April 2, 1963 A. TROUP ET AL 3,083,624

PHOTOCOMPOSING AND JUSTIFYING APPARATUS

Filed May 7, 1959 4 Sheets-Sheet 1

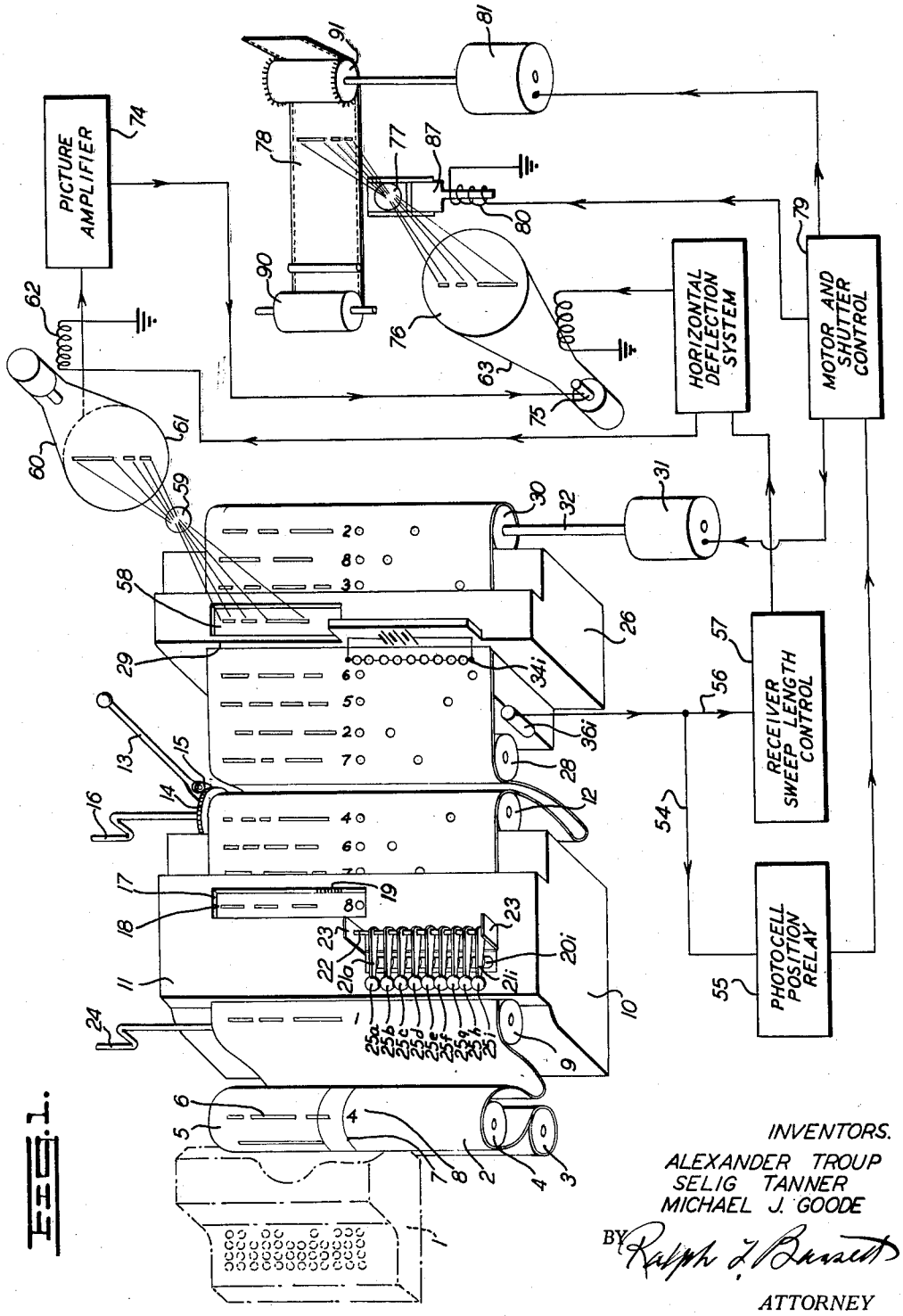


FIG. 1.

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PHOTOCOMPOSING AND JUSTIFYING APPARATUS

Filed May 7, 1959 4 Sheets-Sheet 2

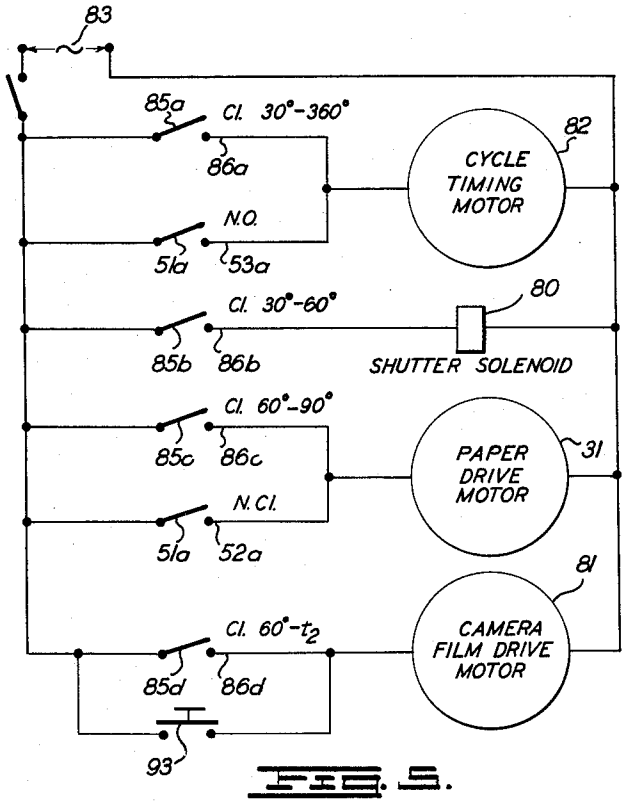


FIG. 5.

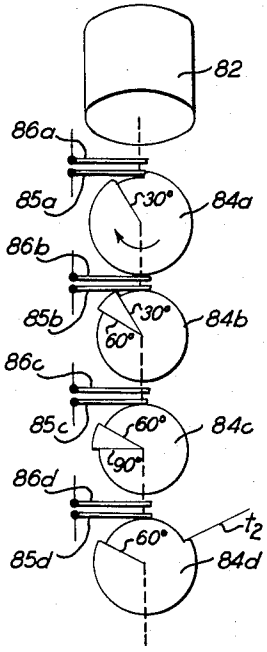


FIG. 6.

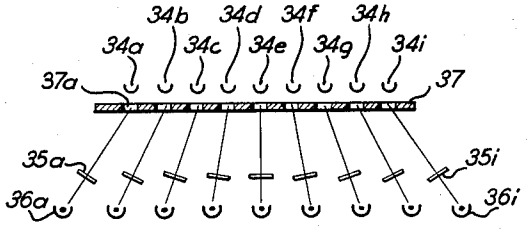


FIG. 2.

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PHOTOCOMPOSING AND JUSTIFYING APPARATUS

Filed May 7, 1959 4 Sheets-Sheet 3

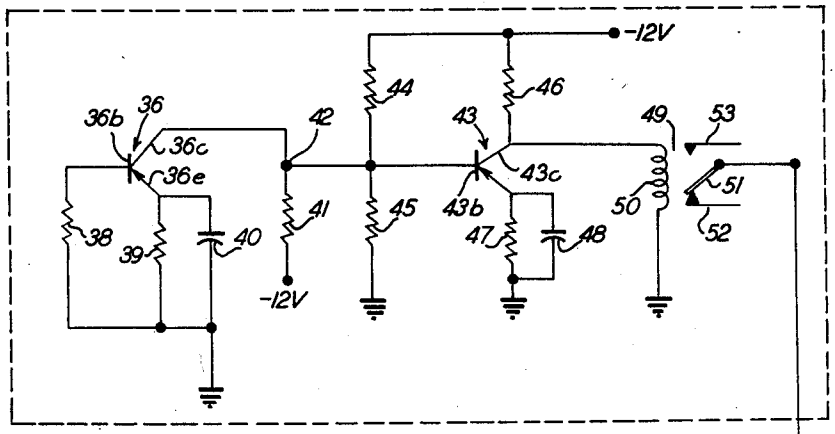


Fig. 3A.

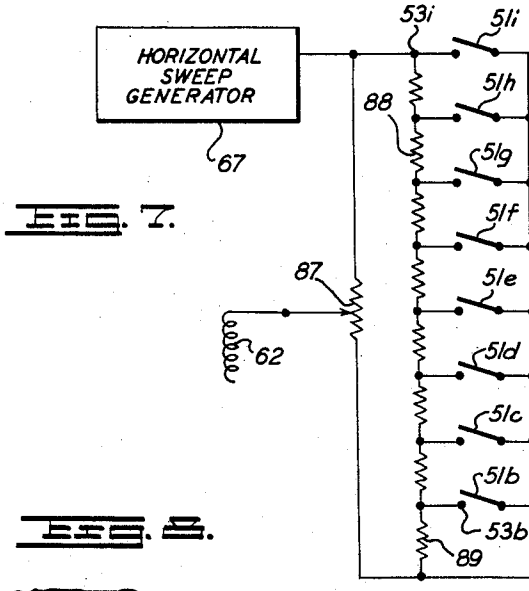


Fig. 7.

Fig. 8.

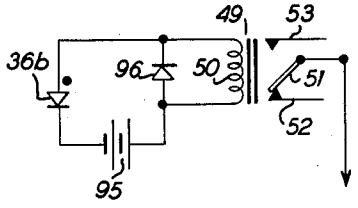


Fig. 3B.

ABC

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PHOTOCOMPOSING AND JUSTIFYING APPARATUS

Filed May 7, 1959 4 Sheets-Sheet 4

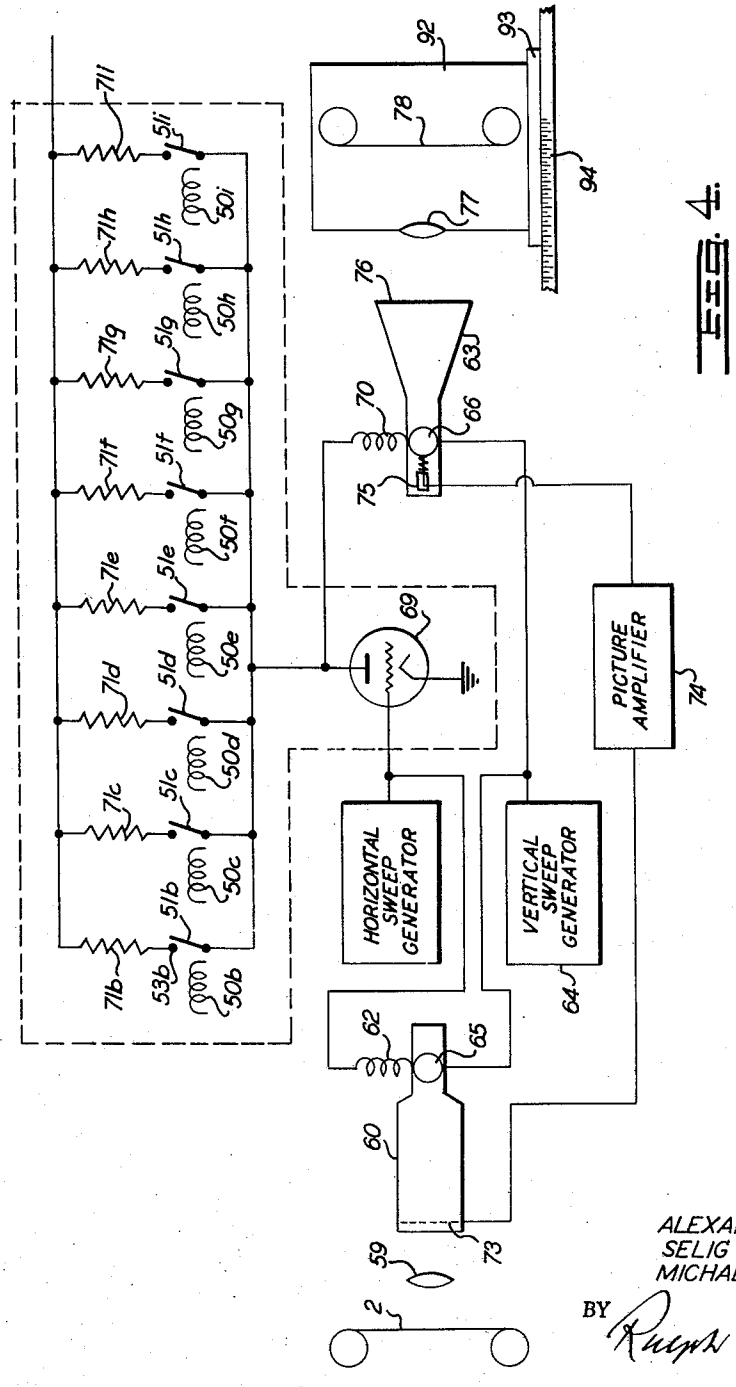


Fig. 4

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United States Patent Office 3,083,624 Patented Apr. 2, 1963

3,083,624 PHOTOCOMPOSING AND JUSTIFYING APPARATUS

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Filed May 7, 1959, Ser. No. 811,570
11 Claims. (Cl. 95—4.5)

Photocomposing machines of the prior art have employed television techniques to successively transpose individual characters from a matrix onto a photosensitive surface. In this invention complete lines of typed matter are similarly transposed to a film and justified by expansion of the lateral scale of an image formed on a cathode ray tube.

From their earliest beginnings, standards of printing practice have included the requirement of a fixed columnar width; each whole line of characters must fully extend to fixed marginal limits. Since grammatical propriety permits division of words only in syllabic increments, it is generally true that the full line can be set in a width less than the limiting width by as much as the length of the longest syllable plus one space. The lateral adjustment of type characters in a line to the marginal limit of the column is known in the art as justifying the type.

In the prior art, justifying has generally been accomplished by adjusting the spacing between words and/or between the characters of each word. The characters themselves were maintained of fixed vertical to lateral proportions. Indeed the revolution introduced by Gutenberg's use of movable type was in a sense based on the use and re-use of characters of fixed proportions. The mechanization of the type setting processes of the latter 19th century: the Mergenthaler Linotype machine in 1884; the Lanston Monotype machine in 1892; did nothing to change the expediency of fixed-proportion characters.

The widespread use of fixed character justifying by spacing adjustment has tended to obscure the other possibilities: (1) that the type characters be laterally expanded to occupy greater width in the line; or (2) that both type characters and spaces be laterally expanded to the extent required to fill the column width. In this invention, the latter possibility is fulfilled by a novel combination of components, mechanical, electrical, electronic, optical and photographic.

In brief, the printed matter of this invention is prepared on an electric typewriter with proportional characters and spacing in lines of randomly varying width. Eight spaces are allowed for the length deficiencies inherent to proper syllabic termination of a line. A justifying number, indicative of the spaces between the last character and the maximum line width, is noted by the typist in the right hand margin. The copy is then transferred to an editing position where a hole is punched in the right hand margin at a station of lateral position unique to the index number. After editing, the copy is transferred to a pick-up machine where it is automatically advanced to a viewing position. An optical image of the typed line is projected onto the screen of a vidicon pickup tube; a video signal transfers the image from the vidicon to a cathode ray TV display tube. Simultaneously a photosensitive detector senses the lateral position of the justifying hole. Circuits responsive to the hole position provide automatic adjustment of the horizontal sweep width on the display tube. In this way each line is laterally expanded, or "stretched" an amount just sufficient to extend it to the right hand marginal limit. As

a result both spaces and characters are adjusted a fixed percentage.

An image of the line so justified is projected onto a photosensitive film in a camera. After a timed exposure, the camera shutter closes, the film is automatically advanced one line space, and the copy is automatically advanced on the pick-up machine until the next line of the text arrives in the viewing position. Here the cycle is repeated, as described above. The photographic image of the justified copy is directly applicable to production of plates for photo-offset or lithographic printing processes.

It is thus a general object of this invention to provide a new and useful photocomposing apparatus wherein a text in typewritten form with varying line widths is transposed into a photographic image of constant or justified width.

It is another object of the invention to provide an apparatus with which pictorial or display matter, as well as printed matter, may be transposed onto a photocopy.

It is another object of the invention to provide justification by means of high resolution television system in which the horizontal sweep length of the receiving tube is automatically varied to produce constant line width.

It is another object of the invention to permit transmission of the copy matter to remote receiving locations over video transmission lines.

It is another object of this invention to provide a system in wich type editing can be simply and inexpensively accomplished by cutting and gluing in inserts on the copy matter.

It is another object of the invention to permit the typist to abandon a line of text material in which an error is detected and retype it on a new line, whereby only the corrected line will be reproduced and editing time is saved.

It is another object of this invention to permit the editor of the typed copy to elect to skip one or more spaces between copy lines on the photo image.

It is another object of this invention to provide an effective control system for locating the copy matter in exact registry with the vidicon pickup station, irrespective of copy line spacing.

It is a further object of the invention to provide means for accurately gauging the spacing of lines on the justified photocopy.

Another object of the invention is the provision of light print against a dark background for copy material as particularly compatible with superior kinescope system performance.

These and other objects of the invention will become apparent from the following detailed specification and appended claims, in which:

FIG. 1 is a schematic representation of the components of the overall system;

FIG. 2 shows one arrangement for the array photosensitive detectors for the indexing and justifying coded perforations;

FIG. 3A shows a circuit by which each photosensitive pickup may trigger a relay;

FIG. 3B shows an alternate embodiment of the circuit shown in FIG. 3A;

FIG. 4 is a horizontal sweep deflection circuit for the receiving kinescope showing the relay system for selection of resistance for justifying by sweep length modification;

FIG. 5 is a diagram of the paper and film-driven motor controls and the camera shutter control;

FIG. 6 shows the switch actuating cams as driven by the cycle timing motor of FIG. 5;

FIG. 7 shows an alternate arrangement for the system shown in FIG. 4;

FIG. 8 shows the preferred appearance of the matter to be copied as white characters on a dark background.

Referring now to the figures in which like reference characters denote like components throughout the several views, the general scheme of operation will now be described with reference to FIG. 1. The text copy matter to be prepared for printing is copied with a commercially available typewriter **1** onto paper **2**. The paper will normally be supplied from storage on roll **3** and is withdrawn therefrom onto typewriter roller **4** as rotated by the typist in his normal line spacing manipulation.

The paper width is roughly divided into two regions: the left hand portion contains the columnar text; the right portion contains the justifying coding, line spacing, and indexing information. For purposes of illustration the copy paper is shown in FIG. 1 to be 10 units in width. Proceeding from left to right, the left hand margin **5** is set one unit from the left hand edge. In order for a line to be justified the text material **6** must occupy more than three, but not more than four units to the right of the margin. The type characters for this example are ⅛ unit in width so that up to eight spaces may be left vacant short of the right hand marginal limit **7**. The number of vacant spaces remaining is counted by the typist and recorded at position **8** within the next one-half unit to the right of the text, that is between 5 and 5½ units from the left edge.

Should the typist make and/or discover an error in a line it will usually be quicker to re-type that line on the next regular space than to correct the error. As will be described later, this invention permits a line or lines to be discarded at the option of the operator. If a line is to be discarded the typist will designate position **8** with an appropriate character, such as the integer **9** or the letter X.

As the typing and justifying or discard information is completed, the paper is rolled out of the typewriter in the normal manner. The copy may be completely removed from the typewriter before further processing, or, as is illustrated in FIG. 1, it may be fed directly into the editing table **10**.

The editing table provides apparatus for insertion of the justifying coding in the right hand portion of the copy sheet as well as a convenient platform for eding the typed copy. The typed copy will be started sufficiently down from the top of the paper to provide a leader of blank paper which can be inserted through bridge **11** and into engagement with roller **12**. Positive driving thrust from roller **12** to paper **2** may be provided by suitable standard means, such as a pressure roller or by marginal perforations engaged by sprocket teeth in the roller; to enhance clarity in the illustration these are omitted from FIG. 1. Once the paper is engaged on roller **12**, it may be advanced by manual reciprocation of lever **13** engaging roller **12** by means of ratchet **14** and pawl **15**. It may also be advanced more rapidly by rotation of handle **16**.

At the left side and forward end of bridge **11** a generally rectangular aperture is provided to form a frame bounding editing station **17**. A pointer **18** protruding from the left hand side of the station **17** permits accurate positioning of each line by manipulation of lever **13**. It may be reversed by rotation of handle **24** connected to roller **9**. A grid of eight equally spaced pointers **19** is provided to correspond to the eight spaces between minimum and maximum right hand marginal limits. These may be used to measure the number of spaces remaining so as to check the justifying information supplied by the typist or to provide this information if it does not appear on the copy or is altered in the editing process.

Once the line of text is positioned opposite pointer **18**, the justifying information may be coded into the paper. In this invention the paper is coded by punching a hole at a lateral station of position unique to the degree of expansion required to justify the line. In the example described in conjunction with FIG. 1, units of paper width left to right from 5½ through ten are used for indexing and justifying coding. Over the center of each half unit of width in this region nine hole-perforation dies 20^{a-i} are positioned by direct connection to levers 21^{a-i} which have fulcrums provided by journals on shaft **22** which in turn is attached through brackets **23** to bridge **11**. On the end opposite the fulcrum, each lever is provided with a finger key 25^{a-i}. Properly positioned female cutter dies are positioned below the plane of the paper to facilitate penetration by punch **20**. Each key is provided with means to restore it to the retracted position after it is depressed.

To aid in identifying their function, each key **25** may be marked with an appropriate code. The leftmost key 25^{a} is depressed for each line which is to appear on the finished photocopy. It may be designed by a check √. If a line has been abandoned by the typist in favor of a corrected line in the next regular line space, the line to be abandoned is not punched with the check key 25^{a}. The remaining keys 25^{b-i} will be marked to correspond to the justifying coding, that is the number of spaces between the end of the typed line and the right hand marginal limit.

It will be noted from FIG. 1 that the line in which the justifying and indexing coding is punched is some distance below the typed line to which it pertains. This is arranged to avoid mechanical interference between the optical viewing of the line and the sensing system for the punched holes, both in the copying machine to be described hereafter. In the example depicted in FIG. 1, each line of text matter is triple spaced and the coding information for a given line is punched opposite the line six spaces below it.

The task of editing the typed text is greatly simplified by the present invention. Since the typist has the option of abandoning any line after an error is perceived, the need for later editing can be almost eliminaed by an observant typist. If editing is required, it can be accomplished by painting out the portion to be changed and re-inserting characters with stamps. Another technique consists in re-typing the correction on a strip of paper which may be glued over that portion of the line which is to be corrected. Still another possibility is to re-insert the copy in a typewriter and copy the line in the space between it and the next line.

As in emergence from the typewriter, the copy paper upon completion of editing may be fed directly into the copying machine desingated generally by reference character **26** or it may be stored for future copying. The continuous process is illustrated in FIG. 1. Here again the extended leader on the paper is utilized to permit feeding through the machine, in this case over entry roller **28**, under bridge **29** and into engagement with driving roller **30**. Once engaged the paper is automatically driven through the copying machine **26** by an electric motor **31** connected through shaft **32** to driving roller **30**.

The copying machine **26** is provided with two stations, offset with respect to each other a distance identical to that established on the editing table. At the right hand station, a plurality of photosensitive relay circuits are provided to identify the location of indexing and justifying code holes previously punched on the editing table **10**. With reference also to FIG. 2, for the nine hole system illustrated herein each possible hole position is instrumented with one of nine light sources 34^{a-i}, positive lenses 35^{a-i}, and photocells 36^{a-i}. Corresponding to each possible perforation position, a plate **37** is provided with nine holes, spaced one-half a width unit apart. The lenses **35** serve to focus the light passing through a given hole onto a particular photocell to the exclusion of all others. The ability to focus a photocell on a particular hole makes it possible to separate the photocells **36** more than the spacing between the holes

on the copy paper, thus allowing adequate space for the photocells and associated circuitry.

The electrical signal output from many types of photosensitive detectors **36** will not be sufficient to energize an electromagnetic relay switch directly and/or at a distant location. Accordingly a stage of amplification may be inserted, such as the one shown in FIG. 3A. Transistor elements are ideally suited for this application: their compact size permitting incorporation of the circuits within the physical confines of the copying machine, their low voltage requirements eliminating this source of shock hazard at the copying machine. In the circuit shown in FIG. 5, photo-transistor **36**, such as a type GT66, is located so as to receive the light from a particular lamp and hole. Both base 36^b and emitter 36^e are resistively coupled to ground: the base through resistor **38**; the emitter through resistor **39** in parallel with capacitor **40**. A source of negative D.C. voltage is supplied to the collector 36^c through load resistor **41**. Connected in this way transistor **36** functions essentially as a diode, its resistance varying as the light input, thereby producing a signal at point **42**.

The amplification stage is valved by transistor **43**, of which the base 43^b is biased by its connection between voltage dividing resistors **44** and **45** connecting a negative source of direct current to ground. The collector 43^c is energized by its connection to the negative source through load resistor **46**. The emitter is grounded through resistor **47** in parallel with capacitor **48**. A relatively large capacitance is employed at **48** tending to stabilize relay actuation. A sensitive relay switch **49** actuated by this circuit has its solenoid coil **50** connected at one side to collector 43^c and at the other side to ground. A single pole double throw switching is provided between movable contact **51** and stationary contact **52** normally closed and **53** normally open. In operation the optical system for each aperture provides sufficient illumination at photo-transistor **36** to trip the relay **50** and thereby to close the contact between **51** and **53**.

There are now available certain types of photo diodes having sufficient current carrying capacity and sensitivity to trip a sensitive relay without additional amplification. A suitable circuit utilizing such a detector is shown in FIG. 3B, where a photo diode 36^b, such as a Clairex CL–2P, is connected in series with a source of D.C. potential **95** and relay coil **50**. The diode **96** connected in parallel with coil **50** serves to discharge the relay coil. With the light intensity which is collected at the detectors **36** from lamps **34** in this machine and a 24 volt source **95**, a one milliamp relay with a resistance of 5000 to 10000 ohms can be actuated.

A suitable relay actuating circuit, such as that shown in FIG. 3A or FIG. 3B, is provided for each of the nine photocells 36^{a-i}. The circuit serving the left-most, or positioning hole, designated as block **55** in FIG. 1, is connected to its photo-detector by line **54**. The remaining light circuits are designated as block **57** connected to the justifying photo-detectors by line **56**. The parts of these circuits specific to a given channel will be designated by the numerals shown in FIG. 3 followed by a lower case letter *a–i* corresponding respectively to each of the nine photo-detector channels.

The relay coils **50** in general will be remotely positioned with respect to the detector and amplifier circuits. The requirement of only a low voltage for operation of the photo-detector circuits will thus be seen to be of considerable advantage, as one source of shock hazard about the copying machine **26** will thus be eliminated, and the substantial signal at collector 43^c permits operation of the relay at locations remote from the photo-detector elements.

Since a hole in the "*a*" position will be punched for each line which is to be copied, arrival of such a hole will energize relay coil 50^a, opening the circuit normally established between contacts 51^a and 52^a, thus stopping the paper drive motor **31** (FIG. 4). The paper is stopped with the line to be copied accurately positioned in copying frame **58**. Deferring for the moment the explanation of the motor controls, the transformation of the unjustified copy in frame **58** into justified line on a film will now be considered. Suitable illumination will be provided within frame **58** so that a bright optical image of the line may be projected by lens **59** onto the high resolution vidicon tube **60**. The signal electrode **61** of such a tube is scanned by an electron beam which is horizontally deflected by coil **62**.

In commercially available industrial television systems, an image projected on the camera tube is transferred to the receiving cathode ray tube without change in proportions. In this invention the scale of one of the sweeps must be controllably varied in increments which will justify the printed line. A system by which this result is accomplished is illustrated in FIG. 4 taken in conjunction with FIG. 1. Both vidicon pickup tube **60** and cathode ray display tube **63** will be served to advantage by the same sources of vertical and horizontal sweep. Since the vertical scale is not altered, the signal from a vertical sweep wave generator **64** may be applied in fixed proportion to both the vertical deflecting coil **65** of the vidicon and the vertical deflecting coil **66** of the cathode ray tube. With the horizontal sweep, or that in the direction of the type printed line, the same generator **67** may serve both tubes provided that the proportion of the signals delivered to the cathode ray tube may be varied. To accomplish this, the output of the horizontal sweep generator is fed directly to horizontal deflecting coil **62** of the vidicon, while the same signal is selectively reamplified with electron tube **69** before it is fed to horizontal deflecting coil **70** of the cathode ray tube **63**. The amplification factor of tube **69** is varied by changing the value of its anode resistance **71**. As previously described, relay coils 50^{b-i} are selectively energized in correspondence with the lateral position of the justifying index hole for each line. The resistance values 71^{b-i} are selected so as to "stretch" the typed line just sufficiently to bring it to a constant length on the cathode ray tube. In the system described, proceeding in order from actuation of relay 50^b to 50^i, the extra amplification required will increase, requiring correspondingly increased values of anode resistance **71**. The required values of these resistances will depend upon characteristics of tube **69** and associated circuit parameters. Proper values may be readily selected either by circuit analysis or by experiment. Appropriate connections in the horizontal sweep circuit are here designated as line **68** for control grid input, **72** for cathode connection, **73** for anode to load resistance connection, and **71** for output connection. Proper components for these connections will be apparent to those skilled in the art and are provided in commercially available industrial television systems.

Once the proper relationship between raster proportions has been established, the picture information may be transferred. Thus the electrical output appearing on the signal electrode **73** of vidicon **60** may be amplified in picture amplifier **74** and thence applied to intensity modulation electrode **75** of cathode ray tube **63**. Appearing on screen **76** is a justified copy of the typed line from paper **2**. An image of this copy is focused onto photosensitive film **78** by means of lens **77**. Film from a storage spool **90** is drawn across the focal plane with sprocket roller **91** driven by motor **81**.

During transfer of the typed line from vidicon to cathode ray viewing tube, both paper **2** and film **78** must remain stationary. After a properly timed exposure the paper must advance until the next line reaches the center of viewing frame **58**, and the film is moved the desired spacing between lines on the photocopy. A suitable control system for regulating these movements is designated generally as motor and shuter control **79** of FIG. 1 and is shown in detail in FIGS. 5 and 6. Paper

drive motor **31**, film drive motor **81**, and shutter solenoid **80** provide the actuation; a timing cam switch motor **82** and photosensitive relay switch **50**[a] provide the control action. For simplicity, all motors will be assumed to run at constant speed while energized and to stop instanly when de-energized, although this idealized condition is not a necessary one. To begin the cycle, motor **31** may be considered to be driving the paper through the copying machine. When an indexing hole arrives at hole **37**[a] in plate **37** (FIG. 2) relay switch **55** is actuated, thereby connecting contacts **51**[a] to **53**[a] so as to apply power from source **83** to cycle timing motor **82.** Simultaneously contacts **51**[a] to **52**[a] are opened so as to remove power from paper drive motor **31.** The typed line on paper **2** comes to rest at the proper viewing position in frame **58** so that its image may be transferred to the screen **76** as previously described. After the cycle timing motor turns through 30 degrees, cam **84**[a] closes contacts **85**[a] and **86**[a] thereby holding the cycle timing motor on during a complete rotation of the cam to 360 degrees. At 30 degrees cam **84**[b] closes contacts **85**[b] to **86**[b], thereby actuating the shutter solenoid **80**, exposing the film **76** to the justified image. Shuter **87** may be timed by the dwell of cam **84**[b], shown by way of illustration to terminate at 60 degrees, or it may be timed by a mechanical timer of the type employed in photographic camera construction. Assuming that the shutter will be closed at 60 degrees, cam **84**[c] connects contacts **85**[c] to **86**[c] thereby starting paper drive motor **31.** After a short time, the indexing hole in the paper will move forward, cutting off the light to photocell **36**[a], thus connecting contacts **51**[a] to **52**[a] to hold on motor **31.** The switch contacts **85**[c] to **86**[c] may then be released, shown by way of illustration to occur at 90 degrees, and the paper will advance until the next indexing hole arrives at the photocell station.

The film drive motor **81** is started at 15 degrees by action of cam **84**[d] on contacts **85**[d] and **86**[d]. Cam **84**[d] is adjusted to open its switch at t_2 or the interval required to drive the film **78** a distance equal to the desired spacing between lines on the justified photocopy. At 360 degrees the cycle timing motor stops itself with cam **84**[a] and with the paper either arriving or having arrived in position, the cycle starts anew.

It will be noted that the speed of the camera drive motor **81** must bear a fixed ratio to the speed of the cycle timing motor **82** to obtain precise spacing of lines on the photocopy. In practice this is readily accomplished with small A.C. synchronous motors of gear ratio selected to effect the proper driving speeds. The paper drive motor may also be of the synchronous type although it need not be as its control is effected by the photosensitive relay, rather than by the timing motor.

Several advantages derived from use of the control system of this invention will now be apparent. It is well known in the art that much of the editing of typed script is consequent of typographical errors which are immediately apparent to the typist. In this system, such a line may be abandoned, simply by omitting the indexing perforation. The paper drive will thus continue until the next perforation arrives in position, thereby passing over the line or lines to be abandoned. In the meantime the film will advance only one space.

Should the editor desire to skip a space on the photocopy this can be accomplished by insertion of an extra indexing hole between the typed lines so that an exposure will be made with no typing in view. It will in general be preferable, however, for the typist to determine the extra space by omitting the type from a regular line.

An alternate system for adjusting the scale ratio between horizontal sweep lengths on vidicon **60** and cathode ray tube **63** is shown in FIG. 7. Here the output of the horizontal sweep generator **67** is applied directly to a voltage dividing network. The sweep generator signal is assumed to be of sufficient amplitude to effect the most expanded scale of cathode ray tube sweep and more than sufficient to fully sweep the vidicon. The portion of the signal required to full sweep the vidicon is picked off by adjustment of potentiometer **87**, connected to vidicon horizontal deflection coil **62.** The incremental expansion of the cathode ray tube sweep is accomplished by tapping resistor **88** at various points by appropriate actuation of one of the photosensitive justifying switches **51**[b–i] connected in common to deflection coil **70.** The range of expansion of about 25% required for this system would require the total resistance **89** to be about three times that comprised in tapped resistor **88.** The use of fixed resistors forming a voltage divider for scale adjustment has the advantage of excellent stability, being independent of changing characteristics of an amplifier tube such as **69** of FIG. 4. Since the ratio, and not the absolute magnitude of the sweep signal, is the critical parameter for exact replication of images, stability of this ratio is a highly desirable feature.

Reduction to practice of this invention has revealed that superior photocopy is obtained by use of a white type character on a dark background, as shown in FIG. 8. This may be provided by use of a white typewriter ribbon on a dull black paper. In this way small "pin hole" imperfections which characterize the white areas of high contrast photocopy are eliminated. A further advantage is realized in the production of a "positive" image on the first photocopy, that is dark type on light field after one reversal inherent in the photographic process. It thus becomes possible to project the image directly onto a sensitized metal plate which may be processed for direct application to lithographic printing.

An important advantage of this machine is its adaptability to the copying of illustrations directly onto the photocopy without requiring additional apparatus. To insert an illustration the operator would superimpose the illustration directly over the columnar text matter at frame **58** (FIG. 1). Switch **93** (FIG. 5), permitting manual bypassing of cam switch **85**[d], is held closed until the film **78** has advanced sufficiently to obtain the column height required for the illustration. The film may then be exposed by manual actuation of shutter **87.** After exposure, the film will normally require further advancement by means of switch **93** until a copy line image will be formed the desired distance below the illustration. If an enlarged picture size is desired, this may be accomplished by expanding the raster size on display tube **63** or by moving up camera **92** on track **94.**

Many types of illustrations may be copied in this manner, as for example, line drawings, original art work, and photographs. If a half-tone image is required, the necessary screen pattern can be obtained by superimposing a suitable mask, such as one obtained with crossed parallel line rulings, over the image face **76** of display tube **63** during exposure of the illustration.

It will be noted in FIG. 4 that the camera **92** is depicted as mounted on a base **93** which may be variably positioned on a calibrated track **94.** The variation in photocopy image size permitted by this adjustment allows the width of the typed line to be expanded to more or less than a standard column width. After movement of the camera, the focus may be restored by manual adjustment of lens **77.**

While the preferred embodiment has been illustrated with the copy paper divided in a manner suitable for copying lines of single column width, the invention is not limited to this specific function. For example, it will be apparent to those skilled in the art that justification of copy two or more columns in width may be accomplished in a manner similar in every respect to that described for the case of single column width.

The system set up for multiple column widths would require, of course, a decreased range of lateral scale expansion. Thus, while justification of a single column

width requires a width expansion of about four percent for each character space, two column width will require only two percent, three column width one and one-third, and so on. The values of justifying resistances **71** of FIG. 4 or of **88** and **89** of FIG. 3A may be suitably altered to obtain a correct sweep-expansion-ratio per character. The distance from the copy matter to the vidicon will also require readjustment to permit the image area **61** to contain the complete line width. Resolving power of the television system will be enhanced by maintaining an image size approaching the available screen width.

It should also be understood that while the preferred embodiment of the invention has been illustrated for a case in which each line of less than columnar width is stretched or expanded to full width, other relative size alterations which would accomplish justification of the type are intended to lie within the scope of the invention. Thus it would be possible to contract, rather than expand, the width to height ratio of each line to a smaller width, such as the width of the shortest possible line. Another possibility would consist of contracting the longer lines and expanding the shorter ones to some intermediate width to height ratio. The latter scheme would require a reduction in the maximum alteration in character proportions, a feature of particular advantage for narrow columns for which maximum alteration will be larger than that for wide columns.

What we claim is:

1. In a photocomposing machine, a source of written copy matter containing a column of unjustified lines of proportional characters and spacing, means for coding each line of said copy in a manner unique to the degree of lateral expansion needed to justify that line, a conveyor for said copy matter, a copying station for said conveyor, means for arresting said conveyor as each line of characters arrives at the copying station, a television pickup tube, an optical system for simultaneously projecting the complete line of copy matter in said copying station onto said pickup tube, a receiving tube, a lateral sweep generator for said receiving tube including an amplifier stage of selectively variable gain, means for transferring the image from said pickup tube onto said receiving tube, photoelectric means for detecting the justifying coding indicative of the justifying requirement of the line, means for automatically selecting the gain of said sweep amplifier in accordance with the justifying coding so as to obtain a fixed line width on said receiving tube, a photosensitive surface, and optical means for projecting the image formed on said receiving tube onto the photosensitive surface.

2. In a photocomposing machine, a source of typewritten copy matter containing a column of unjustified lines of proportional characters and spacing, means for coding each line of said copy with a perforation of lateral position unique to the degree of lateral expansion needed to justify that line, a conveyor for said copy matter, a copying station for said conveyor, means for arresting said conveyor as each line of characters arrives at the copying station, a television pickup tube, an optical system for simultaneously projecting the complete line of copy matter in said copying station onto said pickup tube, a receiving tube, means for transferring the image from said pickup tube onto said receiving tube, photoelectric means for detecting the perforation position indicative of the justifying requirement of the line, means including an amplifier of selectively variable gain connected between said pickup tube and said receiving tube for expanding the width of the line image including both the type characters and spaces formed on said receiving tube in accordance with the perforation position so as to obtain a fixed line width, a photosensitive surface, and optical means for projecting the image formed on said receiving tube onto the photosensitive surface.

3. In a photocomposing machine, a source of unjustified printed matter constituting typewritten lines of randomly varying width, television pickup apparatus, optical means for forming an image of an entire line of said printed matter on said pickup apparatus, a television receiver, means for transposing the image from said pickup apparatus to said receiver, an automatic control system including a sweep circuit amplifier of selectively variable gain for expanding the lateral scale of the image of the type characters and spaces on the receiver to a justified fixed width, and a photographic camera arranged for copying the expanded image appearing on said receiver.

4. In a photocomposing machine, a source of unjustified printed matter consisting of lines of randomly varying width, television apparatus including an image pickup tube, optical means for projecting an image of a complete line of said printed matter on said pickup tube, a television receiving apparatus including a display tube, means for transposing the image from said pickup tube to said display tube, an automatic control system including an amplifier of selectively variable gain for expanding the lateral scale of the image of both the type characters and spaces of the complete line on the display tube to a predetermined width, and a photographic camera arranged for copying the expanded image appearing on said display tube.

5. In a photocomposing machine, a source of unjustified printed matter consisting of lines of type characters and spaces of randomly varying width, television apparatus including an image pickup tube, optical means for projecting an image of a complete line of said printed matter on said pickup tube, a television receiving apparatus including a display tube, means for transposing the image from said pickup tube to said display tube, an automatic control system including an amplifier of selectively variable gain for expanding the lateral scale of the image including both the type characters and spaces on the display tube to a predetermined width, a photographic camera arranged for copying the expanded image appearing on said display tube, and means for variably spacing said camera from said display tube to control the image size.

6. A photocomposing machine for justifying and copying columns of typewritten matter, a television apparatus including a pickup tube and a receiving tube, a vertical electric scanning generator connected to the pickup tube and the receiving tube, a horizontal electric scanning generator connected to the pickup tube and the receiving tube, optical means for projecting an image of a complete line of copy matter including type characters and spaces onto said pickup tube in a direction parallel to the horizontal scanning direction, electrical means for impressing signal impulses generated in said pickup tube upon intensity modulating means in said receiver so as to replicate the line image thereon, a voltage divider inserted between the horiozntal scanning generator and the receiving tube, means to selectively alter the proportion of the horizontal sweep signal obtained from said voltage divider so as to expand the line image including type characters and spaces formed on said receiving tube to a fixed width, a photosensitive surface, and optical means for projecting the justified image on the receiving tube onto the photosensitive surface.

7. In a photocomposing machine, a source of typewritten copy matter containing a sequence of unjustified lines of proportional characters and spacing, means for forming a perforation on the copy matter and associated with each line at any one of a plurality of positions of which each is indicative of a differing degree of line expansion required to justify the line, a conveyor for said copy matter, a copying station for said conveyor, means for arresting said conveyor as a line of characters arrives at the copying station, a television apparatus including a pickup tube and a receiving tube, optical means for projecting an image of the line of characters at the copying station onto said pickup tube, a horizontal electric scan-

ning generator arranged to sweep both the pickup tube and the receiving tube, a vetrical electric scanning generator arranged to sweep both the pickup tube and the receiving tube, electrical means for impressing signal impulses generated in said pickup tube upon said receiving tube to transfer an image of the line therebetween, a photoelectric sensing device for each of said plurality of perforation positions, a relay switch connected to each photoelectric sensing device and arranged to be actuated thereby, an amplifying stage interposed between the horizontal scanning generator and the receiving tube, selected load resistances for said amplifying stage connected to each relay switch and connected to the amplifier stage by selective actuation of each switch so as to expand the line image on the receiving tube to a constant width, a photosensitive surface, and optical means for projecting the justified image from the receiving tube onto the photosensitive surface.

8. In a photocomposing machine, a source of typewritten copy matter containing a sequence of unjustified lines, means for perforating information on said copy in a manner indicative of the spacing remaining between the last character of the line and a justified right hand margin, a conveyor for said copy matter, a copying station on said conveyor, means for arresting said conveyor as each line of characters arrives at said copying station, a television pickup tube, an optical system for projecting the complete line of copy matter in said copying station onto said pickup tube, a receiving tube, a lateral sweep generator for said receiving tube including an amplifier stage of selectively variable gain, means for transferring the image from said pickup tube onto said receiving tube, photoelectric pickup means for sensing the perforation location indicative of justifying requirement for the line, means for automatically selecting the gain of said sweep amplifier to expand the width of the image including the typed characters and spaces formed on said receiving tube in accordance with the perforation location so as to obtain a fixed line width, and optical means for projecting the image formed on said receiving tube onto a photosensitive surface.

9. A photocomposing machine for justifying and copying columns of typewritten matter, a television apparatus including a pickup tube and a receiving tube, a vertical electric scanning generator connected to the pickup tube and the receiving tube, a horizontal electric scanning generator connected to the pickup tube and the receiving tube, optical means for projecting an image of an entire line of copy matter onto said pickup tube so as to be oriented thereon in the horizontal scanning direction, electrical means for impressing signal impulses generated in said pickup tube upon intensity modulating means in said receiver so as to replicate the image thereon, an amplifying stage inserted in the connection between the horizontal scanning generator and the receiving tube, means to vary the load impedance of the amplifying stage in stepwise increments just sufficient to expand the image on said receiving tube to constant or justified breadth, a photosensitive surface, and optical means for projecting the justified image on the receiving tube onto the photosensitive surface.

10. A photocomposing machine for justifying and copying columns of typewritten matter, a television apparatus including a pickup tube and a receiving tube, a vertical electric scanning generator connected to the pickup tube and the receiving tube, a horizontal electric scanning generator connected to the pickup tube and the receiving tube, optical means for projecting an image of a complete line of copy matter onto said pickup tube in a direction parallel to the horizontal scanning direction, electrical means for impressing signal impulses generated in said pickup tube upon intensity modulating means in said receiver so as to replicate the line image thereon, a voltage divider inserted between the horizontal scanning generator and the receiving tube, means to selectively alter the proportion of the horizontal sweep signal obtained from said voltage divider so as to adjust the line image including both the type characters and spaces formed on said receiving tube to a fixed width, a photosensitive surface, and optical means for projecting the justified image on the receiving tube onto the photosensitive surface.

11. In a photocomposing machine, a source of typewritten copy matter containing a sequence of unjustified lines of proportional characters and spacing, means for forming a perforation on the copy matter and associated with each line at any one of a plurality of positions of which each is indicative of a differing degree of line width alteration required to justify that line, a conveyor for said copy matter, a copying station for said conveyor, means for arresting said conveyor as a line of characters arrives at the copying station, a television apparatus including a pickup tube and a receiving tube, optical means for projecting an image of the line of characters at the copying station onto said pickup tube, a horizontal electric scanning generator arranged to sweep both the pickup tube and the receiving tube, a vertical electric scanning generator arranged to sweep both the pickup tube and the receiving tube, electrical means for impressing signal impulses generated in said pickup tube upon said receiving tube to transfer an image of the line therebetween, a photoelectric sensing device for each of said plurality of perforation positions, a relay switch connected to each photoelectric sensing device and arranged to be actuated thereby, an amplifying stage interposed between the horizontal scanning generator and the receiving tube, selected load resistances for said amplifying stage connected to each relay switch and connected to the amplifier stage by selective actuation of each switch so as to alter the line image on the receiving tube to a constant width, a photosensitive surface, and optical means for projecting the image from the receiving tube onto the photosensitive surface.

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