

Nov. 18, 1958

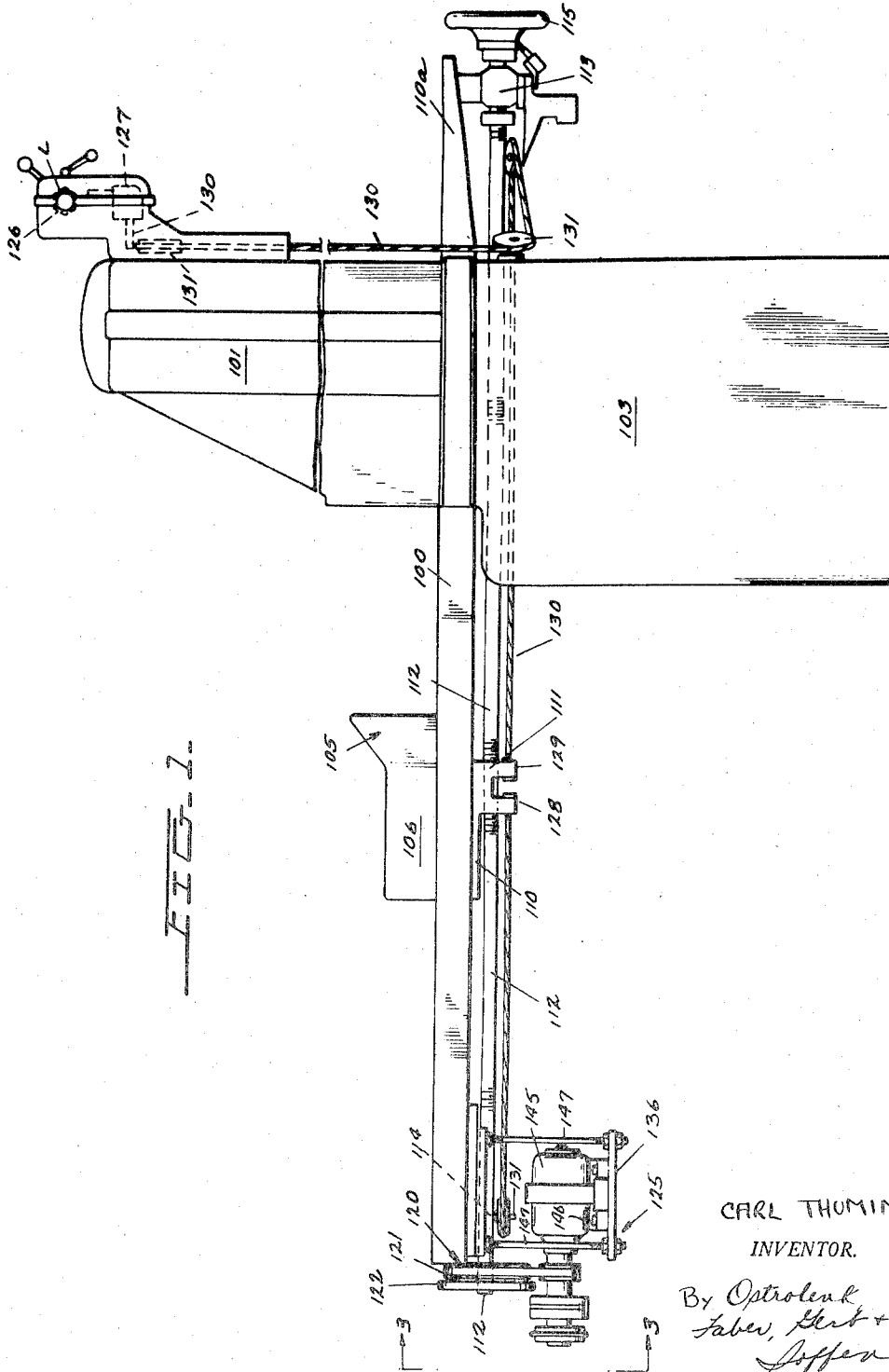
C. THUMIM

2,860,705

PHOTOELECTRIC CONTROLLED BACK GAUGE

Filed April 24, 1956

5 Sheets-Sheet 1



CARL THUMM
INVENTOR.

By Optrolenk
Faber, Hart +
Joffe

Nov. 18, 1958

C. THUMIM

2,860,705

PHOTOELECTRIC CONTROLLED BACK GAUGE

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5 Sheets-Sheet 3

FIG. 3.

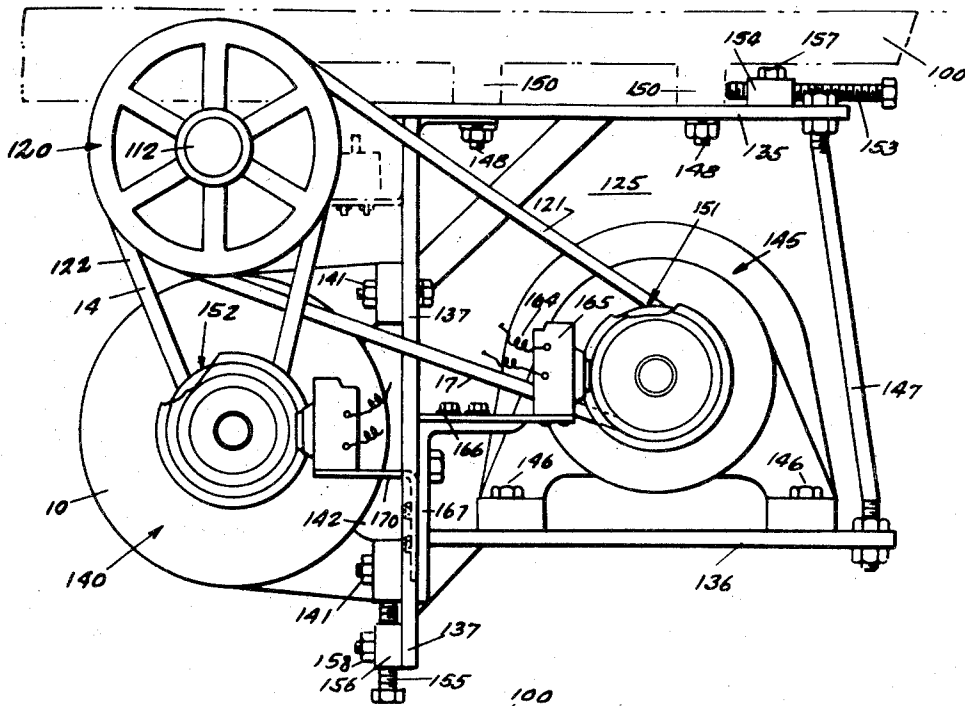
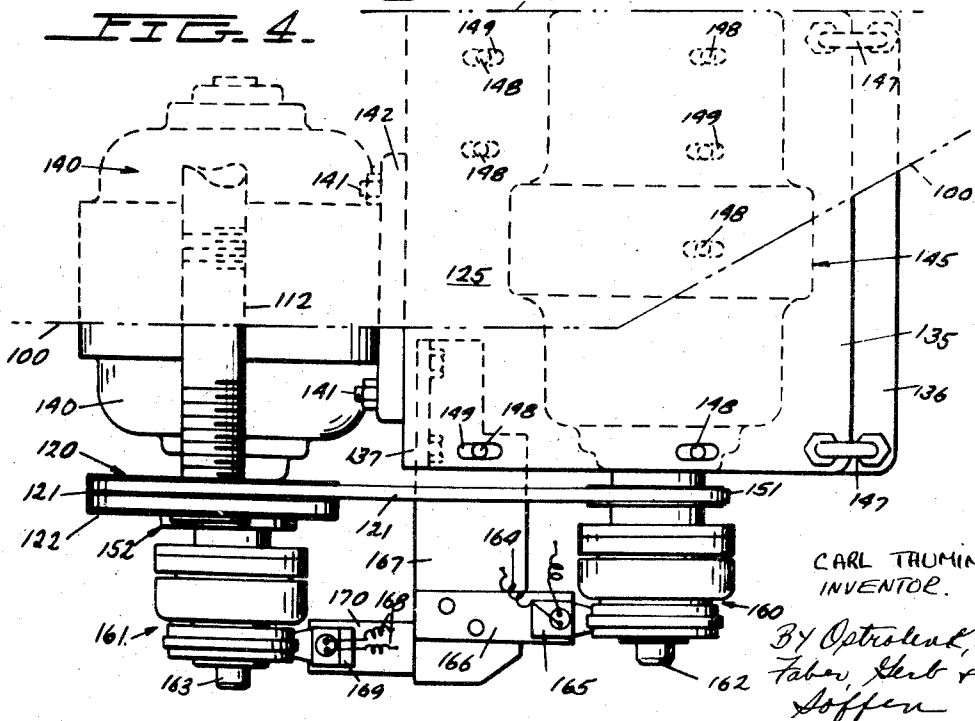


FIG. 4.



CARL THUMIM
INVENTOR.

By Optrolent,
Faber, Kert &
Soffen

Nov. 18, 1958

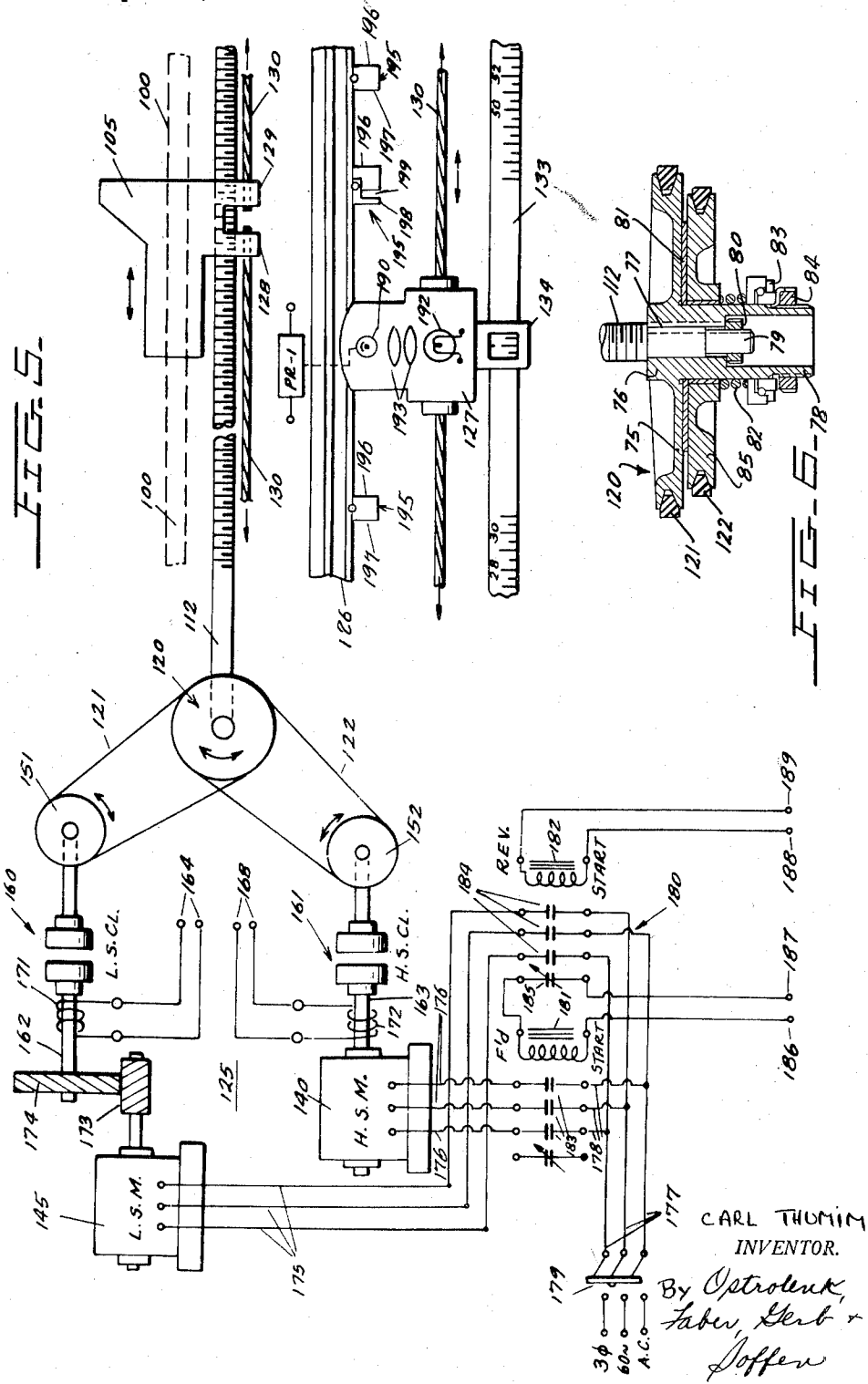
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C. THUMIM

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PHOTOELECTRIC CONTROLLED BACK GAUGE

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5 Sheets-Sheet 5

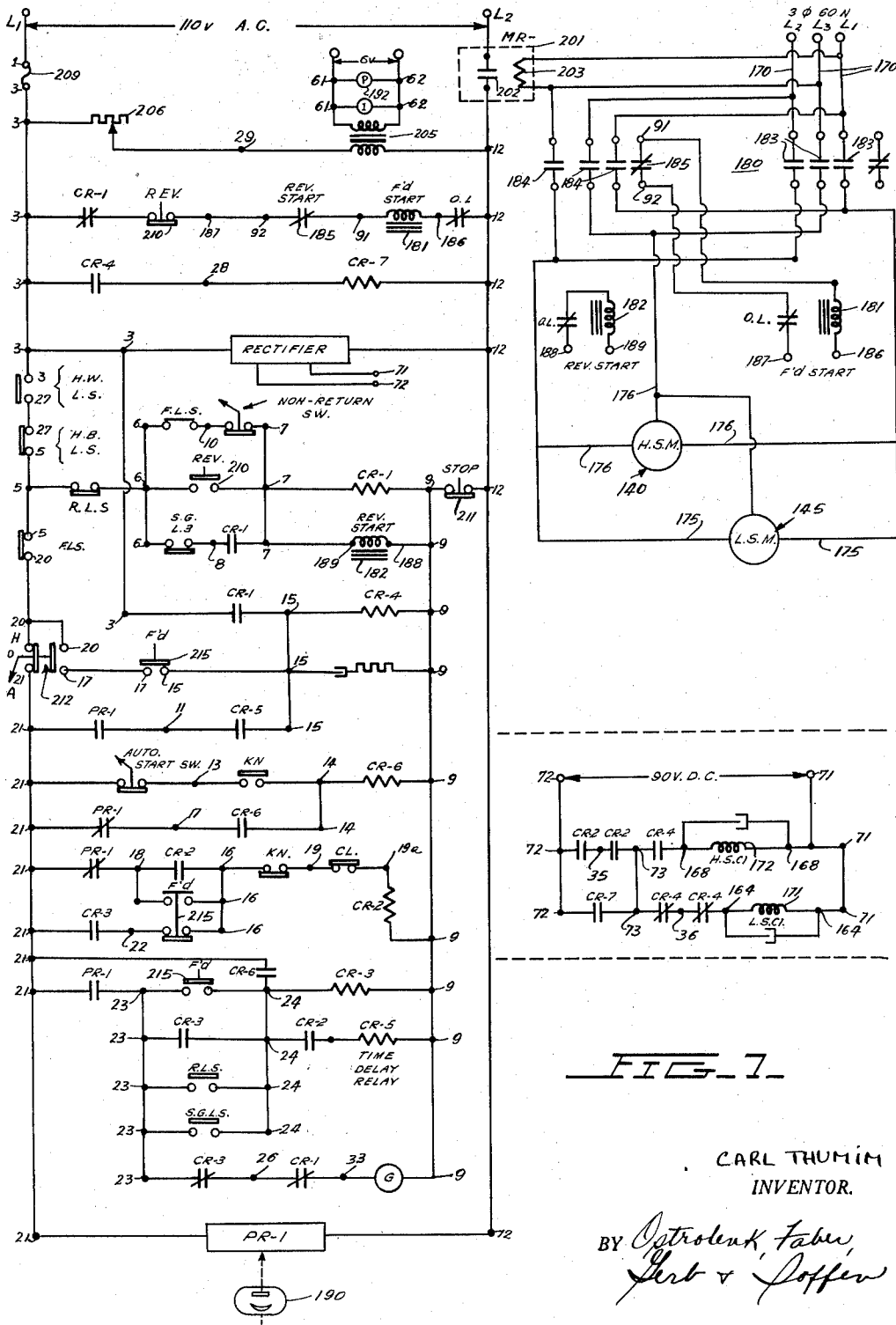


FIG. 7.

CARL THUMIM
INVENTOR.

BY *Ostrolenk, Faber,
Hart & Loffler*

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2,860,705

PHOTOELECTRIC CONTROLLED BACK GAUGE

Carl Thumim, Westbury, N. Y., assignor to E. P. Lawson Co., Inc., New York, N. Y., a corporation of New York

Application April 24, 1956, Serial No. 580,200

8 Claims. (Cl. 164—59)

The present invention relates to improvements in automatic spacing mechanism, specifically in providing fully electrically controlled operation of the back gauge of paper cutting machines.

The present invention relates to improvements upon paper cutting machines as shown and described in Patent No. 2,628,680, issued February 17, 1953, and applications Serial No. 200,013, filed December 9, 1950, now Patent No. 2,737,158, Serial No. 391,217, filed November 10, 1953, now abandoned, and Serial No. 571,518 filed March 14, 1956, and now abandoned, all assigned to the same assignee as the present invention.

In the operation of guillotine type paper cutters, a pile of paper is placed on the work table beneath the cutting knife. The back gauge provided on the work table is adjusted so that the portion of the pile which it is desired to cut off extends forward of the cutting knife edge. Thus, when the reciprocable knife blade is brought down, it will cut off an exactly dimensioned section of the pile.

In operating paper cutters of this type, it frequently becomes necessary to adjust the position of the back gauge many times for the different cuts which are to be made, such as on a printed pile of sheets. Even if a plurality of regular cuts are to be made from a single pile, the back gauge must be moved up each time to ensure that the forward edge of the pile is perfectly squared so that the exact desired cut may be made.

In the aforesaid pending applications, a control system is shown whereby the back gauge is automatically motivated by spacing mechanism actuated through photoelectric cells in accordance with predetermined set-ups. The operator presets stops along a program member, all related to the movements of the back gauge. The stop set-up is at the operating front of the cutting machine, as shown and described in the referred to applications, and is directly related to the desired cutting strokes to be performed on the sheets forming the pile of work in the paper cutter.

Should trim-outs be required between closely spaced imprints, such as of labels, the herein system is adapted to readily perform such trim-out cuts as well. The electrical system comprises a signal lamp which flashes whenever the control causes the back gauge to be stopped for the cutter to be motivated, as will be described. The lamp indicates to the operator that the pile is in a desired position for cutting so that he may activate the reciprocating knife which co-jointly operates with a clamp, in a manner familiar to those skilled in the art.

By the use of the invention system, the operator need do nothing more than place the initial pile of papers on the machine against the back gauge and arrange a program of cutting with the stop units. The operator then actuates the cutter blade each time a signal lamp flashes. The program of stop units controls the spacing mechanism so that the back gauge driving mechanism automatically moves the back gauge the necessary distance after each cut and before the next cut is started. The stop and trim-out program units are used in conjunction

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with a carriage containing a single photoelectric cell control unit that moves transversely across the front of the cutting machine in synchronism with the movement of the back gauge. The present invention is a continuation-in-part of my co-pending application Serial No. 571,518, aforesaid, wherein a two-photoelectric cell control system is disclosed. The present case utilizes a single photoelectric cell control.

When the operation of the back gauge is initiated, a light beam passes in the space between stop units and impinges upon the exposed photo-cell. This operation takes place at full speed, driving the back gauge forward at its rapid speed. At the same time, the carriage is synchronously driven transversely from right to left, through cable attachments to the back gauge. When light to the photo-cell is first interrupted by the right-hand edge of a stop unit, circuits are operated that directly reduce the forward speed of the back gauge (and the carriage) to its slow speed of movement forward.

With the carriage now at the slow speed, when the light beam is interrupted by the left-hand edge of the stop unit, the back gauge and the carriage are directly halted in their movement. Thus, a heavy pile of paper may be brought up rapidly by the back gauge to near the point where it is to be stopped. Thereafter, it is slowed down, and then finally brought to a stop. Such slow-down interval prevents a sudden stop of the heavy back gauge and avoids causing the heavy paper pile to cross beyond a predetermined position. The final speed of the back gauge may be as little as 1% of the fast forward speed at which the paper pile is brought up close to the stopping point. Preferably, the reinitiation of the back gauge cycle of operation to the next cutting position is arranged so that the lifting of the knife and clamp clear of the paper pile towards their nesting position resets the control apparatus through a switch. A bypass switch is also provided so that the automatic back gauge cycle may be reset manually whenever desired.

The control elements are so arranged that a first change in the light beam condition on the photo-cell due to the right-hand opaque edge of a stop unit causes the back gauge to be slowed down, and a second change in the light condition, due to the left-hand edge of the stop unit after initiation of the slow operation will cause the back gauge to be directly stopped. That is, the darkening of the photo-sensitive element causes a slow down, and the lightening of the photo-sensitive element causes the control means to stop the back gauge.

When the cutting machine is used to cut labels or other material printed upon the sheets of the pile of paper, the back gauge is required to move forward an inch or more between each cutting operation. However, on printed sheets where many rows of labels or the like appear, there is also found a small strip such as between $\frac{1}{16}$ " to $\frac{1}{4}$ " that remains unprinted. Such unprinted areas are due to the plate hooks which are located between adjacent printing plates for clamping these plates to the printing cylinder, as is known in the art. Hence, after the back gauge has been moved forward several cycles of fast to slow speed to stop for cutting a series of printed label rows, it becomes necessary that the back gauge be moved forward by only a fraction of an inch to permit the cutting or trim out of the small unprinted strips. In such case, after a main cut, the back gauge starts to move forward at its slow speed and then to a stop for the nearby trim-out cut. For the purpose of trimming out the narrow unprinted strips of paper, a separate stop unit element is used for the light beam interrupting of the photo-cell system. This separate means is called the trim-out unit stop which controls the back gauge movement in such manner that it starts to move forward from a

stopped position only at a slow speed, travels a fractional part of an inch programmed for it and then comes to a stop for the cutting out or trimming out of the unprinted strip.

Assuming that a trim-out stop unit is adjacent a regular stop unit, a slit of only a small fraction of an inch will exist between the lower parts of the two stop units through which the light beam can pass. When the signal light has flashed, indicating that an accurate stop has been made, the operator can start the cutting blade operation. The knife blade on its return upward movement operates the recycling switch, initiating thereupon the slow speed of the back gauge, since the light beam is blocked after passing the narrow slit for the first cut. The back gauge continues to advance at the slow speed until the control light beam in the carriage reaches the left-hand edge of the trim-out unit. At this point, the light beam strikes the photo-cell to cause the electrically controlled driving mechanism of the invention to bring the back gauge to a stop. The signal light indicates that a stop has been made by the back gauge and paper pile, for the cutting operation to take place for trim-out of the unprinted strip of the paper.

The present invention incorporates a novel and effective electric motor driven mechanism for the back gauge operable in conjunction with the aforesaid single photo-electric cell control system to accomplish all of the functions for the back gauge: a predetermined and programmed relationship of the back gauge, the stack of sheets on the work table, and its cutting by the reciprocable knife. As will now be understood, precise positioning of the back gauge is requisite under the control of precisely set stop units coactable with the light beam and the photo-electric cell, and a control carriage movable in synchronism with the back gauge.

In accordance with the invention herein, a novel arrangement is provided including two motors both coupled to the driving member or lead screw of the back gauge; one is a high speed motor; the other a low speed motor; both preferably electric but may be hydraulic or other types. The shafts of these two motors are coupled to the work table drive member through individual electro-magnetic clutches. A system of electrical control is provided to actuate the high speed motor into forward or reverse rotation as required in the cycling. The high speed motor when engaged moves the back gauge forward or backwards at its rapid speed. When properly actuated by the control system, the low speed motor takes over to move the back gauge towards an accurate position for cutting at its slow speed, all as determined by the single photo-electric control system and preset stop program. The present invention is an improvement of the system set forth in the application Serial No. 571,518 affording direct positive actuation of the back gauge with only a single photo-electric control that is simpler and less expensive than the dual control of the application.

It is accordingly an object of the present invention to provide a novel system for operating the back gauge of a paper cutter either manually or automatically through a novel arrangement of electro-mechanical mechanisms and a single photo-electric control.

A further object of the present invention is to provide a novel automatic back gauge spacing system incorporating a plurality of electric or hydraulic motors, electro-magnetic clutches, and single photo-electric cell control therefor actuated by a stop unit program.

Another object of the present invention is to provide a novel, automatic back gauge mechanism incorporating electric motor drives and electro-magnetic clutches for directly operating the back gauge in response to predetermined stops programmed by the operator for successive cutting positioning and/or trim-outs with a single photo-electric cell system.

The foregoing and other objects of the invention will

become more apparent in the following description taken in conjunction with the drawings in which:

Figure 1 is a side view of a reciprocable knife paper cutter machine embodying the present invention.

Figure 2 is a plan view of the paper cutter machine shown in Figure 1.

Figure 3 is an end view of the motor drive mechanism for the back gauge corresponding to Figures 1 and 2, enlarged to show details thereof, being the view taken along the line 3—3 of Figure 1 in the direction of the arrows.

Figure 4 is a plan view of the motor drive mechanism shown in Figure 3, with the work table thereof partially broken away.

Figure 5 is a diagrammatic representation of the invention back gauge control system and the motor drive mechanism, schematically showing some of the circuit elements thereof.

Figure 6 is a cross-sectional view through the novel dual motor drive pulley arrangement.

Figure 7 is a schematic electrical diagram of a preferred control system that is responsive automatically to the photo-electric cell control and/or to manual control, for operating the back gauge in a predetermined manner.

Figures 1 and 2 show a paper cutting machine comprising structural arrangements the same as that shown in the aforesaid application Serial No. 571,518. The paper cutting machine comprises a work table 100 carried between upright side frame casings 101, 101. Side frame casings 101, 101 are cross-braced by cross-member 102. The rear end (left) of work table 100 is supported by a bracket (not shown) which also may serve as a partial support for the back gauge operating mechanism 125 to be described. Work table 100 and side frame members 101, 101 extend from and are basically secured to housing 103 which also comprises the base for the cutter machine.

The paper cutting mechanism comprises a reciprocable knife blade arranged between side frame casings 101, 101 and cross-bracing member 102 (not seen in the drawings). A suitable clamping arrangement is generally provided with the cutting knife mechanism. The mechanism for operating the reciprocable cutting blade and clamp is generally contained underneath the work table 100 and within the housing 103. The cutting blade assembly and its operating mechanism are not shown in the drawings, for clarity purposes, as they form no particular feature of novelty in the present invention, it being understood that suitable means well known in the art are utilized therefor.

Back gauge 105 comprises a metal casting 106 which extends transversely across cutting table 100. Back gauge 105 has a plurality of forward extensions 107 seen in Figure 2. The aligned front edges of forward extensions 107 form the back gauge surface which coacts with the pile of sheets to be cut by the machine. Work table 100 is provided with a central longitudinal slot 108 through which a depending bracket 110 of back gauge 105 extends downwardly. The slot 108 forms a track for the back gauge bracket 110 and for the back gauge in its longitudinal traverse along work table 100. A nut 111 is formed in an extension of the back gauge bracket 110 which is in threaded engagement with the back gauge feed screw 112. It is understood that rotation of feed screw 112 causes back gauge 105 to longitudinally traverse work table 100 in a forwardly or rearwardly direction depending on the sense of rotation of the feed screw; and that the speed of traverse of back gauge 105 is proportional to the rate of rotation of the feed screw. Furthermore, in view of the positive engagement between feed screw 112 and nut 111 of the back gauge, accurate positioning of the back gauge is feasible, as will be set forth hereinafter.

Feed screw 112 is rotatably carried beneath slot 108

of work table 100 in front bearing 113 mounted under the forward extension 100a of table 100 and the rear bearing at 114 under table 100. The front end (right) of feed screw 112 is provided with a hand wheel 115 for manual operation of the back gauge 105 through the feed screw. The rear end (left) of back gauge lead screw 112 is provided with a double pulley 120. Two drive belts 121, 122 coast with pulley 120 through the motor drive mechanism 125 under the control of automatic and/or manual means, all to be described in detail hereinafter, and forming an essential basis of the present invention. Lead screw 112 is mounted so that while it may rotate freely, it has no longitudinal movement. Accordingly, rotation of screw 112 by either operating mechanism 125 through pulley 120 or manually through hand wheel 115 results in a corresponding longitudinal movement of the back gauge 105 across work table 100 at a speed and direction in accordance with the rotation of lead screw 112.

The automatic operation of back gauge 105 through motor drive system 125 is under the control of a series of stop units preset along a program bar 126 and coactable with a photoelectric cell contained in movable carriage 127. The carriage 127 traverses across the front of the machine in synchronism with the longitudinal position of back gauge 105. Such inter-related motion is performed in a precise manner in order that the triggering of the photoelectric cell and, in turn, activation of motor control system 125, will correspond directly to the intended programmed action for the positions of back gauge 105. The positioning of carriage 127 along the front of the cutting machine is accomplished as follows: Back gauge 105 is provided with two depending lugs 128, 129. A cable 130 terminates in the lugs 128 and 129 separately. Back gauge 105 is firmly coupled to carriage 127 by cable 130 being disposed across the cutting machine in a series of sheaves 131 as detailed in the said co-pending applications Serial Nos. 200,013 and 391,217. Cable 130 is secured to carriage 127 at extending lugs 132, 132 thereof.

The overall extent of movement of carriage 127 across the front of the machine is equal to the full operating traverse of back gauge 105 on work table 100. Figure 5 diagrammatically represents the relationship of carriage 127 and back gauge 105. A scale 133 is positioned along a reading opening 134 of carriage 127, across the path of carriage 127 in front of the cutting machine. Scale 133 is graduated in inches or centimeters as desired, and indicates the exact position of back gauge 105 through indicator 134. Since there is a one-to-one relationship in the movements thereof, the movement of carriage 127 exactly duplicates the movement of back gauge 105. Also, the exact location of back gauge 105, or rather the exact distance of its operating front face 107 from the cutting knife, is thus directly known at all times by the operator.

Electric motor drive system

The electric drive system 125 operates on the rear end of back gauge lead screw 112 through double grooved pulley 120 secured to the lead screw. Figures 3 and 4 illustrate a particular embodiment for the motor drive 125 supported beneath the rear end (left) of the work table 100. Work table 100 is shown in dotted lines in these two figures; and in the plan view of Figure 4 is partially broken away to show the supporting frame 135 for the drive assembly 125. The assembly for the drive mechanism 125 comprises two further frames, namely bottom frame 136 and vertical frame 137 secured between frames 135, 136. Electric drive motor 140 is secured to vertical frame member 137 by a series of bolts 141 through mounting holes in its base 142. Electric drive motor 145 is secured to bottom frame member 136 through suitable bolts 146. The cantilevered (right) side of frame member 136 is supported by stay bolts 147, 147

extending through and secured with top frame member 135. Suitable struts and supporting members are utilized among the three frame members 135, 136, 137 to secure the motor drive structure 125 rigidly as a sub-assembly.

Top frame member 135 is secured to work table 100 by bolts 148 extending through slots in frame member 135 to posts 150 extending from the bottom of work table 100. The motor drive assembly 125 is accordingly adjustable in a direction transverse of work table 100 for the purpose of adjusting for a proper tension in the drive belt 121 connecting pulley 120 with drive pulley 151. Drive pulley 151 is driven by motor 145 in a manner to be described. Similarly, belt 122 connects the pulley 120 to the drive pulley 153 operated by electric motor 140 in a manner to be set forth.

A set screw 153 is shown in Figure 3 for adjusting the said transverse position of the motor assembly 125 with respect to the fixed position of lead screw 112. Set screw 153 is rotatably mounted in a threaded post 154 extending from frame 135 and is arranged to abut a post 150 in bed 100. Suitable rotation of set screw 153 creates a desired tension in belt 121 between pulleys 120 and 151. Similarly, motor 140 is slideably mountable on vertical frame member 137, and a set screw 155, mounted in threaded post 156 secured to frame 137, adjusts the position of motor 140 on frame member 137 in a vertical direction. In this manner, the tension in belt 122 between pulleys 120 and 152 is suitably adjusted. It is to be understood that the nuts on the respective bolts 141 and 148 are tightened when the proper tension in belts 121 and 122 is derived; and that the bolts 157, 158 acting on set screws 153, 155 in their respective posts 154, 156 also secure the set screws after the said adjustment.

Electro-magnetic clutches 160 and 161 are incorporated in the electric drive system 125. Electromagnetic clutch 160 is arranged between the output shaft 162 of motor 145 and drive pulley 151; electro-magnetic clutch 161 between output shaft 163 of motor 140 and drive pulley 152. Electro-magnetic clutches 160, 161 may be of any suitable type and construction, a preferred embodiment employing the well-known Warner clutches. Clutch 160 is connected to the electrical control system through its coil leads 164 extending from electrical connection block 165 of clutch 160. Block 165 is suitably mounted on bracket 166 fastened to extension support 167, in turn secured to frame 137. Similarly, clutch 161 is connected to the control circuit through its coil leads 168, extending from connection block 169 of clutch 161. Block 169 is mounted on bracket 170 suitably secured to extension bracket 167.

Figure 5 diagrammatically illustrates the electric motive system 125 and its drive relationship with back gauge 105 through lead screw 112. Electric motor 145 drives lead screw 112 when its associated electric clutch 160 is engaged. Engagement of electric clutch 160 is accomplished when its clutch coil 171 is suitably energized by the control circuit through its leads 164 in a manner to be set forth hereinafter. Likewise, motor 140 operates lead screw 112 through belt 122 when its associated electro-magnetic clutch 161 is actuated. Actuation of clutch 161 occurs when its clutch coil 172 is suitably energized by the control circuits to be described, through its leads 168.

In the illustrated embodiment, motor 140 is a reversible three-phase alternating current induction electric motor operating off a commercial 60 cycle line. Motor 140 is herein the high speed motor termed H. S. M. In a suitable embodiment of system 125, the H. S. M. motor 140 operated at 900 R. P. M. and had an output rating of 0.75 horsepower. The electric motor 145 is also a three-phase 60 cycle induction motor, herein the low speed motor and termed L. S. M. Motor 145 is preferably an industrial gear motor shown in Figure 5 as having step-down helical gearing 173, 174. In the described embodiment, with output shaft 163 of H. S. M. 140 operated at

900 R. P. M., the output shaft 162 of L. S. M. 145 operates at the slow speed of 25 R. P. M.; and its output rating being one-third horsepower.

Selective energization of clutch coils 171 and 172 correspondingly firmly connects pulleys 151 and 152 to the respective motors 145, 140 through magnetic clutches 160, 161. Motor 145 is connected directly to the leads 176 of motor 140, through leads 175. When clutch 160 of L. S. M. 145 is energized to operate pulley 151, it is motivated in a predetermined direction at a low speed of rotation, as is lead screw pulley 120. Both H. S. M. 140 and L. S. M. 145 are connected to main line 177 through motor starter unit 180 in a manner to be more fully described in connection with Figure 6, through three-phase leads 176. The motors are connectible normally for forward drive, and into reverse by starter 180, as will be described. High speed drive pulley 152 is arranged to turn lead screw 112 in either direction and at the fast speed, in accordance with the actuation through motor starter 180 and clutch 161.

Motor starter unit 180 comprises two solenoids: solenoid 181 for forward or "F'd Start," and solenoid 182 for reverse or "Rev. Start," as indicated in Figures 5 and 7. When forward (F'd) Start solenoid 181 is energized, normally open starter contacts 183 of motor starter 180 are closed and directly connect leads 175, 176 of motors 140 and 145 to the main three-phase line 177 through leads 178. The main power line 177 is connected to the three-phase 60 cycle A. C. source through electrical switch 179. When the reverse (Rev.) Start solenoid 182 is instead energized, the three normally open contacts 184 of motor starter 180 are closed thereby and in turn also directly connect the motor leads 175, 176 to main line 177, except that two of these leads are reversed in their three-phase relationship as compared to the connections through contacts 183. This causes lead reversal and motors 140 and 145 operate in the reverse direction, as will be further detailed.

Upon energization of Rev. solenoid 182 for reverse operation of motors 140 and 145, the normally closed contact 185 in the gang of contactors 184 is opened to in turn break a possible circuit connection to the forward (F'd) Start solenoid 181 in series connection. Thus, when reverse (Rev.) solenoid 182 is energized, the forward (F'd) Start solenoid 181 is definitely de-energized and the motor control unit 180 operates motors 140 and 145 in only the one direction, and at full speed. Forward solenoid 181 is connected to the control circuit, as shown in Figure 7, through leads 186, 187 which carry solenoid 181 and contacts 185 in series. The Rev. Start solenoid 182 is connected to the control circuit through leads 188, 189.

Back gauge control system

The operation of back gauge 105 is pre-arranged by a programming procedure diagrammatically shown in Figure 5. As hereinabove described, carriage 127 duplicates the movement of back gauge 105. When the back gauge 105 is all the way back, the carriage 127 will be over to the right-hand side. As back gauge 105 moves forward toward the cutting blade, the carriage 127 will move to the left as viewed in Figure 5. Supported in carriage 127 is photo-tube 190 and a light source 192. A condenser lens arrangement 193 is mounted in carriage 127 between light source 192 and photo-tube 190.

The photo-electric cell 190, automatically operates the control system to be detailed in connection with the description of Figure 7, by change of illumination, either from dark to light or vice versa. It is preferred that the photo-electric cell be illuminated from light source 192 while the back gauge 105 is travelling at its high speed condition. In the operation of back gauge 105, it is necessary for practical reasons to move the back gauge rapidly between cuts but to slow down the movement of the back gauge as the end of its movement before a cutting position

approaches to prevent its coasting and, therefore, that of the pile of paper beyond the cutting point, when the back gauge is stopped. The control elements through photo-electric cell 190 and the circuit operation on motor drive system 125 accomplish this requisite function as will be hereinafter described.

The simplified control system of the present invention and motor drive herein provides operation that affords first slow, then after a short delay fast forward movement of the back gauge. A series of stop signal units 195 is disposed along a slotted hexagonal program bar 126 to define the desired operation of the motor drive 125 upon back gauge 105. Stop signal units 195 are opaque shadow producing elements that predeterminedly intercept the light beam between source 192 and photo-cell 190, as carriage 127 moves (to the left) with respect to the stationary stops 195. When the right edge 196 of a stop unit 195 is positioned to intercept light to photo-cell 190, its associated photo-relay PR-1 connected therewith is de-energized and arranged to slow down the fast forward drive of back gauge 105.

The slow speed of back-gauge 105 is a prelude to its predetermined stoppage, and avoids overshooting the mark. As the carriage 127 continues now slowly, to the left, the left or trail edge 197 of the stop signal 195 will permit the light beam to impinge on photo-cell 190 when it is reached. The photo-cell 190 is thereupon activated and the relay PR-1 is energized, whereupon the back-gauge 105 and carriage 127 stop. A signal light (green) thereupon lights up signalling the operator that the machine is set for activation of the cutting knife. The operator merely presses a button to effect the knife cutting cycle during which the motor circuits are kept open. The automatic control system is recycled upon completion of the cutting cycle.

The exposed space 199 between depending opaque portions 198 of stop unit 195' permits slow speed operation of back gauge 105 after its first stop by edge 197 until the back gauge is stopped again at a short interval by depending element 198. This arrangement corresponds to a trim-out cutting position. Where no trim-out is required, the section 198 is removed from the stop unit 195' so that no space 199 exists for the program. In such case, only a single projecting unit corresponding to 195 remains. Stop units 195 are used where no trim-outs are needed.

Figure 6 is a cross-sectional view through the novel and useful pulley arrangement 120 of the motor drive system 125. A basic pulley 75 has a V-groove for V-belt 121 to the L. S. M. motor 145. Pulley 75 has a hub 76 keyed to back gauge screw shaft 112 at 77. The hub end 78 is hollow, and recessed internally to be held at the end 79 of shaft 112 by nut 80. Pulley 75 is accordingly firmly engaged with screw shaft 112. A second pulley 85 coacts with V-belt 122 from H. S. M. motor 140 for high speed driving. Pulley 85 is firmly frictionally engaged with concentric pulley 75 through a friction disc 81 located between them. The pulleys 75, 85 are clamped together, across friction disc 81, by means of compression spring 82. Spring 82 is held in compression by ball bearing 83 set onto hub extension 78 with lock nut 84.

The slipping pulley 75, 85 arrangement herein eliminates hard jolts in starting. It further eliminates extreme stresses on the driving belts (121, 122) in case the clutch that is deenergized (160, 161) hangs on long enough to overlap the clutch which is being energized, since the two would try to drive the screw shaft 112 at different speeds, and a belt would have to slip. Either belt 121, 122 is thus directly connected with screw shaft 112 to drive the back gauge 105.

Automatic electric control system

Referring now to Figure 7 an overall schematic electrical representation is shown of the automatic electrical control system, its circuits and the motor drive and clutch connections therewith. The back gauge 105 is moved for-

ward by motor 145 at slow speed when the low speed clutch (L. S. Cl.) 160 is energized by associated circuitry. Promptly upon the energization of L. S. clutch coil 171, the low speed clutch 160 engages the drive pulley 151 to the back gauge pulley 120 with the output shaft 162 to the low speed motor 145.

The high speed motor H. S. M.) 140 when connected to run continuously forward, i. e. in the direction of rotation carries back gauge 105 in the forward direction at the fast speed (when its associated clutch 161 is engaged through energization of H. S. Cl. coil 172). The forward (F'd) Start solenoid 181 is normally engaged for the automatic operation to be described. However, when instead the Rev. Start solenoid 182 is energized, H. S. M. 140 and L. S. M. 145 operate in the reverse direction. The back gauge 105 is moved in reverse at the fast speed (when the motor 140 clutch 161 is engaged through energization of H. S. Cl. coil 172).

Relay PR-1 is a photo-electric relay. When light strikes light sensitive photo-tube 190 connected to this relay, the normally open contacts PR-1 are thereupon closed. When the light beam is shaded by a stop unit 195, relay PR-1 is de-energized, and contacts PR-1 are opened.

Relays CR-1 through CR-7 are electrically operated in the control system, as indicated by the circuit diagram. When a relay coil is energized, the relay operates to close its correspondingly indicated normally open contacts. When a relay coil is de-energized only its indicated normally closed contacts make connection. Relays CR-2, CR-4, and CR-7 contain contacts for selective control of the energization of the direct current clutch coils 171, 172, as will be described. Relay CR-5 has a built in time delay action, used for permitting the slow motor 145 to motivate the back gauge first, before the fast motor 140 drive takes over, in the operation of the invention system, as will be set forth.

A rectifier unit 200 is provided within the control circuit, the output 71, 72 of which is 90 volts direct current, in turn connected to the electromagnetic clutch coil circuit terminal 71, 72.

The electrical control system is connected between power lines L₁ and L₂, providing 110 volts alternating current thereto.

Relay MR-201 is a motor actuated relay. Contacts 202 of relay MR-201 are connected in line L₂. When the three-phase motor lines 177 are energized, solenoid 203 of motor relay MR-201 is, in turn, energized to close its contacts 202 and provide the full control voltage to terminals 12 of the circuit. Thus, the control system is inoperative unless motor relay MR-201 is energized by the motor line operation.

A step-down transformer 205 is connected between terminals 12, 29 and 3 through control resistor 206 to provide 6 volts A. C. to pilot light (I) and lamp 192 (P). A fuse 209 is connected between points 1 and 3 of the control circuit.

The forward start (F'd) control solenoid 181 of starter 180 is connected to terminal 12 and line L₂ by its contact 186; and, as described, in series with normally closed reverse start contact 185, through terminals 91, 92, and in turn, through connection 187 through the contacts of normally closed Rev. (reverse) button 210 and through a pair of normally closed CR-1 contacts to the opposite potential 3 and line L₁. Unless the manual reverse starter button Rev. 210 is actuated, the forward (F'd) Start solenoid 181 is in normal circuit energization and the motor starter contacts 183 closed to directly connect motors H. S. M. 140 and L. S. M. 145 to the power lines 177.

It is to be understood that although the motors 140 and 145 are continuously rotating corresponding to a forward direction of back gauge 105, the back gauge lead screw 112 is not actuated by motor 140 unless the associated motor clutch 161 is energized through its H. S.

coil 172, as will be more evident hereinafter. Clutch coil 172 is not energized unless the relay CR-4 is energized.

Similarly the back gauge screw 112 is not actuated by motor 145 unless the associated motor clutch 160 is energized through its L. S. coil 171. Clutch coil 171 is not energized unless relay CR-4 is de-energized and relay coil CR-2 is energized.

The motors 140 and 145 are made to rotate in their reverse direction when the Rev. (reverse) push button 210 is pressed down manually. With Rev. button 210 of Figure 7 moved downwardly, the circuit between points 3 and 187 is open, and energization to the F'd Start motor coil 181 is interrupted. At the same time, the portion of Rev. switch 210 across points 6-9 of the circuit is bridged to energize relay CR-1 and reverse start coil 182 across reverse limit switch R. L. S. from terminal 5, and through to 12 across manual Stop switch 211, the function of which is to be detailed. Energization of relay CR-1 causes the reverse (Rev.) Start solenoid 182 of starter 180 to remain energized after the reverse switch 210 is released across 189-188-9, across limit switch S. G. L. S. 6-8, across contacts CR-1 at 7-8 and to terminal 12, across Stop switch 211.

Thus, the manual reverse Rev. switch 210, when pressed in, opens the F'd Start solenoid 181 circuit and engages into energization the Rev. Start solenoid 182. The motor starter 180 thereupon connects motors 140 and 145 in their reversed direction of rotation. When the H. S. clutch coil 172 is energized (with the energization of relay CR-4) the lead screw 112 is rotated in the direction to move the back gauge 105 rearwardly and at high speed. The rearward movement of back gauge 105 continues until either the operator presses the Stop switch 211 to open the solenoid 182 circuit, or when the reverse limit switches R. L. S. or S. G. L. S. are tripped.

Other limit switches are incorporated in the control circuit: H. W. L. S. 3-27; hexagonal program bar H. B. L. S. 27-5, and F. L. S. 5-20. These limit switches together with R. L. S. and S. G. L. S., as described in the aforesaid applications, not only limit the forward motion and intermediate positions on its backward travel, as desired. This prevents the back gauge 105 jamming into the front or rear of the cutting machine, and ensures its stopping at an intermediate position when desired.

For automatic operation the selector switch 212 is moved to its automatic position (A) whereby its contacts are as shown in Figure 7: bridging points 20-21 in the circuit; and contacts 20-21 in the circuit; and contacts 20-17 remaining open. When selector switch 212 is moved to the central or (O) position, the control circuit is off; when thrown to (H) position, it is in the position for manual operation.

Automatic operation is provided by the signals from photo-electric cell 190 coacting with the program of stops 195, as heretofore set forth. With selector switch 212 in the automatic (A) position, contacts 20-21 are bridged, connecting the amplifier PR-1 photoelectric cell 190 across points 12-21 to main lines L₁-L₂. After a short interval for the electron tubes within amplifier PR-1 to heat up, the system is ready to operate. The output of the PR-1 amplifier, when actuated by light impinging upon photoelectric cell 190, causes its associated PR-1 relays to be energized and close the indicated open relay contacts PR-1, and correspondingly open the normally closed PR-1 relay contacts.

With the slit (not shown) in front of photoelectric tube 190 lighted up by lamp 192 (see Fig. 5), forward motion of the back gauge 105 is started by pressing down forward push button 215. This closes contacts 23-24 and opens contacts 22-16. Since photoelectric unit PR-1 is energized, its PR-1 contacts 21-23 are closed completing the circuit through relay CR-3, at 24-9. Upon energization of relay coil CR-3 its contacts at 23-24

across forward button 215 effect closure for the forward position thereat, maintaining energization of the CR-3 relay coil. This in effect is an interlocking contact, whereby when the forward button 215 is pressed, the relay CR-3 remains energized upon release of the forward button.

The closure of relay CR-3 effects connection of its contacts 21—22, to complete the circuit through relay CR-2 across 19a—9. Also upon subsequent release of forward button 215, connections 22—16 are normally closed. The circuit through relay coil CR-2 at 19a—9 is energized across lines 21—9 through the thereupon closed relay contacts CR-3 at 21—22, the reclosed forward button 215 across 22—16, the normally closed knife-switch KN at 16—19, and the also normally closed clamp CL switch across 19—19a. Thus, pressing the forward button 215 sets up relay CR-3, but permits no motion of the back gauge 105 until the forward button 215 is thereupon released.

Energization of the relay coil CR-2 effects closing of its contacts at 72—35, and 35—73 in the clutch coil 171, 172 circuit. In view of the normally closed CR-4 contacts across 73—36 and 36—164, the low speed or L. S. clutch coil 171 is thereupon energized. Energization of the L. S. clutch coil 171 effects forward movement of back gauge 105 at slow speed through the forward drive of L. S. M. motor 145. Also, energization of relay CR-2 closes its contacts across 24—25 to close or otherwise energize time delay relay CR-5. After a predetermined interval of time delay, the contacts of relay CR-5 close across 11—15. Since no programming or stop signal 195 is yet in front of phototube 190, PR-1 relay is still energized and its contacts 21—11 are closed.

Energization of the relay CR-4 causes its normally closed contacts 73—36, and 36—164 in the clutch coil 171 circuit to open, and thereupon disconnect the low speed clutch 160 connection to motor 145. Also, the relay CR-4 energization causes its normally open contacts 73—168 to close in the high speed clutch coil 172 circuit. The high speed clutch coil 172 is thereupon energized, as relay CR-2 contacts across 72—35—73 are already closed up to line 72. In summary, after the forward pushbutton 215 is pressed and released, the low speed clutch 160 is engaged through energization of its clutch coil 171, and after a predetermined time delay built into relay CR-5, the high speed clutch 161 connects high speed motor 140 to back gauge 105 through the energization of high speed clutch coil 172, causing the back gauge to move rapidly forward, as the low speed clutch is disengaged.

Referring to Fig. 5, movement of the back gauge 105 forwardly corresponds to its movement from left to right; the corresponding movement of carriage 127 linked to back gauge 105 by cables 130 being from right to left. The hexagonal program bar 126 containing the predetermined spaced stop signals 195, remains fixed. Accordingly, as back gauge 105 moves forward on the cutting machine, carriage 127 moves to intercept a fixed stop signal 195. The beam of light from lamp 192 passing condensing lens 193 is interrupted on its path to photocell 190 first by the right hand edge 196 of a stop signal 195. The photoelectric cell amplifier PR-1 thereupon becomes deenergized.

De-energization of amplifier PR-1 causes the normally closed PR-1 contacts 21—18 to close and maintain the circuit through the CR-2 relay coil. Thus, the CR-2 relay contacts 72—35—73 in the clutch coil circuit remain closed. At the same time, PR-1 contacts 21—23 open to de-energize the CR-3 relay and open its contacts 21—22. The time delay relay CR-5 is also de-energized by the opening of the 21—23 contacts of PR-1. The PR-1 relay contacts 21—11 are also opened, to de-energize relay coil CR-4 across 15—9, opening its contacts 73—168 in the H. S. clutch coil 172 circuit. The deenergization of CR-4 relay causes normally closed contacts at 73—36—164 to close the circuit of the L. S.

clutch coil 171 across lines 72—71, as the CR-2 contacts are maintained in their closed position. The low speed clutch coil 171 engages its associated clutch 160 to low speed motor 145, while the opening of the contacts across 73—168 de-energizes the high speed clutch 172, causing the back gauge 105 to move forward at the slow speed.

As the back gauge 105 moves forward slowly preparatory to its stopping, carriage 127 moving to the left causes the left edge 197 of the intercepting stop signal 195 to pass the light beam through the slit in front of photocell 190. When the left edge 197 of the signal 195 is thus reached, the light beam again strikes the photocell 190, picking up the photoelectric relay PR-1 which opens its contacts 21—18 from their normally closed condition. This action drops out the CR-2 relay, opening the circuit through low speed clutch coil 171 through the opening of the contacts at 72—35—73, and the back gauge thereupon stops.

An important feature of the present invention is the slowing down of the back gauge drive, through operation of the L. S. motor 145, prior to its abrupt stopping by disconnection of the low speed clutch 160. The two-stage control of stoppage of the back gauge operates upon interruption by the right-hand edge 196 of the stop signal to the slow motor drive 145, thereafter, the drive operates at slow speed until the left hand edge 197 of the stop signal causes the back gauge to stop accurately at the signal position. Thus over-shoot of the mark is avoided with the use of the single photocell control system herein. It is to be noted that at the stop position, the light beam strikes the photoelectric cell 190, and the relay amplifier PR-1 is in its energized position at this time, with its contacts 21—23 closed. The green signal light G across 33—9 thereupon has its circuit closed, giving the signal to the operator that the cutting operation can be performed.

When the knife starts its cutting action on the downward stroke, the knife limit switch KN, which has been held closed by a cam on the knife crank (see aforesaid copending applications) is thereupon caused to close its contacts 13—14, and pickup or energize relay CR-6. Energization of relay CR-6 in turn closes its contacts 21—24 to keep the circuit through relay CR-3 for setting up the forward motion of the back gauge 105 which, however, cannot proceed until the knife has returned to its upper position and operated its KN switch at 16—19 and further, until the clamp has reached its top position to close its CL-1 switch 19—19a. When both of these actions have been accomplished the CR-2 relay is energized and forward motion of the back gauge 105 can proceed.

Should the operator hold the clamp down by means of a foot treadle, the clamp CL contacts 19—19a will remain open, and the back gauge 105 cannot be moved forward by the control system until the operator releases the foot treadle and the clamp returns to the top position, releasing the pile of paper. This action is advantageous since it permits the operator to align the paper pile which has just been cut but disarranged by the bevel on the knife blade against the vertical surface of the paper pile which is still under the action of the clamp. The danger of the back gauge 105 trying to move the paper pile while the front of the pile is being held firmly by the clamp is thus avoided.

Occasionally the printing on the paper pile to be cut is not located accurately, and the cut which would otherwise be proper would cut at the wrong point. Should the operator have reason to readjust the back gauge slightly to the rear, it would cause the light beam for the photocell 190 to be interrupted by the left edge 197 of the stop signal 195. In such case, operation of the knife would close contacts 13—14 at KN to energize relay coil CR-6 as in the standard operating condition, and closing its contacts 17—14. Since in this case the photoelectric relay

PR-1 is de-energized, its contacts 21-17 are closed. Thus, even though the KN contacts 13-14 are open, relay CR-6 will be held energized. Relay CR-6 contacts 21-24 in turn pick up relay CR-3, and subsequently relay CR-2 causing forward motion of the back gauge in the aforesaid manner.

When the left edge 197 of the signal 195 is reached in formal cases, the back gauge 105 stops. However, since relay CR-6 can be de-energized only after the PR-1 contact 21-23 closing, and 21-17 opens, the PR-1 contacts 21-23 will keep the relay CR-3 energized, and the back gauge 105 will keep moving regardless of the signal until the right hand edge 196 of the next signal 195 is reached in the usual manner. In other words, when the back gauge 105 is readjusted, such readjustment does not cause the back gauge to again stop due to being at the signal 195 from which it has just been readjusted, but it will travel forward automatically until the next signal has been reached. In this manner, manual readjustment of the back gauge does not interfere with the automatic operation, and renders a practical advantageous addition to the system.

When the back gauge 105 is located so that the light beam is interrupted by a signal 195 in its passage to photocell 190, the back gauge can be started manually in a forward direction by depressing the forward button 215 which closes contacts 18-16 to pick up relay coil CR-2 and energize the low speed clutch coil 171. The back gauge 105 will thus move forward at the slow speed until the left edge 197 of the signal 195 is reached, upon which condition clutch coil 171 becomes de-energized and the back gauge 105 stops. However, since at that instant the photoelectric PR-1 contacts 21-23 are closed, the relay CR-3 will pick up and cause the back gauge 105 to move in a forward direction as soon as the push button 215 is released.

Where a trim-out operation is required, namely the cutting of a line close to a previous cut, a composite stop signal shown at 195' in Fig. 5 is used. Signal 195' comprises the basic signal corresponding to 195 with an additional leg 198 carried to the left therefrom to encompass an open space 199. The operation of the trim-out signal 98 will now be understood by those skilled in the art. As the back gauge is stopped by the passage of carriage 127 to the left, the light beam to cell 190 reimpinges thereon at the space 199. The previous energization of low speed clutch 160 is de-energized when the space 199 first results in light to impinge on cell 190, corresponding to the action of the left edge 197 of signals 195.

By pressing and releasing the forward button 215 the low speed clutch 160 becomes energized, moving the back gauge 105 in the slow speed for the duration of the time delay interval of relay CR-5. By proportioning the relay delay to correspond to the extent of the average or longest trim out spacing corresponding to 199 of signal 195', the motor drive for back gauge 105 will continue at the slow forward speed until the right edge of tab 198 of the signal 195 causes interruption of the light beam to photocell 190. On the other hand, by maintaining the forward button 215 depressed manually for the duration of the trim out spacing, insurance is had of the slow speed movement of the back gauge 105 during this operation. In any event, when the left edge of trimout tab 198 is reached, de-energization of clutch coil 171 is effected to stop the back gauge for the trim-out cutting.

After the last cut has been made on the paper pile, back gauge 105 moves forward until the forward limit switch of the machine, corresponding to F. L. S. 5-20, stops its motion by interruption of the L₁ power line to the control relays. At the same time, another forward limit switch contacts 6-10 closes the reverse circuit, energizing the reverse start coil 182 across lines 5-9. This is equivalent to pressing the reverse button 210 across contact 6-7 as described hereinabove, and causes the motor starter contacts 184 to close and connect both

motors 140 and 145 to the power lines 177 in the reverse direction of operation. Also, the clutch coil 172 is thereupon in circuit to actuate the back gauge 105 rearwardly at the high speed until the back gauge has moved all the way back or when either of the reverse limit switches are actuated. The side gauge limit switch (S. G. L. S.) can be by-passed by pushing of the reverse button 210. When the furthestmost reverse location is reached, reverse limit switch R. L. S. 5-6 opens, disconnecting the reverse starter 182 and connecting the forward starter 181. The other contacts 23-24 reverse switch R. L. S. close, picking up relay CR-3 and causing the back gauge 105 to move in a forward direction until the first signal 195 is reached.

Thus, the operation of the control system is completely automatic. The operator simply puts the pile of paper in the machine, operates the cutting knife when the green light informs him that the back gauge 105 has stopped, and then removes the cut material. After the last cut has been made, the back gauge pushes the remainder of the material out onto the front table, so that the operator can remove it, and thereupon moves to the first cutting position of the next pile of paper to be inserted. The signals 195 are readjustable on program bar 126 for different paper pile printings. Manual readjustment does not interfere with the automatic cycling. Pushing of the stop button 9-12 will immediately stop operation of the machine at any point, by interrupting the relay paths to line L₂ across 9-12.

Manual operation of system

To operate the back gauge 105 of the cutting machine by manual control, the selector switch 212 is moved to the H position. This shift of selector 212 opens the control line L₁ circuit below terminal 20; de-energizing relays PR-1, CR-2, CR-3, CR-5 and CR-6; and closing the circuit across 20-17 that leads to relay CR-4 across normally open contacts 17-5 of forward button 215. Pressing of forward button 215 manually, thereupon directly energizes relay CR-4 across points 15-9. The CR-4 contacts 3-28 are thus closed, and the relay coil CR-7 is energized across 28-12. Energization of relays CR-7 closes its normally open contacts 72-73 in the clutch coil circuit. Also, energization of the CR-4 relay closes its CR-4 contacts in the H. S. clutch 172 coil circuit at 73-168 to engage high speed clutch 161 and cause high speed motor 140 to drive back gauge 105 forwardly. During such actuation of relay CR-4, the normally closed contacts 73-36-164 thereof become opened, and the L. S. clutch 171 remains de-energized. During this cycle, normal engagement of the forward start solenoid 181 prevails, connecting motors 140 and 145 in their forward rotation connection to power lines 177. When the forward button 215 is released, back gauge 105 stops, as clutch 161 is disengaged through its coil 172 becoming de-energized due to the opening of the CR-4 relay.

Reverse motion in the manual cycle is imparted to back gauge 105 by pressing the Rev. button 210, thereupon closing the contacts across 6-7. The reverse start solenoid 182 of motor starter 180 is thereupon energized, since relay CR-1 closes its contacts across 7-8. The normally engaged forward start solenoid 181 is disconnected across 91-186 by the Rev. contacts becoming opened across 3-187 to insure only reverse operation of the motors. The opening of the normally closed contacts 185 in the "reverse" contactor gang operated by reverse start solenoid 182 further insures that the forward start circuit 181 is de-energized during the engagement of the reverse start circuit 182. Relay CR-1 also closes the circuit across 3-15 to engage relay CR-4 at 15-9. The high speed clutch coil 172 thus becomes energized during this reverse cycle, to engage clutch 161 between the H. S. motor 140 and the back gauge lead screw 112.

Energization of the CR-4 relay effects the energization of the high speed clutch coil 172 during this manual cy-

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cling, in the manner of the aforesaid forward operation through the intermediate energization of the CR-7 relay and the relay contacts associated with relays CR-7 and CR-4 across the line 71-72 for clutch coil 172 energization. Back gauge 105 is thereupon moved into reverse at the fast speed until the reverse circuit is interrupted by either release of the Rev. button 210; by the pressing of stop switch 211; or by the opening of the reverse limit switches R. L. S. or S. G. L. S., at 5-6 or 6-8. Clutch coil 172 thereupon becomes de-energized to disengage H. S. clutch 161, whereupon the back gauge 105 stops.

Motors 140 and 145 resume their forward direction of rotation when the forward start solenoid 181 is re-energized upon the release of the Rev. button 210. The energization of relay CR-1 upon pressing of the reverse button 210 closes contact 6-7 and causes the closure of its CR-1 contacts at 7-8 in parallel across the reverse button contacts 6-7. This permits the reverse button 210 to be released without effecting reverse motion of the back gauge 105. Such condition keeps on until either the side gauge limit switch or reverse limit switch is opened by the motion of the back gauge, as aforesaid.

After the H. S. clutch 161 is disconnected when the CR-4 relay is de-energized, the back gauge 105 tends to coast. To make it possible to stop the back gauge accurately on release of the forward button, the relay CR-7 is provided. When relay CR-4 is energized, one of its contacts 3-28 picks up relay CR-7 which has a time delay built in on de-energizing. When relay CR-4 is de-energized, the CR-7 contacts 72-73 hold on for a predetermined short interval engaging the L. S. clutch coil 171 through the normally closed CR-4 relay contacts 73-36-164, acting as a brake for a very short time. The release of relay CR-7 after the short delay promptly opens the L. S. clutch circuit, and the back gauge is smoothly stopped.

The invention herein has been described in connection with an exemplary embodiment of an automatic manual back gauge spacing control. It is to be understood that the electric motors 140 and 145 may be replaced by suitably controlled hydraulic motors, or other mechanically equivalent drives. The control system incorporating the single photoelectric cell and the associated relay circuitry may be applied to equivalent controlled members, as will be apparent to those skilled in the art. It is therefore not intended to be limited except as set forth in the following claims.

I claim:

1. Spacer mechanism for a machine having a work table, a back gauge movable across the work table, and a program of stop signals for predetermining the positions of the back gauge, comprising: motor means; driveable means connecting the back gauge with the output of said motor means including clutching means with first and second solenoids for controllably effecting movement of the back gauge by said motor means; and circuit means for controlling the movement of the back gauge in accordance with said program of stop signals incorporating photoelectric responsive means coactable with the stop signals and moveable in relation with the back gauge, said photoelectric responsive means activating said circuit means to correspondingly engage and disengage said solenoids to drive the back gauge selectively forward starting at slow speed and after a predetermined interval at fast speed; said circuit means having a time delay relay actuated upon the starting slow speed forward drive, which relay effects the fast speed drive after the predetermined interval.

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2. Spacer mechanism for a machine having a work table, a back gauge movable across the work table, and a program of stop signals for predetermining the positions of the back gauge, comprising: motor means; driveable means connecting the back gauge with the output of said motor means including clutching means with first and second solenoids for controllably effecting movement of the back gauge by said motor means; and circuit means for controlling the movement of the back gauge in accordance with said program of stop signals incorporating a single photoelectric cell coactable with the stop signals and moveable in unison with the member, said photoelectric cell activating said circuit means to correspondingly engage and disengage said solenoids to drive the back gauge predeterminedly and selectively forward starting at slow speed and after a predetermined short interval then at fast speed, and stopping the back gauge by first reducing it to slow speed when signaled by a stop signal and then stopping the back gauge at a position as determined by the said stop signal.

3. Apparatus as defined by claim 1 in which the motor means comprises a high speed motor and a low speed motor and the clutching means includes a clutch individual to each of the motors and each of the solenoids for selective motivation of the back gauge by individual clutch engagements through the circuit means.

4. Apparatus as defined by claim 2 in which the motor means comprises a high speed motor and a low speed motor and the clutching means includes a clutch individual to each of the motors and each of the solenoids for selective motivation of the back gauge by individual clutch engagements through the circuit means.

5. Apparatus as defined by claim 4, further including a pulley coupled to each of the clutch outputs, one of the pulleys being mechanically connected to the back gauge, the other of the pulleys being spring pressed into frictional engagement with the one pulley.

6. Apparatus as defined by claim 1 in which the motor means comprises a high speed motor and a low speed motor and the clutching means includes a clutch individual to each of the motors and each of the solenoids for selective motivation of the back gauge by individual clutch engagements through the circuit means, and a pulley coupled to each of the clutch outputs, one of the pulleys being mechanically connected to the back gauge, the other of the pulleys being spring pressed into frictional engagement with the one pulley.

7. Apparatus as defined by claim 2, further including manually operable control means for interrupting the circuit means forward control on the back gauge and effecting reverse movements thereof without interfering with the program control action by successive signals.

8. Apparatus as defined by claim 6, further including manually operable control means for interrupting the circuit means forward control on the back gauge and effecting reverse movements thereof without interfering with the program control action by successive signals.

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