Dec. 6, 1960 G. SMITH 2,962,962

PRINT MACHINE AXIAL REGISTER MECHANISM

Original Filed June 21, 1952 6 Sheets-Sheet 1

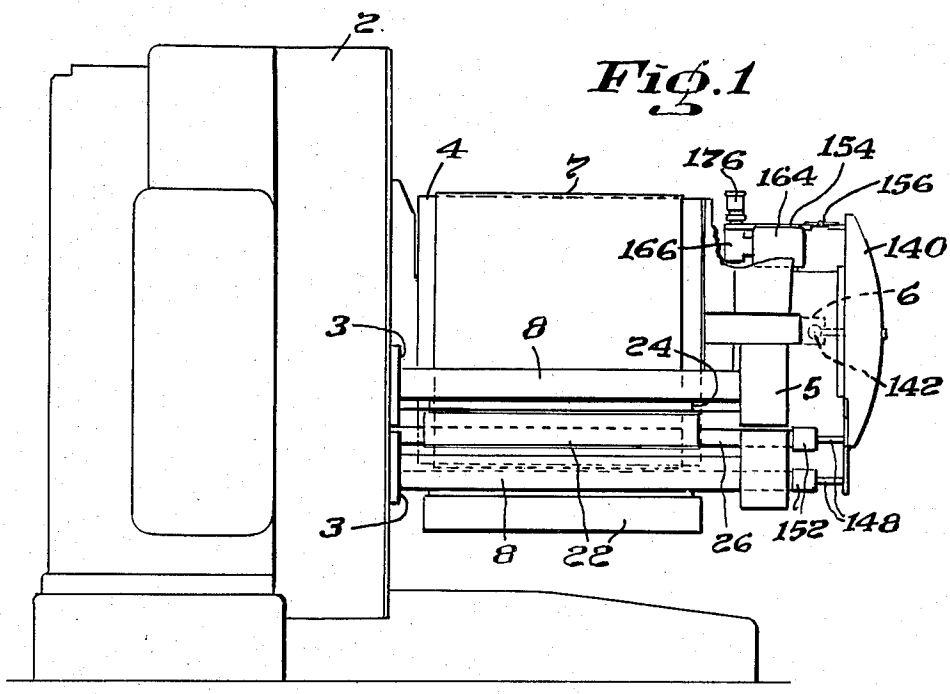


Fig. 1

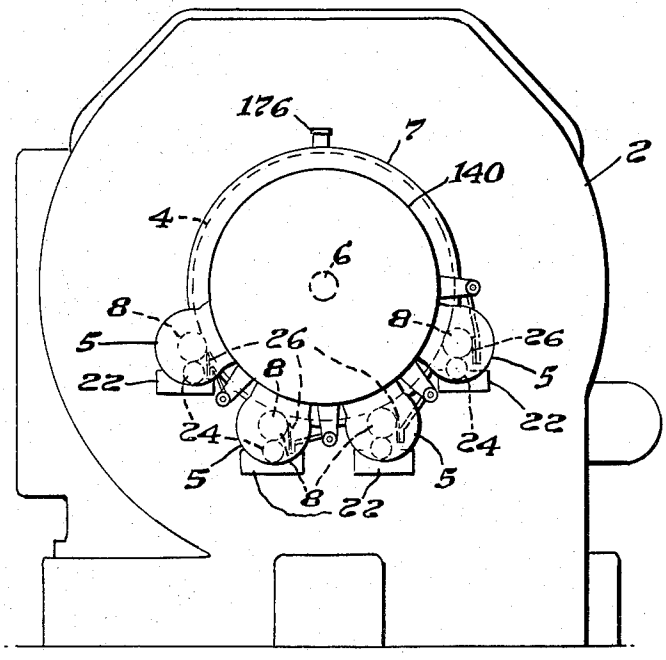


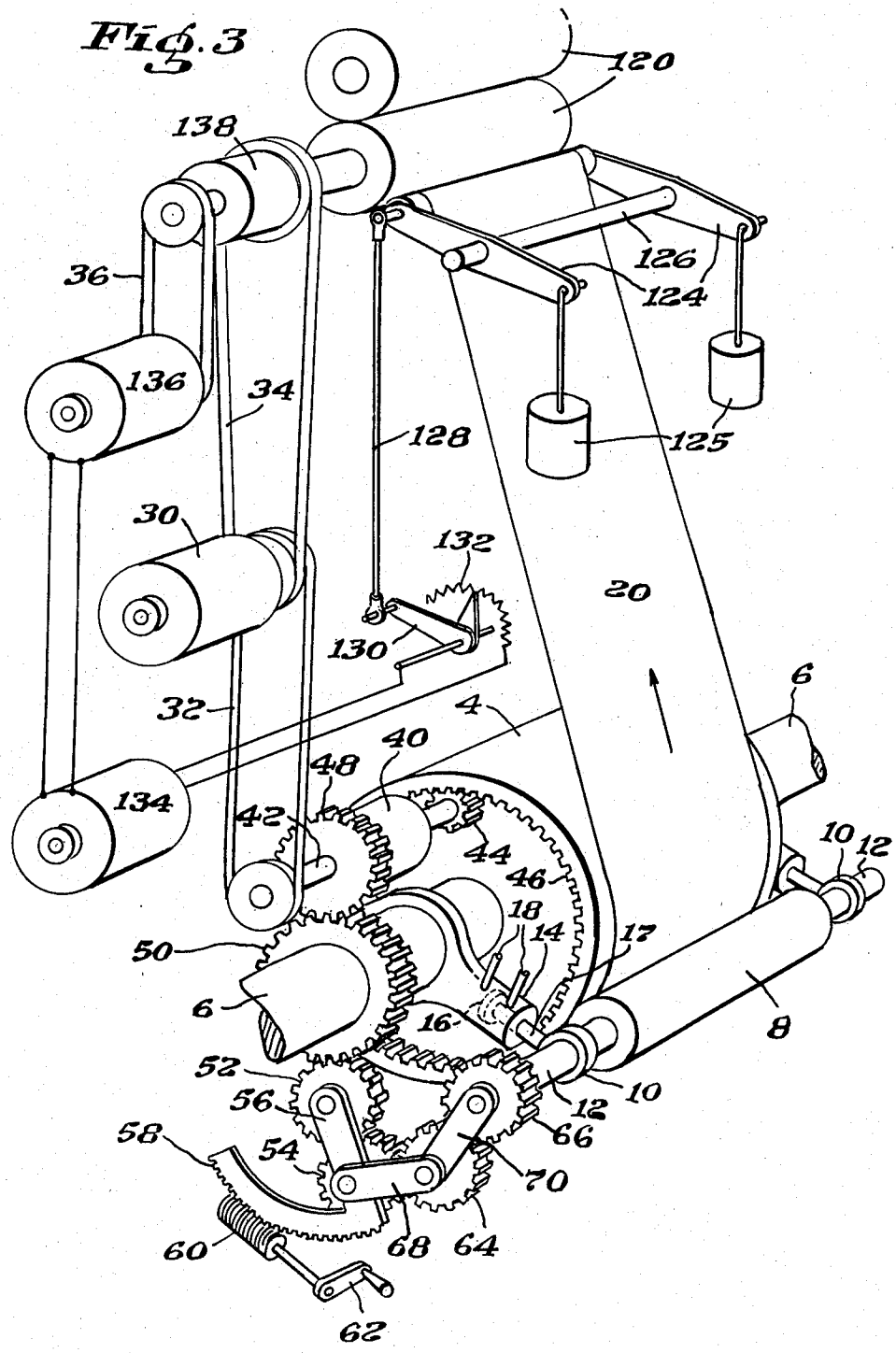
Fig. 2

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PRINT MACHINE AXIAL REGISTER MECHANISM

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Fig. 3



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PRINT MACHINE AXIAL REGISTER MECHANISM

Original Filed June 21, 1952 6 Sheets-Sheet 3

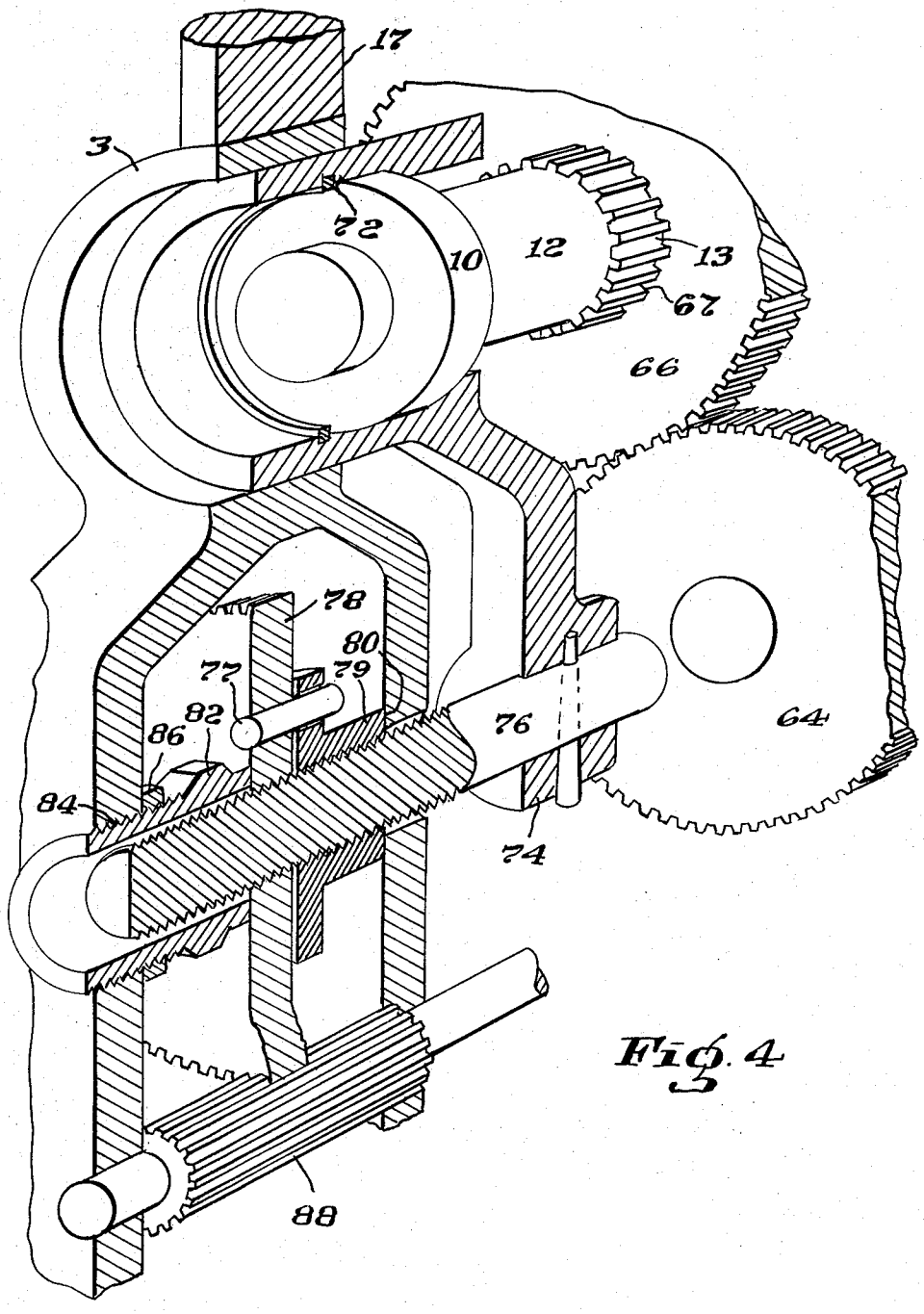


Fig. 4

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PRINT MACHINE AXIAL REGISTER MECHANISM

Original Filed June 21, 1952 6 Sheets-Sheet 4

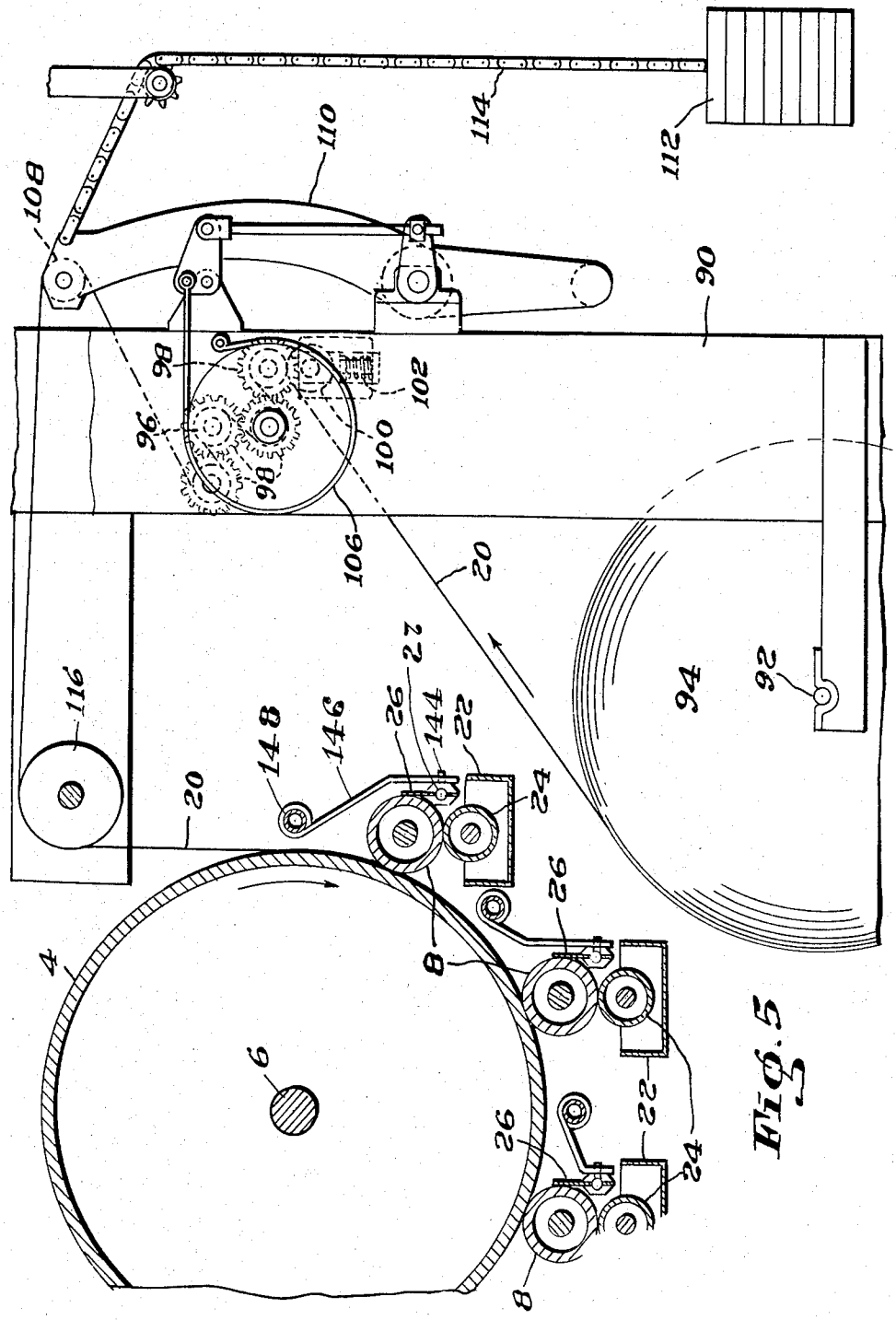
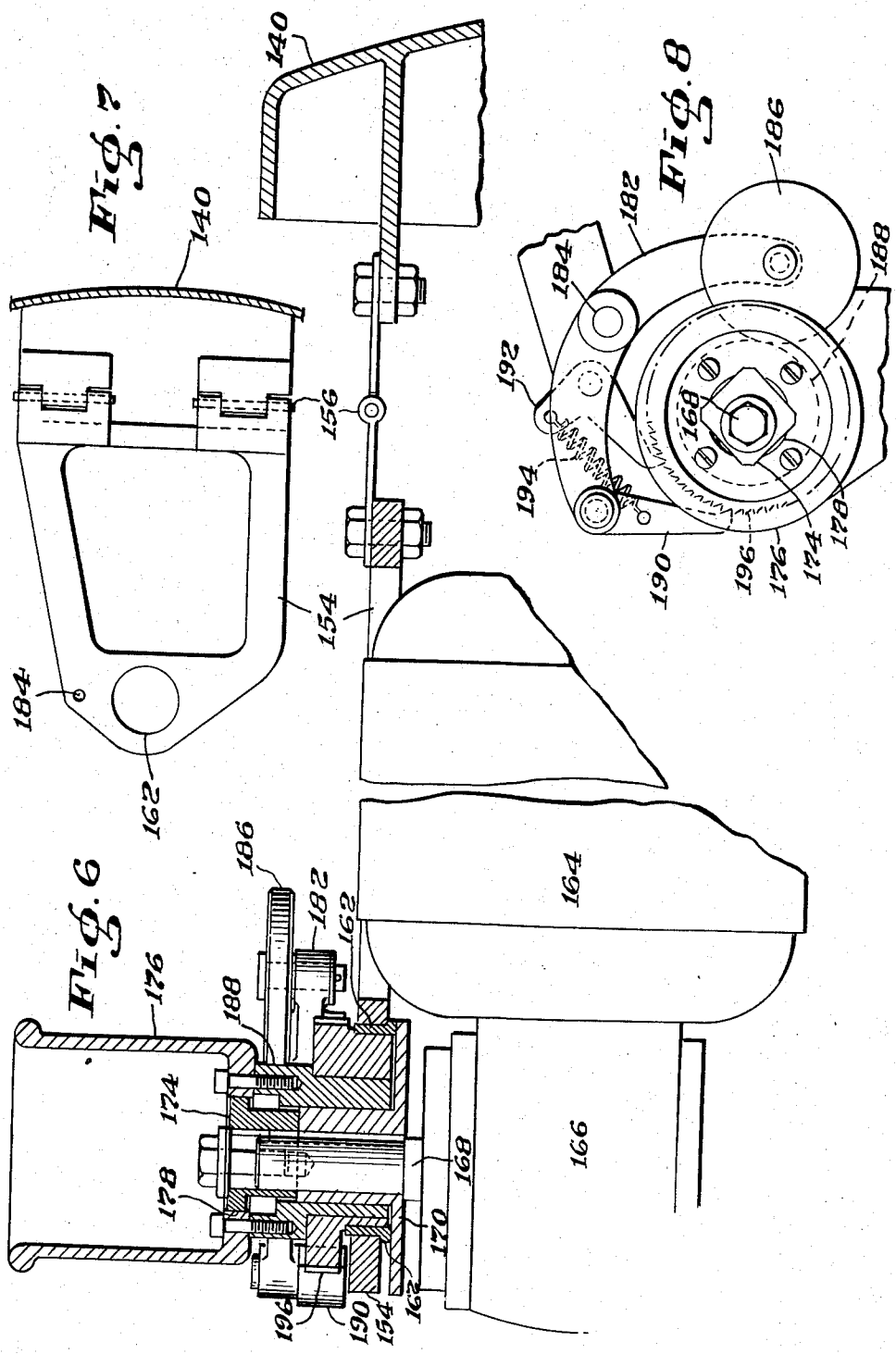


Fig. 5

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PRINT MACHINE AXIAL REGISTER MECHANISM

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PRINT MACHINE AXIAL REGISTER MECHANISM

Original Filed June 21, 1952 6 Sheets-Sheet 6

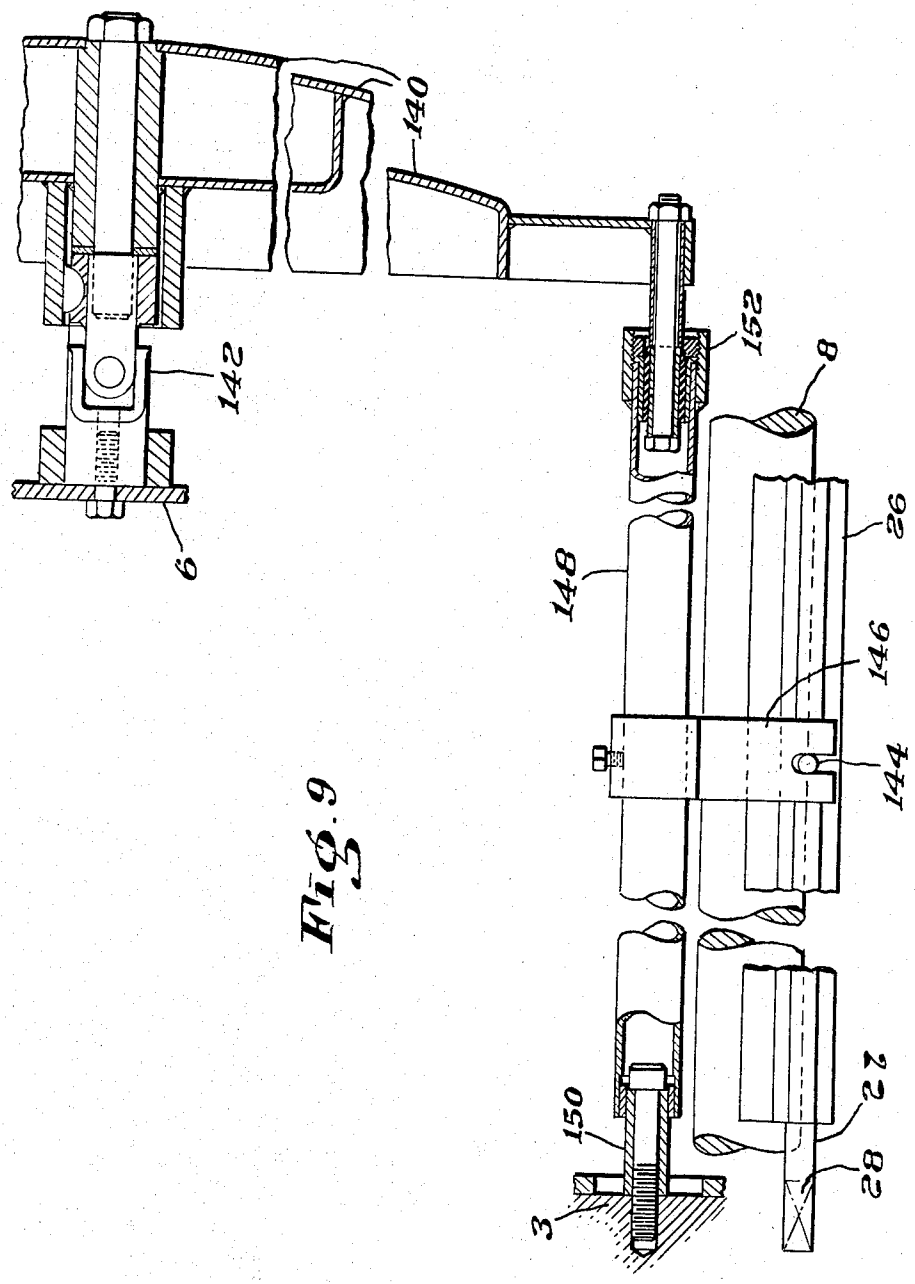


Fig. 9

United States Patent Office 2,962,962
Patented Dec. 6, 1960

2,962,962

PRINT MACHINE AXIAL REGISTER MECHANISM

Graydon Smith, Concord, Mass., assignor to Cranston Print Works Company, Cranston, R.I., a corporation of Rhode Island

Original application June 21, 1952, Ser. No. 294,773, now Patent No. 2,816,504, dated Dec. 17, 1957. Divided and this application Feb. 19, 1957, Ser. No. 645,390

6 Claims. (Cl. 101—178)

This application is a division of my copending application Serial No. 294,773, filed on June 21, 1952, now Patent No. 2,816,504.

This invention relates to textile fabric printing machines and more particularly to those of the type having a rotary backing cylinder with one or more print rolls associated therewith to print in one or more colors a textile fabric in sheet form continuously fed between the backing cylinder and the print rolls, and then to dry cans to dry the freshly printed fabric.

The heretofore known machines of such type have changed little in the past century and have a number of well known disadvantages, the chief one of which is the difficult problem both of initially adjusting or "setting" the machine and then maintaining accurate register when a textile fabric is to be printed in the usual manner with more than one color by successive print rolls, it being necessary, as is well understood, to employ a separate print roll for each color. The register under such conditions is, of course, in two dimensions, across the sheet of textile fabric—hereinafter referred to as lateral register—and along the sheet—hereinafter referred to as longitudinal register. Both the setting and maintaining of register in either dimension are affected by the physical characteristics of the fabric being printed, primarily by its shinking or stretching, as well as by the print machine; hence register must be set when the machine is operating.

To set register accurately in heretofore known machines required considerable time and skill, and due to the nature of prior machines, was quite dangerous. In particular the large amount of time required to set up a print machine whenever the pattern to be printed was changed was an especial disadvantage when patterns were changed frequently. Furthermore, the setting of register on such machines, even if done skillfully, left much to be desired as to accuracy and, similarly, as to the maintaining of register after initial setting.

For example, such machines tended to lose longitudinal tension and hence register, principally because of the necessity of employing different pressures on the print rolls due to variations in degree of fineness of roll engraving and in types of printing pastes and dyes, and occasionally formed a bulge (of the fabric being printed) away from the backing cylinder as the fabric passed around the backing cylinder between successive print rolls which were rotated simply through their contact with the fabric. Of course, as soon as such a bulge, even though slight, was formed, longitudinal as well as lateral register was lost and the print frequently was spoiled. Furthermore, if such bulge before being detected built up sufficiently to fold over and pass between a print roll and the backing cylinder, it broke the print roll bearings.

The formation of a bulge is to some extent aggravated by the relatively soft blanket and lapping used on the backing cylinder, as the speed of the fabric is then affected by the pressure with which the print rolls are forced toward the backing cylinder. Such pressure commonly is not the same for each print roll—as optimum printing pressures vary depending upon the nature of the print engraving and printing paste or dye employed—and hence the fabric may tend to be driven at a different speed by each driven print roll since due to the soft blanket and lapping, the print rolls might be at slightly different distances from the axis of the backing cylinder. It was thus necessary, with heretofore known machines, either to employ a drag roll on the backing cylinder, or to arrange the pressure of the print rolls so that the speed of the fabric tended to be increased, thus stretching it as it passed around the backing cylinder, and the resulting arrangement was not the best one from the standpoint of printing.

Lateral register is even more difficult accurately to maintain than longitudinal register, it being affected primarily by the lateral stretching and shrinking of the fabric. The amount of such stretching was affected by the variations in longitudinal tension which occurred in the heretofore known machines. Thus, the different pressures on the individual print roll will cause variations in the lateral stretching from print roll to print roll, so that it is particularly difficult to maintain accuracy, for example, in printing longitudinal adjoining stripes of different colors.

A further problem arose in the common type of printing machine in which the power drive to the dry cans—around which the freshly printed fabric is passed to dry it—was taken from the backing cylinder, in that the non-uniform fabric speed, primarily resulting from the shrinking and stretching of the fabric, as well as the backlash in the drive, commonly caused a break in the fabric.

In addition to the setting and maintaining of register and other problems as above set forth, it was also a long and difficult operation with such prior machines to change an endless backing cylinder blanket which surrounds the backing cylinder, since, in order to do so, the machine had to be largely disassembled. This required, not only that the print rolls be entirely taken out of the machine, but that the large backing cylinder itself be lifted and its bearings removed so that the endless backing cylinder blanket could be removed by sliding it endwise off the cylinder. The new blanket was then slid onto the backing cylinder, the cylinder replaced in its bearings in the frame, and the print rolls replaced and reset to register.

Accordingly, it is an object of the present invention to provide a novel textile printing machine in which the register, both across and along the sheet of textile fabric, is quickly, easily, and precisely set and, once being set, will be maintained over long periods of time without attention. I am enabled to maintain register in my novel printing machine over long periods of time by maintaining uniform tension in the textile fabric passing through the machine; various means, as hereinafter more fully explained, contributing to the maintenance of such uniform tension. For example, I controllably pre-tension to a considerable extent the fabric before it passes to the first print roll, and remove it from the last print roll at very low tension, thus providing a substantial tension on the fabric from the input end of the machine. This not only eliminates bulges and the resulting loss in longitudinal register, but also permits the arrangement of each print roll for optimum printing, without other regard to its pressure.

It is another object of my invention to provide a textile printing machine which may be readily stopped and started without breakage of the goods. I am enabled to do this not only by providing a low output tension, but also by driving and controlling the dry cans by novel means.

It is a still further object of my invention to provide a doctor blade drive means of relatively simple construction and one which has a wide range of adjustment so that the doctor blades may be reciprocated with both simple and complex motions for greatest efficiency. Adjustment of my novel drive means is furthermore quick and easy and may be made while the print machine is in operation.

A particular feature of my invention resides in my novel means combining in one simple mechanism the print roll drive and register means together with means allowing the print roll to move radially of the backing cylinder.

Another feature of my invention resides in its novel construction which not only permits the quick and easy setting of register but also which greatly simplifies the replacing of backing cylinder blankets, in that it is not necessary to disassemble a large part of the machine and lift the backing cylinder in order to replace the endless blankets.

For the purpose of pointing out further objects and features of a preferred embodiment of my invention, reference is made to the following drawings, in which—

Fig. 1 is a general side elevational view of the printing machine of my invention;

Fig. 2 is a general end elevational view of the printing machine of Fig. 1;

Fig. 3 is a diagrammatic isometric view of the print roll backing cylinder and dry can drive means and print roll, the longitudinal register adjusting and drive means of the printing machine of my invention;

Fig. 4 is a diagrammatic partially sectional isometric view of the lateral register adjusting means;

Fig. 5 is a diagrammatic side elevational view of the pretensioning means of the printing machine of my invention;

Fig. 6 is a diagrammatic elevational partly sectional view of a portion of my novel doctor blade drive means;

Fig. 7 is a plan view of a portion of the doctor blade drive means as shown in Fig. 6;

Fig. 8 is a plan view of another portion of the doctor blade drive means as shown in Fig. 6; and

Fig. 9 is a side e'evational view of another portion of my novel doctor blade drive means.

Referring to the drawings, the textile printing machine of my invention in general, as best shown in Figs. 1 and 2, includes an upstanding supporting frame and drive portion generally designated **2** having a cantilever mounted backing cylinder **4** rotatably mounted on a fixed cantilever shaft **6** forming a portion of said frame **2** and extending generally horizontally outwardly from said frame **2**. Said backing cylinder is provided with the conventional lapping covered by blanket **7**.

One or more intaglio print rolls **8** are rotatably mounted adjacent said cylinder and extend outwardly from frame **2** with their axes parallel to that of said backing cylinder **4**, the ends of each of said rolls being retained by a hydraulic pressure mechanism, as hereinafter more fully explained, which urges said rolls into pressure contact with the intervening fabric **20** (Fig. 5) against the backing cylinder, a subframe assembly **3** being provided to secure the bearings and associated components of each of the print rolls **8** at the inboard end thereof, and a subframe assembly **5** being provided to secure same at the outboard end thereof, such subframe assemblies being adapted to be moved as a unit by said pressure mechanism.

The sheet of textile fabric **20** to be printed is led around said backing cylinder **4** between the print rolls **8** and the backing cylinder blanket **7**. The print rolls **8** carry an intaglio engraved design suitable for carrying a printing dye or paste for printing on the sheet of fabric **20**, said dye or paste being conveyed from a trough **22** to the print rolls **8** in the usual manner as by a dip roll **24** running in the trough and in contact with a print roll **8**. Reciprocating doctor blades **26** are also provided for removing the excess printing paste from the peripheral cylindrical portion of the printing rolls, said blades running in bearings **28** in subframes **3** and **5** and being provided with a novel operating mechanism as hereinafter more fully explained.

In the usual situation, in which a multi-color pattern is to be printed on a sheet of textile fabric by the use of two or more print rolls, it is essential not only to provide suitable mechanical means for setting register, but also to maintain such register, once, set, over long periods of time. The setting or adjusting of register, as hereinafter more fully explained, has some effect on the maintaining of register in that suitable rigid and backlash-free adjusting means must be provided. As hereinbefore pointed out, however, the maintaining of register, both lateral and longitudinal, is largely affected by the control of the tension of the sheet of fabric while it is passing through the print machine between the backing cylinder **4** and print rolls **8**.

I have found that the tension of a deformable, resilient material such as textile fabric is affected by a number of factors, all of which must be simultaneously controlled if the tension of the fabric is to be controlled with precision. Specifically, it appears to be desirable to impart drive to both the backing cylinder and the print rolls, to prevent slippage of the textile fabric, such as was caused by driving the backing cylinder through the fabric as in heretofore known machines, and for such purpose I have provide a novel differential drive for driving both the backing cylinder **4** and the print rolls **8** so that no driving power is required to be transmitted through the intervening fabric to the backing cylinder.

A'so, I have found that it is most desirable uniformly to tension the textile material while it is being printed, in order that it will smoothly contact the backing cylinder and maintain register. Such tension has heretofore been provided between the print rolls, as pointed out above, by varying the print roll pressures so that the final print roll tended to drive the fabric faster than those preceding it; however, such arrangement completely failed to provide optimum printing pressure for all the print rolls. In order, then, to provide a uniform printing pressure at each roll without regard to fabric tension, I pretension the fabric to a controlled value before it passes to the first print roll **8**. By so doing, the danger of bulges in the fabric between print rolls is eliminated and the print roll pressures may be adjusted for optimum printing.

The print roll and backing cylinder drive means, as best shown in Fig. 3, drives both the backing cylinder **4** and the opposing print ro'ls **8**, since the heretofore non-uniform lateral stretching with its resulting deleterious effect on lateral register can be minimized by such an arrangement together with the application of uniform tension to the fabric sheet. Said cylinder and said rolls should be driven varying speeds caused by their effective diameters varying due to the resilient backing-cylinder blanket **7** and the sheet of textile fabric **20** passing through the machine. I thus drive said backing cylinder **4** and said print rolls **8** from a common power source, motor **30**, through a differential mechanism **40** so that said cy'inder and said rolls are at all times automatically driven at speeds adjusted to variations in their pitch line due to changes in their effective diameters. Thus, the differential driving shaft **42** is driven by main drive motor **30** through belt **32** and, through a suitable bevel pinion, rotates about an axis concentric with that of shaft **42**, but independently thereof, a planetary cage carrying planetary bevel pinions freely rotatable about axes perpendicular to said shaft **42**. The cage in turn drives a hollow driven shaft on which is mounted print roll drive pinion **48** for rotation with said cage independently of driving shaft **42**. The planetary bevel pinions on the cage in turn drive a central bevel pinion and its driven

shaft about an axis concentric with that of driving shaft 42, but again independently thereof, said latter driven shaft carrying backing cylinder driving pinion 44. Although the two driven shafts with their pinions 48 and 44 are independent, the sum of their rotation rates with a constant input speed is constant, a characteristic of such a differential mechanism. The backing cylinder driving pinion 44 engages an internal gear 46 on backing cylinder 4 positively to drive said cylinder, while the common print roll drive pinion 48 engages a print roll bull gear 50 from which all of the print rolls 8 are driven by a combined driving and registering mechanism, as hereinafter more fully explained.

For setting longitudinal register, it is essential to be able to move relatively to one another the patterns provided by each of the print rolls 8, as well as to allow movement of the print rolls radially of the backing cylinder. This I accomplish by providing a novel elbow differential means which not only drives a print roll but through which a print roll 8 may also be rotated about its own axis by separate adjusting means, hence moving its surface with respect to other print rolls while the printing machine is in operation, as is most desirable. As best shown in Fig. 3, each printing roll 8 has an individual intermediate driving pinion 52 mounted on the frame 2 of the printing machine for rotation about a fixed axis and running in engagement with bull gear 50, the bull gear 50 and intermediate driving pinion 52 constituting gear means for driving the pinion. Each pinion 52 in turn drives a first register pinion 54, the shafts of said pinions 52 and 54 being connected by a link 56—extending somewhat beyond pinion 54—which at all times maintains said pinions in mesh and hence driving engagement. The link 56 has mounted on its end extending beyond pinion 54 a worm wheel portion 58, so that said link 56 carrying pinion 54 may be moved about pinion 52 by the rotation of a worm 60 rotatably mounted on frame 2 of the machine and engaging worm wheel 58, said worm being rotatable by a suitable handle 62. The first register pinion 54 drives print roll pinion 66 through a second register pinion 64, the shaft of said second register pinion being connected to the shaft of first register pinion 54 by a link 68 and to the shaft of print roll pinion 66 on print roll shaft 12 by a link 70, said print roll pinion 66 being mounted for rotation about an axis fixed with relation to inboard and outboard subframes 3 and 5. Thus, when pinion 54 is moved around pinion 52 by turning worm handle 62 to move the axis of said pinion 54, the axis of pinion 64 will likewise be moved around print roll pinion 66 and print roll 8 will be rotated about its own axis independently of backing cylinder 4 to adjust the register. Subframe assemblies 3 and 5 have been omitted from Fig. 3 for clarity, the detailed arrangement being shown in Fig. 4. The other print rolls 8 omitted from Fig. 3, for clarity—have identical driving and register mechanisms, being driven from bull gear 50 through a mechanism as above described. Any print roll 8 may thus be rotated about its own axis without its moving around backing cylinder 4, such rotation being independent of the movement of each of the other print rolls 8, and, at the same time, my novel differential permits free movement of each print roll, with its subframes radially of the backing cylinder. Since such rolls may be moved by their worm handles when the printing machine is in operation, register adjustment is easy and can be observed by an operator while he makes adjustments. The above arrangement additionally provides an entirely rigid and backlash free arrangement for the maintenance of longitudinal register as set.

In order to provide for setting axial register of each of the print rolls 8 relative to the backing cylinder 4 or to each other as best shown in Fig. 4, I have provided a sleeve 72 for retaining print roll bearings 10, said sleeve being mounted in inboard subframe 3 of the printing machine for sliding movement relative to said subframe in a

direction parallel to the axis of backing cylinder 4. Sleeve 72 has extending outwardly therefrom an arm 74 on which is mounted in fixed position relative to subframe 3 a screw threaded member 76 which extends parallel to the axis of printing roll 8. Screw threaded member 76 is moved axially to move print roll 8 by means of an internally threaded assembly fitting on screw threaded member 76, said assembly comprising an internally threaded gear 78 and an internally threaded nut 79, to provide a backlash free arrangement by screwing them apart until they are separated by a small distance, the thrust surfaces on each side thereof thus serving to press said gear and said nut in opposite directions to eliminate the backlash therebetween. They are then locked together by a pin 77 to prevent relative rotational movement therebetween. One side of nut 79—the side opposite to that adjacent gear 78—bears against a surface 80 on the subframe 3 of the machine to prevent movement in one direction of the assembly relative to said subframe. Movement in the other direction is prevented by an externally threaded nut 82 which fits into an internally threaded hole 84 in the subframe 3 of the machine and bears against the side opposite nut 79 of said gear 78, a lock nut 86 being provided on said externally threaded nut to bear against the subframe 3 at hole 84 and lock said nut 82 against rotation.

The assembly comprising gear 78 and nut 79 thus is normally locked against axial movement relative to the subframe, but may be adjusted, by means of nut 82, to a backlash free position to maintain the lateral register as set. Gear 78 may be rotated to move print roll 8 axially of backing cylinder 4 by a pinion 88 rotatably mounted in subframe 3 and meshing with said gear, said pinion being rotatable by any suitable means (not shown) such as a control handle or motor.

Since the longitudinal register adjusting means is not arranged for axial movement, print roll shaft 12 is provided with a spline 13 adapted to engage a mating internal spline 67 on printing roll pinion 66 so that said pinion may be maintained in axially fixed position while permitting lateral movement of print roll 8. The outboard end of said roll is provided with a bearing adapted to permit sliding movement of said roll relative to subframe 5.

With such arrangement, the axial register of each of the print rolls 8, each of said rolls preferably being provided with the axial register mechanism as above described, may be moved either relatively to other print rolls 8 or to the backing cylinder when the printing machine is in operation.

Thus they may be readily adjusted both for lateral register and for alinement with the sheet of fabric 20 while the printing machine is in operation.

The backing cylinder 4 and print rolls 8 are urged into pressure contact by a hydraulic pressure means in general comprising a hydraulic cylinder 14 having a piston 16 and piston rod 17 and provided with hydraulic fluid through lines 18 from suitable pressure sources (not shown). The cylinder of such piston and cylinder is attached to fixed cantilever shaft 6 while the piston rod 17 at the inboard end is connected to subframe 3, said subframe 3 being adapted for limited movement relatively to frame 2 radially of backing cylinder 4, but free of movement in other directions for the necessary maintenance of register. Thus, as hydraulic fluid is supplied to piston 16 through lines 18, the piston will be pushed along the cylinder to urge print roll 8 toward backing cylinder 4 and apply a printing pressure between said roll and cylinder as they are urged together. The outboard end of the backing cylinder 4 and print roll 8 is provided with a similar hydraulic pressure mechanism through which subframe 5 and the outboard bearings of each of said print rolls 8 are attached to the outboard end of cantilever shaft 6.

Fluid under suitable pressure may be supplied to lines

18 by any suitable means well known to the art, the adjustment of the pressure provided by such means determining the pressures with which the ends of each print roll 8 are urged toward backing cylinder 4 to provide suitable printing pressure. It is desirable that each print roll 8 be provided with separate hydraulic fluid supply means so that the pressures may be adjusted to suit the individual requirements of each of said rolls, since, as is known, the printing pressure requirements commonly vary from roll to roll, for example, depending upon the coarseness or fineness of the printing roll engraving, as well as upon the printing dye or paste employed. Such a fluid pressure mechanism has the further advantage of permitting the passage of occasional thick places in the fabric sheet, such as places where two lengths of fabric are seamed together, without damage to the printing machine and without interrupting the printing operation.

As heretofore pointed out, I provide a uniformly tensioned sheet of textile fabric 20 around backing cylinder 4 by pretensioning the fabric before it passes beneath the first print roll 8. Thus, the tension in the fabric being printed by the first of the print rolls 8 is controlled by my novel pretensioning means.

The pretensioning means, as best shown in Fig. 5, operates to tension the sheet of textile fabric and to aid in alining it with the backing cylinder 4 and print rolls 8. Such means include a mill roll stand 90 having suitable bearings 92 for holding the shaft of a mill roll 94 of fabric to be printed. At the upper portion of said stand 90 are mounted a plurality of brake rolls 96— herein shown as four in number—said brake rolls being rotatably mounted on frame 90 and being driven one from the other by gears 98 so that all of said rolls will rotate at the same speed. A nip roll 100 is provided beneath the first of said brake rolls 96, said nip roll being loaded by a suitable spring 102 to establish a nip between said roll 100 and first brake roll 96. A brake drum 104 is provided on the shaft of one of said rolls, 96, said brake drum being controlled by a brake band 106 operated by pretensioning dancer roll 108. The dancer roll 108 is mounted on lever 110 having a weight 112 connected thereto by a chain 114, said lever being pivotally mounted on stand 90. Thus, the tension of a loop of the sheet of fabric 20 passed around said dancer roll 108 may be determined by the weight 112, since the movement of lever 110 in response to variations in fabric tension serves to tighten or loosen the pressure of brake band 106 on brake drum 104 and thus increase or decrease the snubbing action of the sheet of fabric passing around brake rolls 96.

In operation then, the sheet of fabric 20 is led from mill roll 94 between nip roll 100 and the first of said brake rolls 96, thence in a tortuous path around each of said brake rolls 96 to dancer roll 108, around a guide roll 116 mounted at the upper portion of frame 90, and then onto the backing cylinder 4 of the print machine. The pretension of the sheet of fabric 20 may be adjusted by varying weight 112 so that such pretension will stretch the fabric before it passes beneath the first print roll. By this means I am able to print a multicolor pattern on a substantially uniformly tensioned fabric without the necessity of arranging the several print rolls for the most desirable fabric tension, since the tension of the fabric is otherwise determined.

The tension control apparatus on the output end of my printing machine serves to synchronize the rotation of the dry cans 120 with such speed, thus eliminating all danger of breaking the fabric by a difference in speed between the dry cans and the fabric as it passes from the print machine, this being accomplished primarily by a common driving motor 30 driving both the print machine and the dry cans, together with a control motor 136 arranged to add or subtract a correcting rotation. Such means includes an output tension dancer roll 122 rotatably mounted on levers 124, said levers being pivoted on shaft 126 and having on their opposite ends removable weights 125 for adjusting the output tension. The dancer roll levers 124 have connected thereto a rod 128 arranged to move the control arm 130 of a rheostat 132 as said dancer roll moves. The rheostat 132 controls an amplidyne 134 or other servo amplifier which supplies power to reversible control motor 136 in accordance with the value of resistance of the rheostat 132 as determined by the motion of dancer roll 122. The dry cans 120 are driven through a differential mechanism 138 by both the main drive motor 30—through belt 34—and the control motor 136—through belt 36—to synchronize their speed with that of the fabric, the control motor 136 normally being arranged to be stopped when the desired tension is applied to the sheet of textile fabric, and to add or subtract its rotation when the control roll 122 is in too high or too low a position.

Thus, the dry cans 120 are primarily driven by the main motor 30 alone, the control motor merely adding or subtracting a correcting rotation to the dry cans 120 as called for by the dancer roll 122. Under these circumstances, the control motor 136 need be of relatively small size and capacity compared to the main motor 30, and thus, due to its small inertia, may be readily stopped and started to provide a practically instantaneous correction to give a constant tension to the fabric sheet without hunting. Also, such arrangement has the advantage of permitting an operator to inspect a considerable length of printed fabric merely by stopping the print machine main motor 30 and pulling the fabric backwards from the dry cans 120, the control motor 136 then operating to rotate the dry cans backwards as the operator increases the tension on the fabric to change the position of dancer roll 120. When the operator has finished his inspection, he need only release the fabric and the control motor will then rotate the dry cans 120 to pull the fabric back into them.

My novel doctor blade operating mechanism as best shown in Figs. 6 through 9 include a generally circular wobble plate 140 mounted by a universal joint 142 on the end of fixed cantilever shaft 6 beyond the end of backing cylinder 4. The shafts 27 of doctor blades 26 are mounted for sliding movement along print rolls 8 in the usual manner. Each of said doctor blades 26 has mounted thereon a pin 144 adapted to be engaged by a yoke 146 mounted on doctor blade driving shaft 148, said shaft being mounted at the inboard end thereof for sliding movement relative to subframe 3 by a suitable bearing 150 mounted on said subframe. The outboard end of each of said shafts 148 is attached to the outer rim of said wobble plate 140 through a suitable flexible joint 152, but one doctor blade and operating shaft being shown in Fig. 9 for reasons of clarity. Wobble plate 140 does not rotate.

The wobbling motion of wobble plate 140 (so that each selected point of its rim serves to reciprocate a doctor blade) is accomplished through universal joint 142 and an eccentric mechanism adapted to move a connected driving plate 154 which extends parallel to the axis of fixed cantilever shaft 6 and generally perpendicular to a radius of such shaft and is attached to wobble plate 140 along a chord near the outer rim of said plate. The driving plate 154 is preferably either flexible or articulated, as shown, but a suitable hinge 156, the axis of which extends across the driving plate 154 and a plane perpendicular to the axis of fixed shaft 6. In order to move to plate 154, it is provided at its opposite end with a relatively large bearing 162 for receiving the operating portion of the eccentric mechanism, such mechanism including three eccentrics having circular cam surfaces driven by eccentric driving motor 164 through speed reduction gear 166. The speed reduction gear shaft 168 is keyed to inner drive eccentric 170 and runs within an intermediate setting eccentric 172 which in turn runs within an outer driven eccentric 180. The intermediate

setting eccentric 172 is normally driven by drive shaft 168 through square stub shaft 174 mounted on the upper end of drive shaft 168, since the upper end of setting eccentric 172 has mounted on the end thereon a cup shaped setting knob 176 having a square hole 178 in the bottom surface thereof adapted to engage square stub shaft 174. Setting knob 176, however, together with setting eccentric 172 may be moved upward for a slight distance to disengage square hole 178 from stub shaft 174 to allow setting of eccentric 172 to any one of four positions to vary the amount of circular movement of driving plate 154 transmitted through outer driven eccentric 180.

In order to impart a very slow circular movement to driving plate 154 in addition to the more rapid circular movement as described above, I have also provided a ratchet mechanism adapted to slowly rotate outer eccentric 180. Such mechanism includes a ratchet arm 182 rotatably mounted on a pin 184 on driving plate 154, one end of said arm having mounted thereon a cam follower 186 adapted to engage a cam surface 188 on setting eccentric 172, and the other end of said arm having rotatably mounted thereon a drive pawl 190 and a stop pawl 192 connected by a pawl spring 194, said pawls being adapted to engage pawl teeth 196 on a cylindrical surface concentric with driving shaft 168 on the upper portion of driven eccentric 180. Thus, when ratchet arm 182 is reciprocated by cam 188, pawls 190 and 192 will slowly advance outer eccentric 180.

In operation, then, my novel doctor blade driving mechanism provides a superimposed low frequency and high frequency reciprocating movement to each doctor blade 26, since the circular movement transmitted to driving plate 154 wobbles wobble plate 140 to reciprocate each of said doctor blades. Furthermore, the amplitude of the reciprocating motion of said doctor blades 26 may be varied by means of setting eccentric 172 while the printing machine is in operation to provide an extremely simple and effective means of producing the desired doctor action under working conditions. In general, the necessary or desirable doctor blade motions are well understood by those skilled in the art, and my novel doctor blade operating mechanism enables the use of the most effective doctor action under all conditions.

It will thus be seen that I have provided a novel textile fabric printing machine by which the register—both lateral and longitudinal—may be quickly and easily set, and, once set, will be maintained over long periods of time. It will also be seen that the machine thus provided is far superior to heretofore known machines in many other particulars as herein described.

It will be apparent to those skilled in the art that various modifications may be made in my invention within the spirit thereof and the scope of the appended claims.

I claim:

1. A continuous textile printing machine having a main frame, a backing cylinder rotatably mounted in said main frame, said backing cylinder having a relatively soft and yielding surface, a print roll having an axis parallel to that of said backing cylinder, print roll supporting means mounted adjacent the periphery of said backing cylinder and supporting said print roll for radial rotational and axial movement relative thereto and with its surface in contact with said backing cylinder surface through the material being printed, print roll sub-frame means supporting said print roll supporting means, hydraulic pressure means for yieldably urging said print roll sub-frame means radially inwardly toward said backing cylinder, print roll driving gear means mounted on said main frame, print roll gear means movable axially relatively to said driving gear means, a plurality of print roll register gears interconnecting said driving gear means and said print roll gear means, and print roll axial register means for moving said print roll axially of said backing cylinder including a first externally screw threaded member mounted on and movable with said print roll supporting means, a second internally screw threaded means mounted on said first screw threaded member between opposite fixed thrust surfaces on said sub-frame for adjustable movement axially of said print roll, one end of said internally threaded screw means being in engagement with one of said surfaces, axially adjustable means interposed between the other end of said internally screw threaded means and the opposite surface to axially position said internally screw threaded means into engagement with said one surface, and means for rotating said second screw threaded means to move said print roll axially of said backing cylinder.

2. A printing machine as claimed in claim 1 further including print roll peripheral register means for moving the axes of said register gears to rotate said print roll about its own axis and for driving said print roll in any relative axial or radial position thereof.

3. In a continuous printing machine having a backing cylinder and a print roll cooperating therewith, print roll axial register means for moving said print roll axially of said backing cylinder including bearing means supporting said print roll for rotation, frame means supporting said bearing means for axial movement therein with said print roll, and means for moving said bearing means relatively to said frame means including first screw threaded means mounted on and movable axially with said bearing means, second screw threaded means mounted between opposite surfaces on said frame means spaced from one another along the axis of said first screw threaded means, one end of said second screw threaded means being in engagement with one of said surfaces, axially adjustable means interposed between the other end of said second screw threaded means and the opposite frame surface to axially position said second screw threaded means with its one end in engagement with said one surface, and means for rotating said second screw threaded means to move said first screw threaded means axially thereof.

4. A printing machine as claimed in claim 3 wherein said second screw threaded means includes two spaced members mounted on said first screw threaded means with their threads engaging opposite sides of the threads of said first screw threaded means, said two members being secured against relative rotation.

5. In a continuous printing machine having a backing cylinder and a print roll cooperating therewith, print roll axial register means for moving said print roll axially of said backing cylinder including bearing means supporting said print roll for rotation, frame means supporting said bearing means for axial movement therein with said print roll, and means for moving said bearing means relatively to said frame means including an externally screw threaded member mounted on and movable axially with said bearing means, a pair of internally threaded screw threaded members mounted on said externally screw threaded member in spaced positions thereon and secured against rotation relatively to one another with their threads engaging opposite sides of the threads of said externally screw threaded member, said pair being positioned between opposite fixed thrust surfaces on said frame means spaced from one another along the axis of said externally screw threaded member with one end of said pair being in engagement with one of said surfaces, axially adjustable means interposed between the other end of said pair and the opposite frame surface to axially position said pair with said one end in engagement with said one surface, and means for rotating said pair to move said externally screw threaded member axially thereof.

6. A printing machine as claimed in claim 5 wherein said axially adjustable means includes an externally screw threaded tubular member surrounding said externally screw threaded member, said frame means having

an internally screw threaded hole for receiving said tubular member for axial adjustment relatively thereto.

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