Feb. 16, 1960 E. A. CRAWFORD 2,925,035

REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

Original Filed April 29, 1953 12 Sheets-Sheet 1

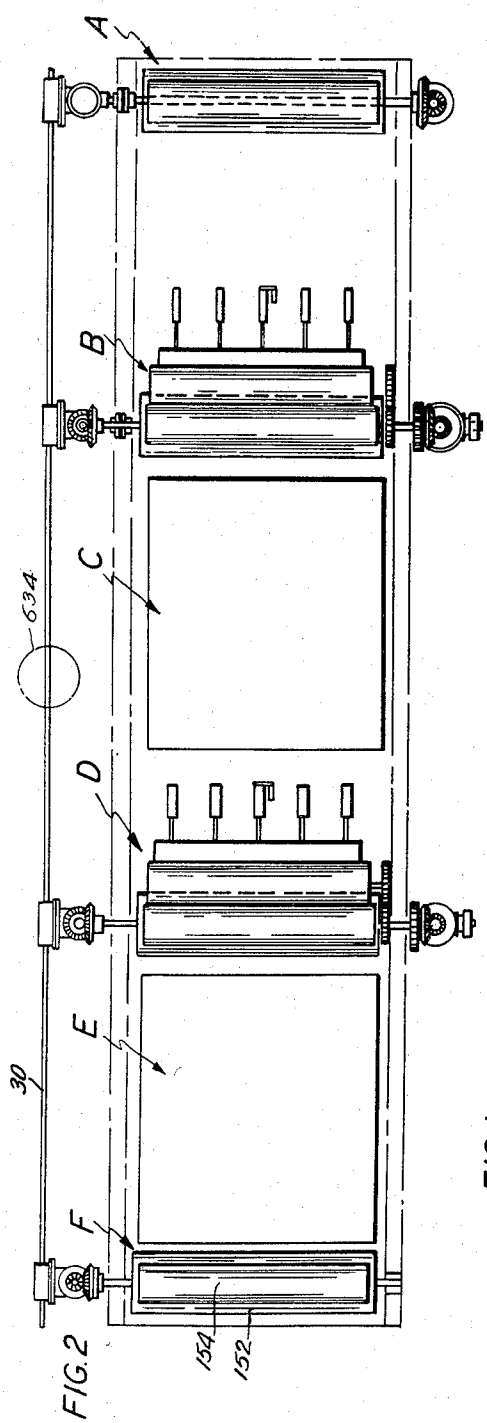

FIG. 2

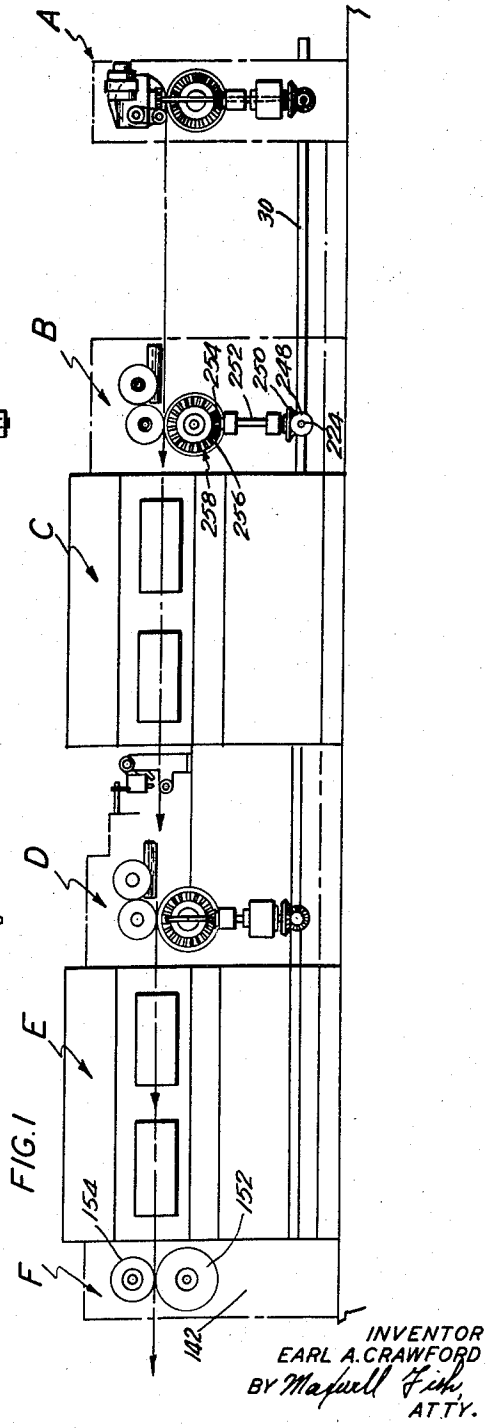

FIG. 1

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Feb. 16, 1960 E. A. CRAWFORD 2,925,035

REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

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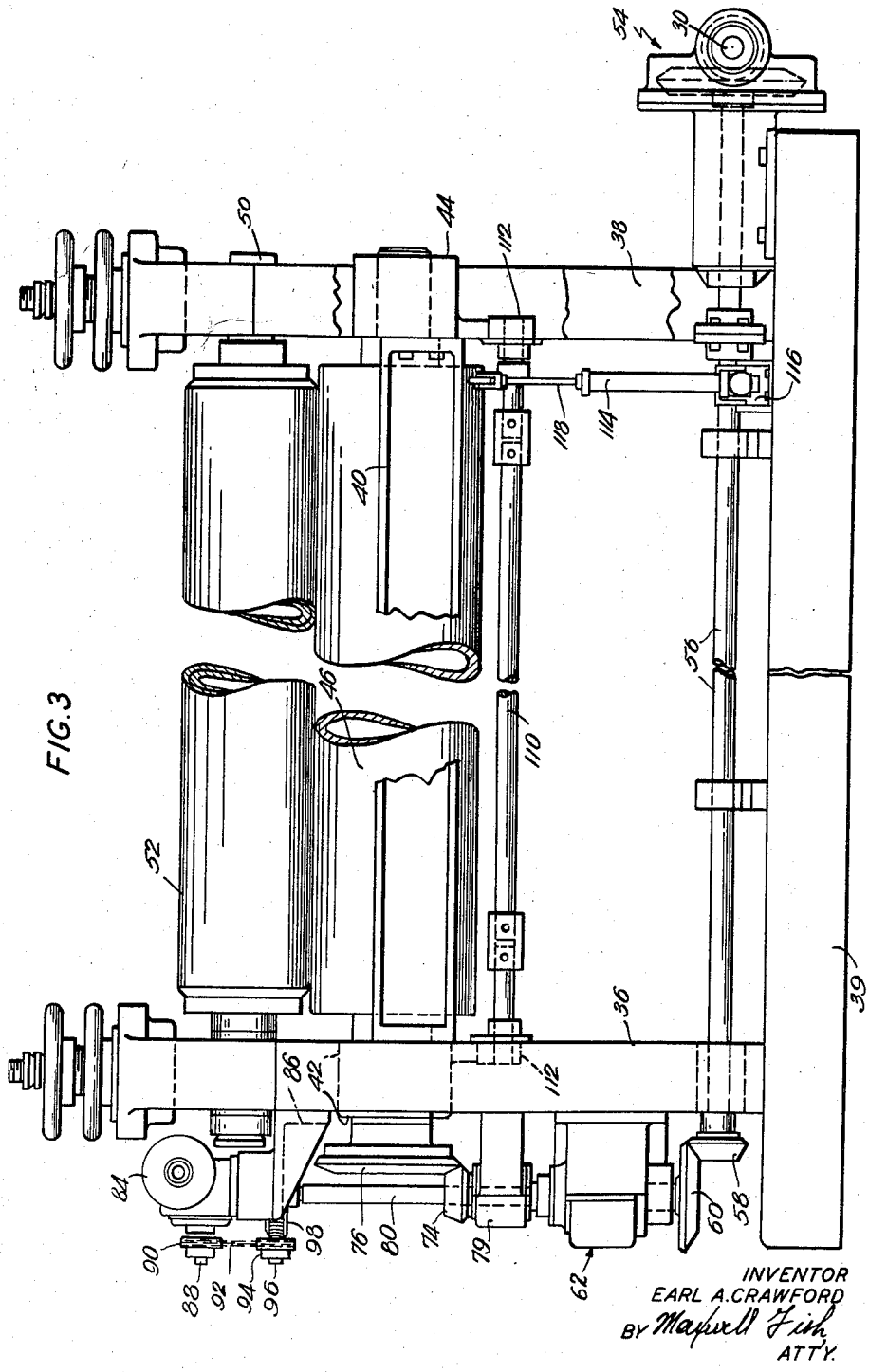

FIG. 3

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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

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FIG. 5

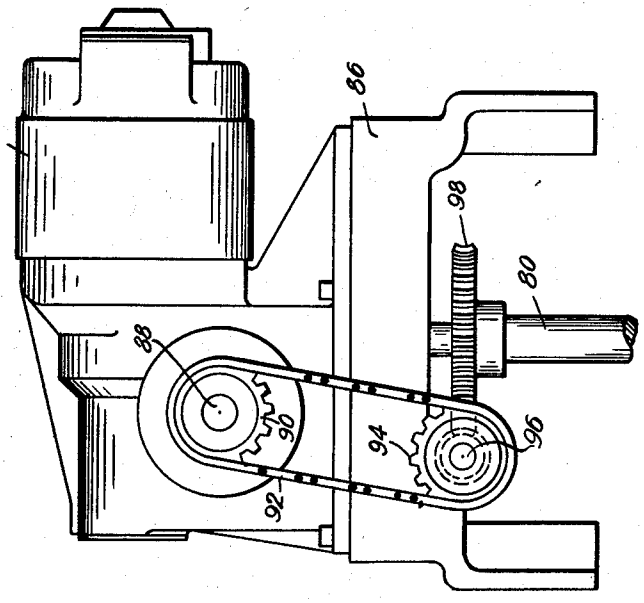
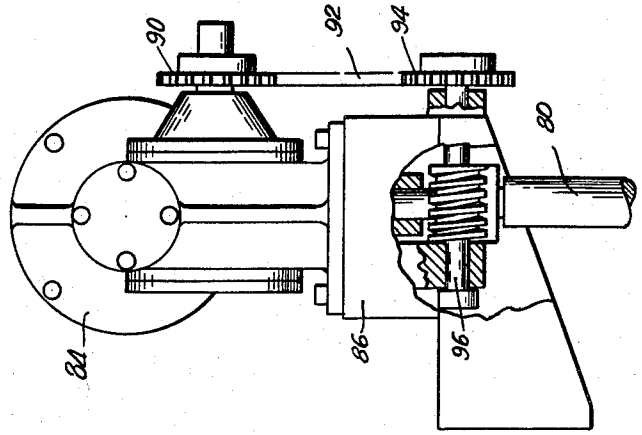


FIG. 4



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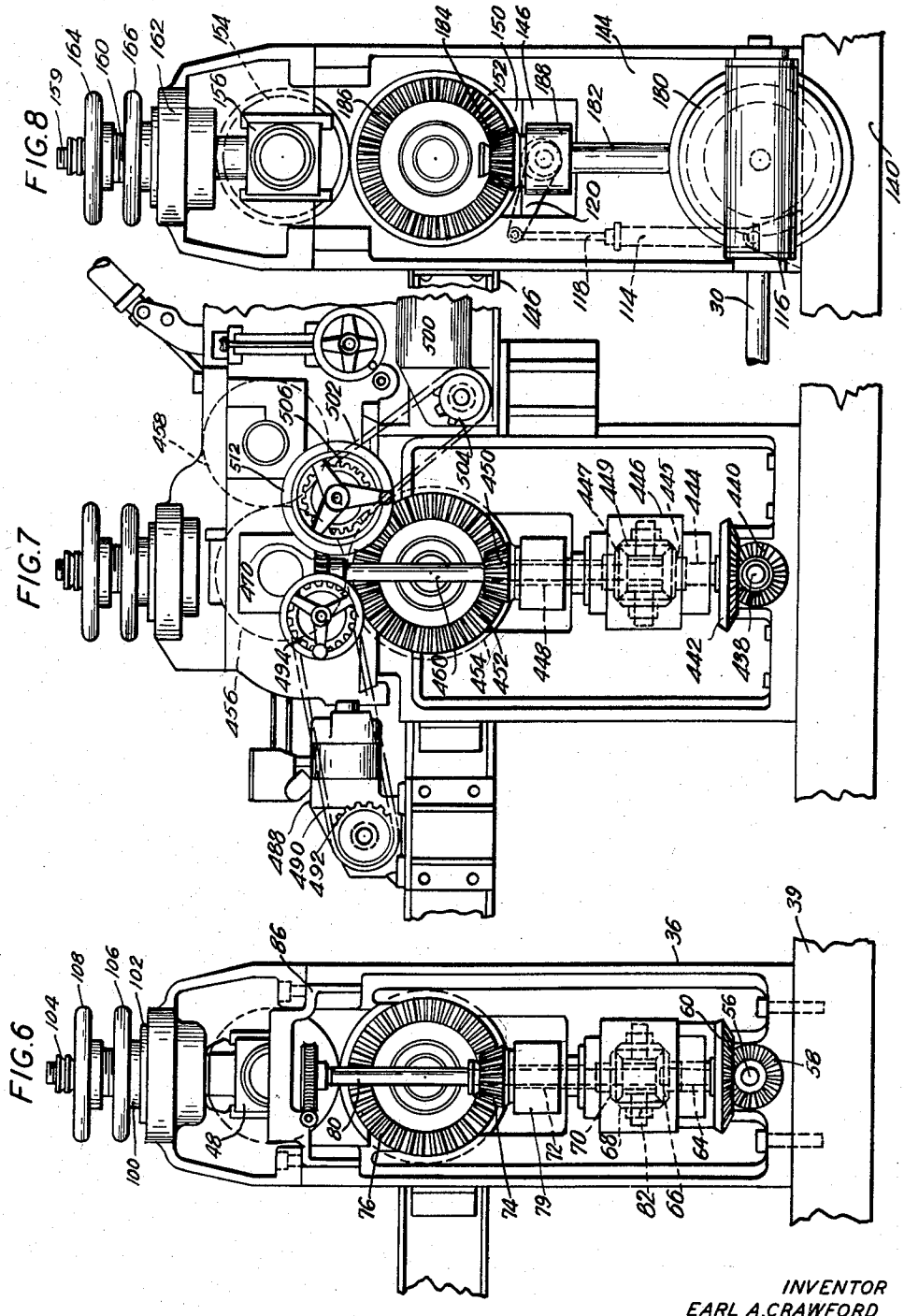
Feb. 16, 1960 E. A. CRAWFORD 2,925,035

REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

Original Filed April 29, 1953 12 Sheets-Sheet 4



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Feb. 16, 1960 E. A. CRAWFORD 2,925,035

REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

Original Filed April 29, 1953 12 Sheets-Sheet 5

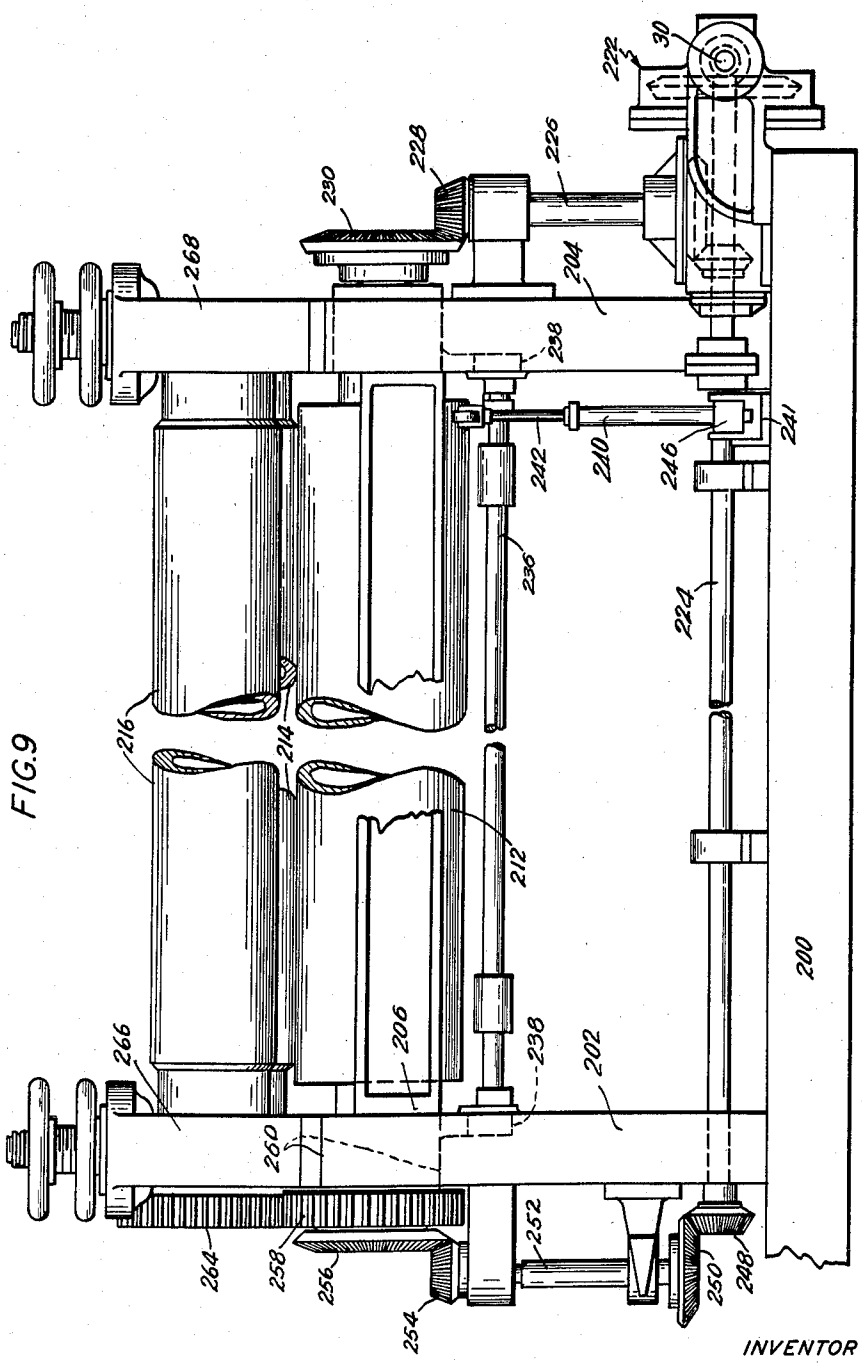

FIG. 9

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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

Original Filed April 29, 1953 12 Sheets-Sheet 6

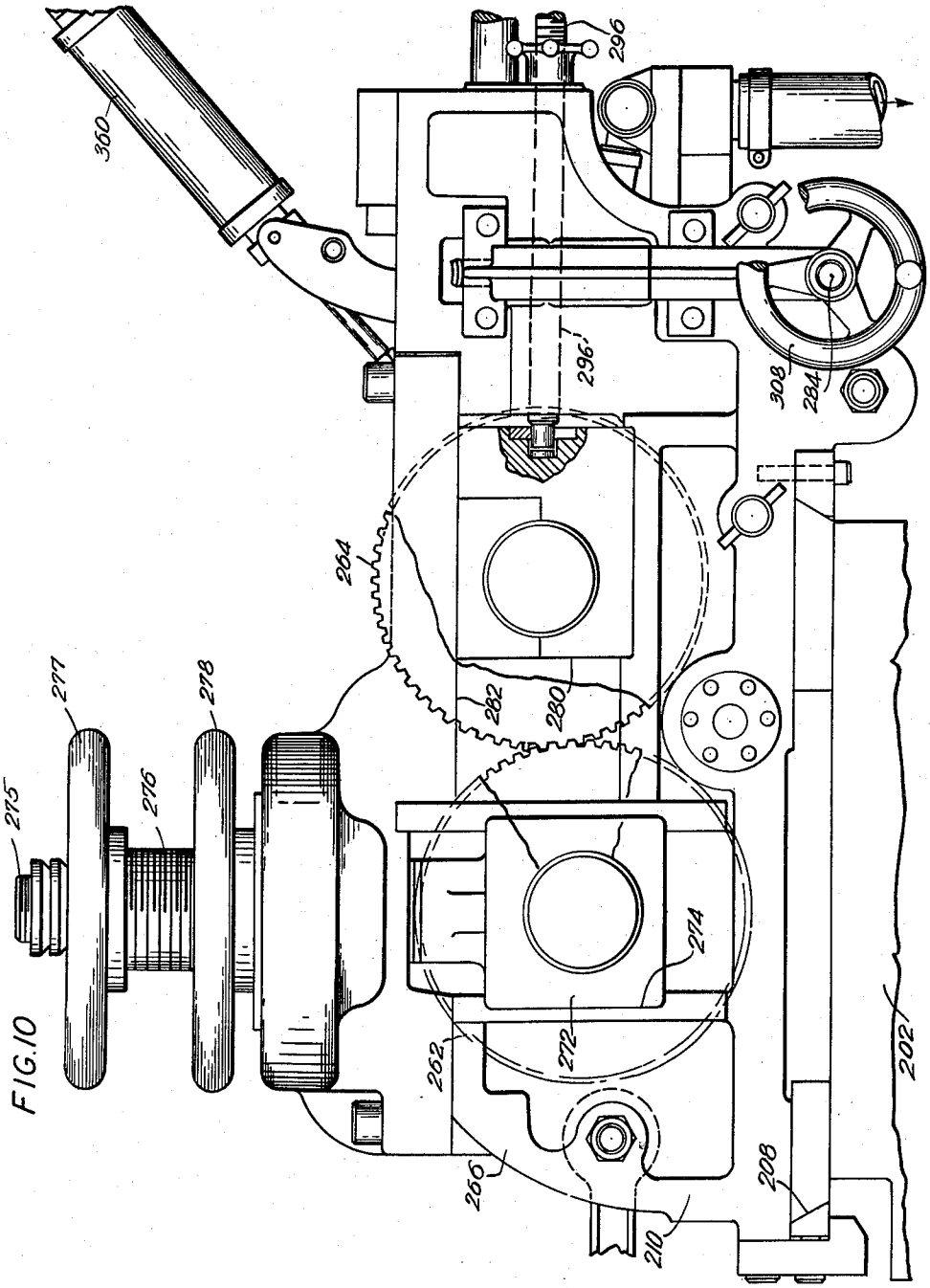

FIG. 10

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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

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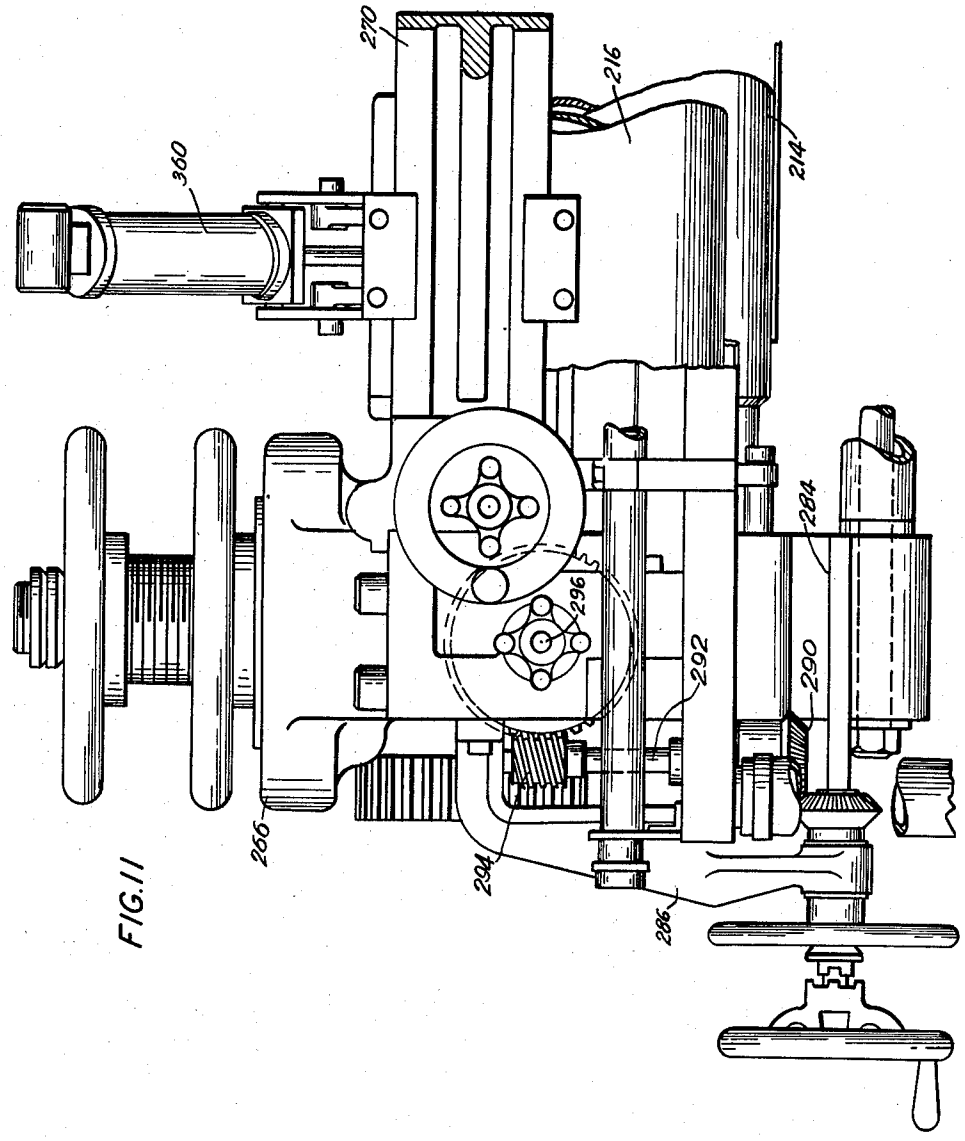

FIG. 11

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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

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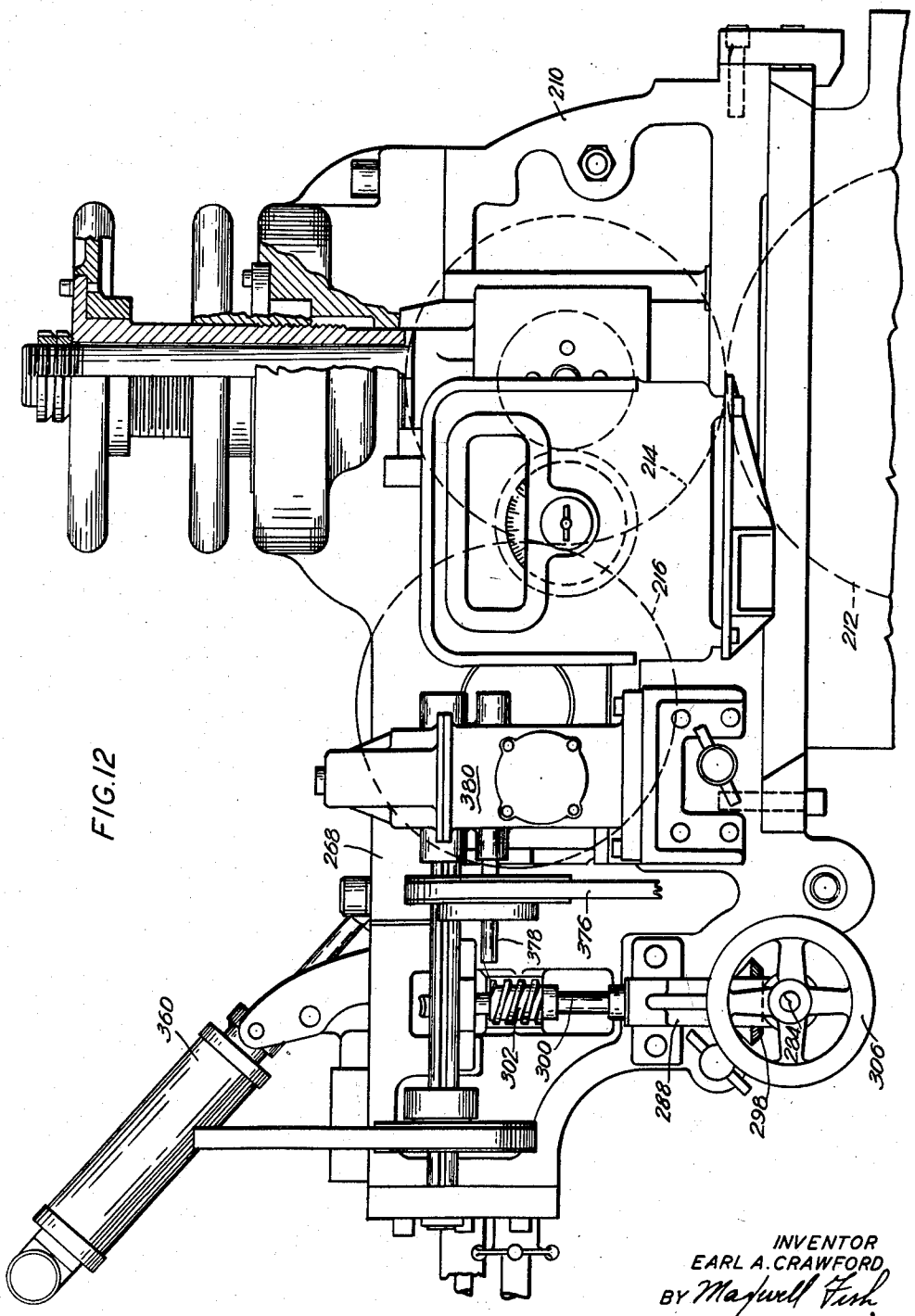

FIG. 12

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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

Original Filed April 29, 1953 12 Sheets-Sheet 9

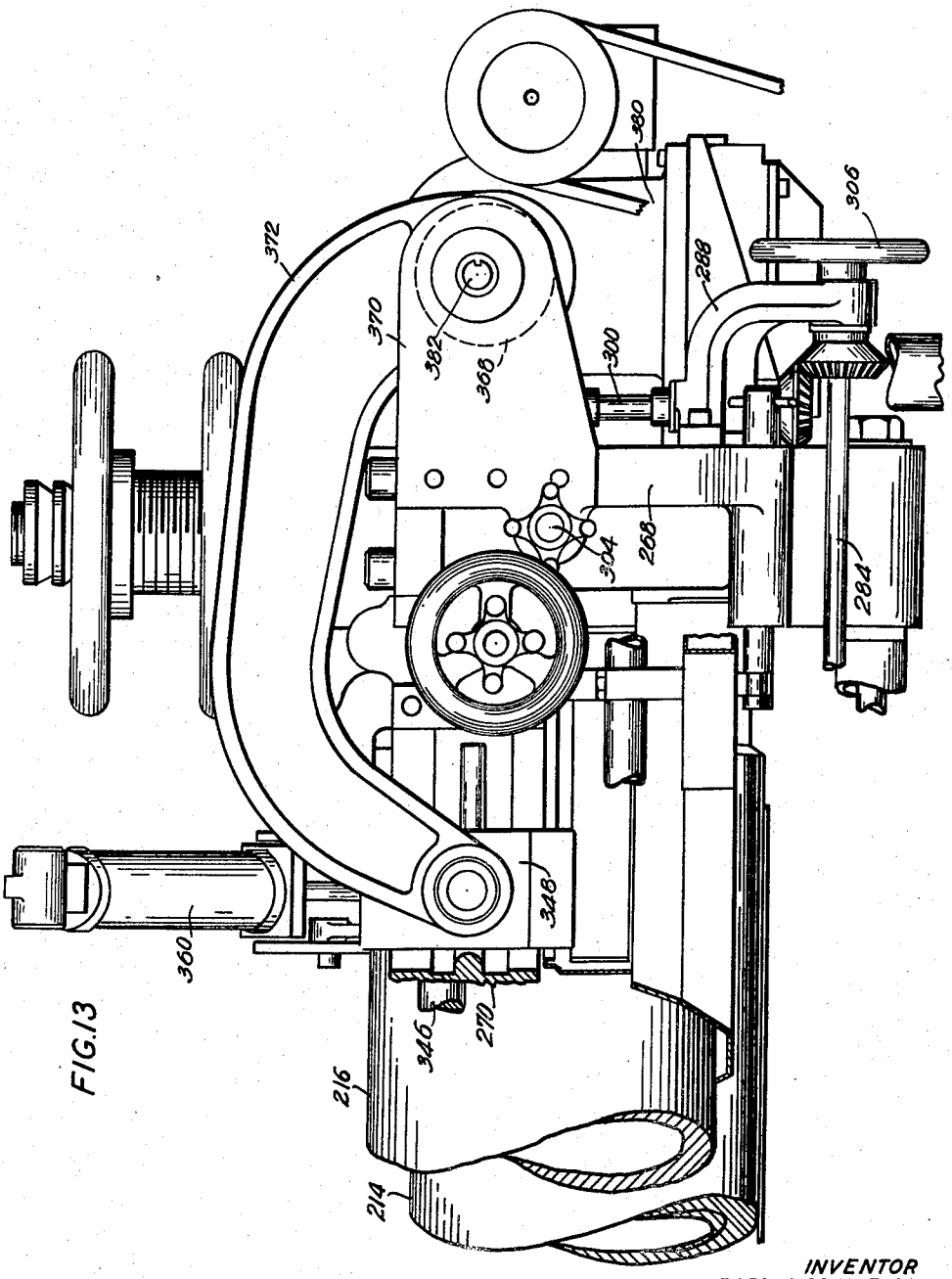

FIG. 13

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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

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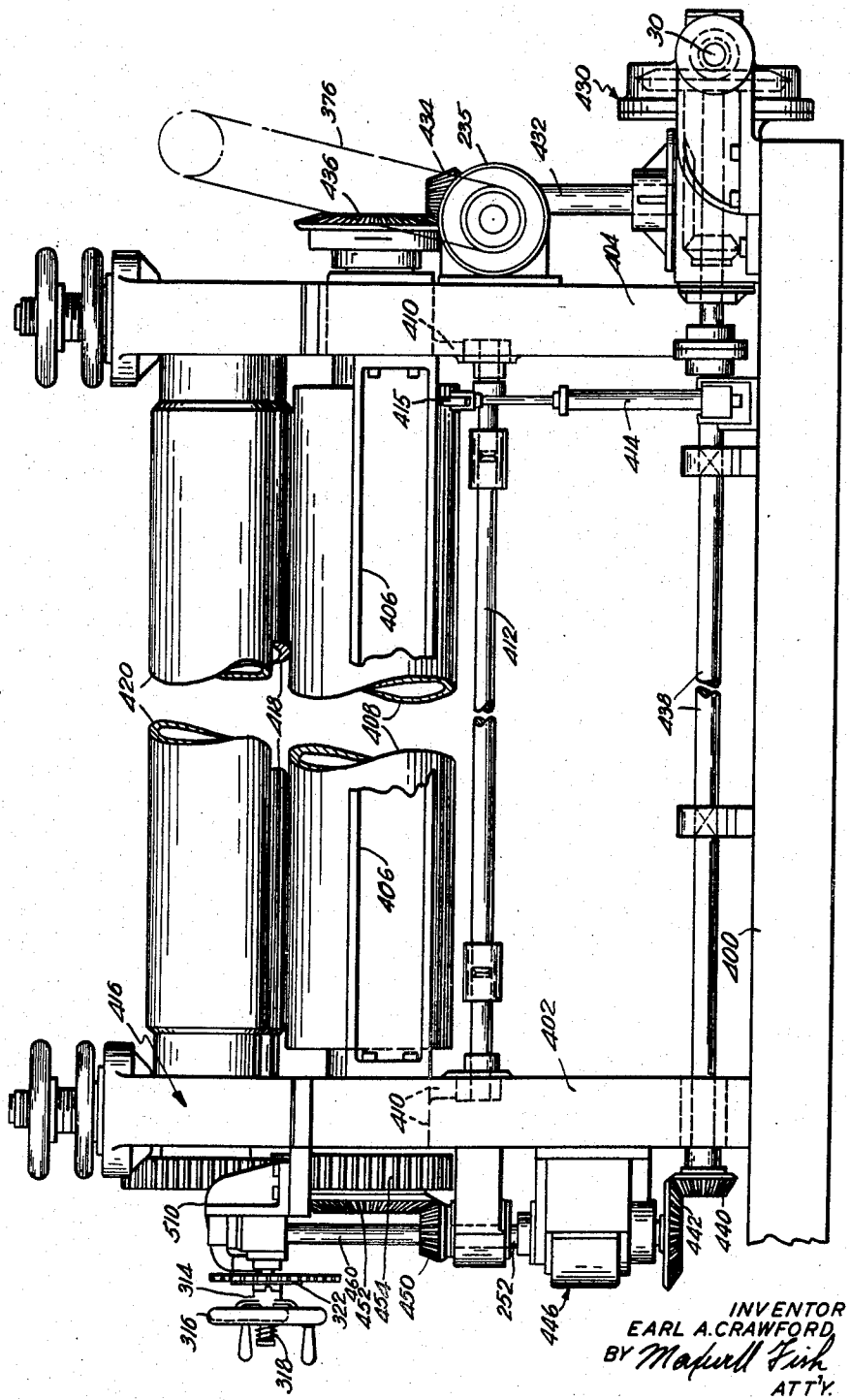
FIG. 14.



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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

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FIG. 15.

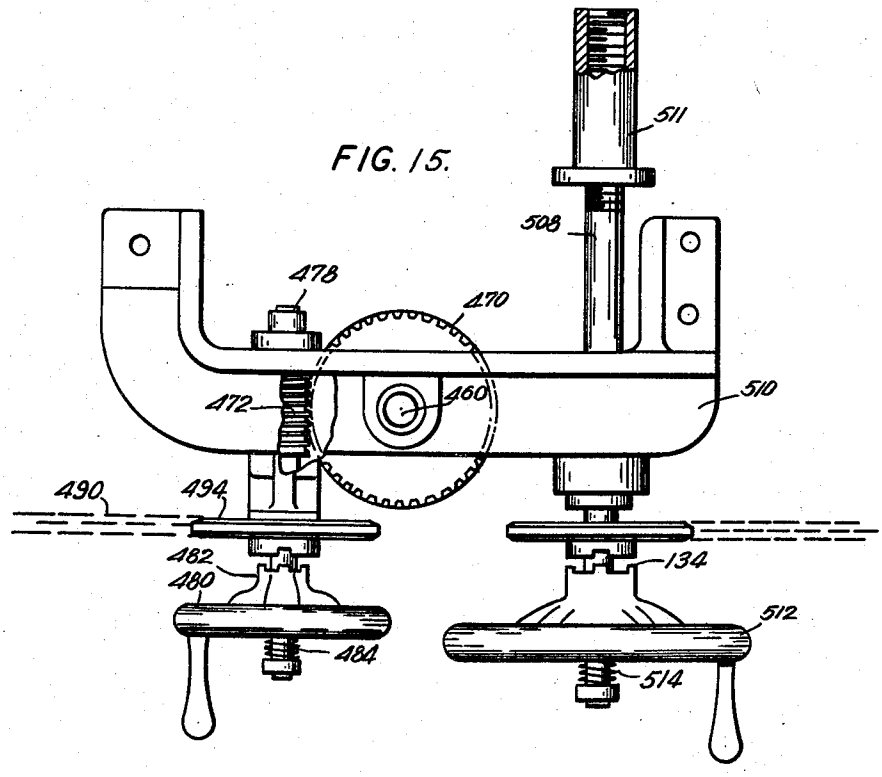
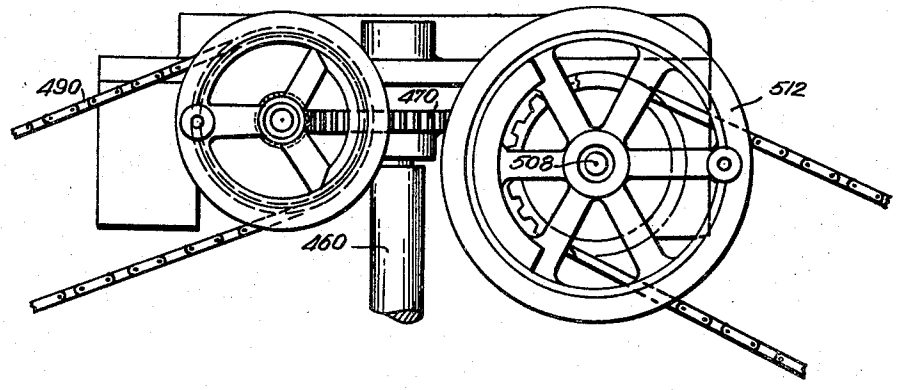


FIG. 16.



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REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

Original Filed April 29, 1953 12 Sheets-Sheet 12

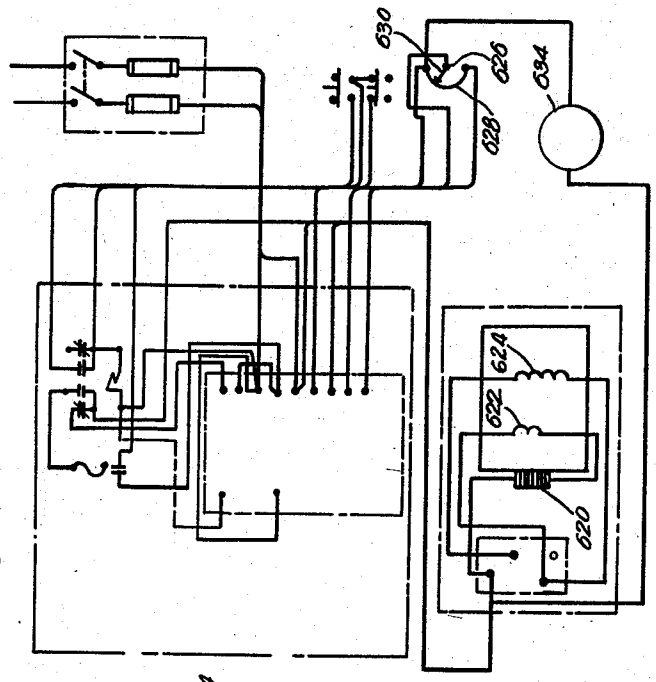

FIG. 18.

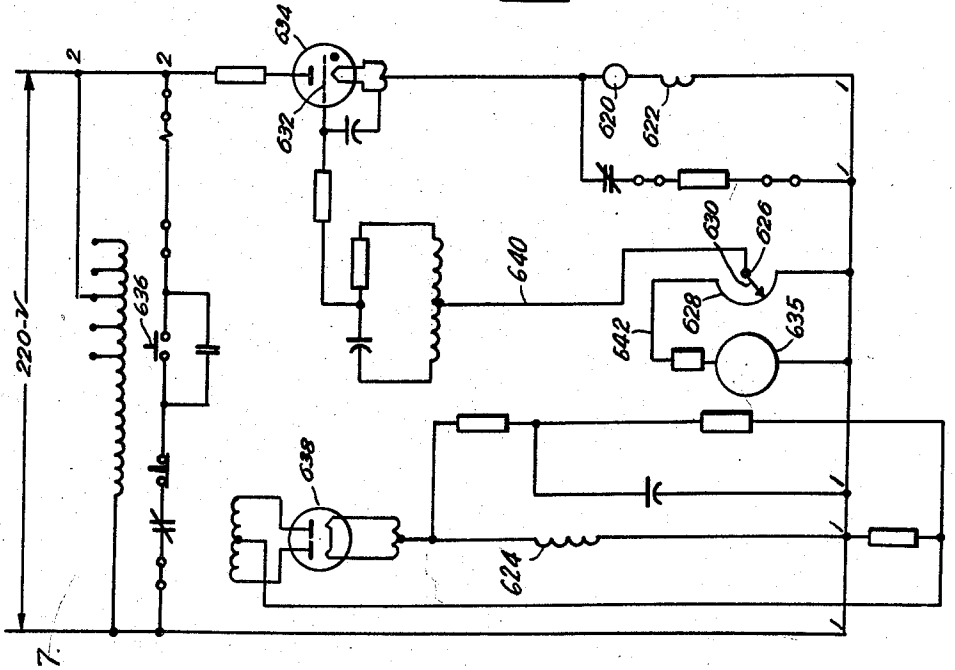

FIG. 17.

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United States Patent Office 2,925,035
Patented Feb. 16, 1960

2,925,035

REGISTER PRODUCING MEANS FOR A ROLLER PRINTING MACHINE

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Original application April 29, 1953, Serial No. 351,970, now Patent No. 2,809,582, dated October 15, 1957. Divided and this application December 21, 1956, Serial No. 629,925

2 Claims. (Cl. 101—181)

The present invention relates to improvements in a multiple roller type printing machine, and more particularly to a machine having a conveyor system adapted for transferring a web while stretched to substantially its elastic limit along a flat horizontal run at high speed in combination with a series of roller printing units and control devices for most efficiently causing the impressions from said units to be at all times accurately registered with one another upon the webbed material passing through the conveyor.

It is a principal object of the invention to provide a novel and improved printing machine of the general type referred to having the several printing units thereof particularly constructed and arranged for adjustment with relation to a rapidly moving horizontally disposed web.

It is a further object of the invention to provide novel and improved controls which include both manual and automatic controls suitable for use in a machine in which the web is traveling over a horizontal run while stretched to substantially its elastic limit to produce accurately registered impressions on the web.

The present invention is a division of applicant's copending application Serial No. 351,970 filed April 29, 1953, now Patent No. 2,809,582, for Machine and Method of Processing Webs of Paper Base and Similar Materials.

With these and other objects in view as may hereinafter appear, the several features of the invention consist also in the devices, combinations and arrangement of parts hereinafter described and claimed, which, together with the advantages to be obtained thereby will be readily understood by one skilled in the art from the following description taken in connection with the accompanying drawings in which,

Fig. 1 is a front side view of a printing machine embodying in a preferred form several features of the invention;

Fig. 2 is a plan view of the printing machine shown in Fig. 1;

Fig. 3 is a view in elevation of the draw-in unit looking from the right hand end of the machine;

Fig. 4 is a detail view in elevation of the torque motor drive for producing a drag on the feeding web, shown in Fig. 3, looking from the front of the machine;

Fig. 5 is a view of the torque motor drive, shown in Fig. 4, looking from the left;

Fig. 6 is a view in elevation of the draw-in unit looking from the front side of the machine, but with the torque motor, for driving the differential tensioning device, omitted;

Fig. 7 is a view in elevation of the second printing unit looking from the front side of the machine;

Fig. 8 is a view in elevation of the draw-off unit looking from the rear side of the machine;

Fig. 9 is a view in elevation of the first printing unit looking from the right hand end of the machine;

Fig. 10 is an enlarged detailed view in elevation looking from the front of the machine of the carriage associated with the first printing unit;

Fig. 11 is a view in elevation of the parts shown in Fig. 10 looking from the right;

Fig. 12 is an enlarged detailed view in elevation of the carriage associated with the first printing unit looking from the rear side of the machine;

Fig. 13 is a view in elevation of the parts shown in Fig. 10 looking from the left side of Fig. 12;

Fig. 14 is a view in elevation looking from the right hand end of the machine of a second printing unit;

Fig. 15 is a detail plan view of the end supporting bracket, associated with the base portion of the second printing unit, on which are mounted the manual and automatic controls for effecting longitudinal and transverse adjustments;

Fig. 16 is a view in elevation of substantially the parts shown in Fig. 15;

Fig. 17 is a single line diagram of the torque motor drive for producing a drag on the web extending through the draw-in and draw-off units; and

Fig. 18 is a supplementary diagram view on the electrical controls for the torque motor.

Referring to the drawings the multiple impression printing machine herein disclosed as embodying in a preferred form the several features of the invention comprises a web draw-in unit generally designated at A in Fig. 1 having a drive support roller and a cooperating pressure roller, a first roller printing unit designated at B, an associated drying oven C, a second roller printing unit D, an associated drying oven E, and a web draw-out unit, generally indicated at F, comprising a drive support roller and a cooperating pressure draw-off roller. These units are constructed and arranged to cause a web of material to be processed, which in the preferred form of the invention is floor covering material, to pass through the several units in a straight line run.

The several operating units of the machine referred to are driven in synchronism with one another by means of a torque shaft **30** which runs along the full length of the machine at the rear side adjacent the floor level, and is connected through individual reduction gear boxes with each of the separate units. The torque shaft **30** is continuously driven from any convenient source of power which may be an electric motor not shown.

Draw-in unit

The web draw-in unit A, above referred to, as best shown in Figs. 3 and 6 comprises a front standard **36**, and a rear standard **38** supported on a base member **39** and rigidly connected by a spacer member **40**. The standards provide support for two vertically slidable bearing blocks **42**, **44** for a drive support roller **46**. The standards also support two bearing blocks **48**, **50** (Figs. 3 and 6) for a pressure roller **52** which forms the upper roller of the pair. The drive support roller **46** is driven from the torque shaft **30** through a gear box **54**, and a drive shaft **56** which extends from the rear to the front side of the machine slightly above the level of the base member **39**. At its forward end the shaft **56** is provided with a bevel gear **58** which meshes with a bevel gear **60** forming the driving element of a differential gear unit generally indicated at **62**, and is secured to a vertically disposed drive shaft **64** of said unit. The elements of the differential unit also include a bevel gear **66** which is secured to the shaft **64** and is connected by two idler bevel gears **68** with a driven bevel gear **70** mounted on a driven sleeve **72** in vertical alignment with the drive shaft **64**. A bevel gear **74** keyed to turn with and slidable axially on the sleeve **72** meshes with a large bevel gear **76** which is mounted to turn as a unit with the drive support roller **46**. A lug **79** formed

integrally with bearing block 42 engages beneath and supports the bevel 74 in mesh with gear 76 for any vertical adjustment of the bearing blocks 42, 44 and driving support roller 46. The control element of the differential gear unit comprises an upwardly extending control shaft 80 which is mounted above and in axial alignment with the drive shaft 64 and which extends upwardly through an axial bore in the driven bevel gear 70 and sleeve member 72. At its lower end the shaft 80 is provided with a transverse bearing pin 82 on opposite ends of which are mounted the idler bevel gears 68 of the differential unit. With this arrangement it will be understood that rotation of the control shaft 80, causing the idler bevel gears 68 to rotate about the axis of the driving and driven bevels 66 and 70 has the effect of changing the angular relation of the driving roller 46 to the main driving connections including torque shaft 30. Thus a continuous rotation of the control shaft 80 of the differential gear unit in one direction will cause the driving roller 46 and associated pressure roller 52 to be continuously driven at a slower rate than that which would normally be imposed thereon by the main driving connections including torque shaft 30.

A torque driving motor is employed in combination with the differential driving connection above described to produce a regulated retarding tension or drag upon that portion of the webbed material, passing between the draw-in rollers 46, 52 and the draw-off rollers 152, 154 (Figs. 1 and 8). The amount of drag, which is in effect a braking force exerted on the traveling web is readily controlled by well known electrical means for adjusting the driving torque motor unit. The mechanism for producing a tensioning drag on the webbed materials specifically shown in Figs. 3, 4 and 5 comprises an electric torque motor 84 mounted on a bracket 86 on the front standard 36 of the draw-in unit A. The motor unit includes a transversely extending jack shaft 88 which is driven by means of reduction gearing from the armature shaft of the motor 84. A sprocket 90 on the shaft 88 is connected by a sprocket chain 92 with a sprocket 94 on a worm shaft 96 which is in turn connected through a worm and gear connection 98 with the upper end of the differential gear unit control shaft 80. The torque motor unit operating through the differential gear unit as above described is employed to impose a drag on the webbed material being drawn through the printing machine. The manner in which this mechanism operates to carry out the objects of the invention will be more fully set forth hereinafter in connection with the description of the operation of the machine.

An individual manual adjustment is provided for each of the bearing blocks 48, 50 to control the position of the pressure roller 52 with relation to the drive support roller 46. Vertical adjustment of each of the blocks 48, 50 is effected by means of a rotatable sleeve element 100 which is externally threaded to a nut 102 fixedly supported on the respective front and rear standards. The sleeve element 100 is supported to turn on an upwardly extending shaft 104 secured at its lower end to the bearing block. A manually adjustable hand wheel 106 is secured to the upper end of the sleeve. A locking nut in the form of a second hand wheel 108 is threaded to the sleeve above the nut 102. For details of this construction reference can be had to the disclosure in Fig. 12 of an identically similar manual adjustment for the transfer roller of the first printing unit.

Draw-off unit

The strip draw-off unit F, above referred to, as best shown in Figs. 1, 2 and 8 compirses a base 140 on which is mounted a front standard 142 (see Fig. 1), a rear standard 144 (see Fig. 8), and a spacer member, not specifically shown, by means of which the standards are rigidly secured together. Each standard is provided with a vertical guideway 146 to receive a vertically slidable bearing block 150 for a web draw-off driving roller 152. A cooperating pressure draw-off roller 154 is similarly mounted for vertical adjustment in the standards 142, 144 in bearing blocks 156, supported for vertical movement in guideways formed in the upper part of the respective standards. For effecting this adjustment each bearing block 156 is provided with an upwardly extending shaft 159 providing support against axial movement relative thereto for a rotatable sleeve element 160 which is externally threaded to a nut 162 fixedly supported on the standard. A manually adjustable hand wheel 164 is secured to the upper end of the sleeve, and a handwheel 166 similarly formed with a hand wheel is threaded to the sleeve above the nut 162.

The draw-off driving and pressure rollers 152, 154 are driven from the torque shaft 30 of the machine through operating connections (see Fig. 8) which include a reduction gear unit 180 having a vertically disposed output shaft 182 to the upper end portion of which is keyed a bevel gear 184 which meshes with a bevel gear 186 secured to the rear end of the web draw-off driving roller 152. A supporting lug 188 on the bearing block 150 is arranged to maintain the bevel gear 184 in mesh with the gear 186 for any adjustment of the block 150.

First roller printing unit

The two roller printing units indicated at B and D in Fig. 1 which are supported and arranged to impart successive impressions registered with relation to one another to the webbed material during the run between the draw-in roller unit A and the draw-out unit F are with only slight differences, hereinafter specifically pointed out, identical in construction. Referring specifically to Figs. 9 to 13 inclusive, the first printing unit designated at B comprises generally a fixed base assembly (see Fig. 9) including a base 200, a front standard 202, a rear standard 204, and a spacer member 206, and a relatively movable upper assembly in the form of a carriage 210 which is supported for forward and back movement transversely of the feeding web on guideways 208 formed in the upper ends of the respective standards 202, 204. The operating parts of the first printing unit include specifically a driving support roller 212 (see for example Figs. 9 and 12) which is mounted beneath the traveling web in the standards 202, 204 and a roller printing mechanism which is supported above the traveling web on the carriage 210. This mechanism comprises a transfer roller 214 mounted on the carriage directly above the driving roller 212, a cooperating gravure roller 216 which is mounted at that side of the transfer roller with the draw-in unit A and slightly above the transfer roller. The transfer roller 214 and gravure roller 216 are maintained at all times in continuous rolling contact in the carriage. An ink reservoir and a ductor blade not specifically shown also are mounted on the carriage 210.

The drive for the transfer and gravure rollers 214, 216 of the first printing unit A is taken frim the torque shaft 30 through a reduction gear box 222 onto a driving shaft 224 which extends between the rear and front standards 202, 204 slightly above the level of the base 200. A vertically disposed power output shaft 226 from the gear box 222 at the rear side of the machine has splined thereto adjacent its upper end a bevel gear 228 which meshes with a bevel gear 230 secured to the rear end of the driving support roller 212.

Vertical adjustment of the driving support roller 212 is effected by means of rock shaft 236 which is mounted on the standard 202, 204 (see Fig. 9) beneath and parallel to the support roller 212. Toward each end the shaft 236 has secured thereto a cam 238 which engages beneath the respective bearing block in which the driving support roller is supported to turn. Rocking movement is imparted to the shaft 236 and to control the vertical position of the driving support roller 212 by means of a pneumatic cylinder 240 which is pivotally

connected at its lower end to a bracket 241 on the base 200.

The transfer roller 214 and the gravure roller 216 are positively driven at the same linear rate with the drive support roller 212. The drive is taken from the torque shaft 30 and reduction gear box 222 through driving shaft 224 to the front side of the machine, thence through bevel gears 248, 250 onto a vertical drive shaft 252. At its upper end the shaft 252 is fitted with a bevel gear 254 which meshes with a bevel gear 256 formed integrally with a large spur gear 258 which is supported to turn in a fixed bearing 260 provided in the upper portion of the front standard 202. A gear 262 (see Fig. 10) secured to the forward end of the transfer roller 214 meshes with the spur gear 258 and also with a gear 264 secured to the forward end of the gravure roller 216. The spur gear 258 (Fig. 9) is of substantial width so that the transfer roller drive gear 262 will always be meshed with the spur gear 258 irrespective of the transverse adjustment of the carriage 210.

First printing unit carriage

The carriage 210 on which the several elements of the printing unit are mounted comprises two end brackets or castings 266, 268, each formed with guides to engage with the guideways 208 on the respective front and rear standards 202, 204. The end castings 266, 268 are rigidly secured together by a connecting member, including specifically a heavy reinforced rail 270 (Figs. 11 and 13) which carries a ductor blade assembly, including a doctor blade assembly which comprises with a doctor blade, not specifically shown, a series of pneumatic cylinders 360 (see Figs. 11 and 12) by means of which the doctor blade is yieldably held along its length against the surface of the gravure roller 216. The transfer roller 214 is supported on the carriage 210 in bearing blocks 272 which are vertically adjustable in guideways 274 in the respective carriage end casings 266, 268. Individual adjustment of these bearing blocks is obtained by means of manually adjustable connections, including a central shaft 275 secured to the bearing block 272 having an externally threaded sleeve 276 supported against axial movement on the shaft 275, and rotated by means of a hand wheel 277. The sleeve 276 is threaded into a fixed nut formed in the end bracket 280 and is adapted to be locked in position by means of a locking nut which is actuated by a locking hand wheel 278. Inasmuch as the constructions and arrangement of this screw and nut adjusting and locking mechanism is identical with that previously described for adjusting the position of the pressure roller 252, and 154, no further description of these parts is believed necessary.

The gravure roller 216 is supported at each end in bearing blocks 280 which are mounted in guideways 282 (see Fig. 10) in the respective carriage end castings 266, 268 for adjustment in a horizontal plane toward and away from the impression transfer roller 214. This adjustment is effected simultaneously for both ends of the gravure roller through connections (see Figs. 12 and 13) which include a control shaft 284 which extends across the width of the machine being supported at one end in a bracket 286 on the end casting 266 of the carriage, and on its other end on a bracket 288 on the end casting 268. The control shaft 284 is connected near its forward end by bevel gears 290 with a vertically disposed worm shaft 292 which acts through a worm and worm gear 294 to rotate a screw threaded bearing block adjusting shaft 296 (Figs. 10 and 11). The shaft 296 is connected with the bearing block 280 carried on the end casting 266. The position of the rear bearing block is simultaneously and identically controlled from the control shaft 284 through operating connections which include bevel gears 298, a worm shaft 300, a worm and gear connection 302, and a bearing block adjusting screw 304 (Fig. 13). The adjustment described can be made manually from the rear side of the machine by means of a hand wheel 306 (Fig. 12) mounted on the control shaft 284 or from the front of the machine, if desired, by means of hand wheel 308 (Fig. 10) mounted on the front end of control shaft 284.

Adjustment of the carriage 210 in a forward and back direction across the width of the feeding web is effected by means of an adjusting screw which is adapted to be manually operated by means of a hand wheel similar to that shown at 512 (Figs. 7, 15 and 16) illustrating the second printing unit, normally disconnected through the disengagement of an actuating clutch 134 (Fig. 15). This mechanism for effecting transverse adjustment of the carriage associated with the first printing unit is not specifically shown but is identical with that hereinafter described and more specifically illustrated in Figs. 7 and 14 to 16 for controlling the transverse position of the carriage 510 of the second printing unit.

Each of the printing units is constructed so that the impression roller and impression transfer roller are mounted above the feeding web so that the several colors of the design are applied to the upper side of the web. This procedure has the advantage that the operator can at all times observe the progress and quality of the printing operation, and provides a most efficient arrangement of the web and ink spread thereon for drying. This arrangement, however, has been found to present a difficult problem to control and to maintain an accurate and even flow of ink to the surface of the feeding strip, and to prevent leakage of ink with consequent blotting of the printed surface.

Second printing unit

The second printing unit designated at D in Fig. 1, and more specifically shown in Figs. 7 and 14 to 16 inclusive, is substantially identical with the printing unit B, previously described, except for the provision of a novel means for securing an accurate register of the impression produced thereby on the traveling sheet of webbing longitudinally as well as laterally with relation to the impression produced on the sheet by the first printing unit B. The second printing unit comprises a base assembly including a base 400, a front standard 402, and a rear standard 404, and an additional spacer member 406 for maintaining these parts rigidly in position. A driving support roller 408 is mounted in the base assembly of the printing unit, being supported in bearing blocks 410 mounted for vertical adjustment in the respective front and rear standards. A control mechanism is provided for shifting the driving support roller 408 between a high operating and a low inoperative position which is similar to that previously described for effecting a similar shift between high and low positions of the first printing unit drive support roller 212. This mechanism includes a rock shaft 412 having at each end cams for engagement beneath the bearing blocks 410, and a solenoid controlled pneumatic cylinder 414 connected with a lever arm 415 attached to the rock shaft 412 for controlling the position of the rock shaft.

The second printing unit D further comprises a carriage 416 mounted on guideways on the respective standards for movement transversely of the feeding strip. The carriage provides support for a transfer roller 418 mounted directly above the driving support roller 408 and a gravure roller 420 mounted at that side of the transfer roller with the draw-in unit A and at a level slightly above that of the transfer roller. The second printing unit is also provided with a ductor blade assembly including a ductor blade and an ink supply system, not specifically shown.

Inasmuch as the construction and arrangement of the carriage 416, the gravure roller 420, and transfer roller 418 together with the supporting devices therefor, are in all respects identical with the corresponding parts of the first printing unit above described, a further detailed

description or illustration of these parts is believed unnecessary and will be omitted.

The drive support roller 408 for the second printing unit is driven from the torque shaft 30, through a gear box 430 and vertical output shaft 432, having a bevel gear 434 splined thereto for engagement with a bevel gear 436 mounted from the rear end of the drive support roller 408.

The drive for the transfer roller 418 and gravure roller 420 of the second printing unit is taken from the gear box 430 through a horizontally disposed drive shaft 438 to the front side of the machine, and through bevel gears 440, 442 to the input shaft 444 of a vertically disposed differential gear unit 446 similar to that illustrated and described for driving the drive support roller of the draw-in unit above described. The unit includes driving and driven bevel gears 445, 447 (see Fig. 7) connected respectively to input shaft 444 and an output sleeve 448, and two interposed idler bevel gears 449. The output sleeve member 448 from the unit aligned with the input shaft 444, carries a bevel gear 450 which meshes with a bevel gear 452 formed internally with a large spur gear 454 which in turn meshes with a driving gear 456 secured to the forward end of the transfer roller 418. The gear 456 meshes also with a driving gear 458 on the gravure roller 420.

The control element of the differential gear unit 446 comprises a shaft 460 disposed within the driven sleeve 448 and having at its lower end a cross shaft which carries the two idler bevel gears 449 disposed between and meshing with the axially aligned driving and driven bevel gear elements 445, 447 of the unit.

In accordance with the invention the differential unit above described is employed to effect an angular adjustment of the second printing unit transfer roller 418 and gravure roller 420 with relation to the driving mechanism for the machine, and thereby to obtain an adjustment of the impression imparted to the feeding web longitudinally thereof.

As shown in Figs. 15 and 16, a worm gear 470 secured to the upper end of the control shaft 460 is in mesh with a worm 472 on a hand wheel supporting shaft 478. A hand wheel 480, loosely supported to turn on the shaft 478, is arranged to be connected therewith by means of a clutch 482. A compression spring 484 tends normally to maintain the hand wheel in an extended inoperative position.

In accordance with another feature of the invention the mechanism, above described for adjusting the first printing unit laterally, and for adjusting the second printing unit both laterally and longitudinally with relation to that portion of the webbed material stretched between the draw-in and draw-off roller units, are adapted for automatic control by scanning devices to maintain an accurate register of the printing units with one another to produce an accurate clean cut pattern in the traveling web. The scanning device, by means of which the angular (longitudinal) adjustment of the second printing unit is made, is of a type well known in the art and comprises a so-called electric eye which operates through suitable electronic devices to operate a small reversible electric motor 488 (see Fig. 7) which is connected through reduction gearing, a sprocket chain 490, a driving sprocket 492, and a driven sprocket 494 on the hand wheel supporting shaft 478. The electric eye acts with relation to a recurring mark placed on the margin of the webbed material by the first printing unit in the event that the printing unit is not properly registered with the mark to drive the electric motor 488 in one direction or the other, and thereby to adjust the angular position of the transfer roller 418 and gravure roller 420 so that the impression imparted by these rollers registers longitudinally with the impression of the first printing unit on the traveling web.

A similar scanning device is provided for effecting an automatic lateral adjustment of the carriage 416 with the transfer roller 418 and gravure roller 420 supported thereon. This mechanism comprises an electric eye which acts through suitable electronic devices, not specifically shown, and an electric motor 500 (Fig. 7) connected through reduction gearing, a sprocket chain 502, a driving sprocket 504, and a driven sprocket 506 with a lateral adjusting shaft 508 (Fig. 15). The shaft 508 is supported to turn in a bearing formed in a bracket 510 on the front standard 402, and at its rear end is in threaded engagement with a nut 511 mounted on carriage 416. Lateral adjustment of the printing unit is effected manually by means of a hand wheel 512 splined to the shaft 508. The handwheel 512 is adapted to be moved inwardly to its operative position in engagement with clutch 134 against the pressure of a compression spring 514. The electric eye acts with relation to a recurring mark placed on the margin of the web material by the first printing unit to operate the electric motor in one direction or the other as required, and thereby to effect by automatic means any necessary lateral adjustment of the carriage and rollers 416, 418 mounted thereon.

The operation of the torque motor unit 84 to retard the rotation of the draw-in pressure and drive support rollers in order to tension the feeding web will be readily understood from an inspection of the electrical diagram of Figs. 17 and 18, of which Fig. 17 is a single line diagram of the electrical operating connections and Fig. 18 is a complementary diagram showing the positions of the several elements including the control switches and the supporting panels. Referring to Figs. 17 and 18 the torque motor 84 is shown having an armature 620, a commutator field 622 and a shunt field 624. The speed or torque of the motor is determined by the adjustment of a speed control 626 having a rheostate 628 and an adjustable arm 630 which is connected to the grid 632 of a thyrotron tube 634 through which direct current is supplied to the armature and the commutator field winding of the motor. A further adjustment of the power input is effected by means of a variable speed generator 635 supported in series with the rhesotat 628 of the speed control and arranged to be driven from the torque shaft 30 of the machine. There is also provided on the same panel with the speed control a start and stop switch 636 for the torque motor 84.

From an inspection of the single line diagram of Fig. 17, it will be noted that a direct current is supplied to the armature 620 and commutator field winding 622 through the thyrotron rectifier tube 634 and that direct current is supplied to the shunt field 624 through a rectifier tube 638. The arm 630 of the speed control unit is connected with the control element on grid 632 of the tube 634 by means of a wire 640 and resistance elements of ordinary construction. The rheostat 628 of the speed control 626 is connected to the variable speed generator 634 by a wire 642 and a suitable resistance unit. The generator 635 is also connected with one of the two line wires indicated at 1. The arrangement of the several elements of the torque motor electrical circuit are such that the power output of the torque motor is held to a constant value which is determined by the setting of the control arm 630, and is further controlled by the rate of drive of the main torque shaft 30 which in turn controls the rate of drive of the generator 634. It is the function of the generator 634 to vary the power output of the torque motor in proportion as the rate of feed of the web through the printing machine is increased or decreased, so that the amount of stretch imposed on the web in accordance with the setting of control arm 630 will remain constant regardless of the speed at which the machine is driven.

The amount of drag exerted on the traveling web by the torque motor 84 and differential connection in the drive to the draw-in rollers 46, 52 is readily adjusted during machine operation by manual adjustment of the speed regulator hand 630. As the torque is gradually increased

any tendency of the web to weave will disappear and the web will be found to be running true along the entire length of the run to the draw-off station. Under these conditions, in which a floor covering material which may be an asphalt impregnated felt or paper is passing through the machine a stretch of about ⅛" per linear yard may be present. If the torque is increased beyond the elastic limit of the material it may be noted that the web tends to ripple, followed by separation and breakage of the web.

The invention having been described what is claimed is:

1. In a machine for roller printing webs of paper base and similar fibrous material passing along a substantially horizontal run between draw-in and draw-off stations including a plurality of printing units stationed along said run, an understructure for said web, web support, drive and tension control devices associated with said understructure including a drive support roller for the web on said understructure associated with each printing unit, drive means for the web on the understructure including means for driving said support rollers continuously at a uniform linear rate, a superstructure comprising a carriage for each printing unit movably mounted from said understructure for adjustment transversely of the web, an impression transfer roller supported on the carriage for engagement with the upper side of the web opposite the associated support roller, a gravure roller mounted on the carriage in engagement with and geared to turn at the same linear rate with the impression transfer roller, and inking control devices mounted on the carriage including a doctor blade assembly, driving connections from said drive means for continuously driving said impression transfer and gravure rollers at the same linear rate in phase relation with said associated support roller, means for adjusting laterally any selected printing unit supporting carriage for correcting the register of said printing unit laterally with relation to the traveling web, and means in said driving connections to permit said transverse adjustment of any selected printing unit supporting carriage without changing the driving phase relationship between said support roller and said impression transfer and gravure rollers.

2. In a machine for roller printing webs of paper base and similar fibrous material passing along a substantially horizontal run between draw-in and draw-off stations including a plurality of printing units stationed along said run, an understructure for the web comprising an individual supporting base associated with each printing unit, web support, drive and tension control devices associated with said understructure including a drive support roller for the web mounted on each said base, a mechanical drive connected to drive each said drive support roller continuously at a uniform linear rate, a superstructure comprising a carriage for each printing unit movably mounted on the associated base for adjustment transversely of the web, elements of a printing unit mounted on each carriage including an impression transfer roller mounted on the carriage for engagement with the upper side of the web opposite the associated support roller, and a gravure roller mounted on the carriage in engagement with and geared to turn at the same linear rate with the impression transfer roller, driving connections from said mechanical drive for continuously driving said impression transfer and gravure rollers at the same linear rate in phase relation with said associated support roller, including a driving phase adjustment mechanism in said driving connections interposed between said driving means and each connected pair of impression transfer and gravure rollers, means for adjusting laterally any selected printing unit supporting carriage for correcting the register of said printing unit laterally with relation to the traveling web, and means to permit said transverse adjustment of any selected printing unit supporting carriage without changing said driving phase relationship between said support roller and said pair of impression transfer and gravure rollers.

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