rolls 16, 18 and 20 may move upwardly in opposition to the force exerted by weights 34 to permit the sliver to pass between the rolls, and yet exert sufficient force to firmly engage the sliver between the rolls.

Each of the lower rolls 10, 12 and 14 is positively driven by gearing which will now be described and the respective speeds of these rolls is furthermore fixed by reason of the interconnecting gearing. As will be well understood by those skilled in the art, the sliver S may move in a direction from left to right in Figures 1–2 and the object of the arrangement is to draw or extend the slivers by having roll 12 revolve faster than roll 10 and roll 14 to revolve faster than roll 12. Thus, the cross-sectional area of the sliver may be reduced. A motor 36 or any other convenient source of power drives a speed reduction pulley 38 through belting 40, then through shaft 42 across the apparatus to a pulley 44 substantially twice as broad as a flat belt 46. Belt 46 is trained over a split-clutch-type pulley designated generally as 48 and comprising an idler section 50 and a drive section 52. The idler section 50 is mounted for free rotational movement on a shaft 54 and the driven section 52 is fixedly keyed to the shaft 54. As will be well understood by those skilled in the art, convenient means may be provided for shifting the belt 46 from the pulley combination 44, 50 to 44, 52 to stop or start the motion of shaft 54. Where a separate motor for the apparatus is provided, this clutch arrangement may not be necessary, but it is preferred for those plants where a common drive is provided for many different pieces of apparatus.

As may be best understood with reference to Figure 2, the turning moment available on shaft 54 is applied directly to the shaft of roll 14 and is also applied through gear 56 to a gear 58 meshing therewith and then through a smaller gear 60 fixed to gear 58 and further to gear 62 attached to the shaft of roll 10. It will be observed that shaft 14 thus revolves at the speed of shaft 54, while roll 10 revolves at a considerably lower speed due to the speed reduction between gears 56 and 58 and further between gears 60 and 62. The intermediate driven roll 12 receives its drive through a gear 64 which engages gear 66 having affixed thereto gear 68 which engages gear 70 affixed to the shaft of roll 14 opposite to the previously mentioned end to which gear 56 is attached. Thus, it will be understood that the roll 12 receives its drive through the roll 14. Again, it will be understood that the gears 64, 66, 68 and 70 are such that the roll 12 revolves at a lower speed than roll 14, but at the same time is arranged to revolve at a speed greater than that of roll 10.

The shafts extending from the ends of rolls 10, 12, and 14 may conveniently be journalled in bearing blocks 72 quite similar to bearing blocks 24 and block 72 may seat in the lower ends of the channels defined by the previously mentioned guides 26. The weights 34 will automatically tend to seat the bearing blocks 72 by reason of the forces exerted on the rolls 10, 12, and 14 through the sliver S by the rolls 16, 18, and 20.

The general framework of the apparatus is characterized in part by rails 74 and 76 having elongated apertures 78 therein for receiving suitable attachment bolts extending downwardly from the guides 26. This arrangement is intended to permit the selective spacing of the roll pairs 10—16, 12—18, and 14—20 along the bed of the machine so that various sized gears may be accommodated on the shafts of the driven rolls 10, 12, and 14 for providing adequate adjustment in the speeds. Also, this arrangement permits adjustment in the spacing of the rolls in accordance with staple length in the slivers being drawn. That is, an interchangeable array of gears may be employed, much as is the common practice in metal-working lathes for adjusting the speed of the lead screw relative to the work spindle.

The sliver feed roll may be best understood by reference to Figure 5 in addition to the figures previously referred to. This roll is designated generally as 80 and is made up of a plurality of grooves rolls 82 fixedly secured to a shaft 84. The shaft 84 is arranged to ride in apertures in a series of upstanding posts 86 extending from a plate 88 fixedly secured to the general framework of the apparatus. The upstanding posts 86 may be conveniently secured as by clamping action of bolts 90 to a block 92 having fingers 94 which may be interleaved with the lower extremities 86′ of the posts 86.

The shaft 84 is arranged to be driven by chain 96 from shaft 98 extending from a speed change device 100 which will be described in more detail below.

Referring now particularly to Figure 3, cooperating with each grooved roller 82 is a follower roll 102 of width sufficient to just fit within the groove of rolls 82. Referring also to Figure 6, rolls 102 are each provided with extending stub shafts 104 which seat in semi-circular apertures 106 in elongated measuring arms 108. Arms 108 are pivotally mounted as at 110 on transverse shaft 112 in apertures in the posts 86. Mounted upon the upper surfaces of arms 108 in juxtaposition to the rolls 102 are guiding funnels 114 through which the sliver S may be drawn. The apertures 116 in the guide funnels 114 are arranged to be substantially aligned horizontally with the lower tangential point of the rolls 82 so that the sliver will pass directly over this point. The distance lengthwise of the arm 108 between the semi-circular apertures 106 and the pivot point 110 is considerably shorter than the remainder of the arm. The ends of the arms 108 opposite the ends receiving the rolls 102 are provided with pulleys 118.

As best shown in Figure 3, near the ends of arms 108 which are provided with the pulleys 118, there is provided in each arm an aperture 120 for receiving a bolt 122 to which is attached a tension spring 124 fixed at its lower end to a bolt 126 adjustably mounted by means of nuts 128 to the framework of the apparatus.

From the structure as thus far described, it will be understood that the spring 124 will serve to pull downwardly on the left-hand end of the arm 108 as shown in Figure 3, for example, so that the roller 102 will be forced upwardly into engagement with the sliver S between roll 102 and roll 82. Thus, the rotational position of the arm 108 about the pivot point 110 will be determined by the cross-sectional area of the sliver S at the point between the rollers 102 and 82.

The support of the feed roll 80 at a plurality of points, by posts 86, is an important aspect of this invention. By such firm support, the feed roll does not flex, as has been the case in prior art machines, and therefore no errors of measurement are introduced.

While the feed rolls 82 and cooperating rolls 102 are shown as having a smooth surface, these rolls may be fluted to produce additional traction on the slivers. However, where sufficient pressure may be exerted to cause frictional engagement, as is the usual case, it is desired to void fluting the feed rolls, since the flutes may tend to introduce some errors in accurate measurement of the sliver weight.

It this point it may be noted that sliver S is fed to the drawing frame from a source (not shown) to the left of the apparatus as shown in Figure 1 and may conveniently be arranged to slide over a table T to substantially incline the incoming slivers with the point of contact between the feed rolls 82 and the follower rolls 102. According to conventional practices, the slivers may be picked up from coiled piles on a table or from coils of slivers in cylindrical containers.

The drawn slivers issuing from the final set of fluted drawing rolls 14—20 may proceed as in conventional drawing frames through a coiling mechanism designated C arranged to revolve and at the same time draw the combined slivers therethrough to lay same in a coil in the cylindrical container D shown in Figure 1.

Referring now particularly to Figure 7 in addition to the other figures, there is mounted on the framework of the apparatus adjacent the outer ends of arms 108 a transverse bar member 130 on which are mounted a plurality of spaced pulleys 132 arranged to appear between and below the pulleys 118 mounted on the ends of arms 108. A length of flexible cable 134 is passed over an idler pulley 132*a* and then alternately over a pulley 132 and an adjacent pulley 118 to a point 136 where the cable 134 is joined to itself, either physically, or by following the same path from there on. There is thus formed a closed loop having the property of permitting the point 136 to retract or extend relative to the pulley system in accordance with the average displacements of the arms 108 from the bar member 130. The final fixed pulley may be double grooved to separate the cable portions, this being designated as 132'. Therefore, the movement of point 136 of the cable is in fact determined by the average thickness of slivers as measured at the plurality of rolls 102. The cable 134 continues over conveniently mounted idler pulleys 138, 140, 142, and 144 as required to a suitable weight 146. Intermediate the idler pulleys 142 and 144 the cable is affixed to an operating arm 148 which extends to the previously mentioned speed change device 100.

The spring "weighting" applied by springs 124 to arms 108, in combination with a weight 146, has been found by test to provide greatly improved results over only a weight 146 and/or only dead weight on arms 108, and this forms an important aspect of the present invention. To set forth one example, without limitation thereto, the weight 146 may be about one and one-half pounds, and the tension exerted by each of springs 124 about three and one-half pounds. The excellent results may possibly be attributed to the fact that a relatively high spring tension is applied to the arms "ahead" of the cable 134.

The output of speed change device 100 has previously been explained as being the shaft 98 which drives the feed roll through chain 96 and shaft 84. The input to the device 100 is through chain 150 extending from a sprocket 152 fixedly attached to the previously mentioned shaft 54 driven by the motor 36 through the belting, as explained above.

While any conventional type of speed change unit may be employed with this invention and no limitation to any particular type is intended, it has been found preferable to employ a now well known type of hydraulic drive in which a cylinder casing provided with a plurality of cylinders is tilted relative to a piston system. This type of drive consists essentially of a high pressure variable flow pump using fluid such as oil and a hydraulic motor connected to the pump by a piping system. The variable flow pump consists of a rotating cylindrical block containing several pistons uniformly spaced in a circle about the center of the block. The axes of the small cylinders into which these pistons fit are parallel to the axis of the cylinder block. The complete assembly is mounted in a tilt box or cylinder head in which the cylinder block rotates. As the block turns the small cylinder openings pass under inlet and outlet ports in a valve plate. The cylinder block is driven by a drive plate through a universal joint, so that the axis of a block may be changed by an angle of as much as 30° either side of the main drive shaft center line. This causes the small pistons, attached to the drive plate by ball-and-socket joints, to move in and out of the block as it rotates. The greater the angle of the block the longer the piston stroke, and vice-versa. At zero angle there is no relative motion between the piston and the cylinder block and therefore no pumping action. However, as the angle of the block passes through zero to the opposite side of the drive shaft center line, the position of the pistons changes with respect to the inlet and outlet ports. The pump may be operated at a constant speed with the pumping action depending upon the angle of tilt. Thus, a change of the angle by means of a mechanical linkage serves to control both the amount and direction of flow.

The hydraulic motor part of the device may be similar in construction to the pump, but the cylinder block has a fixed angle of tilt of approximately 30°. Thus, as the direction of fluid flow is varied because of the angle of tilt in the hydraulic motor, the speed and even the direction of rotation of the motor may be changed. In the present application, it is not, of course, contemplated that the direction of rotation would actually be changed. When this particular type of hydraulic speed change device is employed, the previously mentioned operating rod 148 will be suitably linked to control the angle of tilt of the cylinder block of the hydraulic pump.

From the apparatus as thus far described, it will be apparent that the average thickness of the slivers S passing between the rolls 82 and 102 will cause the speed change unit to change the speed of the feed rolls 82 relative to the fluted roll sets 10—16, 12—18, and 14—20 in a corrective fashion. That is, assuming that the slivers are first of an acceptable or standard size, if the cross-section of the slivers begins to increase, the outer ends of the arms 108 will move away from the bar 130 so that more of the cable 134 is consumed in the closed loop over the pulleys 132 and 118. Thus, referring to Figure 7 the point 136 will move to cause the arm 148 to rotate counterclockwise and this may be linked to the speed change device 100 in such fashion that the speed of shaft 98 is reduced in relation to the speed of the fluted drawing rolls. Thus, the change in thickness detected at the feed rolls 82 will be immediately compensated for by a stretching of the sliver between the feed rolls 82 and the first set of fluted rolls 10—16, so that the drawing operation between the three sets of fluted rolls continues as before. Conversely, if the average thickness of the standard slivers should decrease, the speed change unit will be altered in the opposite direction, the feed rolls will speed up relative to the fluted rolls and feed the slivers at an increased rate into the first set of fluted rolls 10—16 and again the drawing will continue as though the slivers S had come into the apparatus at uniform thickness.

It will, of course, be understood that the normal speed of the feed roll will be somewhat less than the speed of the first drawing roll. Accordingly, some drawing will occur therebetween, thus causing relative changes in feed roll speed to be effective in the manner described.

As has been pointed out in the above recited objects of this invention, it is a very important phase of the invention that the correction of the sliver occur immediately upon detection and before being drawn through the remaining rolls.

The corrective devices illustrated in Figures 8–10 will now be described. In using apparatus of the type described it has been discovered that in automatically changing feed roll speeds under the action of speed changing device 100 to compensate for variations in sliver thickness or weight in the feed stock, a non-linear function between feed stock thickness or weight and feed roll speeds is encountered. This has been encountered although the measuring mechanism produces a linear movement in the cable and works in combination with a linearly variable speed change device. Since this occurs it has been necessary to introduce into the apparatus a means for changing the linear movement of the cable to a non-linear movement to thereby produce a non-linear output from the variable speed unit. For example, it may be assumed that the desired amount of feed stock is to be 100 units at any given feed roll speed. Using

the 100 units of feed stock as a base, the percentage of the base may be calculated when the amount of feed stock is increased by 10, 20, and 30% and also when the amount of feed stock is decreased by 10, 20 and 30%. From this figure the percent change in feed roll speed can be obtained.

A tabulation of examples is as follows:

Feed Stock	Percentage of Base	Percentage Change of Feed Roll Speed Required
130 units	77	−23
120 units	83	−17
110 units	91	−9
100 units	100	0
90 units	111	+11
80 units	125	+25
70 units	143	+43

From the above example it is readily observed that the percentagewise decrease in speed is greater for a 10% increase of feed stock than the percentagewise increase in speed of a 10% decrease in feed stock.

To perform the necessary correcting operation, I provide a device which may be cam-operated for use between the cable **134** and the arm **148** of the speed change device.

A preferred embodiment of the corrective device is illustrated in Figures 8 and 9. Cable **134** is looped about a drum **200** mounted on a conveyor support **202** from the framework of the apparatus. An additional cable **204** may be attached to the drum **200** and looped thereabout and then extend to a weight **206** equivalent to the weight **146** mentioned previously. Fixedly secured to drum **200** is a disc **208** having cut therein a slot **210** extending in a curved path from a minimum radius at point **212** to a maximum radius at **214**. The operating arm of the speed change device **100** here designated as **216** is provided with a pin **218** which rides in the slot **210**. Accordingly, as the cable **134** moves under the action of the pulleys **118** and **132**, the drum **200** will be rotated and this will cause the arm **216** to assume the different positions as the disc **208** is rotated. The contour of the slot **210** may, of course, be designed to take care of any non-linear function which is found to be required upon analyzing the action of the apparatus.

In Figure 10 an alternative arrangement is illustrated. In this case the cable **134** rotates drum **200** to which is affixed an extending segment **220** over the edge of which is trained cable **222**, which further extends to weight **224**. The segment **220** is so arranged that as the drum rotates the effective distance of the point of engagement of cable **222** with segment **220** from the center of the drum **200** varies in an amount determined by the particular contour of segment **220**. Again, it will be observed that design of the segment **220** may introduce a special movement of the operating arm here designated **226** which extends to the speed change device **100**.

The contour of the slot or surface or other operating medium in the corrective device may be readily designed by those skilled in the art by observing the following: As the amount of stock entering between the feed roll and adjacent idler rolls increases the speed must decrease at a decreasing rate. This is to say that the speed will decrease and approach zero, but never reach zero. Accordingly, if x is the percentage of stock entering between the measuring rolls and y is the required percentage of speed change, with the reference amount of stock set at 100 and the reference speed at 100, as x approaches infinity y will approach zero. Conversely, as the amount of stock entering decreases, the speed increases at an increasing rate. In this case as x approaches zero, y will approach infinity. Mathematically, these two conditions indicate a curve with asymptotes. The simplest such curve is the hyperbola which has a well-known characteristic curve. It is adequate for purposes of the present invention to assume that the asymptotes are $x=0$ and $y=0$. Accordingly, the equation for the curve may be $xy=K$, where K is a constant to be computed from known facts above the curve. K may be solved for by permitting x to equal 100 and y equal 100, k therefore being 10,000, resulting in the equation $xy=10{,}000$. This equation will check out to within 0.5 of the figures set out in the above table under percentage of base.

It will also be understood that the nonlinear correction can be built into the speed change unit itself, and correction so introduced is a further part of this invention.

From the foregoing it will be apparent that by the present invention there is provided an improved controlled drawing frame and there is moreover provided unique sliver measuring means which may be employed per se in prior types of drawing frames as well as the type presently disclosed. There is also provided a novel closed loop cable averaging mechanism useful in the present machine and earlier machines. Other objects and advantages of the invention have been pointed out above, and further appear in the appended claims.

Inasmuch as other embodiments of the present invention will occur to others upon reading this disclosure, it is intended that the scope of the invention be determined from the appended claims.

I claim:

1. In a controlled drawing frame, a plurality of drawing rolls, means for driving said rolls at interrelated speeds, a feed roll for feeding material directly to said drawing rolls, means for driving said feed roll, means for measuring the amount of material passing the feed roll, said measuring means including a plurality of independently movable follower means positioned to ride against the feed roll for measuring the thickness of strands of material moving therebetween, pulleys mounted on the follower means and movable therewith in response to changes of thickness of the material, a member mounted upon the drawing frame and passing adjacent the position of said pulleys on said follower means, a plurality of pulleys on said member positioned between said pulleys on said follower means, and a cable loop having first and second ends joined to move in unison and trained alternately over said pulleys on said follower means and said pulleys on said member, means for regulating the speed of said feed roll driving means to maintain substantially constant the amount of material supplied from the feed roll to the drawing rolls, means connecting the ends of said cable loop with said speed regulating means to control the same, and non-linear corrective means including a follower surface curved to produce a substantially hyperbolic function interposed between said cable loop ends and said speed regulating means.

2. Apparatus as in claim 1, wherein said speed regulating means includes a variable flow hydraulic pump.

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