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Berge et al.

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[54] CONTACT PRINTING APPARATUS

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[51] Int. Cl. **G03b 27/10**

[58] Field of Search....355/28, 29, 68, 104, 106, 108, 355/111, 107

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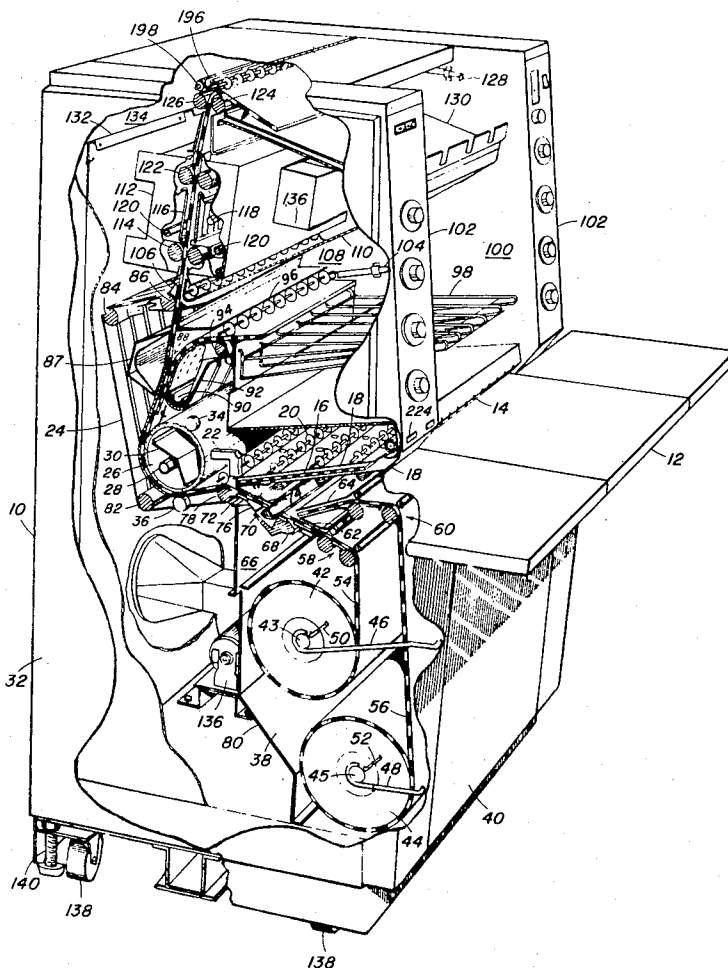
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[57] ABSTRACT

A diazo printer which makes copies of a transparent or translucent type original by automatically measuring the density of the original and thereby controlling the printing speed of the apparatus to produce an exact copy. A developer system is synchronized with the printing speed over a wide range of the latter so that any such type of original can be copied by the apparatus. The width of the copy, as well as the length thereof, match that of the original by a copy control circuit that also operates a supply roll feed mechanism of preselected width corresponding to the width of the original. A vertical cabinet houses the various parts of the apparatus so that they are easily accessible for serving and/or replacement.

2 Claims, 6 Drawing Figures



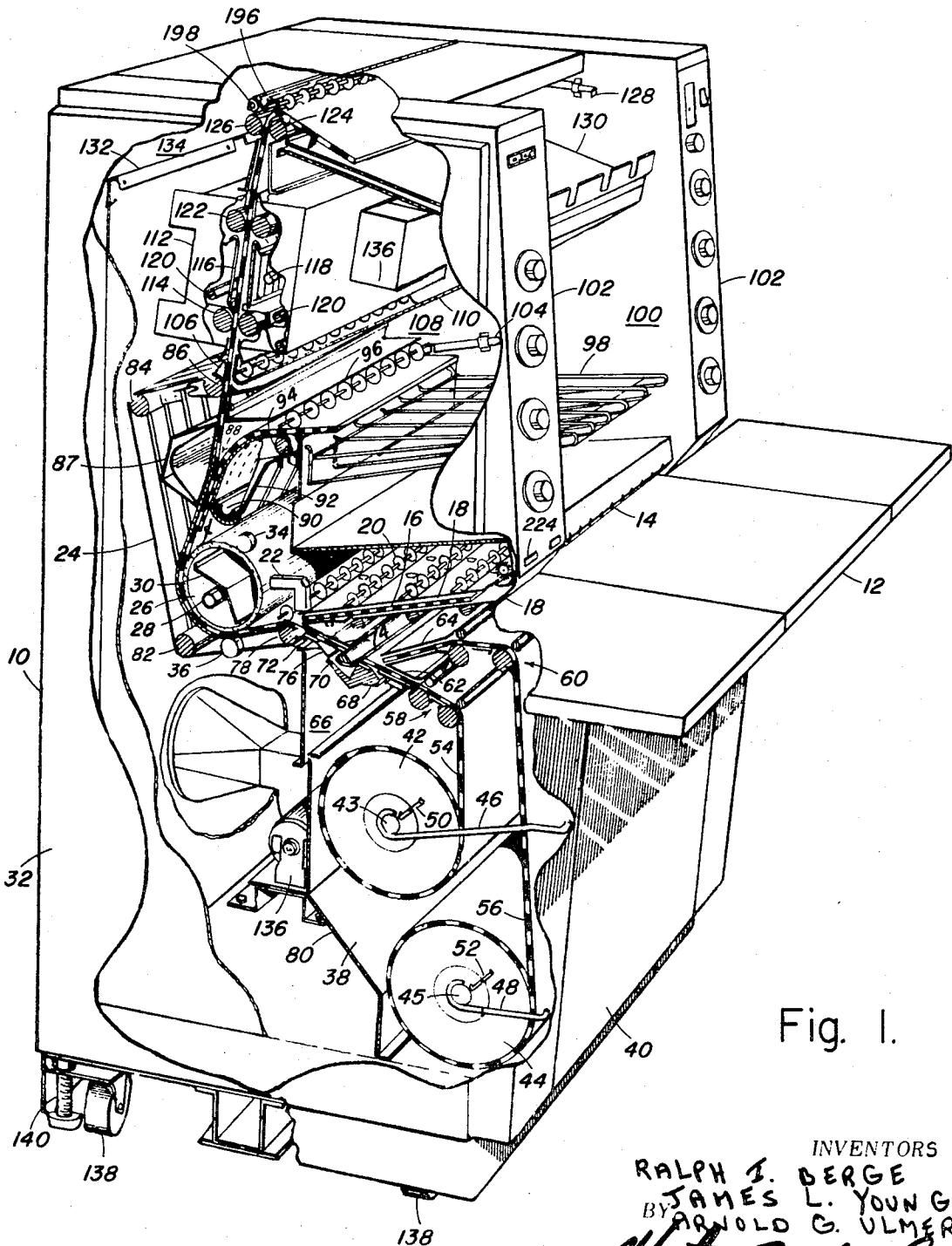
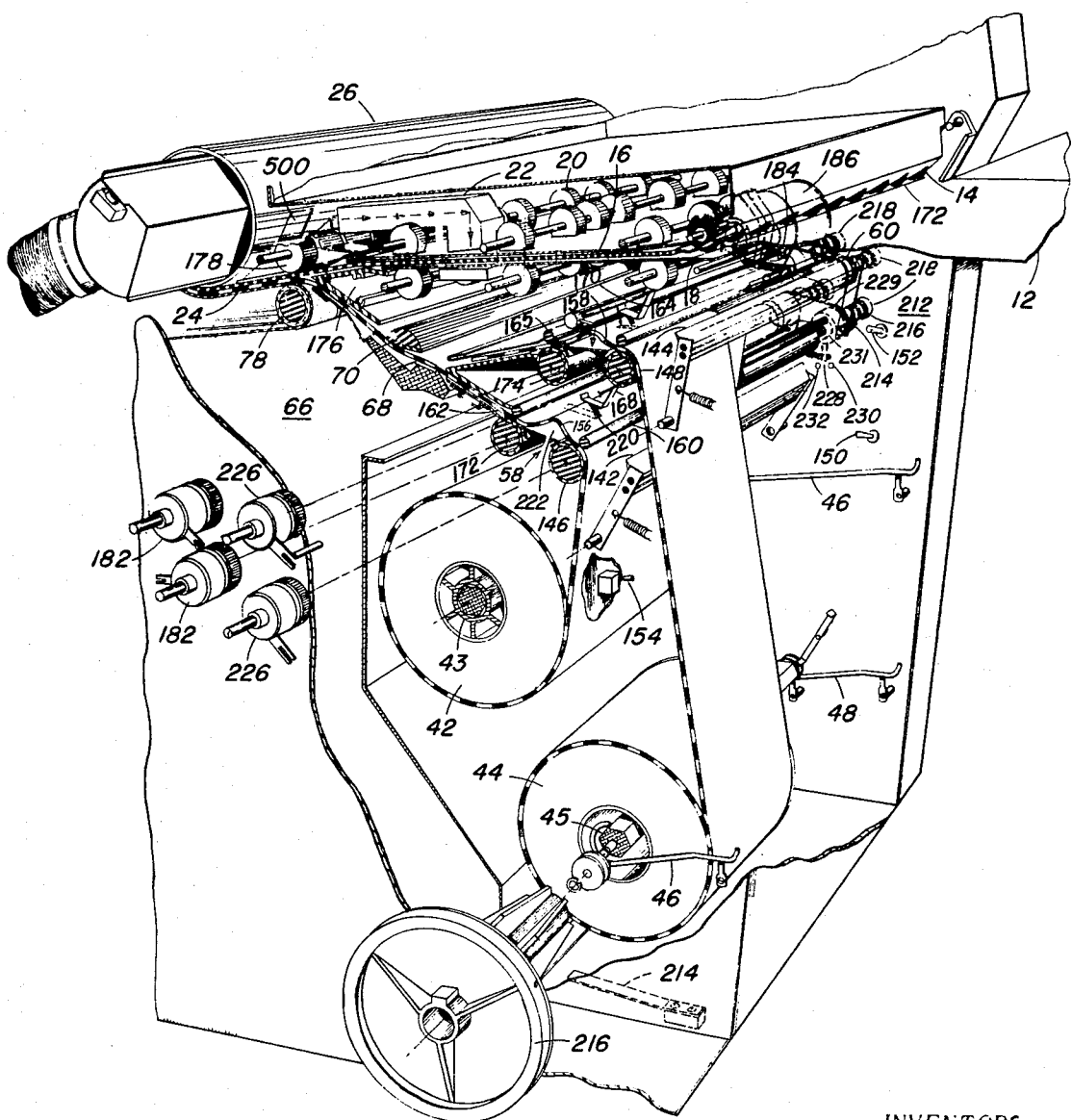


Fig. 1.

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Fig. 1A.



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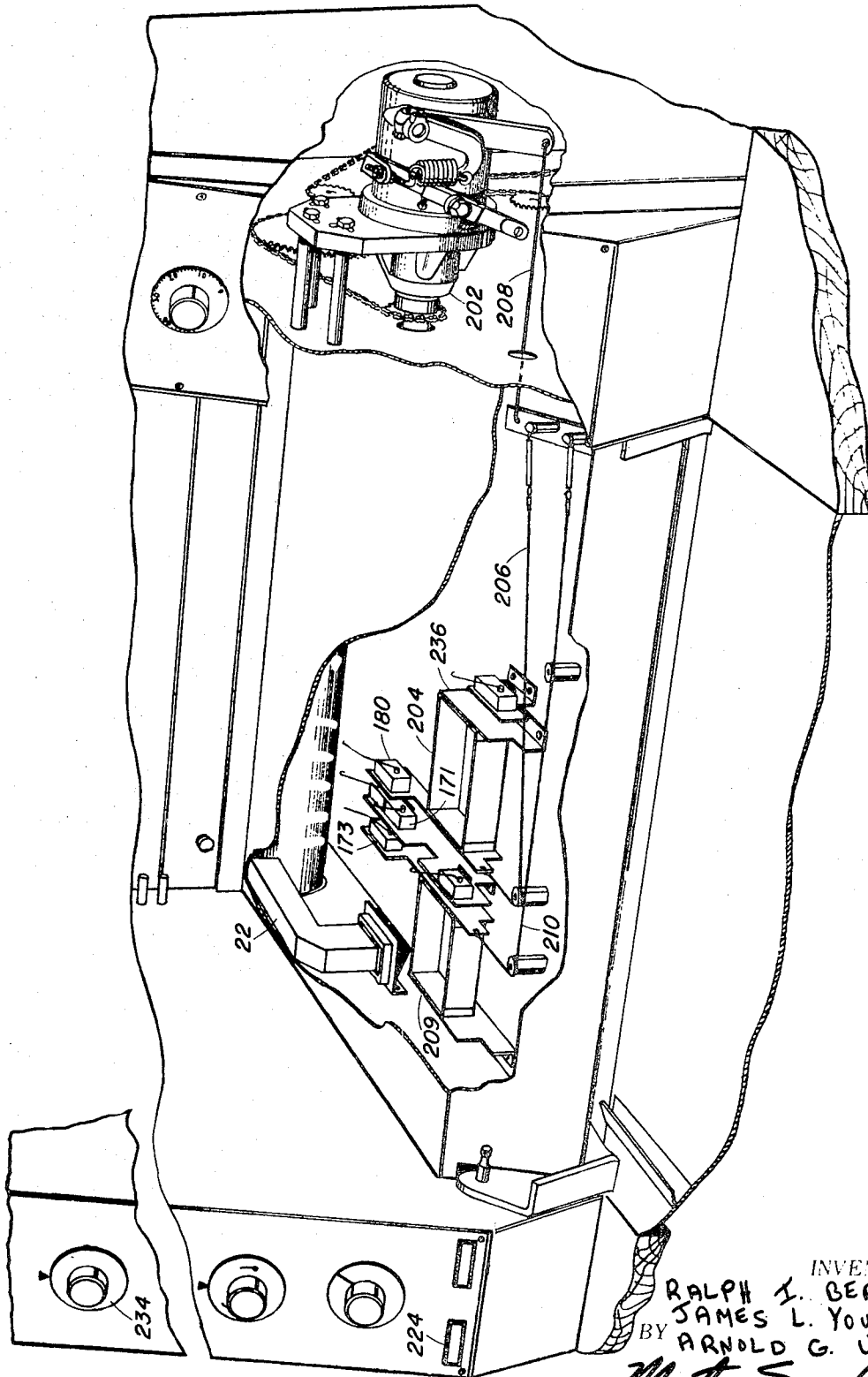


Fig 2.

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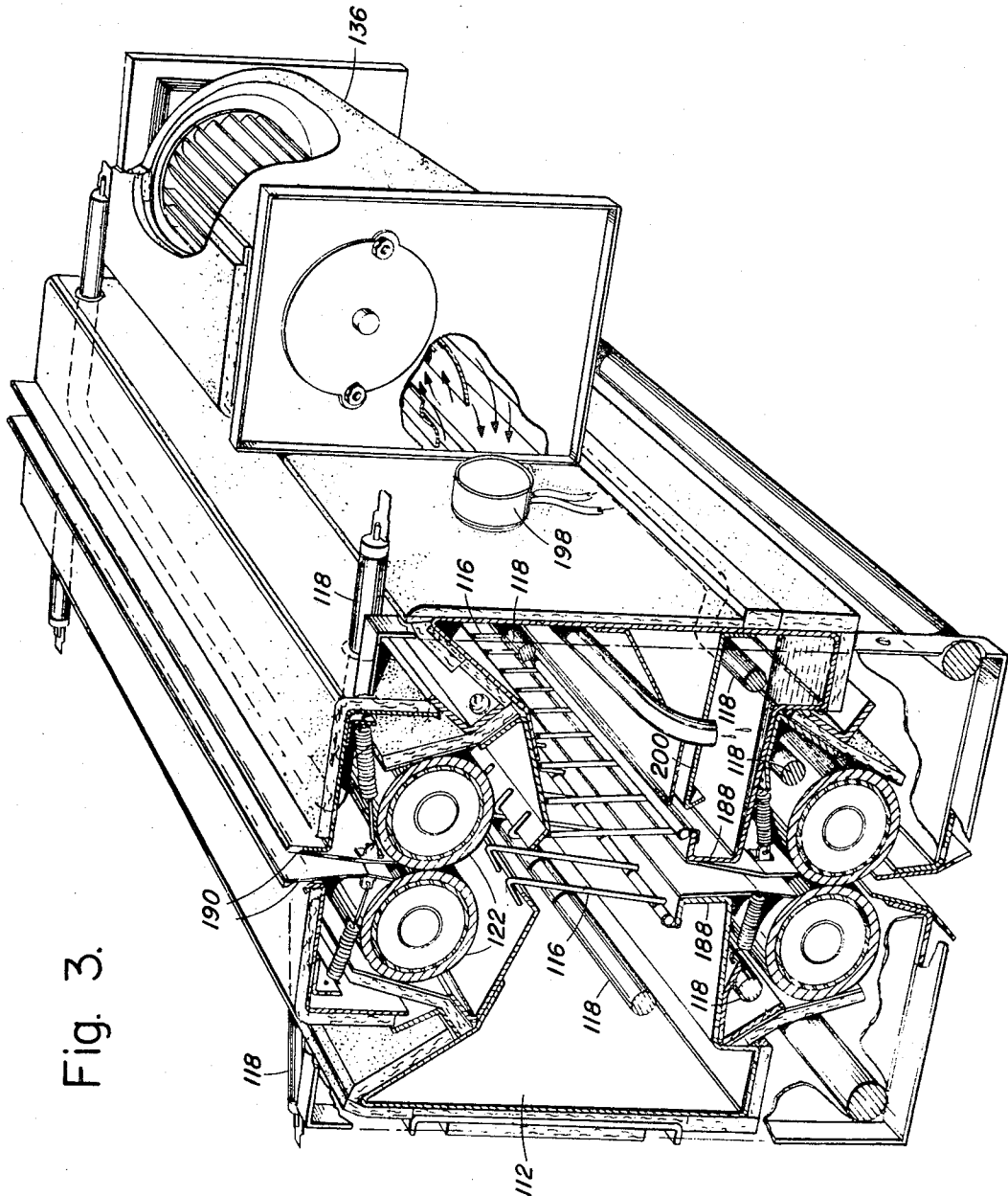


Fig. 3.

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Fig. 4.

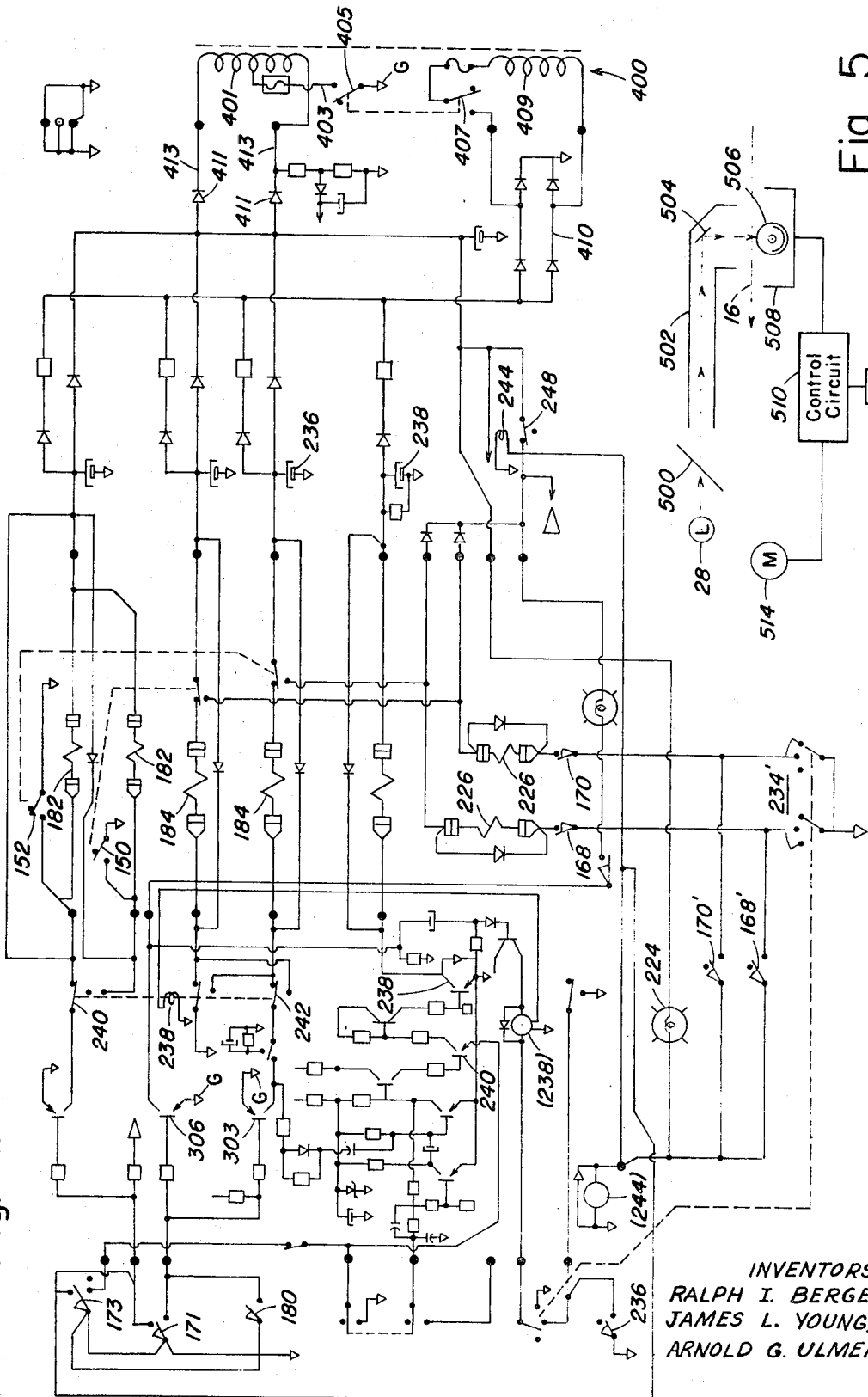


Fig. 5.

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CONTACT PRINTING APPARATUS

This invention relates to photo-copiers, and more particularly to diazo printing apparatus.

While the art of making diazo prints is known, there presently exists a pressing need for more compact, efficient and effective apparatus to make clear diazo prints automatically from any type of transparent or translucent original over a range of widths and lengths thereof.

The main object of this invention is to satisfy such need by the provision of a novel machine for making diazo prints quickly, economically and automatically, which prints are exact and faithful copies of the corresponding originals both in size and appearance.

Another object is to provide a novel and convenient upright cabinet in which the various elements of the apparatus are housed, whereby the parts are readily available for servicing, and in which the operations occur in upwardly moving sequence with respect to an original feeding table that is about waist high, with the original and copy output trays located within a central alcove above such table, between hollow side walls having instrument and control panels at the front thereof.

A further object is to provide means for automatically sensing the relative density of each moving original, and thereby continuously controlling the relative speed of the copying operation to produce an exact copy.

A still further object is to provide means for automatically sensing the width and length of each original, and thereby selecting one of a plurality of copy supply rolls corresponding to such width, which is then used to supply the copy that is cut to the corresponding length of the original.

Other objects are to improve the quality of diazo copies with an automatic machine that is simple to construct and operate, even by unskilled personnel.

Briefly, the invention provides an upright cabinet in which the various parts of the apparatus are housed. About waist high, the cabinet has a horizontal original "in" slot. In front of such slot an original feeding table is mounted which extends forwardly of the cabinet. Above such table are hollow side walls having front control panels provided with knobs and instruments associated with the control circuit of the apparatus in the cabinet. An original return or "out" station, and a copy output tray are located in an alcove between the side walls of the cabinet above the original table.

In the lower part of the cabinet are a plurality of copy supply rolls of different web widths for selective operation depending upon the width of the original that is fed into the "in" slot. An inclined way for such original extends from such slot toward the interior of the cabinet, and below such way is a copy web cutter which is operated automatically to cut the copy so that it exactly matches that of the original.

The original and corresponding copy then merge and pass around a light exposure station, upwardly through a separator and then the copy moves through a developing system. The original is split from the copy in such separator and is normally discharged onto the original "out" station, while the copy moves upwardly above such system. Means are provided for selectively discharging the finished copy into a front tray, or a rear tray; while additional means are provided for discharging copies with their originals before such copies enter the developing system, if desired.

The present machine is provided with novel means for achieving a very high degree of accuracy of cutting and exact registration of each copy with the corresponding original. Also, a unique feature is provided in that, when the end of a copy paper roll is reached, any remaining remnant is caused either to pass harmlessly through the machine, or can be easily retrieved by the operator. In addition, in order to avoid the cutting of undesirable slivers when drawn from alternate rolls, the edge of the copy paper awaiting feeding through the knife, is moved slightly back from the knife edge subsequently to each cutting operation.

In addition, the invention provides means for continuously controlling the relative speed of printing in accordance with the relative density of the original, as the latter advances toward a line of merger with the corresponding copy paper prior to exposure thereof with such original, whereby clear copies are obtained. Such means utilizes light from the exposure source to pass through each moving original onto a photo-cell which measures the density of the original, and thereby operates a control circuit which varies the drive speed of the overlapping original and copy paper elements as they move through the exposure area, through a motor that drives belt means carrying such elements.

In the drawings:

FIG. 1 is a fragmentary perspective view of a diazo printing machine illustrative of the invention.

FIG. 1A is an enlarged fragmentary exploded view of the lower parts of the machine shown in FIG. 1.

FIG. 2 is an enlarged fragmentary perspective view of the console shown in FIG. 1, detailing the original movement sensors.

FIG. 3 is a fragmentary perspective view of the copy developer system.

FIG. 4 is a circuit diagram of the paper web feed cutter control system.

FIG. 5 is a circuit diagram of the original density/printing speed control system.

Referring to FIG. 1, the diazo printer illustrated is housed within an upright cabinet 10 having a waist-high original feedboard or table 12. Located directly above the inner edge of the table 12 is an original "in-feed" slot 14 leading to an inclined original way 16 formed by spaced guide sheets 18, 18 and an "infeed" roller system 20 provided with a photo-cell density sensing system 22. Printer belts 24, located behind the way 16 carry the original and copy in overlapped relationship upwardly around a transparent printer cylinder 26 containing an elongated high-intensity central lamp 28 and a reflector 30. The ends of the lamp 28 and reflector 30 are mounted on end members which are, in turn, removably attached to the side walls 32 of the cabinet. The cylinder 26 rolls with the belts 24, original, and copy, on thrust bearings 34 and 36.

Located in the cabinet under the inclined way 16 is a multi-copy-width paper supply roll compartment 38 having an access door 40 in the front under the table 12. Copy paper supply rolls 42 and 44 having mandrels 43 and 45 are mounted in the compartment 38 on inclined end guide rails 46 and 48, respectively. The mandrels are held in place adjacent the inner ends of the guide rails 46 and 48 by locking levers 50 and 52, respectively. Copy paper 54 and 56 from the rolls 42 and 44 are threaded into a lower set 58, and an upper set 60, respectively of infeed rolls. Such roll sets 58 and

60 are provided with convergent paper guides 62 and 64 for directing the leading edge of the corresponding paper web through a cutting station 66 located directly under the original way 16 in the cabinet. The cutting station 66 contains a stationary knife 68, and a cooperative rotary knife 70. The copy paper web leaves the cutting station 66 by way of a common path 70 between upper and lower guide sheets 74 and 76 which direct the web to printer infeed drive roller 78.

The paper supply roll compartment 38 is made light-tight and ammonia-vapor proof by means including an angular rear partition 80 which extends upwardly, backwardly and then upwardly again from the floor of the cabinet 10 to a point near the roller 78. Other printer-belt support rollers 82, 84 and 86 maintain a closed loop of belt 24 about the printing cylinder 26 and print separator section 87. The print and original are separated at 88. Adjacent to and directly in front of the print separator section 87 is a tracing (original) separator 89 comprising an elongated separator tank 90 which is surrounded by transport belts 92, driven by a roller 94, and guided by a dancer roller 96 onto a removable tray 98. The tray 98 is removably mounted in an upper front space or alcove 100 formed between hollow side walls 102 of the cabinet 10 above the table 12, providing a large original stacking area for extra large or roll drawings at the option of the operator.

A print return lever 104 comprises means for setting pick-off fingers 106 to cause both copy and original to be discharged onto the stacking area when desired. Above the fingers 106 is a re-feed station 108 containing a guide 110 for directing the copy to a developer tank 112. Within tank 112 are housed print in-feed rollers 114, paper guide wires 116, ammonia drip tube 118, heater rods 120, and print feed-out rollers 122.

Front delivery rollers 124, or rear delivery guide rollers 126, controlled by a print delivery selection lever 128, determines whether the finished print is delivered into a front tray 130, or into a rear tray 132. The tray 130 is mounted in the space or alcove 100, between the hollow side walls 102 of the cabinet 10, above the original "out" tray 98. The rear tray 132 is located within the upper back area 134 of the cabinet 10.

The ammonia circulating system also includes a blower 136 associated with tank 112 for recirculating ammonia vapors therein and thereby imparting ammonia fumes directly on the prints to assure high quality copies. Heat and unwanted fumes tending to accumulate within the rear of the cabinet 10 are exhausted by a cooling and blower system 136 located behind the partition 80. The entire machine is movable from one floor location to another on castors 138, and can be set in such position by adjusting leveling jacks 140 located adjacent the lower corners under the cabinet 10.

Referring to FIG. 1A, as well as FIG. 1 after the paper rolls 42 and 44 are loaded in place and locked in such position, the leading ends of each web are threaded under tiltable cutting blades 142 and 144, and on rollers 146 and 148, respectively. Each web is then gently torn across the corresponding blade 142, 144 to provide a straight edge remaining thereon for subsequent transport through the machine. Jog switch 150 then is operated to advance the lower web, and jog switch 152, to advance the upper web, while light pressure is maintained on the appropriate cutter blade 142,

144, until the webs reach the printer cylinder. At such point, in each case, the jog switch 150, 152 is released and a manual cut switch 154 is actuated, resulting in a clean cut with the unwanted pieces of copy paper passing through the machine.

The paper passing through the roll sets 58 and 60, respectively, is normally slack, forming an elevated loop 156, 158 between rolls 160 and 162 in one case, and between rolls 164 and 166 in the other case. The web loop 156, or 158 in each case, thus, is caused to bear or ride against a sensing switch arm 168 or 170 which operates loop rollers 160, 162 or 164, 165 to draw paper from supply roll 42 or 44. Metering rolls 172, 174 drive the paper from the loop so that the web is at substantially zero tension. The loop rollers 162, 164 draw the paper from the supply rolls 42, 44, and are controlled by switch arms 168, 170, so that when the loops 156, 158 recede, loop rollers 162, 164 operate and replenish the loops 156, 158.

The original to be copied is placed on the table or feedboard 12 and the front edge gently inserted into the infeed roller system comprising brush rollers 172 and lower guide sheet 18 constituting "in" slot 14, thence toward its destination by three sets of transport rollers 20 in the inclined way 16. As the leading edge of the original passes over a sensing switch 171, FIG. 2, a brake 184, FIG. 1A, and the roll-feed is de-energized. As the leading edge of the original subsequently passes over a sensing switch 173, FIG. 2, which energizes one of the metering rolls 172 or 174, which drives the selected copy paper web toward its destination. Loop rollers 160, 164 then function as previously described, the loops 156, 158 being alternately formed and reformed under the corresponding switch arms 168, 170.

The original and copy paper converge simultaneously back of V-shaped guide 176 before passing between conveyor belt 24 on roller 78 and rubber rollers 178. The trailing edge of the original eventually passes over sensing switch 180, FIG. 2, which thereupon de-energizes metering clutch 182, thereby disengaging the related metering roller 172, 174. This results in the energization of a brake which stops the metering roll, and energizes knife solenoid 186. Thus, the copy paper is cut quickly and efficiently by the cutter 70, FIG. 1A.

Printer belts 24 transport the original and copy paper behind the printing cylinder 26 and reflector 30, FIG. 1, where exposure to the high intensity lamp 28 occurs. Subsequent to such exposure, the original is separated from the copy by separator tank 90 and transport belts 92, under rollers 96, and advances thereby onto the receiving tray 98 where it is neatly stacked. The separator tank 90 enhances such separation by causing the copy to adhere to the printer belts 24 which deliver such copy upwardly to the ammonia vapor-filled developer tank 112, FIG. 1, between the lower seal and transport rolls 114, 114 in such tank.

Referring to FIG. 3, the copy is guided through the developer tank 112 by pick-off shoes 188, 188, wire guides 116, between outfeed rollers 122, 122, and pick-off shoes 190, 190. The copy then moves out of tank 112, the front delivery roll 124 and under the rollers 192 via guide 194, FIG. 1, and onto the front delivery tray 130. The resulting prints are dry, of high quality,

and neatly stack on the tray 130. Adjustment of the print delivery selector lever 128, FIG. 1, can be made to reposition the guide to direct the copy through the rear delivery rollers 126 and 196 onto the rear delivery tray 132, if desired.

The developer tank 112, FIG. 3, contains a plurality of heater elements 118, and is provided with a thermostatic switch 198, as well as with the cross-flow blower 136, which recirculates the ammonia fumes for homogeneous effect, as well as impacts fumes through longitudinal nozzles 200 onto copy moving through the guide wires 116.

Accurate registration of the copy with the original, as well as accurate cutting of the copy to match its original is obtained as follows: Referring to FIG. 2, a machine speed sensor 202 provides compensation for the response time of the metering clutch 182, FIG. 1A, and knife solenoid 186 over the entire range of machine speeds. Sensing switch 180, FIG. 2, is mounted on a movable bracket 204 which is coupled to the speed sensor 202 by flexible cords 206 and 208. The switch 173 is mounted on movable bracket 209 which is coupled to the speed sensor 202 by flexible cords 208 and 210. Switch 173 is the copy paper feed switch and controls the operation of metering clutch 182, FIG. 1A, and the rotation of metering roller 174. The cut off switch 180, FIG. 2, controls actuation of brake 184, FIG. 1A, and actuation of the knife solenoid 186. As the machine speed increases, speed sensor 202 displaces switch 173 and switch 180 in proportion to the speed, resulting in an earlier signal to the metering clutch 182, FIG. 1A, to feed copy paper. At the same time, an earlier signal goes to the knife solenoid 186, FIG. 1A, to cut the copy paper.

Conversely, as the machine speed decreases, switch 173, FIG. 2, and switch 180 are effectively displaced to provide a later signal to the metering clutch 182, FIG. 1A, and to the knife solenoid 186. Appropriate adjustments result in very accurate cutting of the copy paper to the exact size of the corresponding original, as well as accurate registration of the image on such copy paper.

In normal operation, sensing switch 171, FIG. 2, de-energizing brake 184, FIG. 1A, is activated before the sensing switch 173, FIG. 1A, is activated, to actuate the metering clutch 182. This allows for brake drop-out time, but results in possible creep of the metering roller 174 and copy paper, due to such time lapse. Such copy paper creep, if permitted, results in inaccuracy of the copy paper size. This is overcome by a mechanical dampening brake 212 comprising a friction disc 214, spring 216, and collar 218 on the loop roller 174; and adjacent to retaining collar 218 on the loop roller 148.

The brake 212 also serves to stabilize loop roller 148, eliminating oscillation normally caused by the weight of the copy paper hanging down from roller 148. If not dampened, the weight of such paper would result in roller 148 free-wheeling in reverse, and the loop 158 receding, starting the cycle of switch arm 170 for replenishing the paper. Continuous drag braking of the paper supply rolls 44 is accomplished through friction applied by a brake arm 214 on a drum 216 attached to the mandrel 45; a similar arrangement brakes the roll 42.

Switch arm 168 which controls the loop 158, also serves as an end-of-roll detector. When the paper roll 44 is depleted, arm 168 drops into an opening 218 in paper guide 222, triggering a micro-switch (not shown) which operates a "reload" light 224, FIG. 2, de-energizing loop clutch 226, FIG. 1A, metering clutch 182, and knife solenoid 186, while the brake 184 is given a short (4 milli-second) pulse "on." Such brake "on" pulse stops the copy paper remnant, allowing for easy retrieval if the leading edge had not reached printer belt drive roller 78; or allowing the remnant to pass through the machine, provided the leading edge had reached the roller 78. Either condition allows the original to follow a normal course through the machine undamaged.

A problem associated with drawing copy paper from alternate rolls in a two-roll machine is a slight overhang of the copy paper at the stationary cutter or knife 68, resulting in the cutting of such overhang when the alternate paper is cut.

This produces an unwanted sliver of paper which falls somewhere in the cutting station 66 in the paper path. Such problem is solved by the following novel innovation: The trailing edge of the copy paper energizes, through sensing switch 180, FIG. 2, the brake 184, FIG. 1A, and knife solenoid 186. Metering clutch 182 was previously deenergized by the sensing switch 171, FIG. 2. The armature 229 of brake 184, FIG. 1A, is affixed to and rotates with the copy paper metering roller 174, while the coil 231 of brake 184 floats on the paper metering roller 174. But the amount of brake coil rotation is restrained by an arm extension 228 between fixed posts 230. The slight rotation of the brake coil 231 occurs when the brake armature 229 engages the brake coil 231. The brake response time is about 3—5 milliseconds, while the knife solenoid response time is about 21 milliseconds. When sensing switch 180 signals brake 184 to energize, the brake coil 231 and armature 229 rotate clockwise, due to the pull of copy paper by the belts 24 in the direction of paper travel. Such rotation is limited only by arm 228 engaging a post 230, and occurs when the brake 184 responds to the same original. As the knife 70 cuts copy paper, brake 184 on metering roll 174 is rotated counter-clockwise to the extent allowable by arm 228 and post 230 against the bias of a tension spring 232.

Referring to FIG. 2, a manually operable paper selector switch knob 234 is provided for setting the width of the copy paper. Such knob 234 when set for "Automatic" results in the control circuit making such selection as required by the width of the original. In such case, when a wide original is fed into the machine, it actuates wide roll selector switch 236, whereas when a narrow original is fed into the machine it misses the switch 236. Locating paper roll selector 234 at either "upper" or "lower" allows selection of copy paper from either one, regardless of the width of the original. Such positioning also allows depletion of a selected roll by by-passing through appropriate circuitry either sensing arm 168, or 170, FIG. 1A, which normally would disable metering clutch 182 and knife solenoid 186 when the end of the paper roll is reached.

The cutter members 68 and 70 at the cutting station 66 are in the form of a self-locating module that is easily removable from the cabinet 10 for servicing and/or replacement.

Referring to FIG. 4, the illustrated roll feed control circuit provides accurate registration of diazo prints to the master over a wide range of transport speed. This is accomplished by sensing the paper edges with the mechanical switches 171, 173 and 180. Accuracy, freedom from contact-bounce uncertainty, is achieved by starting time—critical functions on contact opening. Closed contacts of switch 171, for example, short the bases of two transistor switches 306 and 303 to circuit ground G. When the switch contacts open, the base shunt is removed and the supply resistor current turns on the clutch or brake transistor. The inductive components of the brakes and clutches are 12 volt units. They draw 0.6 amp when on. During an OFF period, the supplies for the in-use clutch and either brake have a 500 mfd capacitor 236 which is charged to 42 volts to speed the current build-up and actuation of such inductive components.

Power for the knife solenoid 186 is stored in a large (9K to 15K MFD) capacitor 238 charged to 42 volts. It delivers impulses of about 14 joules (watt-seconds), and it recharges in less than one second for succeeding shots.

The brake transistor triggers a 37 ms single shot which turns on the Q1 power transistor 238 if the emitter of Q10 transistor 240 is grounded by the enable circuit.

One of the two rolls of diazo paper is fed and cut to duplicate the master transparency. Inputs come from the following three paper sense switches:

1. Brake-off and clutch-off switch 171.
2. Brake-on and Cut-on-trailing-edge switch 180.
3. Clutch-on, for leading edge switch 173.

Switches 180 and 173 are moved by the speed governor, forward in time as the transport speed increases. Switch 173 moves a smaller distance to compensate for the clutch lag (about 3 ms) and the variable acceleration lag. Switch 180 moves a larger amount to compensate for the deceleration lag and the fixed (about 23 ms) knife lag. The knife cut occurs in about 4 ms at the end of this period.

Additional inputs are:

Enable — the normally open contact of the No. 3 master sense switch 173 enables an automatic knife actuate only while paper is still depressing this switch. This prevents knife cuts which would be caused by contact bounce while the leading edge is taking the brake off at No. 1 & No. 2 switches 170 and 180.

Manual Cut — A two pole switch 154 closes the enable circuit and delivers a pulse to the knife pulse timer, a 37 ms. single shot.

Manual Roll Select — A three pole, three position switch 234 controls coil 236 of relay CR-1 and regulates the function of the two end-of-roll switches. The first pole disables CR-1 in the upper position U to deliver the transistor controlled clutch and brake power to the Upper-roll clutch 182 and brake 184 via contactors 240 and 242 respectively. The other brake remains ON. In the Lower position L, this switch-pole holds relay CR-1 ON, delivering the controlled power to the Lower-roll clutch 182 and brake 184, and holding the Upper-roll brake 184 ON. In Automatic position A, this pole permits relay CR-1 to be energized by a wide master or original actuating the wide sense switch 236. When this happens relay CR-1 holds itself until a knife cut drops its coil 236 voltage, or until coil

236 current is interrupted by the manual roll selector switch 234.

The end-of-roll switches 168¹ and 170¹ which are actuated by the absence of paper in the feed loop position, energize and hold coil 244 of relay CR-2 in the feed-off and brake-on position by closure of contactor 248. The Manual Roll Selector switch 234¹ disables the opposite end-of-roll circuit so that the machine may be used with a single roll.

Brakes 184 are applied by relay CR-2 so that the operator may turn the Roll Feed OFF and back out a short roll-end. This avoids a possible jam. If the roll-end paper is sufficiently long to reach the drive roll which follows the knife (about 6 inches) it will pass through and cause no trouble.

Jog Switches — Upper and Lower-Roll-Jog switches 150 and 152 are provided for loading and testing upper and lower roll drives. The Manual Roll switch 234 must be set to the roll used if the other is empty. The Manual Cut switch 154 will finish the JOG feed. Sufficient (6 inches or more) paper should be fed to avoid a jam build up.

The power supply for the control circuit of FIG. 4 is provided by a transformer 400 having a secondary winding 401 the center of which is connected to ground G by a circuit 403 containing a switch 405 which is mechanically connected to a switch 407. The switch 407 connects another secondary winding 409 of transformer 400 to a bridge type rectifier 409. Rectifiers 411 are also provided in the ungrounded output circuits 413 which are connected to the brake solenoids 184. The bridge 409 supplies D.C. energy to the clutches 182, knife solenoid 186, and the loop clutches 226.

Referring to FIG. 5, the lamp 28 in the light cylinder 26, FIG. 1, around which the copy paper and original under belts 24 for exposure, shines through a window 500 in an inclined wall in front of the cylinder and into a light tunnel 502, FIG. 5, wherein such light is redirected by a mirror 504 toward a photo-cell 506 located in a housing 508 having an open top. The photo-cell 506 is connected to a solid state control circuit 510 which is supplied with energy from a source 512 of D.C., and drives motor 514 at a speed which is governed by the density of each original moving along path 16 prior to merger with the corresponding copy. The motor 514 drives belts 24, FIG. 1, and thus, the speed of printing of the apparatus is controlled by the density of each original, producing an exact copy in each case. The greater the original density the slower the speed of printing, and vice-versa.

The machine can be operated with only one paper supply roll, or two rolls of equal width, if desired.

What is claimed is:

1. A Diazo printing apparatus comprising in combination means for automatically drawing copy paper from a selected supply roll of a plurality thereof in response to the feeding of an original into the apparatus, said means including a paper metering roller, means acting to cut such paper so that the length thereof corresponds to that of such original as they merge for copying, a braking means to brake said copy paper drawing means during the operation of said cutting means, an armature fixed to one end of said roller, a coil floating on said roller end, an arm extend-

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ing radially from said coil, a pair of arm movement limiting posts located in the path of movement of said arm, control means for energizing said coil shortly prior to the energization of said paper cutting means, a spring urging said arm toward one post when said brake is released, whereby when said brake is subsequently released said spring draws said arm back to said post, thereby also turning the metering roll and paper thereon backwardly a short way to prevent the subsequent cutting of an unwanted sliver therefrom.

2. A Diazo printing machine, as defined in claim 1, wherein said means for drawing copy paper from a supply roll in response to the movement of such original toward such line of merger comprises spaced paper feeding rolls between which an

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elevated loop of the copy paper is normally maintained, a control switch arm normally resting on such loop, control circuit means for operating the leading paper feed roll for feeding paper only when said switch arm falls with such loop below a preselected level, and stopping such operation when the loop reaches its normal level, and switch means responsive to such movement of the original for operating the other paper feed roll to feed copy paper from such loop toward such line of merger with the original, whereby the copy paper is fed toward such line with substantially little tension.

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