APPARATUS FOR PHOTOCOMPOSING AND THE LIKE

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This invention relates to methods and apparatus for photocomposing and the like and particularly to such methods and apparatus involving electrical and electronic techniques.

The present invention pertains primarily to type justification, although the invention is also useful in photocomposing generally wherein one or more characters or words and the like may be individually treated as to dimension and appearance.

Briefly reviewed, in the printing trade it is becoming common to prepare printer's plates by photographic methods. That is, instead of setting type in the time honored manner, it is becoming the custom to prepare a printing plate by photographing the copy and reproducing same on a photosensitive material. The latter is subsequently developed or otherwise processed to produce a plate having raised portions which will apply ink to the paper when the plate is placed in a printing press.

In preparing plates for printing presses and the like it is customary to demand that the lines of characters be "justified." This refers to the technique of having the right-hand ends of each line come out even to present a uniform margin down the right-hand edge of the printed sheet. Also, it may be desired to emphasize some portions of the copy, as by enlargement or other distortion. The principles of the present invention are applicable to treating individual letters, words etc. within a given line of characters, as well as line justification.

According, it is a primary object of the present invention to provide improved electrical and electronic methods and apparatus for type justification and photocomposing generally involving photosensitive techniques. It is a further object of this invention to provide methods and apparatus for utilizing television or facsimile scanning methods for type justification and photocomposing.

It is a further object of this invention to provide photocomposing and justification techniques employing either manual or automatic means for creating reproductions of predetermined dimension from copy of irregular dimension.

It is a further object of this invention to provide electronic methods and apparatus for providing justification wherein a line of unjustified characters is stored pending the adjustment of the line length to be represented in reproducing equipment.

It is a further object of this invention to provide electronic type justification techniques in which a line of characters is first scanned to determine its length and re-scanned to reproduce the line after the line length information has served to adjust the line length to a predetermined amount in reproducing equipment.

It is a further object of this invention to provide electronic justification techniques in which line length determination and reproduction are simultaneously carried out.

Still further objects and the entire scope of the invention will become more fully apparent from the following detailed description and from the appended claims.

The invention may be best understood with reference to the accompanying drawings in which:

Figure 1 shows a basic manually operated system for carrying out the present invention.

Figure 2 shows a further embodiment of a manually controlled system for carrying out the invention.

Figure 2A shows a sweep coordination means.

Figure 3 shows a first embodiment of an automatic type justification system.

Figure 4 shows one embodiment of a signal delay device which may be employed with the circuit of Figure 3.

Figure 5 shows another embodiment of a signal delay circuit which may be employed with the circuit of Figure 3.

Figure 6 shows a second embodiment of an automatic justification system.

Referring now to Figure 1, a basic embodiment of my invention is illustrated. In this figure, 10 designates a camera or pick-up device which may be of a conventional variety such as employed in commercial television. 12 is copy such as a typewritten page having lines of the typed characters to be justified as to the right-hand margin. Copy 12 is placed behind a pick-up screening plate 14 in such manner that the camera 10 can "see" only one line 11 of the copy at a time. The limitation of view is controlled by means of a slot 16 in plate 14, the slot being so arranged that the "horizontal" sweep of the camera 10 will cover the complete line 11 of copy, but the "vertical" sweep will be restricted to substantially only the height of the line. That is, the sweep will extend only a short distance above and below the tops and bottoms of the characters in the line of copy, so that there is no extraneous pick-up of characters in other lines of the copy. The arrangement is such that the copy may be raised and lowered with respect to the slot 16 in plate 14 by any convenient means (not shown) so that the various lines of the copy may be successively scanned.

As an alternative, the "vertical" scan may be accomplished by slowly moving the copy unwarily, so that only a horizontal sweep is required in the pick-up device 10.

A suitable lens system 18 may be employed to focus the line of copy in the camera 10.

A receiver 20 may be any conventional variety of television receiver having suitable optics 19 for focusing the image on the tube face through a slot 22 in a display screening plate 24 onto a plate 26 of photosensitive material. The photosensitive material may normally be protected by a shutter 28 placed immediately behind the slot 22. As in the case at the transmitter, the slot 22 in screening plate 24 may extend horizontally a distance commensurate with the intended length of the lines in the photographic reproduction while the vertical height of the slot will be limited to substantially the height of one line of copy. Or, plate 26 may be moved upwardly in synchronism with copy 12 to develop the "vertical" scan in systems having no vertical sweep per se.

Control circuits designated as 30 may be employed to control the vertical and horizontal sweep gain in the receiver 20. The knob 32 may so control the horizontal gain and the knob 34 the vertical gain. It will thus be apparent that whatever the particular height and/or length of the line of copy picked up by the camera 10, these dimensions may be altered at will on the photographic plate 26 by adjustment of the horizontal and vertical controls at circuit 30. Accordingly, line justifi-
culation may be readily carried out by changing the horizontal control 32 for each complete line of copy that is scanned so that the line is elongated or compressed as required to meet the margin criteria. As at the camera, the plate 36 at the receiver may be so mounted that it can be raised and lowered to permit reproduction of each successive line in proper orientation. Incremental adjustment of the plate in a vertical direction will obviously permit corresponding adjustment in the spacing of each line of copy as may be desired.

Normally the shutter 28 will remain closed and means can be provided for observing the length of the reproduced line on the shutter. Then when the desired length or height has been adjusted by the controls 32 or 34, the shutter is opened and the line photographed on the photosensitive plate 26. Or, continuous operation may be performed by correlating the gain settings to line length as observed on the copy.

The mechanical movement of the camera and display screening plates 14 and 24, respectively, may be synchronized by mechanical means (not shown), and the ratio of their movements adjusted in accordance with the enlargement or reduction of vertical size employed in the horizontal sweep reproduction.

Photocomposing generally may be carried out by (1) restricting the scanned raster of camera 10 or (2) restricting the apertures 16 and 22. By these methods, a single word or character, or any area of the copy 12, may be selected for distortion by means of controls 32 and 34.

Referring now to Figure 2, there is illustrated a more comprehensive system for carrying out photocomposing and line justification as described above. In this figure 40, 42 and 44 are commercially available cathode ray oscilloscopes, of which an example is the Dumont model 3041D. Each of the oscilloscopes 40, 42, and 44 will be equipped with a sweep generator, a horizontal deflection amplifier and a vertical deflection amplifier. These units are designated 40a, 40b, 40c, respectively, in oscilloscope 40 and similarly designated in the other oscilloscopes as 42a, 42b, 42c, and 44a, 44b, 44c. Each oscilloscope will also be provided with a cathode ray tube, designated 40t, 42t, and 44t, respectively, in the oscilloscopes 40, 42, and 44. Each of the oscilloscope cathode ray tubes will be equipped with the usual intensity control grid, horizontal deflection plates and vertical deflection plates as indicated in Figure 2.

The intensity control grid of oscilloscope tube 40t may be adjusted at any suitable control potential to provide a fine bright spot on the face of the tube 40t. This spot may be focussed by a suitable lens system 46 onto copy 48 to be composed or justified. Also, a suitable lens system 50 is provided at the tube 44t of the oscilloscope 44 for focusing the spot on the tube of face 44t onto a photosensitive plate 52 where the reproduction will take place.

The spot will be of very small size as compared to a character. Generally the spot diameter should not exceed the width of the lines which form the characters, and each successive line sweep will be displaced only by the diameter of the spot. Therefore, there will be several sweeps over every line of characters.

The general operation of the system, as in the first described embodiment, is to scan in raster form over the copy 48 and to reproduce the copy in raster form at photosensitive plate 52, except in modified form as to dimension, as will be explained.

The sweep generator 40a of oscilloscope 40 is employed to establish "horizontal" sweeps throughout the system, and the sweep generator 42a of oscilloscope 42 is employed to generate "vertical" sweeps throughout the system.

The terms "horizontal" and "vertical" are employed here and elsewhere in this specification in the popular usage of the trade, and it is not intended to limit the invention to those particular physical deflections.

The output of sweep generator 40a is applied to the input of horizontal deflection amplifier 40b and also to horizontal deflection amplifier 40c. The output of horizontal deflection amplifier 40b is applied directly to the horizontal deflecting plates of tube 40t. On the other hand, the output of horizontal deflection amplifier 42b is applied to the horizontal deflecting plates of both tubes 42t and 44t.

Normally the output of sweep generator 40a is applied to the input of vertical deflection amplifier 42c and vertical deflection amplifier 40c. The output of vertical amplifier 40c is applied to the vertical deflecting plates of tube 49t while the output of vertical deflection amplifier 42c is applied to the vertical deflecting plates of both tubes 42t and 44t.

In operation the sweep generators 40a and 42a may be adjusted to cause the spot on the face of tube 40t to sweep out a coordinated raster, as in commercial television. The raster may completely include the copy 48 or may be limited to only a portion thereof. Also, defining apertures may be employed to screen out portions of the copy 48. Or, only a horizontal sweep may be employed, with the vertical sweep being generated by slowly moving the copy.

Suitable photoelectric cells such as photo multiplier cells 54 are connected in parallel and so positioned with respect to the copy 48 that they may receive reflected light from the copy 48. It will be understood that copy 48 will be maintained in darkness except for the bright spot from tube 40t. Accordingly, while the spot traverses the portions of copy on which no dark marks appear, the photocells will receive light. However, when the spot traverses dark areas, the amount of light received in the photocells will be diminished. A sweep with therefrom result in a series of signals which can conveniently be termed "whites" and "blacks."

The indications detected from the photoelectric cells 54 by suitable detecting circuits 56 are applied to the input of the vertical amplifier 44a of oscilloscope 44. The output of amplifier 44a is applied to the intensity control grids of both of tubes 42t and 44t. In other words, the amplifier 44a, normally used for vertical deflection, can be conveniently employed as an intensity modulating circuit.

With good quality sweep generators 40a and 42a the relationship between the sweeps may be maintained without other synchronization. However, if desired the sweeps may be coordinated by synchronizing signal generator 58 as shown in Figure 2A.

As previously stated, the intensity control grid of tube 49t may be maintained at a constant potential to provide a light spot of uniform brightness on the face of the tube. Adjustment of the horizontal amplifier 40b and vertical amplifier 40c will provide a raster of given dimensions on the copy 48. Rasters having simultaneous start times of vertical and horizontal sweeps will simultaneously appear on the faces of tubes 42t and 44t. This comes about because the horizontal and vertical amplifiers 42b and 44b of oscilloscopes 42 and 44 respectively are under the control of sweep generator 40a, which also feeds horizontal amplifier 40b of oscilloscope 40. Similarly, the vertical deflection in each oscilloscope is under the control of a single sweep generator, that being generator 42a in oscilloscope 42.

Assuming that the copy 48 comprises a typewritten page, having irregular line ends at the right-hand margin, and assuming it is desired to justify individual lines of type, the raster at oscilloscope 40 may be adjusted to scan the entire length of the line but only substantially the height of the line so as not to pick up lines above and below the one to be justified. The vertical amplifier 42c may next be adjusted to provide the desired height of characters on the face of tube 42t. This will simulta-
neously produce characters of corresponding height on the face of tube 44'. Next, a predetermined uniform line length 52 may be decided upon and the horizontal amplifier 426 may be adjusted so that the length of the line appearing on the face of tube 42' may be either elongated or shortened to meet the desired specification. Simultaneously a corresponding line length will appear on the face of tube 44'. The shutter 51 may then be operated so that the line is reproduced. When either the copy 48 or the raster of tube 40' is moved to scan the next line of type, the operator may again readjust the horizontal amplifier 426 to bring the line out to the specified length. Then the shutter 51 may be again operated to reproduce that line.

From the foregoing it will be apparent that I provide a complete system using conventional oscilloscopes, in which an operator monitoring the system at oscilloscope 42' may rapidly produce justified copy at plate 52. It may be noted that the amplifiers 44b and 44c of oscilloscopes 44 are not required in the above system. The composing and justification systems described above have been limited to those wherein the sweep controls are manually adjusted by an operator so that the reproduced copy is justified or otherwise composed as desired. However, by further embodiment of the present invention it is also possible to automatically control the dimensions of the reproductions so that lines are automatically justified or other compensation automatically achieved.

To accomplish automatic operation, there must be a determination of how the copy line length or other dimension corresponds to the desired dimension and there must be an adjustment of the display system in proportion to the ratio of the copy dimension to the desired reproduction dimension. Referring to line justification as an example, under the above requirements the determination of the proper length of the horizontal sweep display in the reproduction device may be determined in advance of the reproduction of each sweep line by either (1) storing what may be termed the "video" information until the line has been completely scanned at the camera and an adjustment made, (2) scanning along a line a first time to determine the length and to re-scan over the line in the same path for supplying the video information to the receiver, or (3) by using the length of a previously scanned path to approximate the length of the next path. Embodiments of such systems will be described in more detail below.

Measurement of actual length of character indicia in each sweep along lines in the original copy may be had by providing starting and stopping signals at the beginning and end of the line. Such starting and stopping signals may be by way of holes punched in the copy, by heavy black lines at the beginning and end on line or some similar systems of notation. Or the measurement may also be accomplished by determining the interval within one horizontal sweep in which voltage fluctuations occur in the output of the pick-up device.

Where some type of notation such as punched holes, black lines and the like are employed, a signal such as generated by transmitted or reflected light at the beginning of the scanning of a line may start a counting device, oscillator or mechanical timing system that measures the interval between the signal at the beginning and the occurrence of a similar signal at the end of the line. The sweep rate over the line may be constant and therefore the time interval may be used as a measure of length of the line.

The above mentioned embodiment in which the voltage fluctuations may produce the length may be based on the fact that as the flying light spot from the camera begins to illuminate the first character in the line, the output circuitry of the photocells will show an abrupt change in voltage output as the "video" signal is developed. The video signal may be rectified and a substantial voltage derived while the signal exists. This rectified voltage can be used to turn on a timing device by switching, for example, a conventional flip-flop circuit. The flip-flop circuit can be held in its "on" or "set" position by the rectified voltage from the video output. Then, at the end of the line when there is no further video output until the next line is to be scanned, the flip-flop circuit may be switched back to its "off" or "reset" position, cutting off the time responsive device to provide the measurement of length.

Referring now to Figure 5, one embodiment of an automatic composing and justification system is illustrated. In this figure, 89 designates the camera or pick-up device and this device is arranged to scan a raster on the copy 81 under the control of vertical and horizontal synchronizing pulses generated in a horizontal and vertical sweep synchronizing pulse generator designated 82. This may be as described in connection with the preceding embodiment. The so-called video signals will be produced over line 84 and these will be applied simultaneously to a line length measure device 86 and a video storage delay device 88. The line length measure device 86 may comprise a rectification circuit and one or more amplification stages to provide sufficient direct current to energize a solenoid coil 90. That is, as the flying spot scans along the line of copy and during the time a video signal is available on line 84, a uni-directional current will flow through coil 90 to pull an armature 92 against the action of a tension spring 94. Depending upon the average time duration of video signals as a line of copy is scanned along a sweep path, the armature 92 will assume a predetermined position against the action of spring 94. The term average is resorted to to explain the fact that where the first and last letters of the printed line do not have a horizontal portion, but may be irregular in the time interval of the rectified video signal will be slightly different. Hence, the physical inertia of the armature 92, spring 94 and other parts connected therewith (and damping means if desired) will serve to ignore minor irregularities. The fly-back time of the spot will also affect the position of the armature 92, but this also will be compensated for. The same action will result if the device 86 operates in response to markers at the beginning and end of each line, instead of by rectification.

Attached to armature 92 through a suitable linkage is an arm 96 connected with a potentiometer knob 98 which is part of a horizontal sweep adjuster circuit 100, the latter circuit being provided for adjusting the horizontal gain in a reproducer 102. The arrangement will be such that where the lines on the copy are longer than the desired justified length longer pulses of current will flow in the solenoid coil 90. This will have the effect of increasing the relative amount of "time on" current in coil 90, which will pull the armature 92 further into the coil against spring 94 so that the potentiometer 90 will be rotated in a direction to decrease the horizontal sweep gain in the reproducer 102. On the other hand, where the length of a line in the copy is less than the desired justified length shorter pulses will flow in coil 90, thus permitting spring 94 to rotate potentiometer 98 in the other direction to increase the gain of the horizontal sweep in circuit 102. Accordingly, it will be clear that the arrangement may be adjusted to automatically justify the lines to form a predetermined uniform margin.

In order that the sweep gain in reproducer 102 may be adjusted before the video information is applied to the intensity circuits of the reproducer it is desirable, as above indicated, to either store the video information momentarily or to re-scan the same path over the line of copy. In Figure 3, the video storage delay device 88 will serve to store the entire line of video information for a time period sufficient to permit the sweep of re-
producer 102 to be adjusted by the sweep adjuster circuit 100. The circuit 88 may take a variety of forms.

Basically, in nearly all applications the video information will consist of a predetermined sequence of "blacks" and "whites," resulting from a "spot" or equivalent interrupting bits of the characters as it sweeps along the line of characters. Such a sequence of signals may be stored in a chain of elements which may register in one of two conditions. For example, the elements of such a chain may be thyratrons, cold gas discharge tubes, Eccles-Jordan trigger pairs, magnetic relays or magnetic storage devices. Suitable storage may also be provided by electromagnetic wire or tape storage devices and many others.

Referring now to Figure 4, the delay device 88 of Figure 3 may most conveniently be a length of magnetizable tape 120 running over rollers 122 and 124. The roller 122 may be driven clockwise as viewed in Figure 4 by means of any suitable electric motor 126 provided with speed governing and adjustment circuits (not shown). A video signal recording magnet 148 may be positioned to operate in a first track 130a of tape 120 and a synchronizing signal recording magnet 130 may operate in a second track 130b. Lociated at another point along tape 120 may be a video pick-up magnet 132 and a synchronizing signal pick-up magnet 134. There may also be provided an erase magnet 136 for carrying a direct current and positioned to erase signals in both tracks 120a and 120b to present a "clean" tape to the recording magnets 128 and 130.

The motor 126 may be operated to continuously cycle the tape 120 at uniform peripheral velocity. This velocity may be correlated with the physical spacing between the recording heads and reading heads to provide a desired delay time between the recording and reading of data. The speed and speed will also be arranged to permit the longest possible complete line of copy to be recorded on the tape and to permit any other additional delay time required before the beginning of the signals is picked up by the reading magnets 132 and 134.

In operation, the video input signal will be applied to magnet 128 and the horizontal synchronizing pulse from circuit 82 (Fig. 3) will be applied to the synchronizing signal magnet 130. The synchronizing signal applied at magnet 130 will serve to record a magnetic flux pulse on the tape 120 in track 120a, to indicate the start of the line of video information which will begin simultaneously with the synchronizing pulse.

After the synchronizing pulse in track 120b has rotated into proximity with the synchronizing signal pick-up magnet 134, a pulse will be available on line 138 to trigger the horizontal sweep in the reproducer 102 of Figure 3. Simultaneously therewith the beginning of the video signal will be picked up by video pick-up head 132 and will be available over line 140 to the reproducer 102.

As above indicated, the dimensions of the tape and the speed thereof may be such as to permit the video signal to be available at the reproducer only after enough time has elapsed to permit the sweep adjuster circuit 100 to have properly adjusted the horizontal sweep time of the reproducer 102.

The video information will now be read from the tape 120 through the pick-up head 132 over the same time interval as was required to receive the video line at pick-up device 80 and record that line through the video recording head 128. The time interval is the same because the speed of motor 126 will have been maintained constant.

The horizontal synchronizing pulse available on line 138 will start the horizontal sweep in the reproducer 102, but since the circuit 100 has acted to adjust the sweep or "rise time" of the horizontal sweep in reproducer 102, the reproduced line may be shorter or longer than the line detected by the pick-up device 80. In greater detail, the light spot in reproducer 102 will be

gin to sweep across the tube face at such speed that it will reach a predetermined point (representing a line of predetermined length) at the end of the time interval during which the video information will be available from the video pick-up head 132 over line 138. Accordingly, if circuit 150 has adjusted the sweep in reproducer 102 to be fast, the reproduced line will be longer than the original copy line. On the contrary, where circuit 102 is adjusted to have a slow sweep the line will be shorter than on the original copy.

It will be clear that the above system is adaptable to arrangements in which the scan is developed as a repeated raster, or is developed by gradual movement of the copy and reproduction plates.

Referring now to Figure 5, another embodiment of circuit suitable for the delay device 88 of Figure 3 is illustrated. This device comprises electronic counter 150 such as a thyratron ring counter having n stages designated 1, 2, 3, 4—nth in Figure 5. Each stage of the ring counter 150 is connected to bias a control grid 152 of a series of thyratron tubes 154. The second control grid 156 of each of the thyratrons 154 is coupled to a video signal input line 175. These grids may be maintained either at a first low voltage representing a "white" or at a second or high voltage representing a "black" video signal. Thus, it will be understood that as the ring counter is cycled to apply a positive control pulse first at the first stage, then at the second stage, etc. through the nth stage, each of the thyratrons 154 will be enabled and will fire if it so happens that the high or "black" signal is present on the video input line 158 at the instant when a particular thyratron is otherwise enabled from the counter 150.

The counter may be supplied with a series of firing pulses from firing pulse generator 160. These pulses may be frequent enough to provide the desired resolution in the horizontal sweep in the pick-up device 80 (Fig. 3). Each horizontal synchronizing pulse developed in the generator circuit 82 (Figure 3) may be applied over line 162 to "set" a flip-flop circuit 164 to open a gate 166. The output of pulse generator 160 then will be applied over line 168 to operate the counter 150. The output of the nth stage of the counter 150 may be applied over line 172 to "reset" the flip-flop 164, and in addition the flip-flop 164 in its reset position may serve to reset the counter 150 to 0. This reset circuit may be in addition to the fact that counter 150 may be electronically cycled to start at the 0 position simultaneously with gate 166 being closed and flip-flop 164 being reset.

As the scanning of a sweep along a line on the copy progresses, at such time as the first thyratron 154 is enabled by the first stage of the counter 150, if the video input line 158 is at a high or "black" voltage, the second control grid 156 thereof will permit the thyratron to fire. Then as the second thyratron is enabled from the counter, if the video input remains at a high voltage second thyratron will fire. On the contrary, if the video input has dropped back to a lower or "white" voltage, the second thyratron will not fire. Thus, as the counter steps through n counts, the thyratrons will be left in conducting or non-conducting condition as detected by the video input. It will be understood that the number of thyratron stages represents the "resolution" of the reproduction. For reproduction of type such as that in which this specification appears, there may be as many as four stages per character. The resolution will generally be based upon the number of discrete positions the scanning "spot" can occupy over the length of the line scan.

The anodes 174 of the thyratrons 154 are connected at spaced points along a series of resistors 176a, b, c, etc., of the resistance designated generally as 176. A potential may be established across each resistor 176 of a battery 178, so that the potential of the first thyratron is considerably lower than the potential of the nth thyratron, with the intermediate thyratrons being at
equally different voltage levels. The entire voltage divider circuit comprising a battery 178 or other suitable source may be replaced by a delay circuit 180 to permit the gain in the thyratron 102 to be adjusted. The output of circuit 180 may then trigger the horizontal sweep in the reproducer 102. At the same time, a video output to the reproducer 102 will be made available on a line 182 (Fig. 5) coupled through a capacitor 184 to the cathode circuit of each of the thyratrons. That is, each cathode 186 of the thyratrons will be connected to ground through a cathode resistor 188.

The voltage divider circuit comprising the resistors 176a, b, etc. will be connected to be biased on a negative-going simulation of the delayed horizontal sweep in reproducer 102 so as to progressively move the entire set of anode voltages of thyratrons 154 toward a more negative value. The simulated sweep will be triggered at the same time as the actual sweep, but will be adjustably amplified under control of circuit 100 (Fig. 3). The anode voltage of the first thyratron will have previously been adjusted to be just above the threshold of conduction. With the other stages of the thyratron chain progressively above the threshold of conduction. Accordingly, as the anode voltages are decreased by reason of the simulated sweep voltage, the first thyratron will be cut off (if conducting). Then the second thyratron will be cut off (if conducting) and so forth through the complete chain of thyratrons. Each time a cut-off thyratron is cut off, a voltage pulse will appear on video output line 182 because of the cancellation of the previously existing voltage drop across the cathode resistor 188 of the thyratron involved. However, if the tube was not conducting, there will be no voltage drop and no pulse will appear on line 182. Accordingly, it will be apparent that as the thyratrons are cut off, either a pulse or no pulse will appear on line 182 as the horizontal sweep progresses in the reproducer 102. The pulses will represent "blacks" and can be employed to decrease the intensity of the video of the reproducer 102 to create a "black" on the reproduced copy. The "whites" can be similarly produced in the justified copy by reason of the absence of a pulse on line 182. In this instance, the length of the justified line will be dependent upon the length of the horizontal sweep in reproducer 102. That is to say, the line of information will be available in the chain of thyratron tubes and are available on the line 182 whenever the simulated sweep voltage reaches predetermined values. Where the gain of the simulated sweep voltage in reproducer 102, as adjusted by circuit 100, is arranged to have the simulated voltage at a maximum after the spot has travelled a relatively short distance across the tube face, the justified line will be shorter than the corresponding line from the copy. However, where the sweep is adjusted to reach the maximum value only when the spot is completely across the reproducer tube face, then the justified line will be longer than the line in the copy.

Referring now to Figure 6, an alternative embodiment of an automatic justification system is illustrated. In this embodiment the requirement for storage of the video information is dispensed with and replaced with an arrangement for re-scanning each line after the length adjustment has been determined. A vertical sweep synchronizing generator here designated 82 will be arranged to develop a vertical sweep in "steps," there being enough elapsed time at each step to permit two horizontal sweeps in the pick-up device 80. Stepped sweeps may be generated by stepping oscillators, as is well-known in the art. The horizontal synchronizing pulses will be applied to the input of a flip-flop circuit 200 which will alternately open first a gate 202 and then a gate 204. The first sweep along a line of the copy will be gated open opened so that the video signal applied to the line length measuring device 86. This will act through the solenoid coil 90, armature 92, and arm 96 to establish a "justified" sweep in reproducer 102. Then, the next horizontal pulse issuing from circuit 82 will serve to close gate 204 and open gate 202. Since the second horizontal sweep will be at the same vertical "position" on the copy, an identical stream of video information will now flow over line 206 to the reproducer 102. The horizontal sweep of reproducer 102 will be simultaneously triggered over line 208 to start the horizontal sweep in reproducer 102. Again, the physical inertia of armure 92, arm 96 and so forth will serve to establish an average justified line length at reproducer 102. A voltage available on line 210 may be employed to blank the reproducer when no input is applied over line 206.

An extension of the foregoing embodiment may be to utilize a lesser number than half of the sweeps for length measurement. In fact, only one length sweep could be relied upon, per line of characters on the copy.

A further modification of the automatic adjust circuit may be to apply the video signals directly to the line length measure device 86 and directly to the reproducer 102 without regard to storing the video signal (Fig. 3) or to alternately detecting line length and reproducing the video information (Fig. 6). With a simultaneous application of video information to both circuits 86 and 102, if the solenoid arrangement comprising armature 92, etc. is caused to have considerable inertia, then instead of using a raster at the pick-up device 80 will ultimately result in the armature 92 reaching a quiescent position which will represent the average length of the copy line in general. The reproducer 102 then will produce a line which is justified to fairly close tolerances. After the stated quiescent condition has been reached, the reproduced line may be photographed. Moreover, where markers at the beginning and end of the lines are employed to operate the length sensing means, the sweep adjustment of reproducer 102 will occur immediately, and the reproduction may be continuously exposed to the reproducer light output.

From the foregoing detailed description of various embodiments of my invention, it will be apparent that basically I provide unique methods and apparatus for photo-composing, justification and the like, which may provide a completely automatic system for justifying type. Also, it is apparent from the foregoing that various manipulations of the viewing apertures and both horizontal and vertical gains a complete sheet of copy or subportions thereof may be distorted as desired to provide photo-composing in general.

It will be understood that the foregoing detailed description has been merely for purposes of illustration and is not intended to limit the scope of my invention. On the contrary, the scope of the invention is to be determined from the appended claims.

I claim:
1. In apparatus for line justification, first scanning means for scanning in closely spaced paths of predetermined length over copy in the direction of lines of characters appearing on the copy, the aforesaid means including a means for sweeping an electronically responsive means over an entire line length on the copy, means to maintain the copy in operative proximity to the first scanning means, reproducing means responsive solely to the signals generated by the sweeping of the above electricity means over the copy and including second scanning means for reproducing the copy, and means for modifying at least one dimension of the reproducing scanning pattern with respect to the dimension of the scanning pattern of the first scanning means, the last-mentioned means compris-
ing means to detect the length of lines of characters on the copy, the detecting means including means for automatically adjusting the second scanning pattern in the direction of lines of characters on the copy so that the lines of characters reproduced in the second scanning pattern are of equal length.

2. In apparatus for line justification, first scanning means for scanning in closely spaced paths of predetermined length over copy in the direction of lines of characters appearing on the copy, the aforesaid means including a means for sweeping an electronically responsive means over an entire line length on the copy, means to maintain the copy in operative proximity to the first scanning means, means to deflect the first scanning means in two directions to develop a scanning pattern over the copy, reproducing means responsive solely to the signals generated by the sweeping of the aforesaid means over the copy and including second scanning means for reproducing the copy, and means for modifying at least one dimension of the reproducing scanning pattern with respect to the dimension of the scanning pattern of the first scanning means, the last mentioned means comprising means to detect the length of lines of characters on the copy, the detecting means including means for automatically adjusting the second scanning pattern in the direction of lines of characters on the copy so that the lines of characters reproduced in the second scanning pattern are of equal length.

3. In apparatus for line justification, first scanning means for scanning in closely spaced paths of predetermined length over copy in the direction of lines of characters appearing on the copy, the aforesaid means including a means for sweeping an electronically responsive means over an entire line length on the copy, means to maintain the copy in operative proximity to the first scanning means, means to deflect the first scanning means in two directions to develop a scanning pattern over the copy, reproducing means responsive solely to the signals generated by the sweeping of the aforesaid means over the copy and including second scanning means for reproducing the copy, and means for modifying at least one dimension of the reproducing scanning pattern with respect to the dimension of the scanning pattern of the first scanning means, the last mentioned means comprising means to detect the length of lines of characters on the copy, the detecting means including means for automatically adjusting the second scanning pattern in the direction of lines of characters on the copy so that the lines of characters reproduced in the second scanning pattern are of equal length.

4. In apparatus for line justification, first scanning means for scanning in closely spaced paths of predetermined length over copy in the direction of lines of characters appearing on the copy, the aforesaid means including a means for sweeping an electronically responsive means over an entire line length on the copy, means to maintain the copy in operative proximity to the first scanning means, means to deflect the first scanning means in a single direction and means to move the copy relative to the first scanning means in a direction substantially at right angles to the single scanning direction to develop a scanning pattern over the copy, reproducing means responsive solely to the signals generated by the sweeping of the aforesaid means over the copy and including second scanning means for reproducing the copy, and means for altering the length of the scan of the first scanning means, the last-mentioned means comprising means to detect the length of lines of characters on the copy so that the lines of characters reproduced in the second scanning pattern are of equal length.

5. Apparatus as in claim 1 and further including storage means for storing signals representing indicia sensed by the first scanning means for a time period sufficient to permit modification of the second scanning means by the adjusting means.

6. Apparatus as in claim 2 and further including storage means for storing signals representing indicia sensed by the first scanning means for a time period sufficient to permit modification of the second scanning means by the adjusting means.

7. Apparatus as in claim 3 and further including storage means for storing signals representing indicia sensed by the first scanning means for a time period sufficient to permit modification of the second scanning means by the adjusting means.

8. Apparatus as in claim 4 and further including storage means for storing signals representing indicia sensed by the first scanning means for a time period sufficient to permit modification of the second scanning means by the adjusting means.

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