Jan. 28, 1958 C. THUMIM ET AL 2,821,252

AUTOMATIC BACK GAUGE SPACER FOR PAPER CUTTERS

Filed March 14, 1956 5 Sheets-Sheet 1

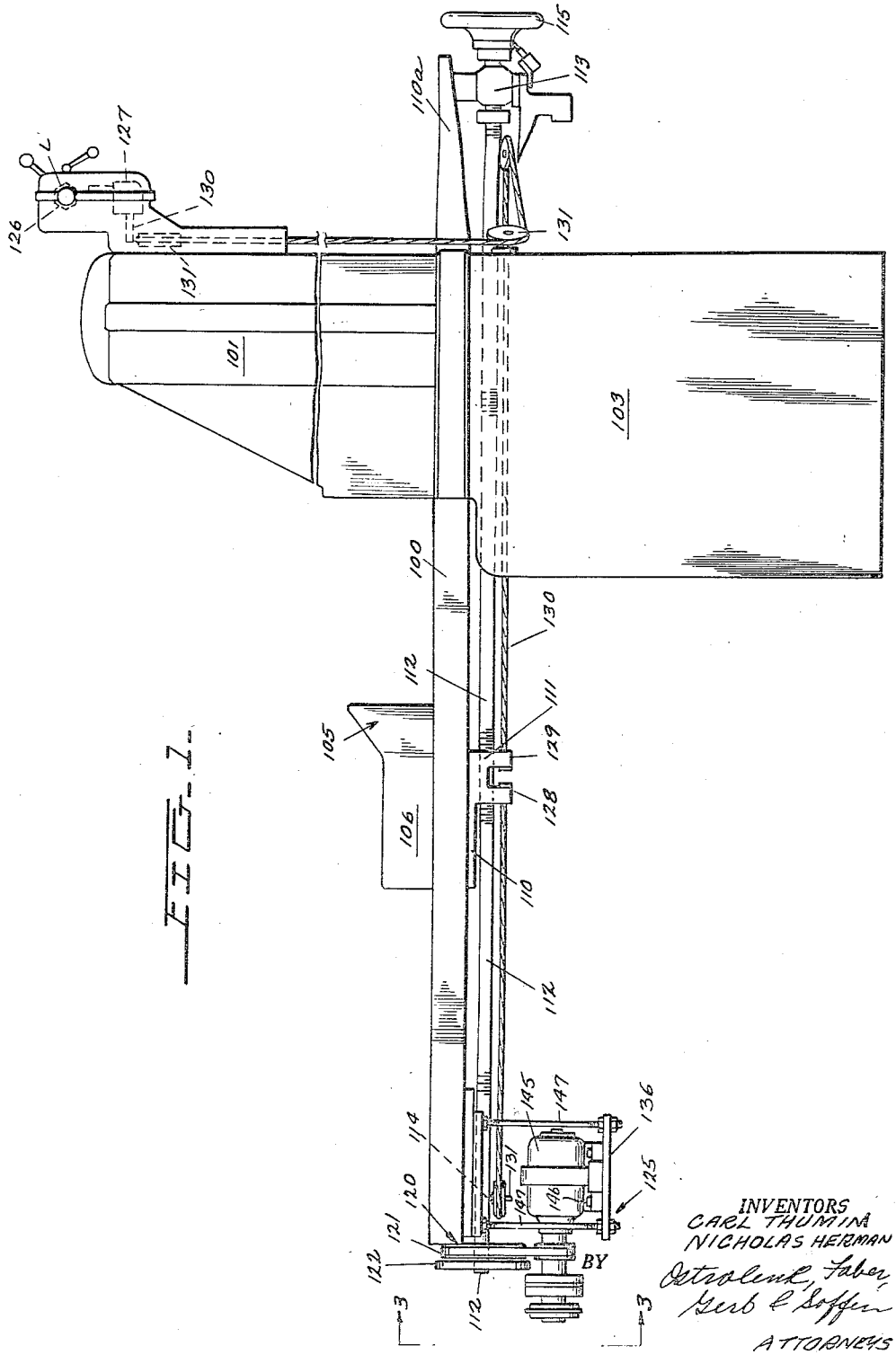


FIG. 1.

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AUTOMATIC BACK GAUGE SPACER FOR PAPER CUTTERS

Filed March 14, 1956 5 Sheets-Sheet 2

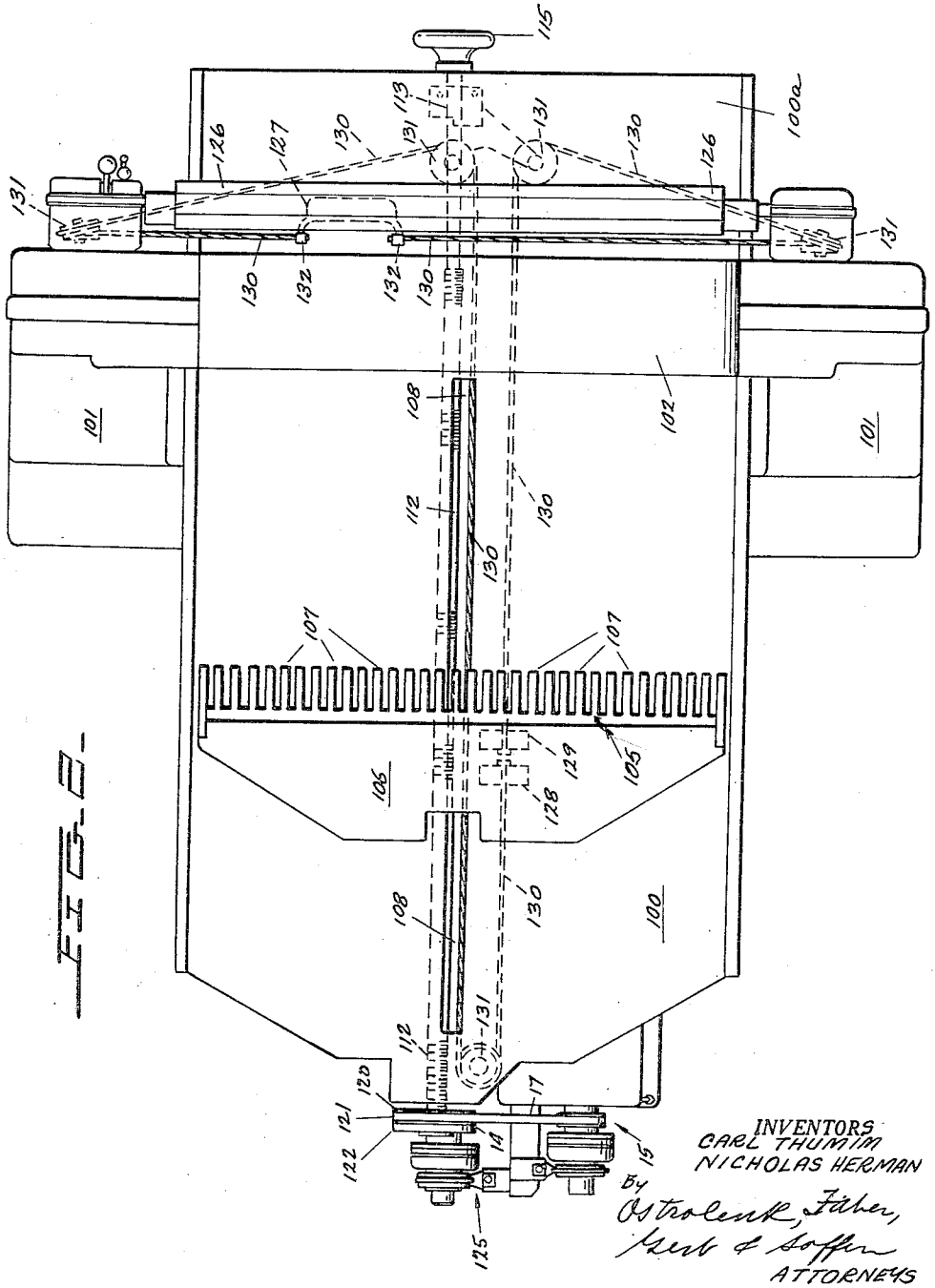


FIG. 2

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AUTOMATIC BACK GAUGE SPACER FOR PAPER CUTTERS

Filed March 14, 1956 5 Sheets-Sheet 3

FIG. 3.

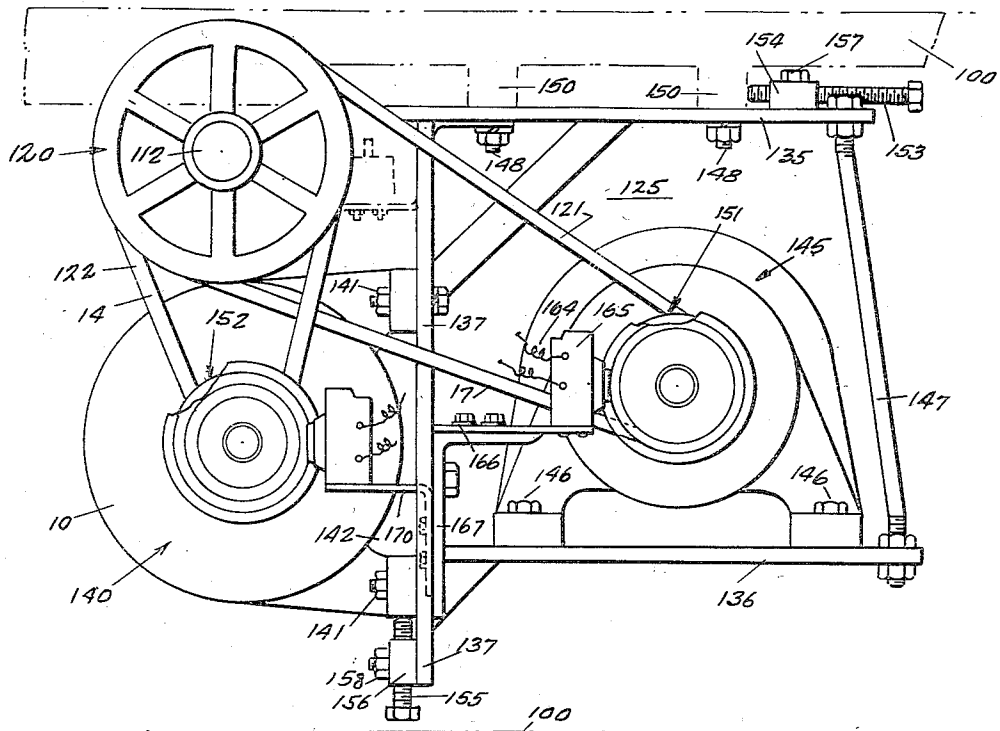
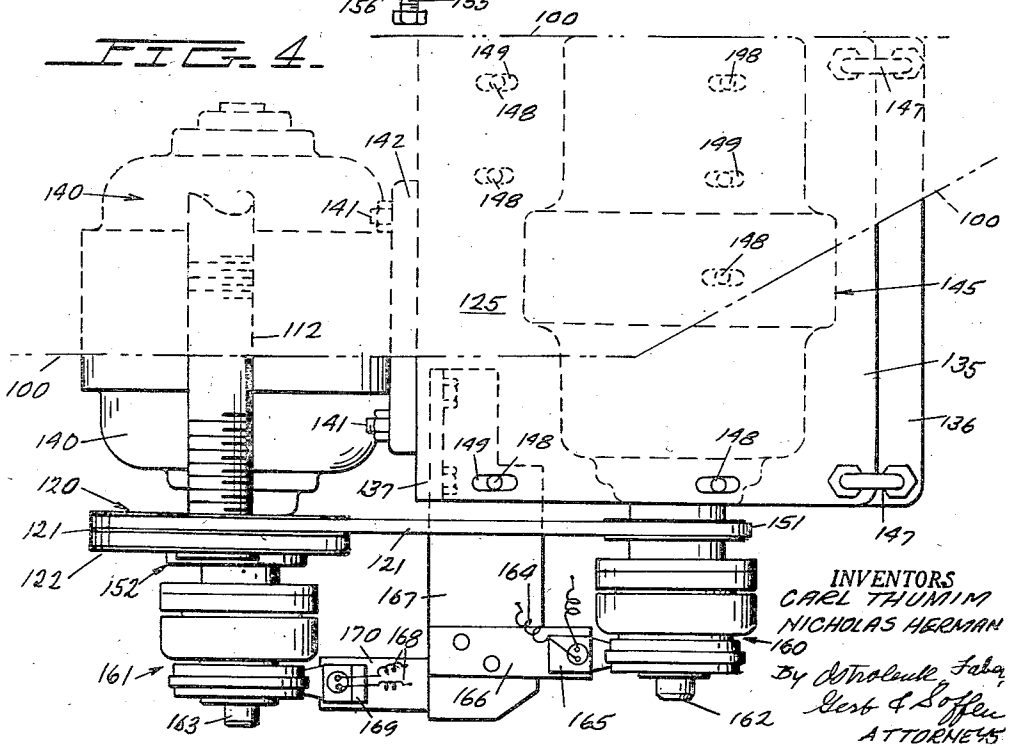


FIG. 4.



Jan. 28, 1958 C. THUMIM ET AL 2,821,252

AUTOMATIC BACK GAUGE SPACER FOR PAPER CUTTERS

Filed March 14, 1956 5 Sheets-Sheet 4

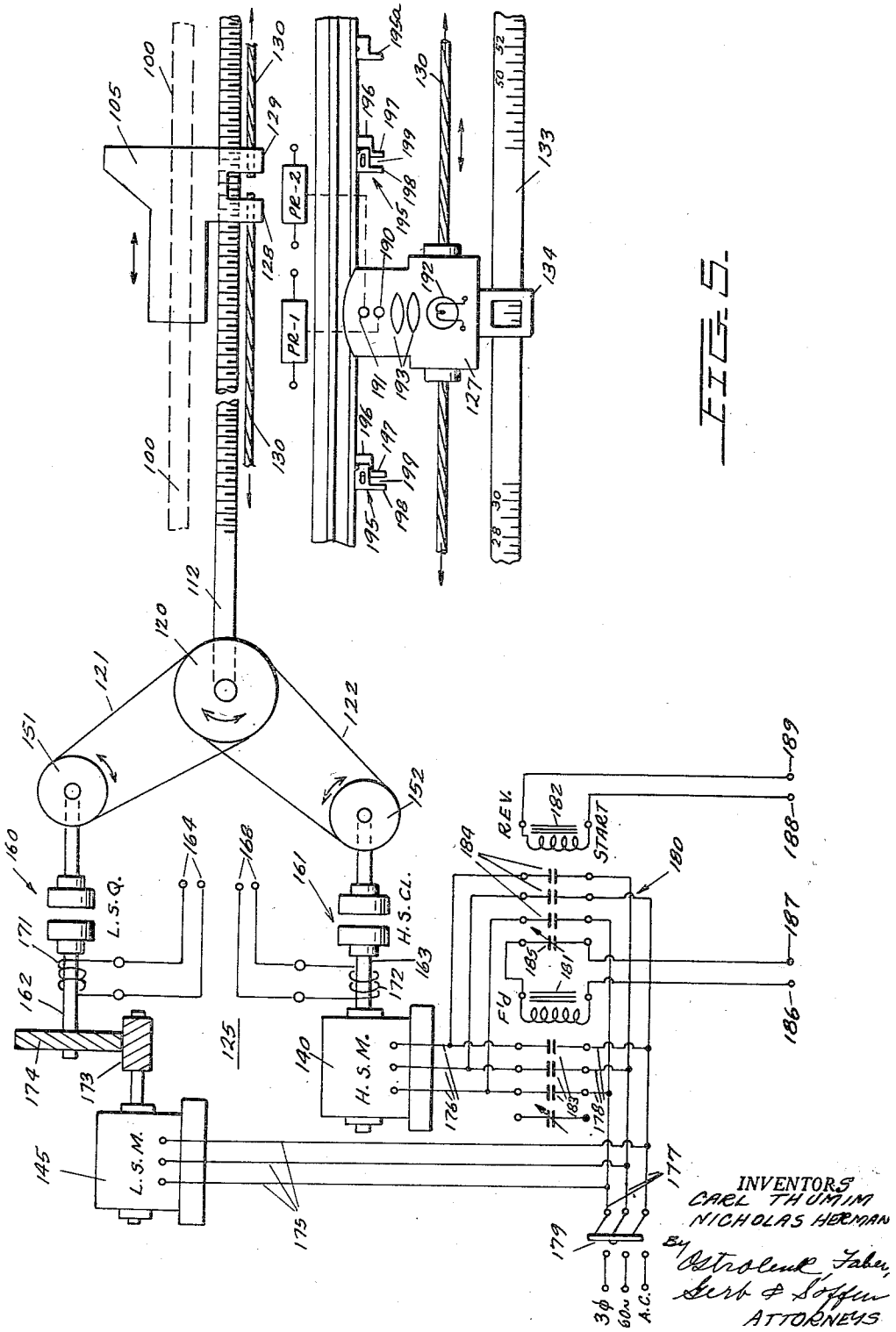


FIG. 5.

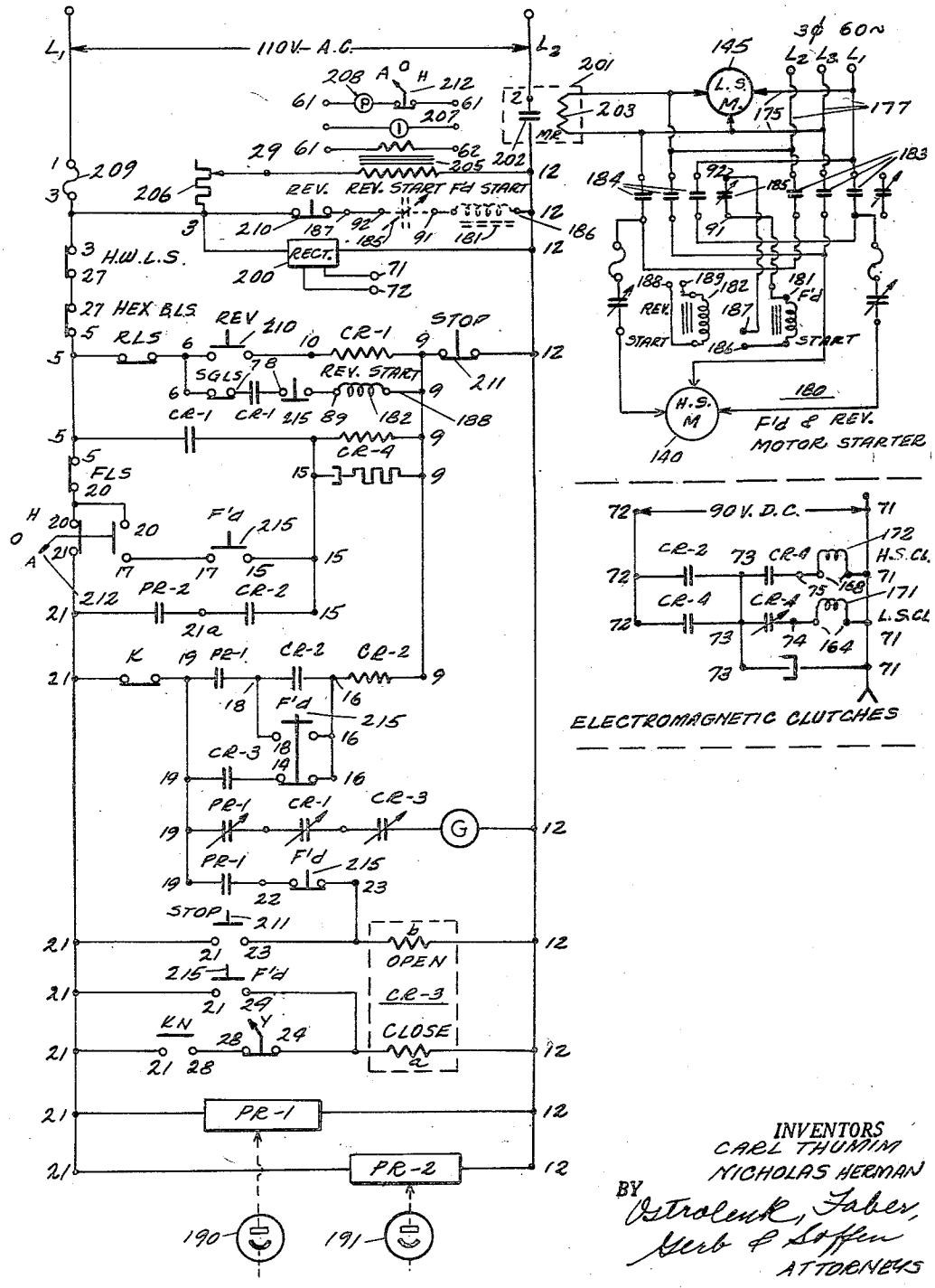
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AUTOMATIC BACK GAUGE SPACER FOR PAPER CUTTERS

Filed March 14, 1956 5 Sheets-Sheet 5

FIG. 6.



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United States Patent Office

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Patented Jan. 28, 1958

2,821,252

AUTOMATIC BACK GAUGE SPACER FOR PAPER CUTTERS

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Application March 14, 1956, Serial No. 571,518

12 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, and Serial No. 391,217, filed November 10, 1953, 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 application, 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 system is adapted to readily perform such trim-out cuts as well. The electrical system comprises a single lamp which flashes whenever the control causes the back gauge to be stopped so the cutter may 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 with a carriage containing the photoelectric cells that moves transversely across the front of the cutting machine in synchronism with the movement of the back gauge.

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-cells. 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 a 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 pin 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 by-pass 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 conditions on the photo-cells 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 arrangement of the stop unit after initiation of the slow operation will cause the back gauge to be directly stopped. That is, the darkening of a first photo-sensitive element causes a slow down, and the darkening of a second photo-sensitive elements 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 1/16" to 3/4" 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 stop unit 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 the required fractional inch will exist between the lower parts of the two stop units through which the light beam can pass. If the green signal light has flashed, indicating that an accurate stop has been made, the operator can then 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 trim out unit. At this point, the light beam is interrupted to cause the electrically controlled driving mechanism of the invention to bring the back gauge to a stop. The green 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 paper.

The present invention is particularly directed to the incorporation of a novel and effective electric motor driven mechanism for the back gauge operable in conjunction with the aforesaid photo-electric cell control system to accomplish all of the aforesaid functions for the back gauge, to accomplish a predetermined and programmed rational 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 a light beam and photo-electric cells, 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 a photo-electric control system and preset stop program. The present invention is an improvement of the mechanism and systems set forth in the aforesaid applications, affording direct positive actuation of the back gauge in a foolproof and relatively inexpensive and trouble-free system.

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.

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

A further object of the present invention is to provide an automatic and/or manual control system for back gauge operation of a paper cutter, providing all the requisite functions and operations of the back gauge that a modern paper cutter requires, and affording a simple, direct and positive drive action on the back gauge, either for fast forward or reverse, or slow and accurate stop positioning, all as programmed advance.

Still 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.

The foregoing and other objects of the invention will become more apparent in the following description in conjunction with the drawings in which:

Figure 1 is a side view of a reciprocable knife paper cutter machine embodying a preferred form of 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 back gauge control system and the motor drive mechanism schematically showing some of the circuit elements thereof.

Figure 6 is a schematic electrical diagram of a preferred control system that is responsive automatically to photo-electric cells 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 similar to that shown in the aforesaid applications Serial Nos. 200,013 and 391-217. 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** and 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 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 is utilized therefor.

Back gauge **105** comprises a metal casting **106** which extends across cutting tabel **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 100*a* 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 coact 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 photo-electric cells 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 photo-electric 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 near a reading opening 134 of carriage 127 and 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 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 to 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 are 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. Electro-magnetic 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 electromagnetic 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 cor-

respondingly firmly connects pulleys **151** and **152** to the respective motors **145**, **140** through magnetic clutches **160**, **161**. L. S. M. **145** is operated continuously in one direction when power line switch **179** is closed. Motor **145** is connected directly to line **177** extending from switch **179** 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**. However, H. S. M. **140** is connected to main line **177** through a motor starter unit **180** in a manner to be more fully described in connection with Figure 6 through three-phase leads **175** and **176**. The motors are connectible normally for forward drive, and motor **140** by control into reverse, as will be described. Accordingly, the 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 forward start, and solenoid **182** for reverse or Rev. Start, as indicated in Figures 5 and 6. When Forward (F'd) Start solenoid **181** is energized, normally open starter contacts **183** of motor starter **180** are closed and directly connect leads **176** of motor **140** 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 **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 motor **140** to operate in the reverse direction, as will be further detailed.

Upon energization of Rev. solenoid **182** for reverse operation of motor **140**, 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 motor **140** in only one direction, and at full speed in either direction. Solenoid **181** is connected to the control circuit, as shown in Figure 6, through the 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** are photo-tubes **190** and **191** and a light source **192**. A condenser lens arrangement **193** is mounted in carriage **127** between light source **192** and photo-tubes **190**, **191**.

The photo-electric cells **190**, **191** automatically operate the control system to be detailed in connection with the description of Figure 6, by a change of illumination, either from dark to light or vice versa. It is preferred that the photo-electric cells 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 cells **190**, **191** and the circuit operation on motor drive system **125** accomplish this requisite function as will be hereinafter described.

The simplified control system and motor drive herein provides operation that affords fast forward movement of the back gauge and then a slow forward movement thereof, as well as an accurate stoppage thereof; and at the proper control actuation, fast reverse of the back gauge **105**. A series of stop units **195** is disposed along a slotted hexagonal program bar **126** to define the operation of the motor drive **125** upon back gauge **105**. Stop units **195** comprise opaque shadow producing elements **196**, **197**, **198** that intercept the light beam between source **192** and photo-cells **190**, **191** as carriage **127** moves with respect to the stationary stops **195**. When a right edge **197** of a stop unit **195** intercepts light to photo-cell **191**, the associated photo-relay PR–2 connected therewith is de-energized and arranged to slow down the fast forward drive of back gauge **105** through motor **140**.

Further, when projecting element **197** intercepts light to photo-cell **190**, photo-relay PR–1 is de-energized and arranged to bring the slow moving back gauge **105** to an abrupt stop. The operator thereupon actuates the cutting knife which, after abutting, recycles the automatic control system to move back gauge **105** fast forward towards the next cutting position, as will be set forth.

The exposed spaces **199** between depending opaque portions **197**, **198** of stop units **195** permit the slow speed operation of back gauge **105** until the back gauge is stopped again by depending elements **198**. This arrangement corresponds to a trim-out cutting position. Where no trim-out is required, the sections **198** are removed from the stop units **195** so that no spaces **199** exist at those sections of the program. In such case, only a single projecting unit corresponding to **195***a* remains. Such stop units **195***a* are used where no trim-outs are needed.

Automatic electric control system

Referring now to Figure 6, an overall schematic electrical representation is shown of the automatic electrical control system, its circuits and the motor drive and clutch connections therewith. The system is arranged with the low speed motor (L. S. M.) **145** running continuously, being directly energized from three-phase power lines **177** through its leads **175**. The back gauge **105** is moved forward by motor **145** at a low 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** is connected to run continuously forward, i. e. in the direction of rotation that would carry back gauge **105** in the forward direction at fast speed (when its associated clutch **161** is engaged through energization of H. S. Cl. coil **172**). In other words, the forward (F'd) Start solenoid **181** is normally engaged in the position for the automatic operation to be described. However, when instead the Rev. Start solenoid **182** is energized, H. S. M. **140** operates 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 closed. When the light beam is shaded by a stop unit **195**, relay PR–1 is de-energized, and contacts PR–1 are opened.

Relay PR–2 is a photo-electric relay coacting with a different part of stop units **195**. This relay PR–2 likewise is energized when the light strikes its associated light sensitive tube **191** and causes normally open contact

PR–2 to close. When the light is shaded by stop unit **195**, contact PR–2 opens.

Relay CR–3 is an electrically operated but mechanically held relay. When its coil *"a"* is energized, it operates to close a normally open contact CR–3 and to open a normally closed contact CR–3. As soon as this condition is reached, a switch (not shown) which is connected to the solenoid *"a"* opens the circuit through the solenoid, but the contacts CR–3 remain latched in their position after *"a"* is de-energized. To reverse the movement of these contacts, coil *"b"* must be energized, and that trips these contacts to their normal unenergized position. The current through coil *"b"* is likewise interrupted by a switch (not shown) connected to it. In this relay, CR–3, therefore, the coils are energized during the closing and non-latching operations only and remain de-energized the rest of the time.

Relay CR–4 contains contacts CR–4 for selectively controlling the energization of the direct current clutch coils **171, 172** in combination with relay CR–2, as will be described.

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 L_1 and L_2, providing 110 volts alternating current thereto.

Relay MR–**201** is a motor actuated relay. Contacts **202** of relay MR–**201** are connected in line L_2. When the motor lines **177** are energized, solenoid **203** of motor relay MR–**202** 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 lights **207** (1) and **208** (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 L_2 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** to the opposite potential **3** and line L_1. Thus, 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 high speed motor H. S. M. **140** to the power lines **177**. It is to be understood that although the motor **140** is continuously rotating corresponding to a forward direction of back gauge **105**, the back gauge lead screw **112** is not actuated by the 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.

The high speed motor **140** is made to rotate in its reverse direction when the Rev. (reverse) push button **210** is pressed down manually. With Rev. button **210** of Figure 6 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 **6–10** of the circuit is bridged to energize relay CR–1 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 be in circuit: across **189—188—9**, across limit switch SGLS**6–7**, across contacts CR–1 at **7—8** and through the normally closed contacts **8—189** of F'd switch **215**, 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 motor **140** in reversed direction of rotation and at full speed. 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 RLS or SGLS are tripped or when the overriding F'd switch **215** is pressed (**8—189**).

Other limit switches are incorporated in the control circuit: H. W. L. S. **3—27**; Hex. B. L. S. **27—5**, and F. L. S. **5—20**. These limit switches together with RLS and SGLS, as described in the aforesaid applications, not only limit the rearward motion of the back gauge but also 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 to ensure its stopping at an intermediate position when desired.

Automatic back gauge spacer operation

The selector switch **212** is moved to its automatic position (A) whereby its contacts are as shown in Figure 6: bridging points **20** and **21** in the circuit; and contacts **20—17** remain 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 manual position of operation.

Automatic operation is provided by the signals from the photo-electric cells **190** and **191** coacting with the program of stops **195** as heretofore set forth. The automatic operation is started by pressing the forward F'd push button **215**. This causes contacts **21** and **24** to be bridged to energize coil *a* of relay CR–3 across potential terminals **21—12**. As described above, the normally open contact of CR–3 (**19—14**) remains mechanically closed until coil *b* of the relay is energized subsequently. When the forward (F'd) push button **215** is released (up), the contacts **14—16** are bridged, to energized the relay CR–2 at **16—9** as CR–3 contacts **19—14** are closed; and thus relay CR–2 is across the full voltage **21—12**.

Energization of relay CR–2 closes contacts CR–2 across terminal **72—73** of the clutch coil circuit. This in turn engages the L. S. clutch coil **171** through the normally closed contact CR–4 at **73—74** to potential **71**. Thus, the pressing of F'd button **215** and its subsequent release results in the energization of the L. S. clutch coil **171** and in turn engages its associated clutch **160** to directly connect the output of low speed shaft **162** from continuously rotating L. S. motor **145**. The back gauge **105** accordingly moves forward at the slow speed. Movement of the back gauge **105** slowly forward also results in a corresponding motion of the carriage **127** to the left until a portion of the stop signal **195** in position when the F'd button was pressed uncovers an aperture to photo-electric cell **190**. The beam of light accordingly impinges on photo-electric cell **190** and causes its associated relay PR–1 to be energized.

This actuation transfers the control system to the automatic control through the photo-cells. The two normally open contacts PR–1 are closed as soon as relay PR–1 is energized through photo-cell **190**, the terminals **18—16** keeping relay CR–2 energized across terminals **21—12** and **18—9—21**. The PR–1 contacts **19—22** thereupon energize coil *b* of relay CR–3 which opens up the contacts CR–3 at **19—14**. Thus, when light impinges on photo-electric cell **190**, the starting relay CR–3 is thrown out of the circuit, and photo-electric cell operation of the

automatic system is instituted. During this state of energization of relay PR–1 (with relay PR–2 unenergized), the relay CR–2 remains energized, and the low speed clutch 160 is engaged, moving the back gauge forward continuously at the slow speed.

When the stationary stop 195 causes the aperture to the other photo-electric cell 191 to be uncovered and have light impinge upon it, its associated relay PR–2 becomes energized. Energization of photo-electric cell 191 simultaneously with energization of photo-electric cell 190 results in the fast forward operation of the back gauge 105 for the reasons now to be described.

Relay CR–4 is incorporated in the control circuit with its contacts arranged in the electro-magnetic clutch system. Energization of the relay CR–4 results in its contacts at 72—72 to close; its normally closed contacts CR–4 at 73—74 to open; and its normally closed contacts at 73—75 to close. The H. S. Cl., high speed clutch coil 172, becomes energized across the full 90 volts direct current line 72—71. With relay CR–4 (15—9) energized, the clutch coil 172 thereupon becomes directly energized, and the low speed clutch coil 171 is disconnected from the D. C. circuit. The high speed clutch 161 is then directly engaged, causing the high speed motor 140 to move the back gauge 105 forward at a fast speed (since the forward start solenoid 181 is normally in circuit).

Relay CR–4 is energized by the closure of contacts PR–2 (when relay PR–2 is energized) at 21—21*a* but only when the corresponding contacts CR–2 in series therewith at 21*a*—15 are closed. In other words, the high speed clutch operating relay CR–4 cannot be energized by the PR–2 contacts (21—21*a*) alone, unless the relay CR–2 (16—9) is also in energization to close contacts 21*a*—15. During automatic photo-electric cell operation, relay CR–2 can only remain energized by the bridging of contacts 19—18 when photo-cell 190 is lighted to energize photo-relay PR–1. This is also a safety feature as will be later explained.

Thus, when the light beam impinges on photo-cell 191, as well as upon photo-cell 190, the high speed clutch relay CR–4 is energized across the contacts 21—21*a* and 21*a*—15. This action engages the high speed clutch coil 171 while also causing the disengagement of low speed clutch coil 171 across 73—74. The motor 140 thereupon moves the back gauge 105 forward at the fast speed during the simultaneous impingement of the light beam on cells 190 and 191 in accordance with the arrangement by stop signals 195.

Automatic stopping of the back gauge to accurate predetermined positions is accomplished in two steps: The first step is to provide a signal that results in the back gauge being moved into the slow speed from a fast forward speed operation; and then, at the proper time, de-energize the slow speed forward position when the back gauge will directly stop. This is accomplished by arranging the stop signal 195, which at this point has the light beam impinged upon both cells 190, 191, to first de-energize the photo-relay PR–2 by causing the light beam to be stopped or opaqued in its passage to photo-cell 191. De-energization of relay PR–2 causes the contacts 21—21*a* to open, to in turn de-energize relay CR–4. Release of relay CR–4 opens contacts 72—73—75 at the H. S. clutch coil 172 disengaging the high speed motor 140 from its driving of back gauge 105. Simultaneously, the relay PR–1 remains energized, since light is still arranged to be impinging on its photo-cell 190. This means that the relay CR–2 still remains energized and, therefore, its contacts 72—73 are closed while the de-energization of relay CR–4 returns the normally closed contacts thereof (73—74) into engagement to complete the circuit through the low speed clutch coil 171.

When it is thereupon desired to stop the back gauge 105, the stop signals 195 are arranged to intercept the light beam to cell 190 (as well as to cell 191 already opaqued). This action deenergizes the associated relay PR–1 and opens the PR–1 contact at 19—18. Relay CR–2 is thereupon deenergized to open its contact 72—73 at the clutch circuit and deenergize the low speed magnetic clutch coil 171. With both clutch coils thus deenergized, the slow moving back gauge is stopped without overshoot and in an accurate predetermined position.

Summarizing the automatic action, the starting (forward) button F'd 215 is pressed, starting the back gauge 105 moving forward slowly, until one photo-electric relay aperture (to cell 190) is uncovered. The light beam control and the next stop unit 195 takes over automatic operation of the back gauge until the next cutting position. With light arranged by stop 195 for impingement on both photocells 190 and 191, the high speed clutch coil 172 is engaged and the back gauge moves forward at the fast speed. When the stop unit 195 is arranged for the light to photo-cell 191 to be covered up, the high speed clutch coil 172 becomes disengaged and the low speed clutch coil 171 engaged to move the back gauge forward slowly. With the stop unit 195 arranged to shield the light to photo-cell 190 (as well to cell 191) energization of the low speed clutch 160 ceases, and the low speed moving back gauge 105 stops abruptly at the predetermined position.

A green signal light G is energized and lights up indicating that a cutting operation on the pile of sheets may be made when a preset new position of the back gauge is thus reached. After the cutting operation on the paper sheets is completed and the knife and clamp are on their way up to their rest or nesting position, a knife switch KN 21—28 is closed to start the automatic cycle all over again (in a manner similar to the recycling by pressing of F'd button 215 across 21—24). It is to be understood that the knife switch KN (21—28) is closed only while the knife is moving upwardly and is opened again to the indicated position in Figure 6 when the knife is nested.

Three normally closed switch contacts are in series with green light G along 19—12, PR–1, CR–1 and CR–3 as described in the co-pending application Serial No. 391,217. During any motion of the back gauge 105, whether forward or reverse, or fast or slow, one of these normally closed switches along the circuit 19—12 including lamp G is open, and the lamp does not indicate. However, as soon as motion of the back gauge stops, the three switches are again all normally closed, and the bulb G lighted up, indicating that a cutting operation may be made. Such operation of the cutting indicator lamp G occurs during either manual or automatic operation of the system.

When the selector switch 212 is in the automatic position A, pushing of the reverse button Rev. 210 at any time in its cycle will cause the back gauge 105 to move in the reverse direction and at fast speed. If the F'd button 215 happens to be pressed down at the same time that the reverse button 210 is down, its normally closed contacts 8—189 will keep the Rev. Start solenoid 182 de-energized and slow forward motion of the back gauge 105 will result. Thus, F'd button 215 at slow forward overrides the Rev. button 210 for fast reverse. The F'd contacts across 18—16 energize the slow speed clutch relay CR–2.

As heretofore described, the photo-electric cell PR–1 cannot energize relay CR–2 (16—9) unless the forward (F'd) push button 215 is pressed down temporarily or the knife switch 21—28 is engaged by the operator. The reason is that when relay CR–2 is de-energized, its contact CR–2 across 18—16 is open and PR–1 cannot close the circuit to the relay CR–2. It is necessary for relay CR–2 to first be energized by the other method, either through the F'd switch 215 or the KN switch. Then the contacts CR–2 at 18—16 are closed, and the photo-relay PR–1 can take over. This also provides a safety measure in case both apertures to the photo-cell 190 and 191 are unshaded at the time the selector switch 212 is thrown

into automatic (A); no motion of the back gauge **105** will occur at all even though the light is shining both photo-cells **190, 191**, until either the operator presses the F'd button or the KN contacts are closed in the normal cycle of operation of the machine.

Thus, it is now apparent that the F'd button **215** overrides the action of Rev. button **210** if both are pressed together and that slow forward speed of back gauge **105** results with the pressing down of F'd button **215**, while in automatic (A) selection. When F'd button **215** is released, the automatic programmed forward motion of back gauge **105** takes place under the co-action of stop units **195** and photo-electric cells **190, 195** as described. Pressing of Stop button **211** will further override the action of both Rev. button **210** and F'd button **215** and also of the automatic control by photo-cells **190, 191**. When Stop button **211** is pressed, it opens the control circuit across **9—12**, deactivating any possible action on high speed clutch control relay CR–4; or on the low speed clutch control relay CR–2, as well as on Rev. Start solenoid **182**. Thus, back gauge **105** cannot be moved while the Stop button **211** is pressed down by the operator.

Stop button **211** also, when pressed, closes across contacts **21—23** to energize the Open coil *b* of relay CR–3, which resets contacts CR–3 to their normal position before energization of coil *a*. Thus, to enable automatic control through photo-electric cells **190, 191**, recycling is necessary by either pressing and then releasing F'd button **215**, or by KN knife switch action. A snap switch Y is provided at **28—24** to prevent automatic action of the system by photo-cells **190, 191** at the will of the operator, by overriding the recycling action of knife blade switch KN at **21—28**.

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 L_1 circuit below terminal **20**: to the relays PR–1, PR–2, CR–2 and CR–3; and closes the circuit across **20—17** that leads to relay CR–4 across normal opened contacts **17—15** of F'd button **215**. Pressing of F'd button **215** manually thereupon directly energizes relay CR–4 at **15—9**. This causes contacts CR–4 across **72—73** and **73—75** to energize H. S. clutch coil **172**. The back gauge **105** thereupon moves forward at fast speed since the H. S. motor **140** is in its normal forward speed operation by the normal engagement of F'd Start solenoid **181**. When F'd button **215** is released, back gauge **105** stops, as clutch **161** is disengaged when its coil **172** is deenergized.

Reverse motion is imparted to back gauge **105** by pressing the Rev. button **210**. Rev. Start solenoid **182** of motor starter **180** is thereupon energized, since relay CR–1 closes its contacts across **7—8**. The normally engaged F'd start solenoid **181** is disconnected across **3—187** to ensure only the reverse operation of motor **104**. An additional safety measure is the opening of normally closed contacts **185** in the "reverse" contactor gang operated by solenoid **182**. Relay CR–1 also closes the circuit across **5—15** to engage relay CR–4 at **15—9**. Thus, H. S. clutch coil **172** is energized to engage clutch **161** between H. S. motor **140** and the back gauge lead screw **112**. Back gauge **105** is thereupon moved in reverse at the fast speed until the reverse circuit is interrupted by either release of Rev. button **210**; pressing of Stop switch **211**; or opening up of reverse limit switches R. L. S. or S. G. L. S. at **5—6** or **6—7**. Clutch coil **172** becomes de-energized to disengage H. S. clutch **161**, whereupon back gauge **105** stops. Motor **140** resumes its forward direction when the F'd Start solenoid **181** is re-energized upon release of Rev. button **210**.

In the foregoing the invention has been described in connection with a preferred embodiment for illustrative purposes. The electric motors **140** and **145** described may be replaced by suitably controlled hydraulic motors, or other mechanical equivalent drives. Variations will now become apparent to those skilled in the art, and it is not intended to be limited except as set forth in the following claims.

We claim:

1. Spacer mechanism for a machine having a work table, a back gauge movable linearly across the work table embodying a series of stop signals for predetermining the positions of the back gauge comprising a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge; 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 series of stop signals comprising first signal responsive means arranged to engage the first solenoid to drive the back gauge forward at slow speed in response to first arrangements of said signal elements, and second signal responsive means arranged to engage the second solenoid to drive the back gauge forward at fast speed in response to second arrangements of said signal elements, said first and second signal responsive means being mechanically coupled to move with the back gauge, and said signal elements being stationary with respect to the work table.

2. Spacer mechanism for a machine having a work table and a back gauge movable linearly across the work table embodying a series of stop signals for predetermining the positions of the back gauge comprising a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge; a first motor having a relatively slow speed output shaft continuously rotatable in the forward direction, a second motor reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said motors including a first and second clutch, respectively, for selectively engaging said motor output shafts to correspondingly move the back gauge along the work table; and circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first signal responsive means arranged to engage said first clutch to drive the back gauge forward at slow speed in response to first arrangements of said signal elements, and second signal responsive means arranged to engage said second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements, said first and second signal responsive means being mechanically coupled with said back gauge.

3. Spacer mechanism for a machine having a work table, a back gauge movable linearly across the work table embodying a series of stop signals for predetermining the positions of the back gauge comprising a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge; a first motor having a relatively slow speed output shaft continuously rotatable in the forward direction, a second motor reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said motors including a first and second clutch, respectively, for selectively engaging said motor output shafts to correspondingly move the back gauge along the work table; circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first signal responsive means arranged to engage said first clutch to drive the back gauge forward at slow speed in response to first arrangements of said signal elements, and second signal responsive means arranged to engage said second clutch to drive said back

gauge forward at fast speed in response to second arrangements of said signal elements, said first and second signal responsive means being mechanically coupled with said back gauge with relay means in circuit with said first and second signal responsive means for engaging only said second clutch when said signal responsive means are simultaneously activated, whereby the back gauge is moved fast forward upon activation of both said signal responsive means, slow forward upon activation of said first signal responsive means alone, and is stopped when neither of said signal responsive means is activated by the said signals.

4. Spacer mechanism for a machine having a work table, a back gauge movable linearly across the work table embodying a series of stop signals for predetermining the positions of the back gauge comprising a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge; a first motor having a relatively slow speed output shaft continuously rotatable in the forward direction, a second motor reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said motors including a first and second clutch, respectively, for selectively engaging said motor output shafts to correspondingly move the back gauge along the work table; circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first photo-electric responsive means arranged to engage said first clutch to drive the back gauge forward at slow speed in response to first arrangements of said signal elements, and second photo-electric responsive means arranged to engage said second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements, said first and second photo-electric responsive means being mechanically coupled with said back gauge with relay means permitting the engagement only of said second clutch, whereby the back gauge is moved fast forward upon activation of both said first and second photo-electric responsive means, slow forward upon activation of said first photo-electric responsive means alone, said signal elements being arranged to lower the speed of the back gauge before its stopping by activating the first photo-electric responsive means alone to move the back gauge into slow speed before deactivating both photo-electric responsive means together, whereupon the back gauge is accurately stopped at the predetermined position.

5. Spacer mechanism for a machine having a work table, a back gauge movable linearly across the work table embodying a series of stop signals for predetermining the positions of the back gauge comprising a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge; a first motor having a relatively slow speed output shaft continuously rotatable in the forward direction, a second motor reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said motors including a first and second clutch, respectively, for selectively engaging said motor output shafts to correspondingly move the back gauge along the work table; circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first signal responsive means arranged to engage said first clutch to drive the back gauge forward at slow speed in response to first arrangements of said signal elements, and second signal responsive means arranged to engage said second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements, said first and second signal responsive means being mechanically coupled with said back gauge; and manually operable reversing means for motivating said second motor and correspondingly the back gauge in fast speed reverse movement, overriding any engagement by the signal responsive means to drive the back gauge.

6. Spacer mechanism for a machine having a work table and a back gauge movable linearly across the work table embodying a series of stop signals for predetermining the positions of the back gauge comprising a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge; a first motor having a relatively slow speed output shaft continuously rotatable in the forward direction, a second motor reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said motors including a first and second clutch, respectively, for selectively engaging said motor output shafts to correspondingly move the back gauge along the work table; circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first photo-electric responsive means arranged to engage said first clutch to drive the back gauge forward at slow speed in response to first arrangements of said signal elements, and second photo-electric responsive means arranged to engage said second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements, said first and second photo-electric responsive means being mechanically coupled with said back gauge with relay means permitting the engagement only of said second clutch, whereby the back gauge is moved fast forward upon activation of both said first and second photo-electric responsive means, slow forward upon activation of said first photo-electric responsive means alone, said signal elements being arranged to lower the speed of the back gauge before its stopping by activating the first photo-electric responsive means alone to move the back gauge into slow speed before deactivating both photo-electric responsive means together, circuit means arranged to stop the back gauge accurately at the predetermined positions when neither of said photo-electric responsive means is activated by said signal elements; and manually operable reversing means for motivating said second motor and correspondingly the back gauge in fast speed reverse movement, overriding any engagement by the photo-electric responsive means to drive the back gauge comprising a motor starter unit for the second motor having a forward and reverse solenoid, said forward solenoid being normally energized to keep said second motor output in forward operation, a manual reverse control, said reverse solenoid being energized upon activation of said manual reverse control to disconnect said forward solenoid and to engage the second motor output into fast reverse operation and disconnect said first photo-electric responsive means from operating the first clutch.

7. Mechanism of the character described for a machine having a work table and a back gauge movable linearly across the work table comprising: a first electric motor drive having a realtively slow speed output shaft continuously rotatable in the forward direction; a second electric motor drive reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said electric motor drives including a first and second clutch for selectively engaging said first and second electric motor drives, respectively, to correspondingly move the back gauge along the work table; a series of stop signals for predetermining the positions of the back gauge including a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge and circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first photo-electric responsive means arranged to engage the first clutch to drive the back gauge forward at slow speed in response to first arrangements of said signal elements, and second photo-electric responsive means arranged to en-

gage the said second clutch to drive the back gauge forward at fast speed in response to second arrangements of said signal elements, said first and second photo-electric responsive means being mechanically coupled to move with the back gauge, and said signal elements being stationary with respect to the work table.

8. Mechanism of the character described for a machine having a work table and a back gauge movable linearly across the work table comprising: a first electric motor drive having a relatively slow speed output shaft continuously rotatable in the forward direction; a second electric motor drive reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said electric motor drives including a first and second clutch for selectively engaging said first and second electric motor drives, respectively, to correspondingly move the back gauge along the work table; a series of stop signals for predetermining the positions of the back gauge including a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first photo-electric responsive means mechanically coupled with the back guage and arranged to engage the first clutch to drive the back gauge forward selectively at slow speed in response to first arrangements of said signal elements, second photo-electric responsive means mechanically coupled with the back gauge and arranged to engage the second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements; and means permitting the engagement only of said second clutch when both said photo-electric responsive means are simultaneously activated, whereby the back gauge is moved fast forward upon activation of both said photo-electric responsive means, slow forward upon activation of said first photo-electric responsive means alone; and circuit elements arranged to stop the back gauge when neither of said photo-electric responsive means is activated by said signal elements.

9. Mechanism of the character described for a machine having a work table and a back gauge movable linearly across the work table comprising: a first electric motor drive having a relatively slow speed output shaft continuously rotatable in the forward direction; a second electric motor drive reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said electric motor drives including a first and second clutch for selectively engaging said first and second electric motor drives, respectively, to correspondingly move the back gauge along the work table; a series of stop signals for predetermining the positions of the back gauge including a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first photo-electric responsive means mechanically coupled with the back gauge and arranged to engage the first clutch to drive the back gauge forward selectively at slow speed in response to first arrangements of said signal elements, second photo-electric responsive means mechanically coupled with the back gauge and arranged to engage the second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements; and relay means in circuit with said first and second photo-electric responsive means for engaging only said second clutch when both said photo-electric responsive means are simultaneously activated, whereby the back gauge is moved fast forward upon activation of both said photo-electric responsive means, and slow forward upon activation of said first photo-electric responsive means alone, said signal elements being arranged to lower the speed of the back gauge before its stopping by activating said first photo-electric responsive means alone to move the back gauge into slow speed before deactivating both said photo-electric responsive means together; and circuit elements arranged to stop the back gauge accurately at the predetermined positions when neither of said photo-electric responsive means is activated by said signal elements.

10. Mechanism of the character described for a machine having a work table and a back gauge movable linearly across the work table comprising: a first electric motor drive having a relatively slow speed output shaft continuously rotatable in the forward direction; a second electric motor drive reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said electric motor drives including a first and second clutch for selectively engaging said first and second electric motor drives, respectively, to correspondingly move the back gauge forwardly along the work table; and manually operable reversing means for motivating said second motor and second clutch and correspondingly the back gauge in fast speed reverse movement, overriding any engagement by said first clutch to drive the back gauge.

11. Mechanism of the character described for a machine having a work table and a back gauge movable linearly across the work table comprising: a first electric motor drive having a relatively slow speed output shaft continuously rotatable in the forward direction; a second electric motor drive reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said electric motor drives including a first and second clutch for selectively engaging said first and second electric motor drives, respectively, to correspondingly move the back gauge along the work table; a series of stop signals for predetermining the positions of the back gauge including a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge circuit means for controlling the movement of the back gauge in accordance with said series of stop signals comprising first photo-electric responsive means mechanically coupled with the back gauge and arranged to engage the first clutch to drive the back gauge forward selectively at slow speed in response to first arrangements of said signal elements, second photo-electric responsive means mechanically coupled with the back gauge and arranged to engage the second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements; and manually operable reversing means for motivating said second motor and second clutch and correspondingly the back gauge in fast speed reverse movement, overriding any engagement by the first photo-electric responsive means to drive the back gauge, comprising a forward and a reverse solenoid, said forward solenoid being normally energized to keep said second electric motor drive in forward operation, a manual reverse control, said reverse solenoid being energized upon activation of said manual reverse control.

12. Mechanism of the character described for a machine having a work table and a back gauge movable linearly across the work table comprising: a first electric motor drive having a relatively slow speed output shaft continuously rotatable in the forward direction; a second electric motor drive reversibly operable and having a relatively fast speed output shaft; driveable means connecting the back gauge with the output shaft of each of said electric motor drives including a first and second clutch for selectively engaging said first and second electric motor drives, respectively, to correspondingly move the back gauge along the work table; a series of stop signals for predetermining the positions of the back gauge including a series of signal elements arranged in succession in accordance with desired work positions and speeds of movement of the back gauge circuit means for controlling

the movement of the back gauge in accordance with said series of stop signals comprising first photo-electric responsive means mechanically coupled with the back gauge and arranged to engage the first clutch to drive the back gauge forward selectively at slow speed in response to first arrangements of said signal elements, second photo-electric responsive means mechanically coupled with the back gauge and arranged to engage the second clutch to drive said back gauge forward at fast speed in response to second arrangements of said signal elements; relay means in circuit with said first and second photo-electric responsive means for engaging only said second clutch when both said photo-electric responsive means are simultaneously activated, whereby the back gauge is moved fast forward upon activation of both said photo-electric responsive means, and slow forward upon activation of said first photo-electric responsive means alone, said signal elements being arranged to lower the speed of the back gauge before its stopping by activating said first photo-electric responsive means alone to move the back gauge into slow speed before deactivating both said photo-electric responsive means together; circuit elements arranged to stop the back gauge accurately at the predetermined

positions when neither of said photo-electric responsive means is activated by said signal elements; and manually operable reversing means for motivating said second motor and second clutch and correspondingly the back gauge in fast speed reverse movement, overriding any engagement by said first photo-electric responsive means to drive the back aguge, comprising a motor starter unit for the second motor having a forward and a reverse solenoid, said forward solenoid being normally energized to keep the second electric motor drive in forward operation, a manual reverse control, said reverse solenoid being energized upon activation of said manual reverse control to disconnect said forward solenoid and to engage said second motor into fast reverse operation and disconnect said first photo-electric responsive means from operating said first clutch.

References Cited in the file of this patent

UNITED STATES PATENTS

1,435,979	Reed	Nov. 21, 1922
2,099,496	Morgan et al.	Nov. 16, 1937
2,701,017	Wiedemann	Feb. 1, 1955