

2,261,538

Filed Feb. 8, 1939

11 Sheets-Sheet 1

3 | 2 |

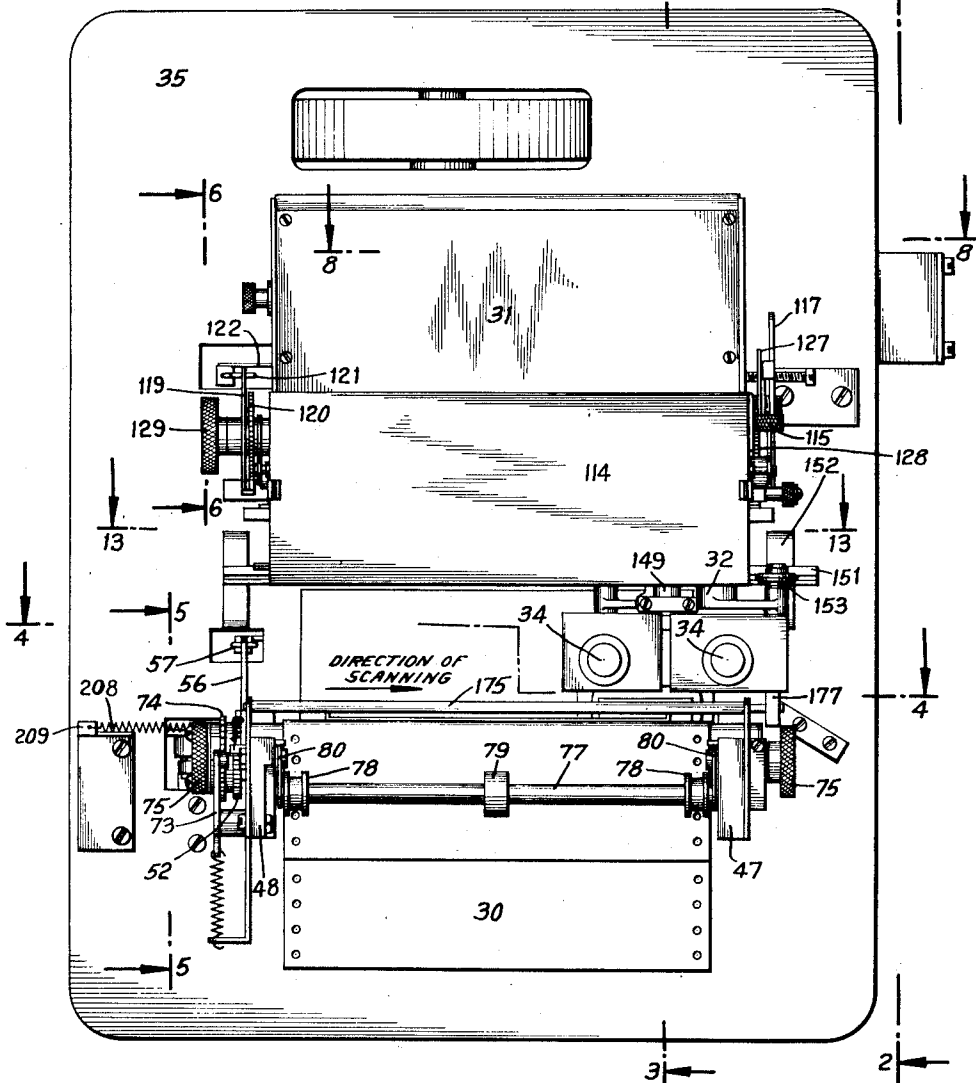
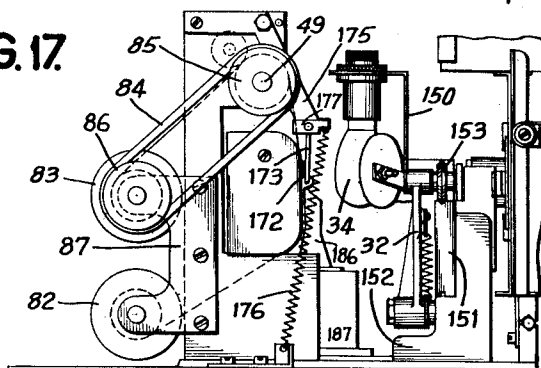


FIG. 17



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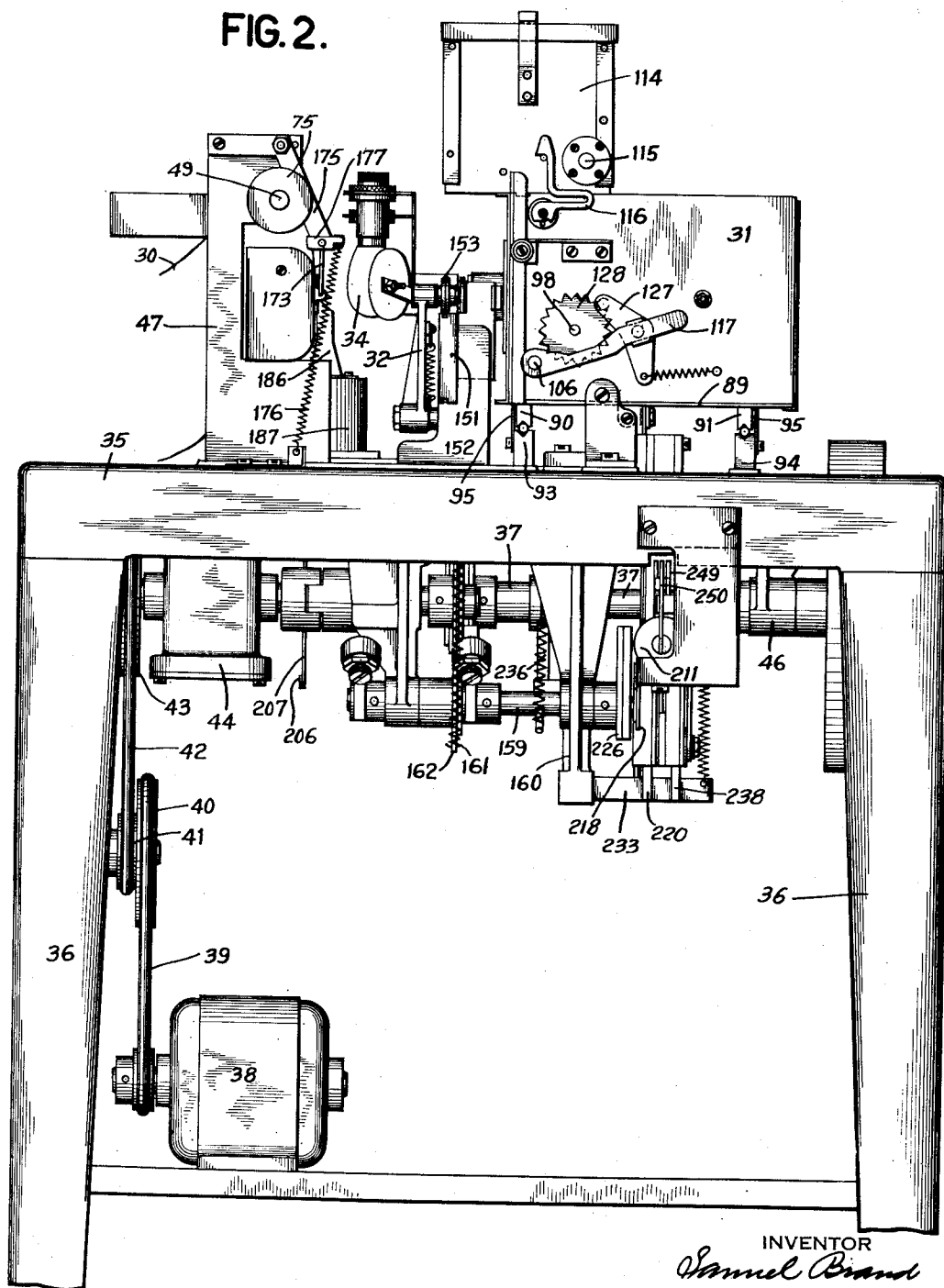
2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 2

FIG. 2.



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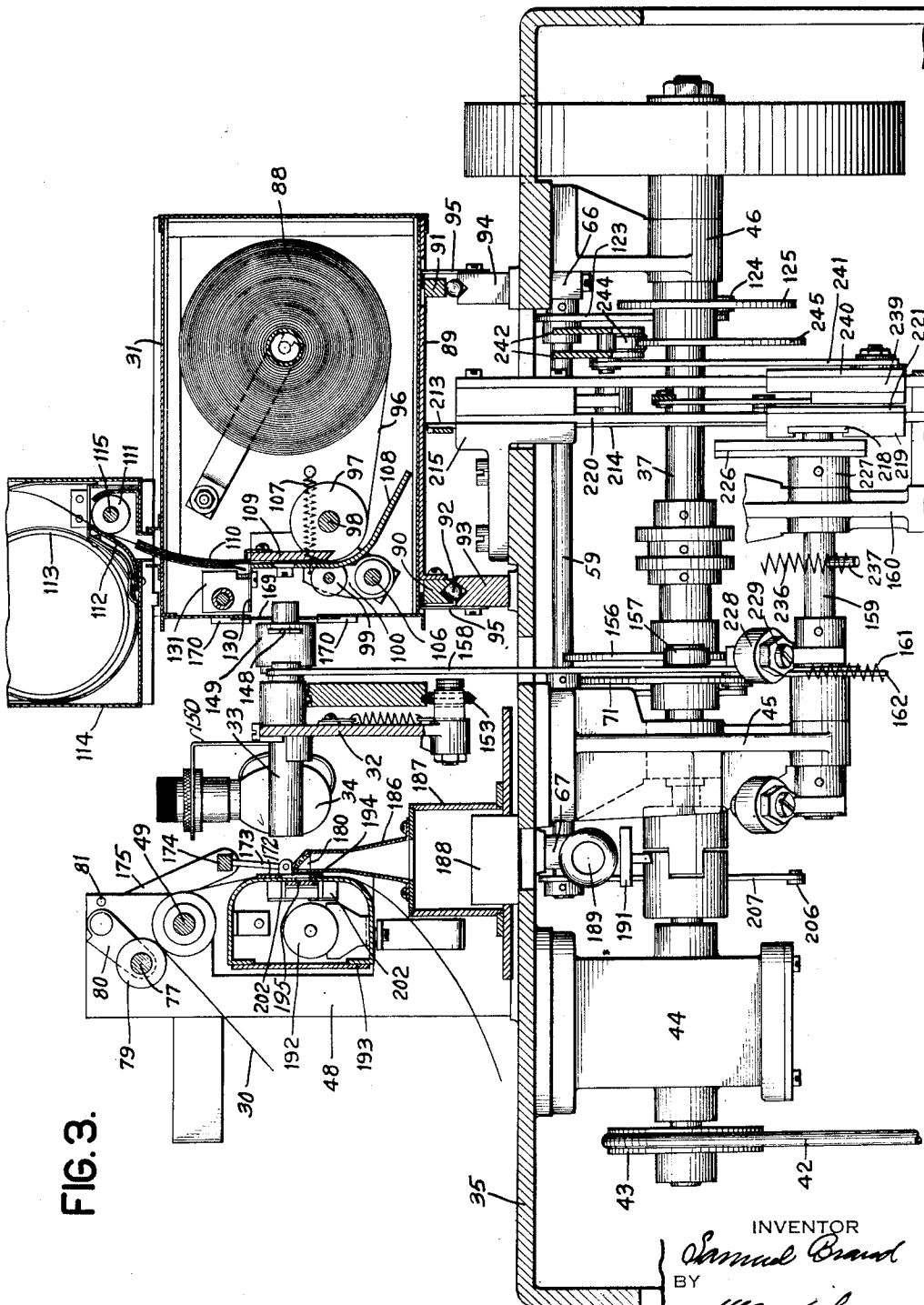
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2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 3



Nov. 4, 1941.

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LINE JUSTIFYING DEVICE

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11 Sheets-Sheet 4

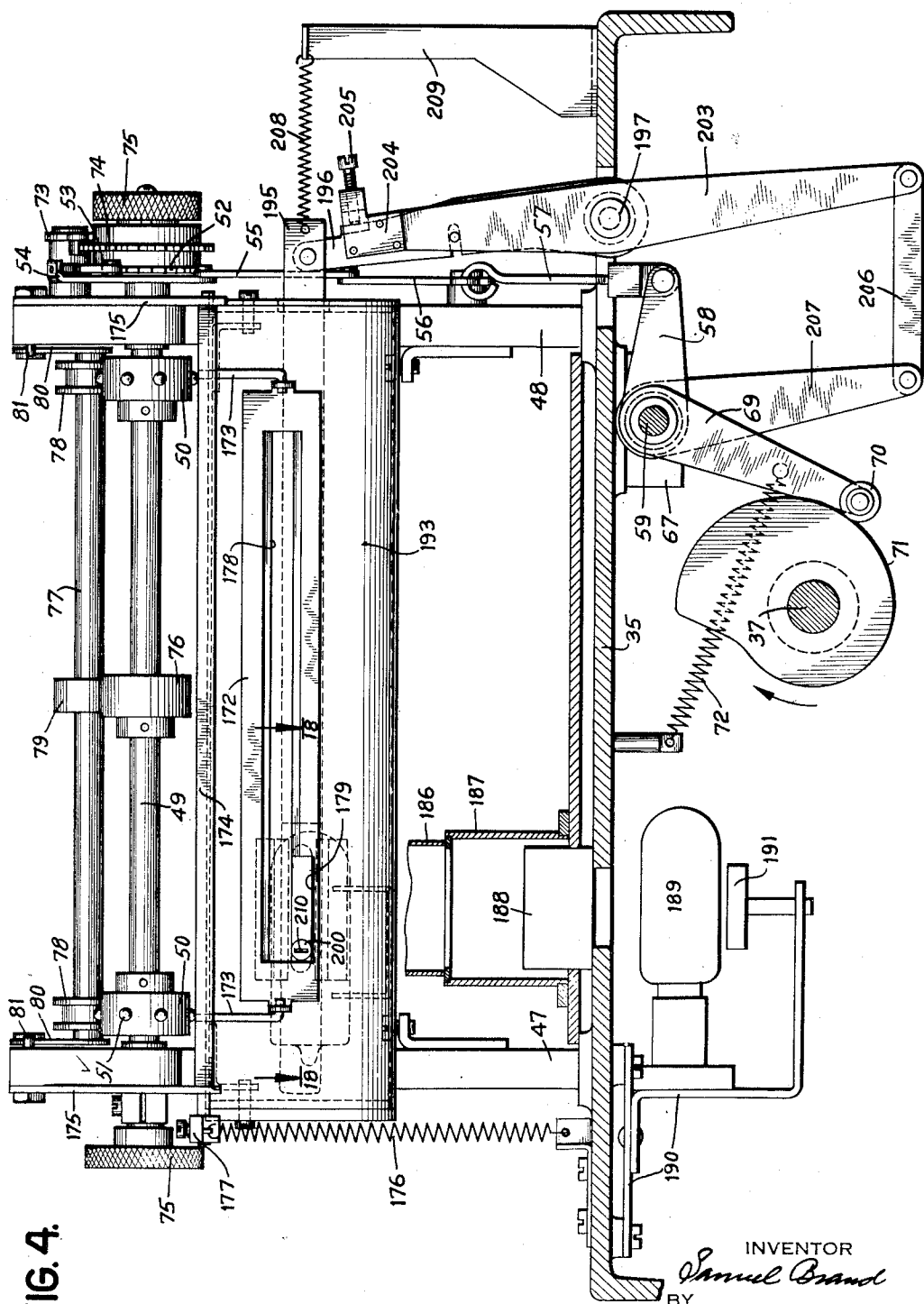


FIG. 4.

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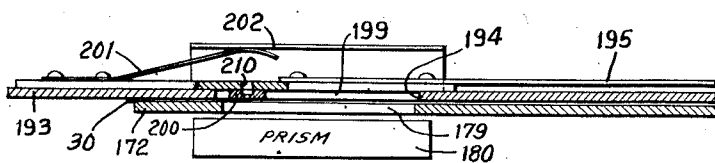
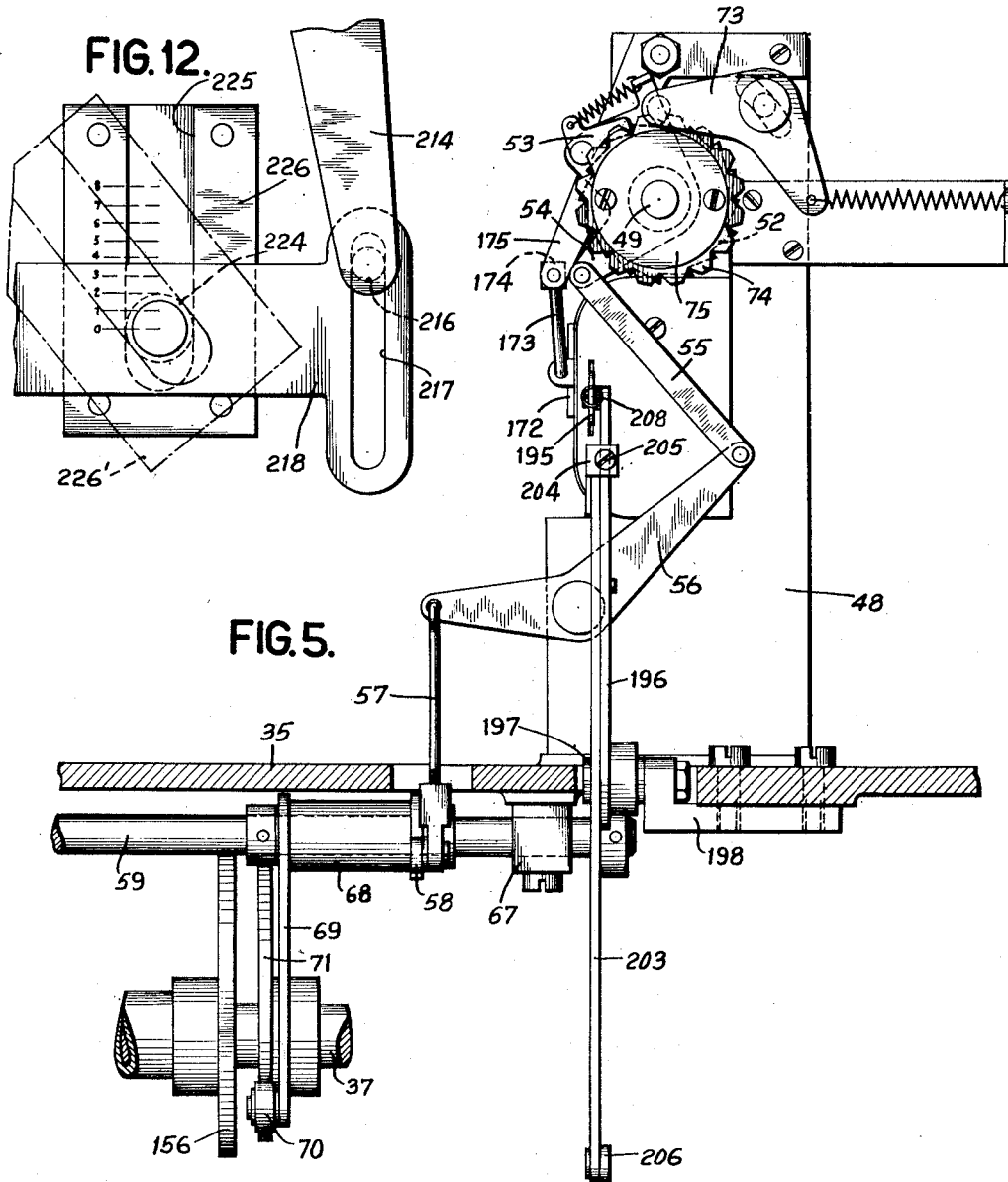
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2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 5



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2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets--Sheet 6

FIG. 6.

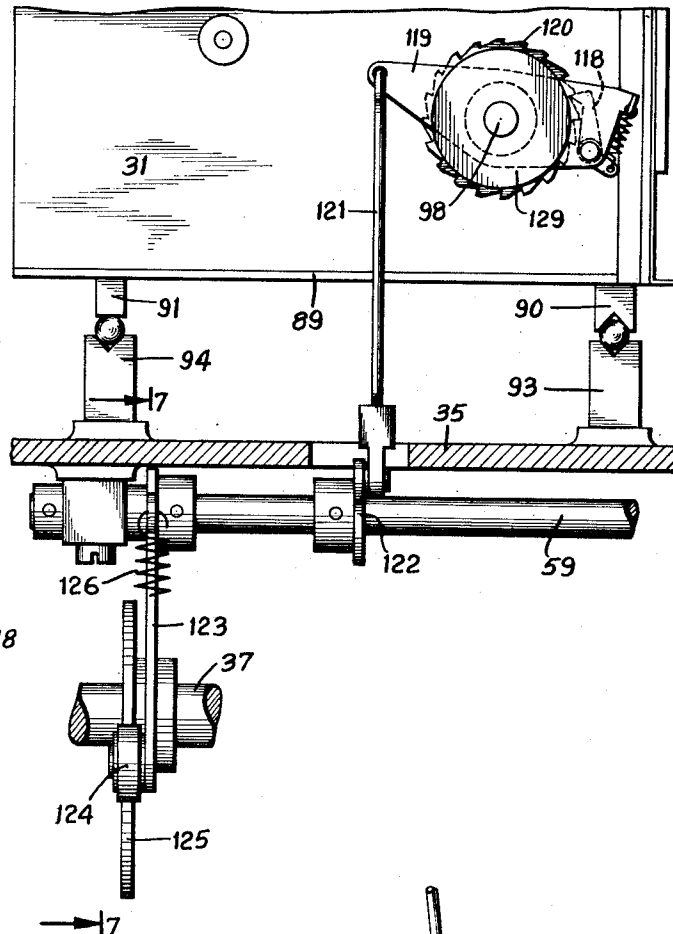


FIG. 11.

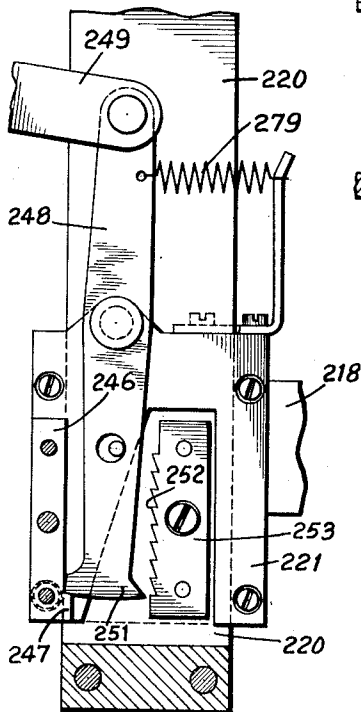
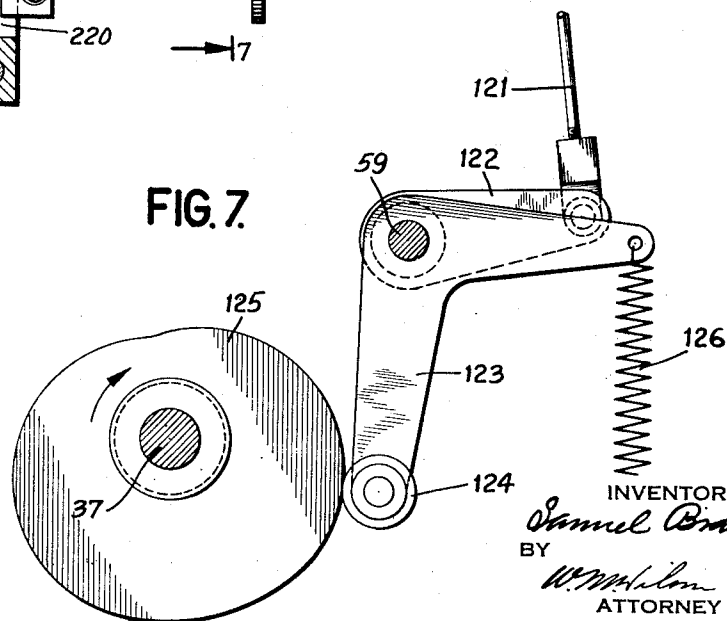


FIG. 7



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2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 7

FIG. 8.

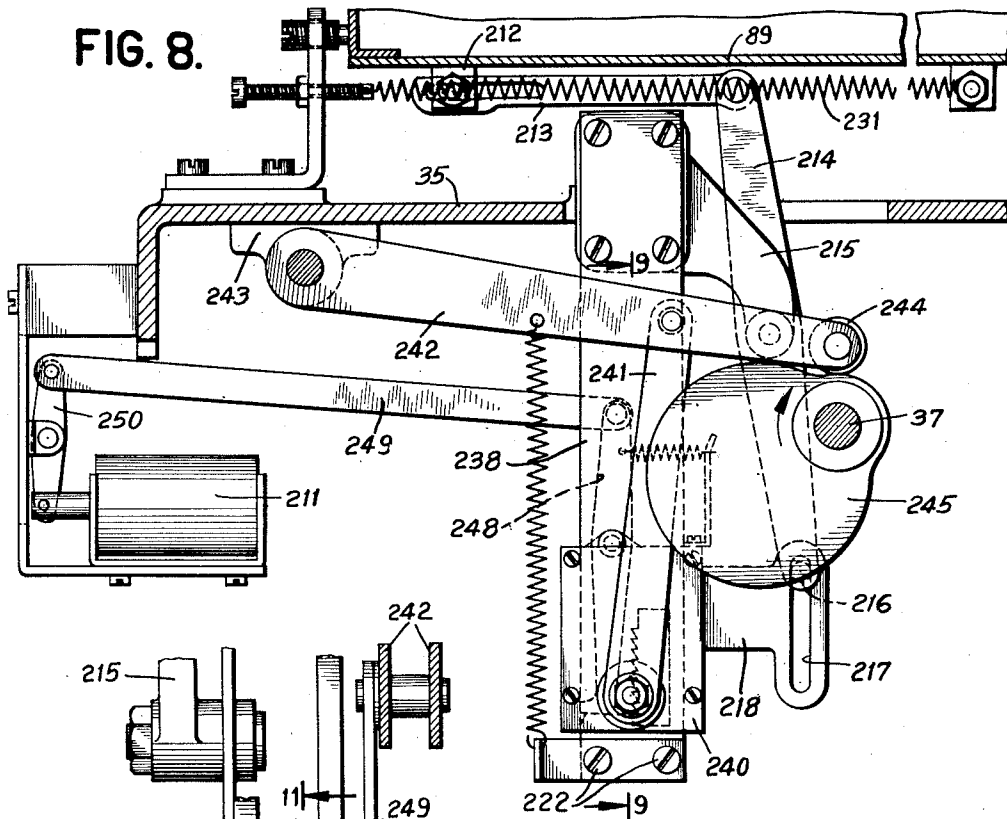


FIG. 9.

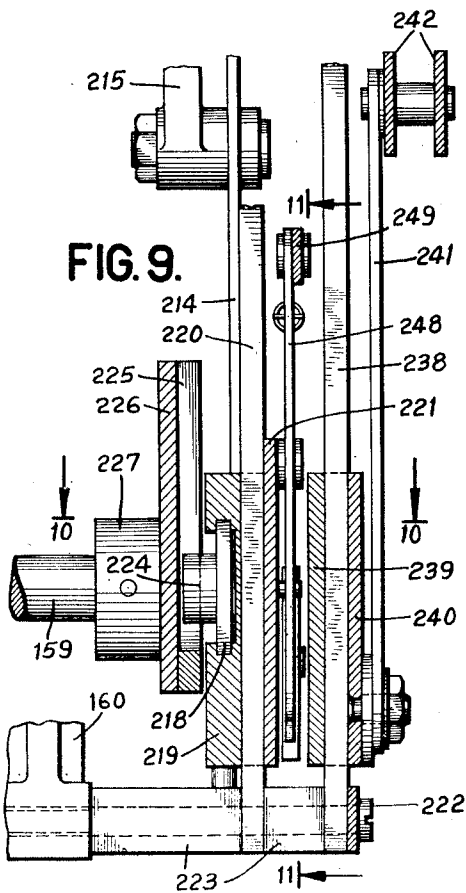
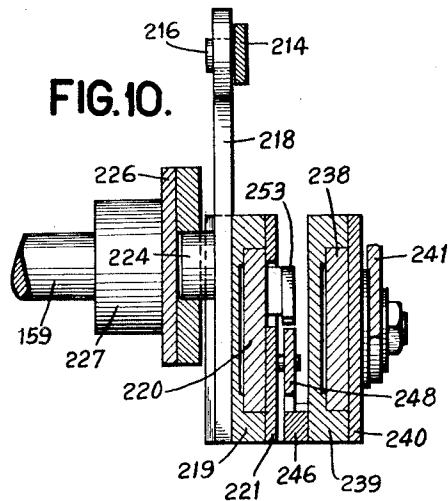


FIG. 10.



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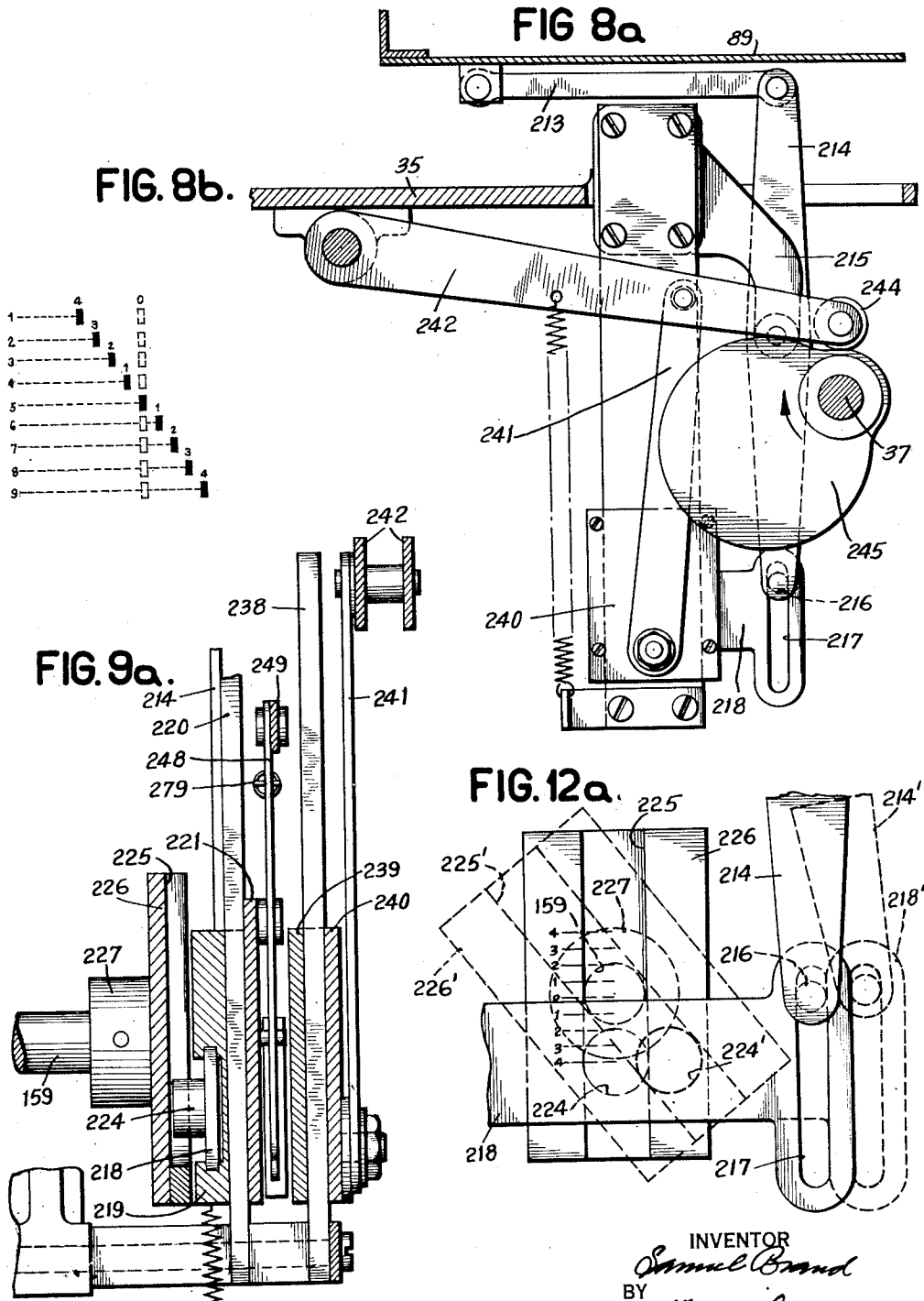
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LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 8



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2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 9

FIG. 13.

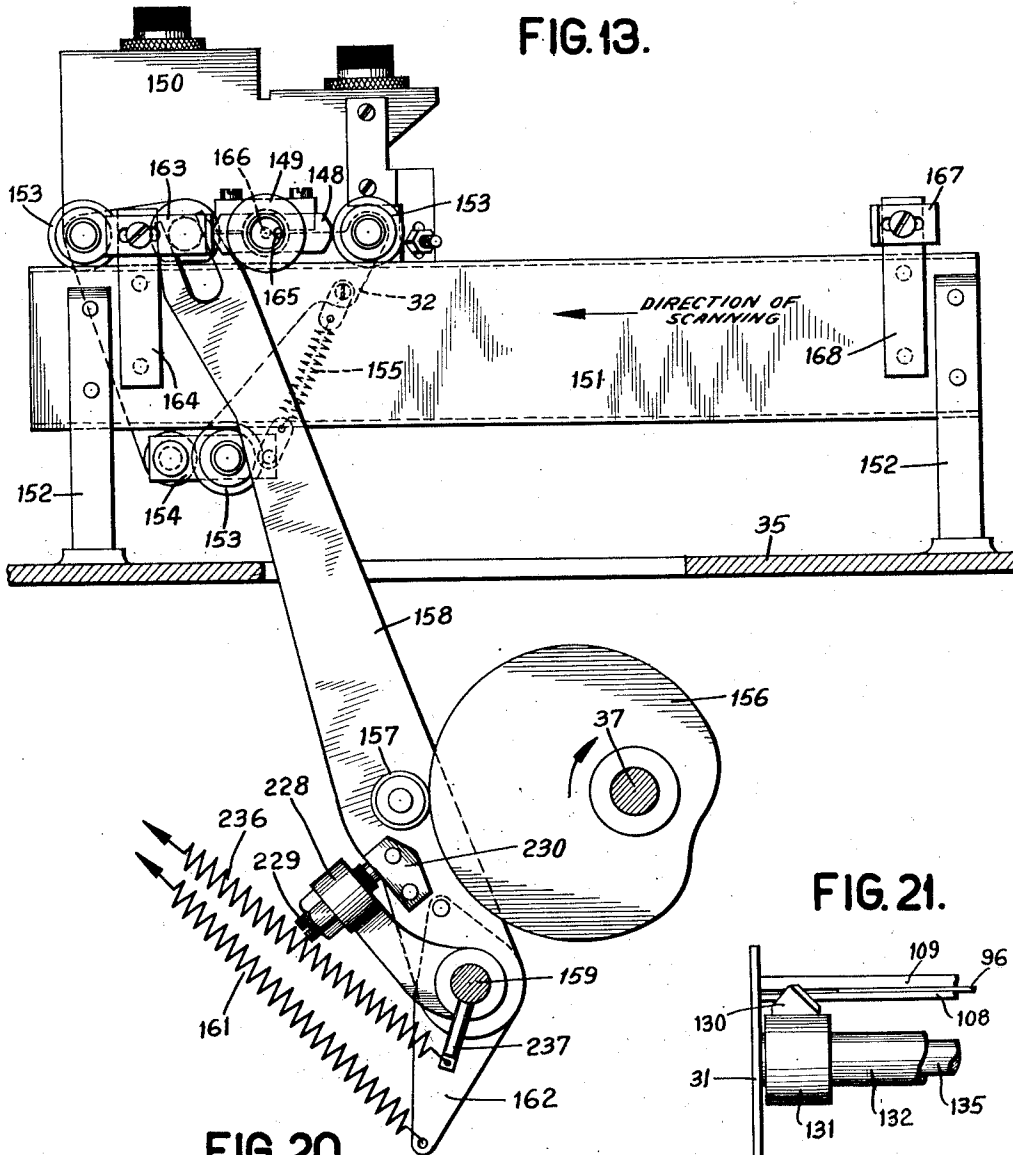


FIG. 20.

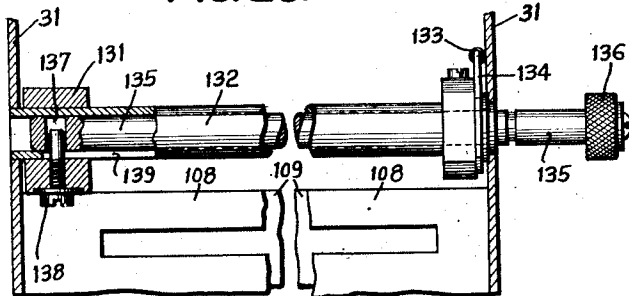
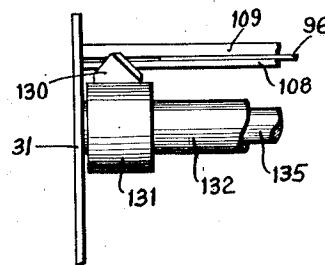


FIG. 21.



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2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 10

FIG. 14.

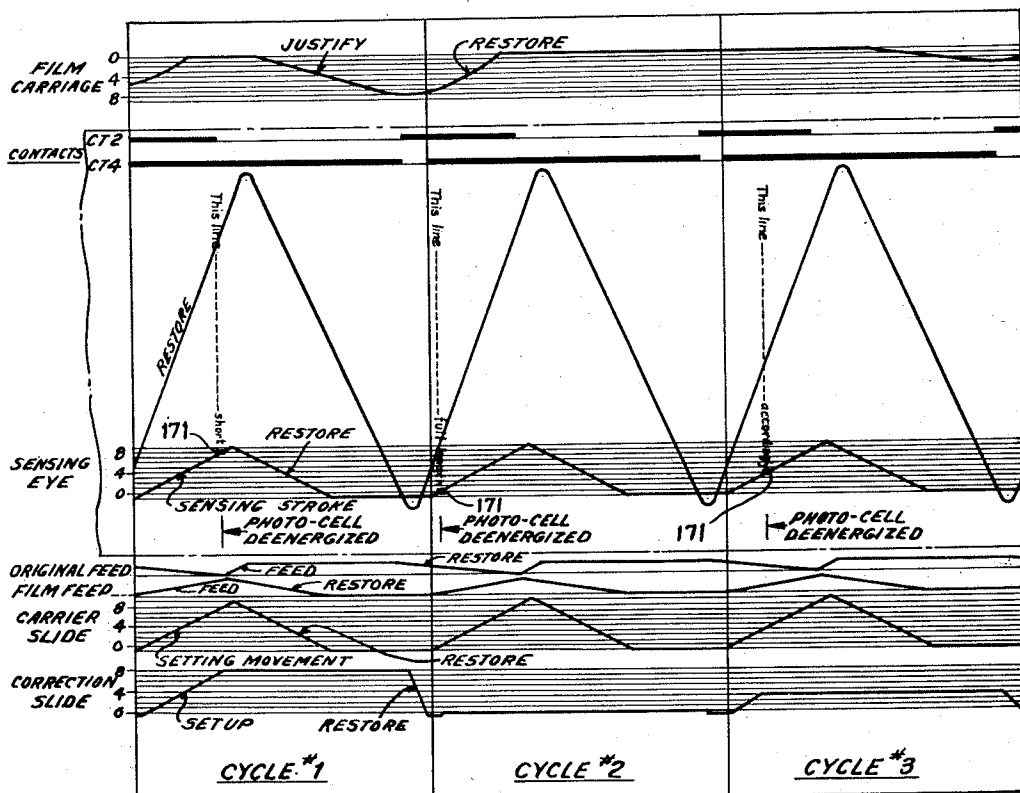


FIG. 15.

This line is 3 points short, and is justified accordingly. 171
 This line does not need to be justified as it is full length.
 This line must be justified, it being 8 points short.

This line is 3 points short, and is justified accordingly.
 This line does not need to be justified as it is full length.
 This line must be justified, it being 8 points short.

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2,261,538

LINE JUSTIFYING DEVICE

Filed Feb. 8, 1939

11 Sheets-Sheet 11

FIG. 16.

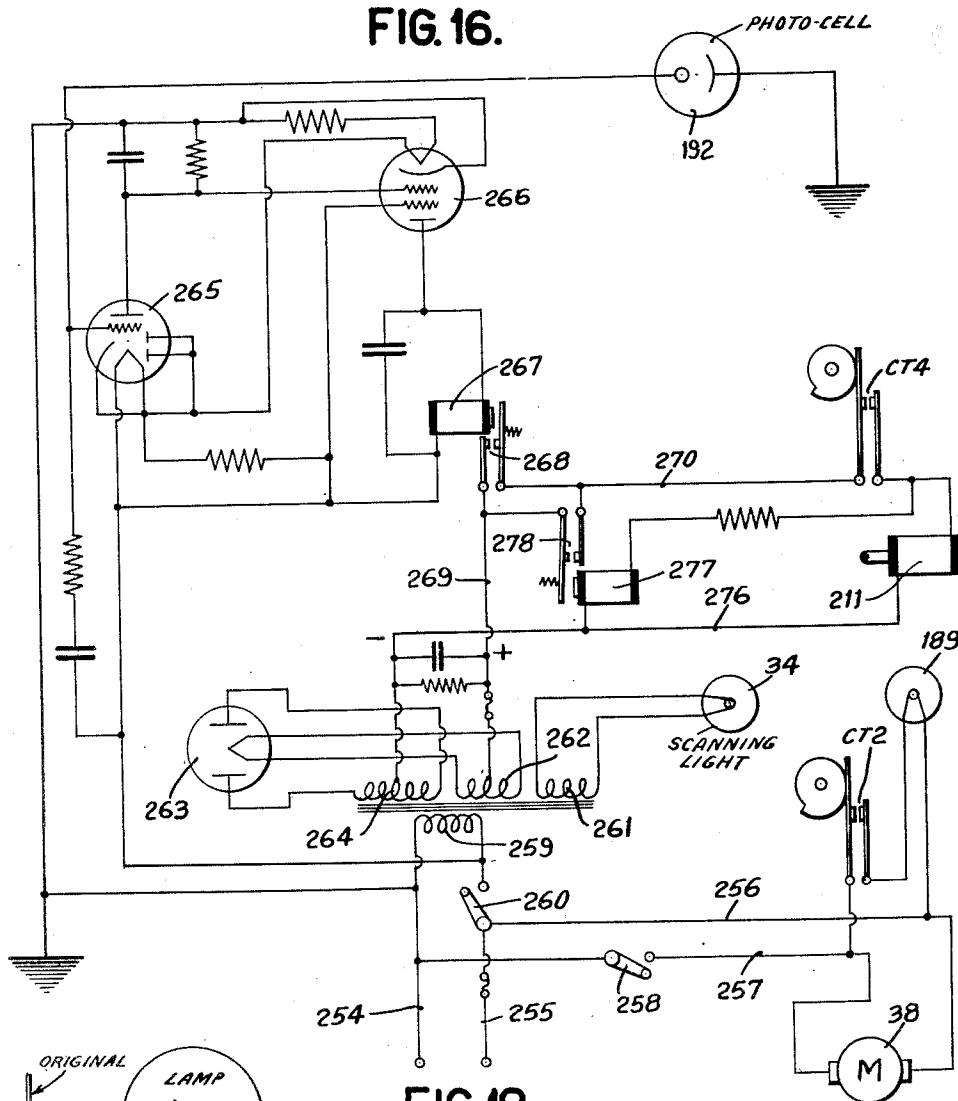
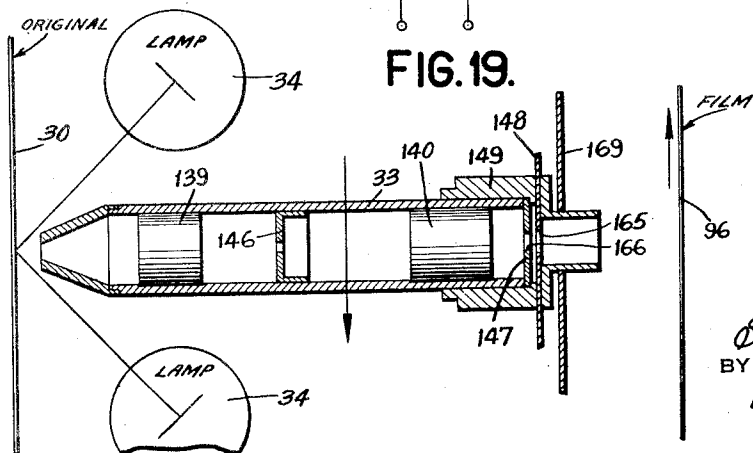


FIG. 19.



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UNITED STATES PATENT OFFICE

2,261,538

LINE JUSTIFYING DEVICE

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York

Application February 8, 1939, Serial No. 255,250

32 Claims. (Cl. 95—4.5)

This invention relates to a method of justifying lines of typewritten matter or the like and optical means for automatically carrying such method into effect.

Heretofore photo-mechanical justification of printed or typewritten matter has been accomplished in a number of ways, one method being to photograph successively each of a plurality of lines of typewriting, varying the distance between the copy and the photographic plate according to the length of each line in order that the lines may be of equal length on the photographic plate; other methods being that of varying the distance between the words according to the length of each line, and that of varying the distances between letters and words of each line so that the lines may be of equal length.

All of the photo-composing devices of which applicant has knowledge, require many manual adjustments, that is, adjustments for each line, word or letter to be justified. With this in mind the present invention has for its purpose the provision of a machine which will justify typewritten matter or the like, the machine being fully automatic, requiring the attendance of an operator only for the insertion of new matter to be justified and to replenish the supply of photographic film.

Another object of this invention is to provide a novel photographic justifying device capable of automatically scanning typewritten documents of indeterminate length, successively justifying each line according to its length and producing thereby photographic negatives of complete documents.

Another object of the invention is to provide a device which automatically determines the amount of justification required for each successive line of a typewritten document or the like and which automatically produces a photographic negative of said document whereon each line is lengthened or shortened accordingly.

A further object is the provision of novel means to automatically determine the amount of justification required for each line of typed matter.

Still another object is the provision of novel scanning means whereby each line of typed matter is automatically reproduced in justified negative form.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In said drawings:

Fig. 1 is a top plan view of the machine.

Fig. 2 is a view in side elevation taken on line 2—2 of Fig. 1 and looking in the direction of the arrows.

Fig. 3 is a sectional view on an enlarged scale taken on line 3—3 of Fig. 1 looking in the direction of the arrows.

Fig. 4 is a sectional view on an enlarged scale taken on line 4—4 of Fig. 1 looking in the direction of the arrows.

Fig. 5 is a detail sectional view on an enlarged scale taken on line 5—5 of Fig. 1 and showing the mechanism for feeding the original document to be justified.

Fig. 6 is a detail sectional view on an enlarged scale taken on line 6—6 Fig. 1 showing the mechanism for feeding the photographic film.

Fig. 7 is a detail view of the cam for operating the feed mechanism shown in Fig. 6.

Fig. 8 is a detail view of the mechanism for controlling the extent of justification.

Fig. 8a illustrates a modified form of the mechanism shown in Fig. 8.

Fig. 8b is a diagram illustrating justification by lengthening or shortening the line.

Fig. 9 is a sectional view on an enlarged scale taken on line 9—9 of Fig. 8 looking in the direction of the arrows.

Fig. 9a is a modified form of the mechanism shown in Fig. 9.

Fig. 10 is a sectional view taken on line 10—10 Fig. 9 looking in the direction of the arrows.

Fig. 11 is a detail view of the justifying set up mechanism.

Fig. 12 is a detail view of a part of the justifying mechanism.

Fig. 12a shows a modified form of the mechanism shown in Fig. 12.

Fig. 13 is a detail view of the mechanism for operating the scanning lens carriage.

Fig. 14 is a timing chart.

Fig. 15 illustrates printed matter before and after justification.

Fig. 16 is the circuit diagram.

Fig. 17 is a detail view showing the paper carriage and the scanning lens carriage.

Fig. 18 is a fragmentary view of a part of the photo-electric sensing mechanism.

Fig. 19 is a horizontal sectional view through the optical system looking downwardly.

Fig. 20 is a fragmentary view showing the structure of the film severing device.

Fig. 21 is a detail view of the film cutter.

To accomplish the objects set forth above, the

illustrative embodiment of the invention includes generally a carriage to support the original document 30 (Figs. 1 and 3) and a carriage, indicated generally at 31, in which is supported the photographic material such as sensitized film or paper, although, obviously, a sensitized plate may be utilized if desired. Between the document carriage and the film carriage is a scanning carriage indicated at 32 (Figs. 1, 2, 3, and 17) upon which is mounted a lens or optical system 33 (Fig. 3) and lamps 34 for illuminating the original document, the lens 33 projecting the image of said document onto the photographic material. Means is provided to move the scanning carriage 32 back and forth across the original document for the purpose of scanning it incrementally line by line.

The several parts of the machine are mounted on a base 35 (Figs. 1, 2, 3, and 4) which is supported on legs 36. A main drive shaft 37 (Figs. 2 and 3) provided to operate the several instrumentalities is driven by a motor 38 (Figs. 2 and 16) through a belt 39, pulleys 40 and 41, a belt 42 and a pulley 43 through a gear reduction encased in a housing 44. The shaft 37 is mounted in the housing 44 and bearings 45 and 46 (Fig. 3) secured to the under side of the base 35.

Document carriage

The carriage in which the original document 30 is mounted includes a pair of upright frames 47 and 48 (Figs. 1, 3, and 4) secured to the base 35. Between frames 47 and 48 is rotatably mounted a shaft 49 having secured thereto at each end, just inside frames 47 and 48, feed rollers 50. These rollers are provided with radially extending pins 51 which cooperate with holes along the edges of the document 30 (Fig. 1) to aline and advance the document.

For the purpose of feeding the document 30 there is secured to the right-hand end of the shaft 49 (Fig. 4) a ratchet 52 (Fig. 5) with which a feed pawl 53 cooperates. The pawl 53 is mounted on a lever 54 pivoted on the shaft 49. A link 55 connects one arm of the lever 54 to one arm of a lever 56 pivotally supported on the frame 48 and having its other arm connected by a rod 57 to an arm 58 pivotally mounted on a shaft 59. The shaft 59 is supported in brackets 66 and 67 (Figs. 3 and 5) secured to the under side of the base 35. A hub 68 (Fig. 5) rigidly connects the arm 58 to a cam follower 69 which at its free end carries a roller 70 cooperating with a cam 71 secured on the shaft 37. A spring 72 (Fig. 4) presses the roller 70 into contact with the periphery of the cam 71.

Referring to Fig. 4, rotation of the shaft 37 and the cam 71 in the direction indicated by the arrow, rocks arms 69 and 58 counterclockwise which movement through the rod 57 (Fig. 5) rocks the lever 56 clockwise. This lever through the link 55 rocks the lever 54 counterclockwise to retract the feed pawl 53. When the high spot of the cam 71 passes the roller 70 the spring 72 reverses the movement of the linkage just described and rocks the lever 54 clockwise to advance the document 30 (Figs. 1 and 3) one line space.

A roller carried by a spring pressed retaining pawl 73 (Fig. 5) cooperates with a notched disc 74 secured to the ratchet 52 to aline and yieldingly hold the shaft 49 and consequently the document 30 in position. Knurled knobs 75 (Fig. 4) are affixed to the ends of shaft 49 for the purpose of manually advancing the document.

In order to hold the paper in close contact with the feed rollers 50 and with a roller 76, a shaft 77 (Figs. 3 and 4) carrying a roller 78 at each end is provided. The rollers 78 are provided with annular grooves to clear the feed pins 51 in rollers 50. A roller 79 also mounted on the shaft 77 cooperates with roller 76. The shaft 77 is supported between two arms 80 which are pivotally supported on studs projecting inwardly from the frames 47 and 48. The arms 80 may be rotated manually to facilitate insertion of new documents, stops 81 being provided on the frames 47 and 48 to limit their movement.

It may be stated here that the original document may take the form of a letter or similar size sheet or it may be in the form of a comparatively long strip of paper a roll of which is indicated at 82 (Fig. 17). After passing the sensing aperture the paper may be wound on a take-up roll 83. A belt 84 passes around a pulley 85 fast on the feed shaft 49 and a pulley 86 on the take-up roll to drive the latter. The supply roll 82 and take-up roll 83 are suitably supported between brackets 87 (only one of which is shown) secured to and projecting from the frames 47 and 48.

Film carriage

The sensitized film upon which the image from the original document is projected and recorded in negative form may be provided in the form of a roll 88 (Fig. 3) supported within a light casing 31 in such a manner that it is easily unrolled and fed past the lens 33 by feed means to be described later.

The casing 31 is mounted on a base plate 89 which is secured to cross bars 90 and 91 extending transversely of the machine. The under side of the bar 90 is provided with a longitudinal groove which embraces and rests upon anti-friction balls 92 which in turn rest in a groove in the upper edge of a rail 93 secured to the base 35 of the machine. The bar 91 also is mounted on anti-friction balls supported in a grooved rail 94 secured to the base 35. Retaining clips 95 secured to the rails 93 and 94 have their upper ends bent over the bars 90 and 91 to prevent displacement of the film carriage but permit movement of the carriage along the rails 93 and 94. The purpose of and means for effecting this movement will be set forth later.

When the film strip 96 is unwound from and leaves the roll 88 it passes around a pair of feed rollers 97 secured to a shaft 98 supported in the side plate of the casing 31. Tension rollers 99 carried on arms 100 mounted on a shaft 106 are urged by springs 107 against the feed rollers 97 to provide sufficient tension for feeding the film. The film passes between a guide plate 108 and a cross bar 109 suitably supported in the casing 31, thence upward through a chute 110, between a roller 111 and a deflector plate 112 where it is coiled as indicated at 113 in a receiving box 114. The roller 111 is mounted on a shaft 115 supported in the end pieces of the film receiver 114.

The film receiver 114 is detachably held in position on top of the film supply chamber 31 by two spring retainers 116, (Fig. 2) one of which is disposed on each end of the chamber 31 and which retainers cooperate with pins projecting from the end pieces of the receiver. When in this position the receiver 114 forms a light tight connection with the film chamber 31.

In order to introduce the leading end of the film between the feed rollers 97 (Fig. 3) and the tension rollers 99, the end of the shaft 106 pro-

jects beyond the casing 31 and has secured thereto an arm 117 (Fig. 2). By moving this arm counterclockwise the operator may rotate the shaft 106 in the same direction to move the rollers 99 out of contact with the feed roller.

Referring now to Fig. 6, a feed pawl 118 carried on one of a lever 119 pivotally mounted on the shaft 98 cooperates with a ratchet wheel 120 secured to the shaft 98. A link 121 connects the other end of the lever 119 to the free end of an arm 122 secured to the shaft 59 (see also Fig. 7). A bell crank 123 also secured to the shaft 59 carries an anti-friction roller 124 which is maintained in cooperative relation with a cam 125 fast on the shaft 37 by a spring 126 having one end fast to the bell crank 123.

As the cam 125 (Fig. 7) rotates in a clockwise direction the spring 126 rocks the bell crank 123, shaft 59 and arm 122 also clockwise (Fig. 7) lowering the link 121. This rocks the lever 119 counterclockwise (Fig. 6) to advance the ratchet 120, shaft 98 and feed roller 97 one step. In this manner the film is advanced one line space. Further rotation of the cam 125 reverses the direction of movement of the train of mechanism just described retracting the feed pawl 118 one step.

A spring pressed retaining finger 127 (Fig. 2) cooperates with a serrated disc 128 fast on the opposite end of shaft 98 to align the feed rollers 97 and consequently the film.

A knob 129 secured to the shaft 98 adjacent the ratchet 120 (see Figs. 1 and 6) permits manual operation of the feed rollers 97. While means for feeding a roll of film, step by step, have been disclosed, it is to be understood that this is merely indicative of any equivalent means for feeding sensitized material, step by step, one line space at a time.

Film severing means

After an indeterminate length of film has been exposed and rolled into the receiver 114, it may be desirable to sever the exposed film from the supply roll in order that the receiver may be removed to a dark room, where the length of exposed film may be removed and processed. To this end a knife 130 (Figs. 3, 20, and 21) carried by a block 131 is provided. The block 131 is slidable on a tube 132 which is rotatably supported in the end pieces of the casing 31. A spring 133 having one of its ends attached to an arm 134 secured to the tube 132 presses the blade 130 against the upper edge of the bar 109. A rod 135 slidably mounted in the tube 132 carries a knurled knob 136 at one end and at the other end is provided with a hole 137 into which projects the end of a screw 138. The screw 138 also passes through a longitudinal slot 139 in the tube 132, thus transmitting the influence of the spring 133 to the block 131 and knife blade 130.

In order to sever the film the operator grasps the knob 136 and draws the rod 135 toward the right (Fig. 20). Through the connection 137-138 the block 131 and the knife blade 130 are moved in the same direction, the knife blade 130 sliding along the guide 108 and block 109 severs the film 96 (Fig. 21). The knife is restored to the position shown in Fig. 20 before the film is advanced.

Optical system

In order to produce a photographic negative of the typed matter it is necessary to project the characters of the original copy 30 (Fig. 3)

onto the light sensitive film 96. To this end an optical or lens system 33 is provided. The optical system includes a tube in which are mounted lenses 139 and 140 (Fig. 19). Between the lenses is mounted a masking disc 146. A second masking disc 147 is fixed to the right-hand end of the tube. Adjacent the latter disc is a shutter 148 slidably mounted in a sleeve 149 forming part of the lens mounting. This shutter is for the purpose of closing the aperture during the return movement of the scanning carriage. The lamps 34 (Fig. 3) mounted on a bracket 150 secured to the carriage 32, illuminate the original document 30 (Fig. 19) whose characters are projected by the lens system onto the film 96 to produce the photographic negative.

Referring now to Figure 13, the carriage 32 is mounted to travel on a bar 151 supported by up-rights 152 secured to the base 35. The carriage is provided with three knife edged rollers 153, two of which travel in a groove along the upper edge of the bar 151, the remaining roller 153 travelling along a groove in the bottom edge of the bar 151. Thus the carriage 32 and the optical system 33 are maintained in accurate alignment and at the same time may travel forth and back along the bar 151.

In order to maintain a more accurate alignment of the optical system the lower roller 153 is mounted on an arm 154 (Fig. 13) which is pivotally supported on the carriage. A spring 155 tensioned between the carriage 32 and the free end of the arm 154 presses the rollers 153 into their respective grooves.

The scanning or lens carriage is operated by a cam 156 (Fig. 13) on the drive shaft 37. This cam cooperates with a roller 157 on an arm 158 free on a rock shaft 159 mounted in the bracket 45 and in a bracket 160 secured to the base 35. A spring 161 having one of its ends fast to the end of an arm 162 integral with the arm 158 presses the roller 157 into contact with the periphery of cam 156.

As the cam 156 rotates in the direction indicated by the arrow the spring 161 rocks the arm 158 clockwise (Fig. 13) shifting the scanning carriage 32 toward the right until the low portion of the cam 156 is under the roller 157 at which point the carriage 32 is in its extreme right-hand position. Continued rotation of the cam 156 reverses the direction of movement of the arm 158 and of the scanning carriage 32, moving the carriage from right to left (Fig. 13). It is during the latter movement, that is, from right to left as viewed in Fig. 13, that the scanning occurs.

It was stated above that the shutter 148 (Figs. 13 and 19) is provided to close the lens aperture during the return movement of the carriage 32. The shutter 148 is slidably mounted in the sleeve 149 and as the carriage traveling leftward (Fig. 13) on its scanning stroke approaches the limit of its movement, the end of the shutter 148 strikes a stop 163, adjustably mounted on a plate 164 secured to the bar 151, stopping the leftward movement of the shutter. The carriage 32 travels a short distance after the shutter 148 is stopped moving the aperture 165 in the shutter out of line with the aperture 166 in the masking disc 147.

The shutter remains in this position (Fig. 13) during the return movement of the carriage and until the carriage approaches the right-hand limit of its travel at which time the shutter 148 strikes a stop member 167 adjustably supported

on a plate 168 secured to the bar 151, shifting the shutter 148 to bring the aperture 165 into alignment with the lens aperture 166. As the carriage 32 proceeds on its scanning stroke the line is scanned and reproduced in negative form on the film 96.

An elongated opening is provided in the casing 31 of the film carriage (Fig. 3) through which projects the reduced end of the sleeve 149 as the scanning carriage 32 is shifted from side to side during operation of the machine. In order to protect the unexposed portion of the film 96 against exposure to extraneous light a slide 169 is provided. This slide is of sufficient length so that the opening is covered at all times regardless of the position of the scanning carriage. The slide 169 is mounted in grooves formed by plates 170 secured to the casing 31 and by the casing itself. The reduced end of the sleeve 149 projects through the slide 169 so that the reciprocatory movement of the scanning carriage is transmitted to the slide, which thereby travels back and forth with the carriage 32.

Sensing for justification

Figure 15 illustrates three lines of typed matter before and after justification. It is an object of the instant invention not only to produce automatically a photographic negative of typed matter but also to justify each line so that all lines are of equal length on the negative. Reference to Fig. 15 discloses that there is printed at the end of each line an opaque spot indicated at 171. This spot is sensed photoelectrically in order to automatically determine the extent of justification required for each line. Justification is then automatically effected by moving the film carriage in the opposite direction to and in synchronism with the scanning carriage on the scanning stroke whereby there is produced a photographic copy or replica whose lines are uniformly justified throughout their respective extents. The several instrumentalities provided to accomplish this justification will be described later.

A pressure plate 172 (Figs. 3 and 4) is pivoted on arms 173 depending from a bar 174 which in turn is pivotally supported in brackets 175 secured to the side members 47 and 48 (see also Fig. 5). A spring 176 having one of its ends fast on an arm 177 secured to one end of bar 174 presses the plate 172 into contact with the original document 30. An elongated opening 178 in plate 172 exposes a single line of typed matter the image of which is to be projected by the lens 33 onto the film as the scanning carriage sweeps from right to left. At its left-hand end (Fig. 4) the opening 178 is enlarged at 179 to expose the next lower line. Directly to the right of the opening 179 (Fig. 3) a prism 180 is mounted in a housing 186 which housing is mounted on a condenser lens housing 187. A condenser 188 is mounted in the base 35 within the housing 187. Just below the condenser 188 is located a light source 189 supported on a bracket 190 (Fig. 4) secured to the under side of the base 35. Also supported on the bracket 190 is a reflector 191.

A photoelectric cell 192 (Fig. 3) is mounted in a housing 193 supported by the frames 47 and 48 (see also Figs. 4 and 17). The cell 192 lies opposite the prism 180 so that light from the source 189 is projected through the condenser 188, and prism 180 which changes the direction of the light rays, to the cell 192. The opening 179 in the plate 172 coincides with a slot 194

(Fig. 18) in the casing 193. A slide 195 (Figs. 3, 4, and 18) located within the casing 193 opposite the prism 180 is pivoted at one end to an arm 196 (Figs. 4 and 5) pivoted on a stud 197 projecting from a bracket 198 secured to the base 35 of the machine. Secured to the other end of the slide 195 is a plate 199 having a disc 200 (Figs. 4 and 18) fast thereon. The disc 200 fits in the slot 194 and is adapted to reciprocal movement therein to support and guide the slide 195—199.

The plate 199 is pressed into close contact with the inside surface of the casing 193 by two springs 201 (only one of which is shown) tensioned against two angle members 202 disposed one above and one below the plate 199.

Referring now to Figs. 4 and 5, a lever 203 pivoted on the stud 197 adjacent the arm 196 has secured to its upper end a formed member 204 embracing arm 196. The member 204 carries an adjusting screw 205 which serves to adjust the position of the slide 195—199. A link 206 connects the lower arm of the lever 203 to an arm 207 fast on the shaft 59 to which shaft, it will be remembered, is also fast the arm 123 (Fig. 7).

It was described above how upon rotation of the cam 125, the spring 126 rocked the arms 123 and shaft 59 first clockwise and then counterclockwise to feed the film in order to bring an unexposed portion thereof into alignment with the optical system. Clockwise movement of the shaft 59 and arm 207, through the connection 206 rocks the lever 203 also clockwise (Fig. 4) at which movement a spring 208 tensioned between the slide 195 and a bracket 209 secured to the base 35 draws the slide 195—199 toward the right keeping the arm 196 in contact with the adjusting screw 205.

An aperture 210 (Figs. 4 and 18) is provided through the plate 199 and disc 200 through which rays of light from the source 189 is projected, the light passing through the condenser 188, prism 180, through the original document 30 to the photoelectric cell 192.

As the aperture 210 is moved from left to right (Fig. 4) the cell 192 is energized until the aperture coincides with the opaque spot 171 (Fig. 15), at which time the light rays reaching the cell 192 are interrupted deenergizing the cell. This deenergization controls a solenoid 211 (Figs. 8 and 16) which controls mechanism presently to be described to determine the distance the film carriage is to be moved at the next scanning operation, that is, the amount the next line is to be justified.

The amount of justification required to bring all lines to the same length is therefore determined by the opaque spot 171 at the end of the line. It has been found that this usually falls within a limit of eight character spaces with the exception of the last line of a paragraph which may be of any length. Accordingly any line whose spot 171 falls within the extent of eight character spaces of the right-hand end of the line will be lengthened an amount determined by the location of the spot 171.

Justifying mechanism

It has been previously stated that justification is effected by moving the film, upon which the image is being projected, laterally in the opposite direction to the scanning lens and in synchronism with the scanning movement of the scanning lens. The mechanism for so moving the film will now be described.

Referring to Fig. 3 it will be remembered that the film carriage 31 is mounted for lateral movement on the rails 93 and 94. Projecting downwardly from the bottom of the carriage is a bracket 212 (Fig. 8) to which is connected a link 213, the other end of the link being connected to one arm of a lever 214. The lever 214 is pivotally supported on a bracket 215 secured to the base 35. The other arm of the lever 214 carries a stud 216 projecting through a vertical slot 217 in a slide 218 mounted to slide horizontally in a correction slide comprising a block 219 (Figs. 9 and 10) and a plate 221. This block 219 is channeled to receive a guide bar 220 and the plate 221 (see also Fig. 11) is secured to the block 219. The guide bar 220 is mounted rigidly at its upper end on the bracket 215 and at its lower end is secured to the bracket 160 by screws 222 and spacing blocks 223 (Fig. 9).

A stud 224 (Figs. 9, 10 and 12) on the slide 218 projects into an open slot 225 in the face of an arm 226, the hub 227 of which is fast on the rock shaft 159. Referring now to Fig. 13 it was described above how the cam 156 oscillates the arm 158 to operate the scanning carriage. Fast on the shaft 159 adjacent the arm 158 is an arm 228 carrying an adjusting screw 229 bearing against a block 230 secured to the arm 158. A spring 236 attached to the shaft 159 by a pin 237 is provided to keep the screw 229 against the block 230 and to give the shaft its clockwise movement. The parts are shown in Fig. 13 at the end of the scanning movement. At this time the arm 226 (Fig. 12) is in the position indicated by dotted lines at 226'. As the cam 156 now rotates, the spring 161 rocks the arm 158 clockwise to restore the scanning carriage and at the same time the spring 236 rocks the shaft 159 and arm 226 (Fig. 12) clockwise to the position shown in full lines in Fig. 12. It is this rocking movement of the arm 226 which operates the slide 218 (Fig. 8) and through the lever 214 and link 213 operates the film carriage for the purpose of justifying the typed lines. The movement of the film carriage is therefore in synchronism with the movement of the scanning carriage. When the scanning carriage is being restored, that is, moved toward the right (Fig. 13) the arm 158 and the shaft 159 rock clockwise thus permitting a spring 231 to restore the film carriage toward the left (Fig. 8). With reference to Fig. 1, when the scanning carriage 32 moves in its scanning direction, that is, toward the right, the film carriage moves toward the left, consequently a length of film greater than the length of the typed line on the original 30 passes the lens in exactly the same time the lens is scanning the line, as will now be described.

In the illustrative embodiment of the invention the length of the line may be increased from one to eight spaces depending on the length of the line. It will be recalled that the photo-electric cell 192 (Figs. 3 and 16) controls the energization of the solenoid 211 (Figs. 8 and 16) when the sensing aperture 210 (Fig. 18) coincides with the opaque spot 171 (Fig. 15), at the end of the line. The solenoid 211 controls mechanism now to be described which determines the extent of movement of the film carriage at the next scanning and justifying cycle.

Adjacent to but spaced from the guide bar 220 (Figs. 9 and 10) is rigidly mounted a similar guide bar 238. A carrier slide comprising a channeled block 239 and a plate 240 secured

thereto is adapted to be vertically reciprocated on the bar 238. A link 241 connects the carrier slide 239—240 to a pair of spaced arms 242 pivotally supported by a bracket 243 (Fig. 8) secured to the base 35. A roller 244 carried between the free ends of the arms 242 cooperates with a cam 245 fast on the drive shaft 37.

Rotation of the cam 245 rocks the arms 242 first counterclockwise and then clockwise to raise and then lower the link 241 and the carrier slide 239—240.

Attached to the block 239 (Figs. 10 and 11) is a bar 246 provided with a shoulder 247 at its lower end normally below the lower end of one arm of a lever 248 pivotally supported on the plate 221 forming a part of the correction slide 219—221. A link 249 connects the other arm of the lever 248 to one arm of a lever 250, the other arm of which is pivotally connected to the armature of the solenoid 211.

As the cam 245 raises the carrier slide 239—240, the shoulder 247 on the bar 246 (Fig. 11) carries the lever 248 and consequently the correction slide 219—221 together with the slide 218 therewith. This movement is in synchronism with the movement toward the right of the sensing slide 195 and the aperture 210 (Fig. 4). When, during this movement, the aperture 210 coincides with the spot 171 the solenoid 211 is energized (in a manner to be later described). Energization of the solenoid 211 rocks the lever 250 (Fig. 8) counterclockwise and through the link 249 rocks the lever 248 in the same direction, a nose 251 (Fig. 11) of the lever entering one of a plurality of notches 252 in the edge of a bar 253 secured to the guide bar 220. This disconnects the correction slide 219—221 from the carrier slide 239—240 and latches the correction slide in its selected position, the carrier slide continuing through its regular travel. The correction slide together with the slide 218 is thus raised a number of steps equal to the number of points or characters the line is to be justified, positioning the stud 224 on the slide 218 upwardly in the slot 225 in the arm 226 accordingly.

If the spot 171 (Fig. 15) is sensed in the "three" position, for instance, the solenoid 211 will be energized and the lever 248 operated to stop the correction slide 219—221 in the "three" position. This positions the stud 224 (Fig. 12) in the corresponding position and upon operation of the arm 226, the slide 218 and lever 214 (Fig. 8) will be moved three points to shift the film carriage a like distance in justifying direction to effect lengthening of the scanned line three spaces.

Circuit diagram

Referring to the circuit diagram Fig. 16, current is supplied to the machine over power lines 254 and 255. Wires 256 and 257 connect the motor 38 and the light source 189 for sensing the spots 171 across the power lines. A manually operated switch 258 is provided to control the motor 38 and lamp 189. A pair of cam operated contacts CT2 are wired in series with the lamp 189. The contacts CT2 are timed to close, energizing the lamp 189 during the period of sensing the spot 171 (see Fig. 14) and to open at the end of the sensing stroke of the slide 195—199 so that the photo-electric cell 192 will be inoperative on the return stroke.

Also connected across the power lines 254 and 255 is the primary coil 259 of a transformer. A switch 260 in the line 255 provides a manual control of the transformer and amplifier circuits.

One coil 261 of the transformer secondary provides current of the proper voltage for the scanning lamps 34 (only one being indicated in Fig. 16). A secondary coil 262 supplies current for the filament of a full wave rectifier tube 263, the plate current for this tube being provided by a third secondary winding 264.

An amplifier including tubes 265 and 266 (Fig. 16) is controlled by the photo-electric cell 192 to energize the relay coil 267 upon a current drop through the cell when the sensing aperture 210 (Figs. 4 and 18) encounters a spot 171. Energization of the relay 267 closes its contacts 268 establishing a circuit from a tap at the center of secondary coil 262, wire 269, contacts 268, wire 270, cam contacts CT4 which, referring to Fig. 14, are closed at this time, solenoid 211, wire 276 to a tap at the center of secondary coil 264. The solenoid 211 is thus energized for the purpose set forth above.

Closure of contacts 268 also energizes a relay magnet 277 which closes its contacts 278 to establish a holding circuit for the solenoid 211. This holding circuit is necessary for the reason that, whereas the relay magnet 267 is energized only for the brief time the spot 171 is between the aperture 210 and the cell 192, it is necessary to hold the solenoid energized for the duration of the scanning operation in order to hold the lever 248 (Fig. 11) in its latched position, thus holding the slide 218 in its adjusted position throughout the justifying period of the cycle. Shortly after the scanning and justifying are completed the cam contacts CT4 open, deenergizing the solenoid 211, whereupon a spring 279 (Fig. 11) disengages the lever 248 from the plate 253 and the correction slide 219—221 is restored by gravity to its lowermost position where it is stopped by the lever 248 striking the shoulder 247 on the bar 246. This occurs near the end of the cycle (Fig. 14) and the parts are in position to be again adjusted under the control of the sensing eye at the beginning of the next cycle.

Operation

At the end of a cycle the several mechanisms are in substantially the following positions referring to the timing chart, Fig. 14: The scanning carriage 32 (Fig. 1) is in its right-hand position having first completed scanning a line of copy and has just commenced its restoring movement. The film carriage 31 has just completed its justifying movement and is starting its restoring movement. Both the carrier slide 239—240 and the correction slide 219—221 (Fig. 9) are in their lower or home positions. During the first part of the cycle the scanning carriage 32 is restored toward the left (Fig. 1) and toward the right as viewed in Fig. 4.

The film carriage 31 completes its restoring movement toward the right (Fig. 1) and toward the left as viewed in Fig. 8. During the first part of the cycle the mechanism illustrated in Fig. 6 operates to advance the film one line space to bring an unexposed portion in line with the lens 33. Also during the first part of the cycle the sensing eye 210 (Fig. 4) sweeps toward the right to sense the spot 171 (Figs. 14 and 15) and in synchronism therewith the carrier slide 239—240 raises the correction slide 219—221 (Fig. 9) carrying therewith the slide 218 until such time as the sensing eye finds the spot 171 on the line below the last scanned line. At this time the relay magnet 267 (Fig. 16) is energized and since the contacts CT4 are closed at this time the

solenoid 211 operates the lever 248 (Fig. 11) to arrest the correction slide in the position determined by the spot 171.

Just after the sensing eye completes its sensing stroke the mechanism shown in Fig. 5 operates to advance the original copy 30 one line space to bring the line just sensed by the sensing eye 210 (Fig. 4) to the scanning position in line with the opening 178 in the plate 172. The contacts CT2 open at the end of the sensing stroke to deenergize the lamp 188 (Figs. 4 and 16).

At the completion of its restoring movement the scanning carriage begins its scanning stroke and at the same time and in synchronism therewith the film carriage begins its justifying movement. The scanning stroke is fixed, that is, it is always the same length scanning a full line. The length of the justifying stroke of the film carriage, however, may vary from one to eight points depending on the length of the line scanned, or, stated otherwise, depending upon the position at which the spot 171 is sensed. It is to be understood that no matter what distance the film carriage travels, whether one, eight or an intermediate number of spaces, the travel extends for the full duration of the scanning stroke so that the image of the scanned line projected on the film will be lengthened from one to eight spaces.

At the end of the scanning movement the contacts CT4 are opened deenergizing the solenoid 211 and permitting the correction slide to restore quickly to its normal position in preparation for the next setting up movement of the carrier slide.

There has been described a device for producing automatically photographic negatives of typed matter whereon the lines may be lengthened from one to eight spaces to a predetermined length. It is obvious that by making minor mechanical changes to effect a movement of the film carriage during the scanning movement in the same direction as the scanning carriage the lines may be shortened one to eight spaces to a predetermined length.

Modified form

Figs. 8a, 9a and 12a illustrate a modification of certain of the mechanical structure to accomplish justification of lines in either or both directions, that is, lengthening certain lines and shortening other lines to a predetermined intermediate length. Comparing Figs. 9 and 9a discloses that the arm 226 has been altered so that in Fig. 9a it extends equal distances above and below the shaft 159. Also the slide 218 has been relocated in the correction slide to bring the stud 224 four spaces (Fig. 12a) below the center line of the shaft 159. It may be noted that the lever 214 (Fig. 8a) has been lengthened to accommodate the lower normal position of the slide 218, also that link 213 has been lengthened. With the parts in their normal position the film carriage may be moved either to right or left.

Referring now to Fig. 8b let it be assumed that the sensing eye on aperture 210 (Fig. 4) is sensing line 5 as indexed at the left of Fig. 8b. The sensing eye will have traveled four spaces before the spot 171 interrupts the ray of light reaching the photo-electric cell 192. Also the carrier slide 239—240 (Fig. 9a) and the correction slide 219—221 will have traveled upwardly four spaces when the cell 192 is deenergized and the solenoid operates to disconnect the correction slide from the carrier slide and latch it in the

selected position. Fig. 12a discloses that the stud 224 will at this time be in alignment with the shaft 159 with the result that when the arm 226 is rocked to the position indicated by dotted lines the slide 218 remains in its normal position and the film carriage does not move. Line 5, therefore, is not justified but is reproduced in negative form on the film the same length as the original copy.

If line 1 (Fig. 8b) is being sensed the sensing eye travels the full eight steps before it encounters the spot 171. In this case the stud 224 (Fig. 12a) is raised eight steps to the position marked "4" above the centerline of shaft 159. When the arm 226 is rocked counterclockwise the slide 218 is drawn toward the left moving the film carriage toward the right (Fig. 8a) and toward the left as viewed in Fig. 1. This is contrary to the direction of scanning and results in the line being lengthened four spaces to the vertical line marked "0" (Fig. 8b).

Consider now that line 9 (Fig. 8b) is being sensed to determine the amount of justification required. The sensing eye 210 immediately encounters the spot 171 at the end of this line causing the lever 248 to be operated to disconnect the correction slide 219—221 in its lowermost or normal position, which is, four spaces below the center-line of shaft 159. Now, when the arm 226 is rocked counter-clockwise the slide 218 is thrust toward the right moving the film carriage toward the left (Fig. 8a) and toward the right as viewed in Fig. 1 which is the direction the scanning carriage travels when scanning the copy. The result is that, since the length of film traversed by the lens is less than the length of the line scanned by four spaces, the line reproduced on the film will be shortened four spaces to the vertical line marked "0" in Fig. 8b.

Thus all lines whether longer or shorter than the intermediate position "0" are shortened or lengthened to a predetermined intermediate length.

While there has been shown and described and pointed out the fundamental novel features of the invention, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a machine of the class described, the combination of a copy having non-justified lines thereon, means to support a light sensitive material, an image forming optical system, means to move the optical system transversely of the copy and the light sensitive material to scan a line of copy and to cause said optical system to project an image of the scanned line onto the light sensitive material, and means to move the light sensitive material to change the length of the image received by said light sensitive material.

2. In a machine of the class described, the combination of a copy having non-justified lines thereon, means to support a light sensitive material, an image forming optical system, means to move the optical system transversely of the copy to scan a line of copy and to cause said optical system to project an image of the scanned line onto the light sensitive material, and means to move the light sensitive material during the

movement of the optical system to change the length of the image received by the light sensitive material to a predetermined length.

3. In a machine of the class described, the combination of a copy having non-justified lines thereon, means to support a light sensitive material, an optical system to scan the copy line by line and to project images of the scanned lines onto the light sensitive material, operating means to move the optical system the length of a line of copy, sensing means to sense the copy lines, and means controlled by the sensing means to move the light sensitive material during the scanning to alter the length of the image received by the light sensitive material.

4. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means to move the optical system the length of a non-justified line to project an image of said line onto the light sensitive material, sensing means to sense the length of a non-justified line, and means controlled by the sensing means to move the light sensitive material to modify the length of the image received by said light sensitive material an extent determined by the length of the non-justified line.

5. In a machine of the class described, the combination of a copy bearing non-justified lines, means to advance the copy line by line, means to support a light sensitive material, means to advance the light sensitive material, an image forming optical system, means to move the optical system the length of the non-justified lines to project images of the lines onto the light sensitive material, means to successively sense the length of the non-justified lines, and means controlled by the sensing means to move the light sensitive material to increase or decrease the lengths of the images received by the light sensitive material to reproduce all lines on said material of equal length.

6. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means to move the optical system the length of a line of copy to project an image of said line onto the light sensitive material, means to move the light sensitive material to modify the length of the image received by said material, means to sense the length of a non-justified line of copy, and means controlled by the sensing means to determine the direction of movement of said light sensitive material.

7. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means to move the optical system the length of a line of copy to project an image of said line onto the light sensitive material, means to move the light sensitive material to modify the length of the image received by said material, sensing means to sense the length of a non-justified line of copy, and means controlled by the sensing means to determine the extent of movement of said light sensitive material.

8. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means to move the optical system to cause said optical system to project an image of a non-justified line onto the

light sensitive material, and means effective during the projection of the image to effect a relative movement between the copy and the light sensitive material to modify the length of the image received by the light sensitive material.

9. In a cyclically operable machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system to scan a line of copy, sensing means to sense the length of a line of copy at one cycle of operation, means to feed the copy to advance the sensed line from the position wherein said line was sensed to scanning position, means to move the optical system at the next cycle following the sensing cycle the length of the sensed line to project an image of said line onto the light sensitive material, means to move the light sensitive material to modify the length of the image received by said light sensitive material, and settable means controlled by the sensing means to determine the direction of movement of the light sensitive material.

10. In a cyclically operable machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an optical system to scan a non-justified line and to project an image of said line onto the light sensitive material, sensing means to sense the end of a non-justified line at one cycle of operation, means to advance the copy line from sensing position to scanning position, means to move the optical system at the next cycle the length of the line, settable means controlled by the sensing means, and means controlled by said settable means to move the light sensitive material in a direction and to an extent determined by the length of the non-justified line to bring the image of said line received by the light sensitive material to a predetermined length.

11. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, operating means to impart a scanning stroke and a restoring stroke to the optical system to project an image of a non-justified line onto the light sensitive material, a shutter for the optical system, and means to automatically open the shutter at the end of a restoring stroke and to close said shutter at the end of a scanning stroke said shutter remaining open during the scanning stroke.

12. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means to reciprocate the optical system the length of a non-justified line and back to scan said line and to project an image of said line onto the light sensitive material, means to move the light sensitive material relative to the copy to control the length of the image received by the light sensitive material, photo-electric sensing means to sense the non-justified line, and means controlled by the sensing means to determine the extent of movement of the light sensitive material.

13. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means cooperating with said system to produce scanning of a line and to project an image of said line onto the light sensitive material, operating means to move the support means, an adjustable connection between

the operating means and the support means, sensing means to sense a non-justified line, and means controlled by the sensing means to adjust the connection to determine the extent of movement of the support means.

14. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, movable means to scan the copy line by line and to form and project successively, images of said lines onto the sensitive material, sensing means to sense the lines, and differentially settable means controllable by the sensing means to move the sensitive material in a direction and to an extent determined by the length of the sensed lines to change the lengths of the images received by the sensitive material to a predetermined length.

15. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, means to successively sense the ends of lines of copy, means to successively scan non-justified lines of copy and to successively project images of said scanned lines onto the sensitive material, means to advance the copy line by line from sensing position to scanning position, means to advance the light sensitive material, means to move the sensitive material laterally while a line of copy is being scanned, and means controlled by the sensing means to determine the direction and extent of said lateral movement to bring the images received by the sensitive material to a predetermined length.

16. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means to move the optical system to scan a non-justified line and to project an image of said line onto the sensitive material, means to sense the number of spaces a non-justified line is shorter or longer than a predetermined length, means to move the light sensitive material synchronously with the movement of the optical system to change the length of the image received by said sensitive material, and means controlled by the sensing means to determine the direction and extent of movement of the sensitive material.

17. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, means to scan a line of copy to project an image of the scanned line onto the sensitive material, a slide provided with a sensing aperture, means to actuate the slide to sense the end of a line of copy, operating means including a settable slide to move the sensitive material to alter the length of the image received by the sensitive material, a drive member cooperating with the settable slide, actuating means to move the settable slide relative to the drive members, and a latch controlled by the sensing means to disconnect the settable slide from the actuating means and to latch said slide in its selected position.

18. In a machine of the class described, the combination of means to support a light sensitive material, means for scanning a line of copy and projecting an image of said line onto the light sensitive material, operating means for moving the sensitive material to modify the length of the image received by said material, a light source, a photo-electric cell, a slide provided with a sensing aperture for sensing the

end of a line of copy, and means controlled by the photo-electric cell when the aperture encounters the end of a line for differentially adjusting the operating means according to the length of the line sensed.

19. In a machine of the class described, the combination of means to support a light sensitive material, means for scanning non-justified lines of copy and projecting images of said lines onto the light sensitive material, photo-electric sensing means for sensing the number of spaces lines of copy are shorter or longer than a predetermined length, operating means including a settable slide for moving the light sensitive material to change the length of the image received, a drive member for the operating means, and differential means controlled by the sensing means for setting the slide relative to the drive member an extent commensurate to the number of spaces the sensed line is shorter or longer than the predetermined length.

20. In a machine of the class described, the combination of means to support a light sensitive material, means including movable means, to automatically scan non-justified lines of copy and to project images of said lines onto the light sensitive material, photoelectric means to automatically measure the amount of justification necessary, and automatic means controlled by the photo-electric means to variably move the light sensitive material during scanning to effect justification.

21. In a machine of the class described, the combination of means to support a light sensitive material, means including image forming optical means to automatically scan non-justified lines of copy and to project images of the scanned lines onto the light sensitive material, means including photo-electric means to automatically determine the direction and extent of justification necessary, and means controlled by the photo-electric means to automatically move the light sensitive material in a direction and to an extent determined by the photo-electric means to effect justification.

22. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, means including image forming optical means to scan the copy line by line and to project images of the lines onto the light sensitive material, means to sense the number of spaces a line of copy is shorter or longer than a predetermined length, operating means including a settable element to move the light sensitive material to alter the length of the image received by the sensitive material, drive means cooperating with the settable element, and means controlled by the sensing means to differentially position the settable element radially of the drive means to control the direction and extent of movement of the sensitive material.

23. In a machine of the class described, the combination of a copy bearing non-justified lines, means to support a light sensitive material, an image forming optical system, means to automatically impart scanning strokes of invariable extent to the optical system to cause said optical system to project images of successive lines of copy onto the sensitive material, and means automatically controllable according to the length of the scanned lines of copy to automatically move the sensitive material variable extents synchronously with the movement of the optical system.

24. In a machine of the class described, the combination of a copy bearing a non-justified line of characters, means to support a light sensitive material, means including an image forming optical system to automatically project progressively images of said characters in the line on to the sensitive material, and means effective during the projection of the images to produce a relative movement between the copy and the light sensitive material to modify the length of the line of character images received by the light sensitive material.

25. In a device of the character described, means to support a copy having non-justified lines thereon, means to support a light sensitive material, scanning means for continuously scanning the respective individual lines and projecting images of said lines upon said material and thereby affecting said light sensitive material accordingly, means automatically determining the degree of justification required, and means controlled by said automatic means for producing a relative shifting of said respective supporting means whereby justification is produced.

26. In a device of the character described, means to support a copy having non-justified lines, means to support a light sensitive material, scanning means for progressively scanning the individual lines of the copy and projecting images of said lines upon said material, and means to cause relative shifting between said respective supporting means in a direction longitudinally of said lines, said shifting means being settable to determine the amount of said relative shifting.

27. In a device of the character described, means to support a copy having a plurality of rows of characters and means designating a point on each of said rows, means to support a light sensitive material, means for progressively and successively scanning said rows and designating means, and projecting images of said characters upon said material and means controlled by the scanning of each of said designating means for producing a relative shift between said respective support means to produce a justified replica of said rows of characters.

28. In a device of the character described, means to support a copy having non-justified lines, means to support a light sensitive material, scanning means for continuously scanning each line respectively on said copy and projecting images of said lines upon said material, and means effective during scanning of each line to produce a relative readjustment between the spacing of at least two components of each line of copy and the spacing of at least two components of each replica of said respective lines to thereby produce justification of said copy.

29. In a device of the character described, means to support a copy having a plurality of non-justified lines thereon, means to support a light sensitive material, scanning means for scanning said lines individually and projecting images of said lines upon said material to affect said sensitive material accordingly and prescanning the next succeeding lines to determine the amount of justification required for said next line, and means controlled by said scanning means for producing a relative shifting of said supporting means during the scanning of said next line and in accordance with said determined amount.

30. In a device of the character described, means to support a copy having non-justified

lines thereon, means to support a light sensitive material, projecting means and means cooperating with said projecting means to produce continuous incremental scanning and to project the image of said copy upon said material, shielding means for limiting the projection of said image to a single line, and means for producing relative movement between said shielding means and one of said support means to produce line by line exposure.

31. In a device of the character described, means to support a copy having non-justified lines thereon, means to support a light sensitive material, means to support scanning means, means for producing movement of said last support means for incrementally scanning the respective individual lines and projecting images of said lines upon said material and thereby af-

fecting said light sensitive material accordingly, and justifying means to produce an effective change in the relative movement of said last support means and one of said other support means.

32. In a device of the character described, means to support a copy having non-justified lines thereon, means to support a light sensitive material, scanning means for incrementally scanning the respective individual lines and projecting images of said lines upon said material and thereby affecting said light sensitive material accordingly, and justifying means for varying the relative rate of movement of said scanning means with respect to one of said support means.

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