

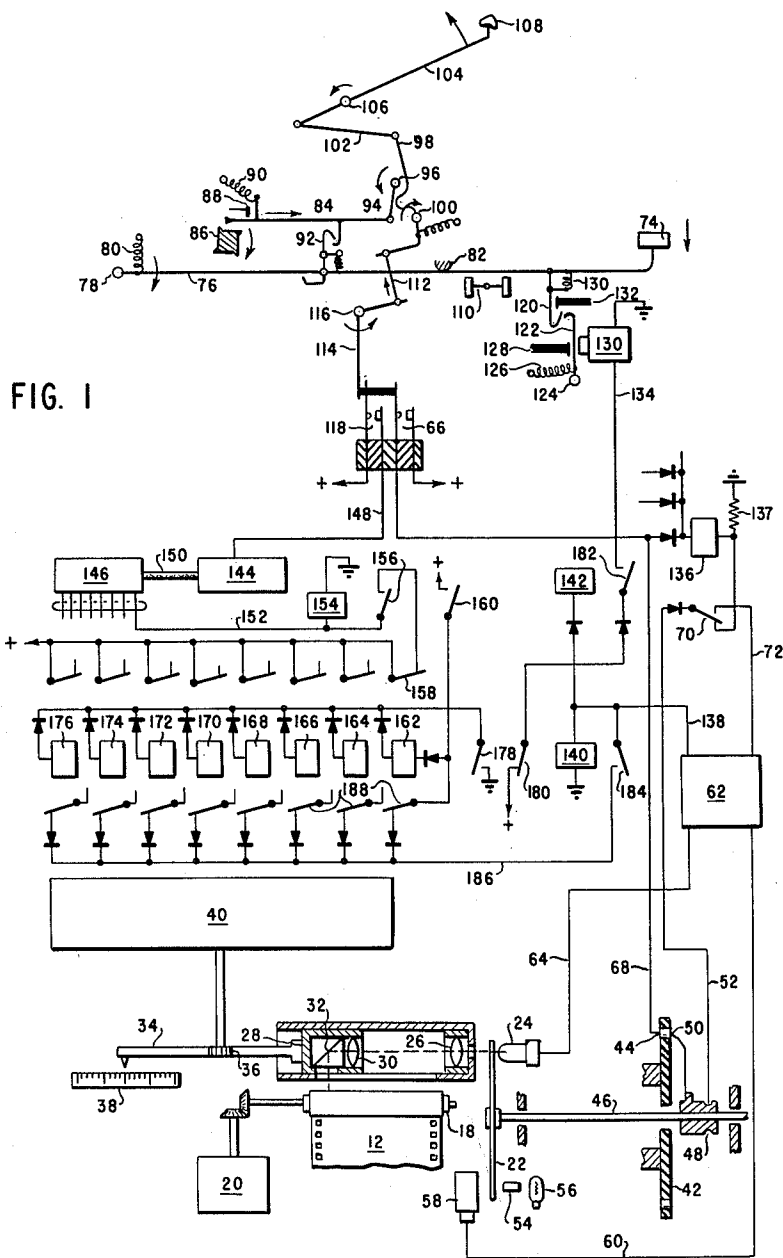
June 18, 1963

R. A. HIGONNET ETAL
PHOTOTYPE COMPOSING METHOD

3,094,050

Filed Aug. 31, 1959

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

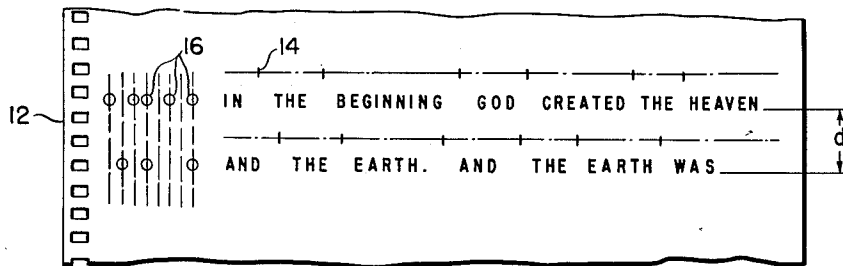


FIG. 2

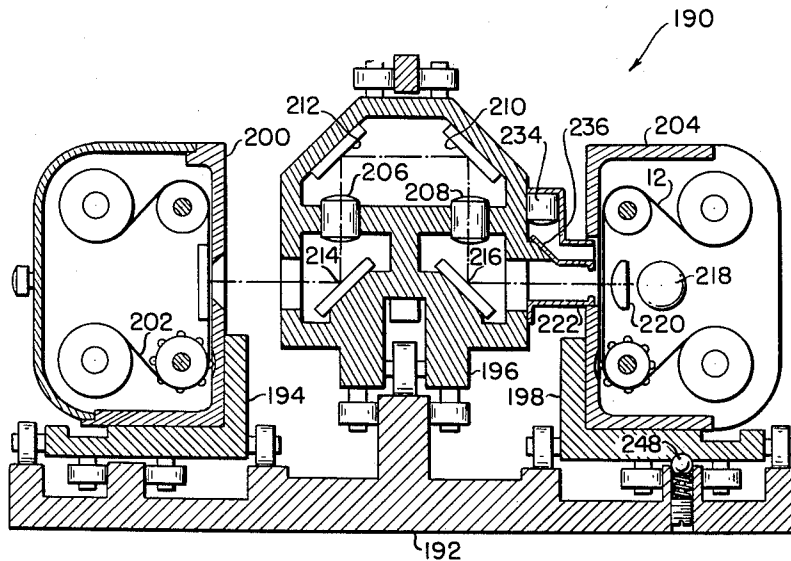


FIG. 3

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3,094,050

PHOTOTYPE COMPOSING METHOD

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Filed Aug. 31, 1959, Ser. No. 837,043

4 Claims. (Cl. 95-4.5)

The present invention relates generally to photographic type composition, and more particularly to a method and apparatus for the photographic composition of lines having characters of variable width, the lines being justified.

One of the objects of this invention is to provide a method and apparatus adapted to separate the functions of composing the lines of type upon a keyboard and transcribing the lines thus composed photographically in justified form. In this way it is possible to carry out the latter function at a rate greater than that at which a single typist can compose the lines at a keyboard and the output of more than one keyboard may be delivered to a single transcribing apparatus.

A second and related object is to provide keyboard-operated means adapted to prepare a photographic record containing the selected characters in a line, indicia at the places where space increments are to be added to the line, and justification information including the space which must be added to the line to justify it.

Another object is to provide apparatus adapted to transcribe the lines appearing on a photographic record prepared in the foregoing manner utilizing the justification information and said indicia to justify the lines.

Another object is to provide a method and apparatus for type composition which may be carried out dependably at a rapid rate.

With the foregoing and other objects in view, the features of the invention include the provision of a keyboard unit and a separate transcribing unit. The keyboard unit is used to prepare a film containing the lines of variable-width characters in unjustified form, this film being transferred to the transcribing unit where it is rephotographed in justified form upon a second film.

According to a second feature, the lines are projected from the film prepared at the keyboard machine to the second film by an optical system having masking means and moving continuously between the films, the line being projected progressively through exposure of a width which is preferably less than that of the smallest character at each instant of time.

According to another feature, the film prepared at the keyboard machine receives successive photographic images of the selected characters in each line, and variable-motion escapement means impart the spaces between successive character projections proportional to their respective assigned widths in accordance with the best typographical practice.

According to still another feature, means are provided for a relative discrete movement of the two films in the transcribing unit at each instant when the sweeping projection system reaches a place in the line previously designated for insertion of a justification increment. In the preferred form illustrated and described herein, the spaces at which increments are to be inserted are designated upon the keyboard-produced film by suitable indicia which may be optically sensed by apparatus supported for movement with the lens system.

Other features of the invention reside in certain features of construction, arrangements of the parts, methods and modes of operation which will be more fully understood from the following description of the preferred

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embodiment of the invention and the method associated therewith.

In the drawings, FIG. 1 is a schematic mechanical and circuit diagram illustrating the essential features of the keyboard unit according to this invention; FIG. 2 is a fragmentary view of a film produced by the machine of FIG. 1; FIG. 3 is an elevation in section of the transcribing unit; and FIG. 4 is a plan view of the transcribing unit of FIG. 3, partially in the form of a block diagram.

Referring to FIG. 2, the keyboard-operated machine of FIG. 1 produces a strip of film 12 on which the selected variable-width characters in each line are photographed in unjustified form with equal word spacing. The lines are spaced on the film 12 by a predetermined distance "d"; and immediately above each word space approximately in the center thereof, there is photographed a mark or indicium 14, the purpose of which is to indicate a place for insertion of a space increment to permit justification of the line in the subsequent transcribing operation.

In the margin of the film 12 adjacent each line, there are provided a number of code punches 16 arranged in binary order, these punches indicating the "line deficit," that is, the total of the required space increments that must be added to the line to justify it.

Referring to FIG. 1, the film 12 is shown supported on a roll 18 which is indexed by a line spacing mechanism 20 to produce the line spacing "d" mentioned above. The characters in each line are projected successively on the film 12 by apparatus of the type described in the patent to Caldwell, No. 2,670,665. Briefly, the system includes an opaque continuously rotatable character disk 22 on which the characters are arranged as transparencies in a circle. Different alphabets or fonts may be arranged on opposite halves of the circle as described in our Patent No. 2,865,270; and the disk 22 may support a number of concentric circles of characters of different styles as described in our Patent No. 2,736,249, in which case provision is made to shift the axis of the disk to present a selected circle of characters in position for optical projection.

The characters on the disk 22 are projected while moving continuously by a flash tube 24 having a discharge time which is extremely short in comparison with the time of passage of a character past a fixed lens 26. The lens 26 is a collimating lens, causing the light from each point in the projected character to reach a movable lens assembly 28 as parallel rays. The lens system 28 comprises a converging lens 30 and a reflecting prism 32, whereby the light is focused on the film 12. The spaces between successive characters are produced by discrete movements of the assembly 28 through a rack 34 engaged with a pinion 36. A scale 38 provides means whereby the operator may see the cumulative length of the line he has composed.

A variable escapement mechanism 40 is operatively engaged with the pinion 36. This variable escapement is preferably of the form described in our Patent No. 2,806,574, or the type described in our copending application Serial No. 590,304, filed June 8, 1956, now abandoned. These escapements each have a number of binary input stages electrically energizable according to the width of each space to be produced by the movable assembly 28.

Means for selection of a particular character for photographic projection comprise a rough control and a precise control as taught in our Patent No. 2,790,362. A stationary disk 42 is supported with a plurality of buttons 44 mounted concentrically about a drive shaft 46 keyed to the disk 22. The shaft may be rotated continuously by any suitable means such as a motor, not shown. A slip-

ring 48 having a wiper 50 secured thereto is keyed to the shaft 46 and is electrically connected with a wire 52. Each of the buttons 44 is associated with a character on the disk 22 and is connected with the wiper 50 during the time interval in which the corresponding character is opposite the lens 26 in position for photography.

The disk 22 also carries a ring of transparent slits or apertures near its periphery in the optical axis of a lens system 54. Each slit is in precise spacial relation to a corresponding character. A continuous light source 56 illuminates the slits or apertures and causes their images to fall upon a photoelectric cell 58, whereby an electrical impulse appears on a wire 60 at the precise instant when each and every character passes through the projection position opposite the lens 26.

A flash circuit 62 is provided for energization of the tube 24 through a wire 64. The flash impulse over the wire 64 occurs only at the instant of an impulse on the wire 60 when a path is completed through the following circuit: from a source of voltage indicated by a plus sign through contacts 66 which correspond with a particular character key, a wire 68, one of the buttons 44, the wiper 50, the lead 52, contacts 70 (when in the position opposite to that illustrated), and a wire 72. The manner in which this circuit is closed is described hereinafter in detail.

In the relay circuits hereinafter to be described, the relay contacts are shown adjacent their respective actuating coils, and in the positions reached when said coils are unenergized. It is also assumed that a source of voltage such as a battery is connected with the terminals indicated by a plus sign in the diagram, and grounded at its negative terminal.

We next turn to a description of the keyboard mechanism and associated circuitry for operation of the photographic and spacing apparatus described above. The mechanism associated with a typical character key 74 is illustrated in the upper part of FIG. 1. The key 74 is attached to a key bar 76 pivoted at 78 and continuously urged upwandy as viewed in the diagram by a tension spring 80. The bar 76 normally rests against an abutment 82.

Above the key bar 76 is supported a bar 84 adapted for translation in the direction indicated by the arrow. This movement is imparted by a power roll 86 normally out of engagement with the bar 84 which rests against an abutment 88. The bar 84 is moved downwardly from its rest position against the reaction of a tension spring 90 by a rocking lever 92 operatively engaged by the key bar 76. When the key bar 76 is depressed, the bar 84 is moved downwardly into engagement with the power roll 86; whereupon, the power roll 86 drives the bar 84 toward the right as viewed in the diagram. The bar 84 is pivotally connected to a lever 94 which is pivoted to the frame of the machine at 96. A bellcrank 98 is pivoted at 100 and is in position to be engaged by the lever 94. At its upper end, the bellcrank 98 is connected by a bail 102 with a type bar 104 pivoted at 106. The bar 104 carries a type slug 108 for striking the platen of an ordinary typewriter through an ink ribbon and a sheet of paper on which the typist may view the line as it is composed. The mechanical parts of the key-actuated typing mechanism hitherto described are shown in greater detail in Patent No. 2,254,764.

There is also preferably provided a key interlock mechanism schematically designated at 110, which mechanically prevents the depression of more than one character key at a time. The mechanism 110 is fully described in our Patent No. 2,758,693.

A pull link 112 is connected to the lower end of the bellcrank 98 and to a bellcrank 114 pivoted to the frame of the machine at 116. The lower end of the bellcrank 114 is operatively connected with contacts 118 and the contacts 66 previously mentioned. From the foregoing description, therefore, it will be evident that when a

character key is depressed, the contacts 66 and 118 are closed.

The key bar 76, once depressed, is latched in the depressed position by a catch 120 and a plate 122 extending across the keyboard transversely of the key bars such as 76. The plate 122 is pivoted at 124 and normally urged counter-clockwise by a tension spring 126 against a fixed stop 128. The catch 120 is normally urged counter-clockwise by a spring 130 against an abutment 132. When the key bar 76 is depressed, the plate 122 engages the catch 120 and holds the bar 76 in the depressed position. The plate 122 is operatively associated with a solenoid 130 which is energizable through a wire 134 to release the key bar. The purpose of the catch and release mechanism described above is to insure the completion of photography of a selected character and the corresponding movement of the spacing lens assembly 28 before the next character key is depressed.

The contacts 66 and 118, which are closed by depression of a corresponding selected key bar such as 76, respectively energize the character photographing apparatus and the spacing mechanism 40 in that order. Referring first to the character photographing apparatus, it will be evident that the contacts 66 may be closed at the instant when any part of the disk 22 is in photographing position opposite the lens 26. In the more common situation in which the selected character is not in the projection position at the instant when its corresponding contacts 66 are closed by the machine operator, a relay 136 is energized to transfer the contacts 70 to the position opposite to that shown in the diagram. When the wiper 50 subsequently reaches the button such as 44 associated with the selected character, the circuit from the contacts 66 through the wire 72 to the flash control circuit 62 is completed. On the other hand, in the case where the contacts 66 of the selected character are closed at an instant in which the wiper 50 is on the button 44 associated with the selected character, a short-circuit is connected around the operating coil of the relay 136 through the lower contacts 70 of this relay, the wiper 50 and the button 44. A resistor 137 protects the source of voltage in this short-circuit condition. The short-circuit disappears when the wiper 50 leaves the button 44; whereupon, the relay 136 becomes energized immediately and prepares the circuit for flashing the character when the wiper 50 again reaches the selected button 44. In this way, possible faulty operation of the photographic apparatus due to the moment of closure of the contacts 66 is prevented.

At the instant of operation of the flash tube 24, a voltage appears on a lead 138 connected with a sequence relay 140 and a relay 142 which, as compared with the relay 140, is slower to operate and slower to release, the difference in release times of these relays being sufficient for energizing the latch release solenoid 130 associated with the depressed character key, as more fully described below. The relays 140 and 142 are adapted to insure, first, that the character spacing operation is delayed until completion of photography of the selected character, and second, that the latch release solenoid 130 is not actuated until after completion of the spacing operation.

We now turn to a description of the character spacing operation. This operation is initially prepared by closure of the contacts 118 which identify the selected character. These contacts are connected with multiple-circuit elements 144 and 146 of the type described in our copending application Serial No. 741,209, filed June 9, 1958, the block 144 designating a plurality of style cards and the block 146 designating a plurality of set width cards. As described in said application, there are as many input wires such as 148 to the card unit 144 as there are keys at the keyboard for character selection. A connection 150 comprises a plurality of leads of which one lead is energized according to the "relative width value" of the character selected in the particular font chosen for composition. The relative width values of the characters in a

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particular font are numbers which bear the same ratios as their respective widths, and are sent to the set cards designated at 146 from which there are provided binary output leads energized in combinations according to the product of the relative width value and the set width selected for the composition of the particular character. This product is the input to the variable escapement device 40 and is proportional to the space to be inserted between adjacent characters in the line.

To illustrate the operation of the present invention, only one of the binary output wires 152 is illustrated. It will be understood that in the embodiment illustrated there are actually eight wires such as 152, each corresponding to a different binary order. When a voltage reaches the wire 152 from the set cards 146, a holding relay 154 is energized and holds through its own make contacts 156 and break contacts 158. Make contacts 160 of the relay 154 close one part of the energizing circuit for a binary escapement solenoid 162 such as those described in detail in said Patent 2,806,574. The contacts 158 are opened when the solenoid 162 is energized. It will be understood that similar relays, holding circuits and energizing circuits are provided for each of the other binary operating solenoids 164-176 of the variable escapement. The holding circuits have the object of maintaining the energization of the relays such as 154 until the corresponding solenoids such as 162 have been energized.

Due to the fact that the energizing circuits of the solenoids 162-176 are connected through make contacts 178 of the sequence relay 140 to ground, these solenoids are not energized immediately upon closure of the contacts such as 160. As described above, the relay 140 is not energized until an impulse on the wire 138 occurs at the instant when a selected character is projected on the film 12. This impulse causes energization of the relays 140 and 142, closing the contacts 178 and immediately initiating operation of the variable escapement mechanism 40. Since the relay 142 is slower to operate than the relay 140, contacts 180 of the relay 140 open before contacts 182 of the relay 142 are closed, thus preventing energization of the wire 134 at this time. The relay 140 holds through its make contact 184 and a wire 186 are connected through rectifiers with break contacts 188 associated respectively with the solenoids 162-176. Thus a voltage appears on the wire 186 as long as the energizing circuit of any one or more of the solenoids 162-176 is operative, until all of such energizing solenoids have opened their respective break contacts 188. This signifies completion of the spacing operation and causes the release of the sequence relay 140 and the relay 142. Since the relay 140 releases more rapidly than the relay 142, the contacts 180 close before the contacts 182 open; whereupon, the wire 134 is energized for a time interval equal to the difference between said release times. This operates the latch release solenoid 130 and allows the selected key 74 to return to its normal position.

The space key on the typewriter is provided with a special character on the disk 22 which is photographed to produce the indicium or mark 14 on the film 12 as shown in FIG. 2. A fixed minimum interword space is associated with this character, whereby the lines will be in unjustified form on the film 12. The mark 14 is situated above the characters in the line.

During the typing of the line, the widths of the selected characters and minimum interword spaces are accumulated and compared with a preset justified line length, in a manner familiar to those skilled in the art of photographic type composition. The line deficit is computed in binary form, for example by apparatus such as that described in our Patent 2,682,814, and this value is punched in binary notation on the film 12 as indicated at 16 by suitable punching apparatus, not shown.

It will be understood that the machine for preparing the film 12 operates at a speed permitting the typist to select the characters at the fastest possible rate. For ex-

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ample, the disk 22 may be rotated at 10 revolutions per second. If there are two alphabets on each circle, all the characters of one alphabet pass through the optical axis of the lens 26 in approximately 50 milliseconds. Thus the maximum waiting period for a flash after the depression of a key such as 74 will be approximately 100 milliseconds, or 50 milliseconds in case the two alphabets on a circle are identical. Allowing additional time for operation of the variable escapement 40, it would be possible for the operator to type at an average speed of fifteen characters per second without feeling any slow-down due to the mechanical or electrical operation of the machine.

The film 12 is transferred after developing to a transcribing unit designated generally as 190 and illustrated in FIGS. 3 and 4. The unit 190 is provided with a rigid base 192 having accurately machined tracks for independent parallel translational movement of three carriages 194, 196 and 198. The carriage 194 supports a light-tight film magazine 200 in which is carried a photosensitive film 202 and which is easily removable to a dark room. The carriage 198 supports a film magazine 204 in which is mounted the film 12. The carriage 196 supports a pair of lenses 206 and 208 and four right angle reflectors 210, 212, 214 and 216. As shown in FIG. 2, the lines of characters are arranged transversely of the film 12, and there is provided a tubular, continuous light source 218 of sufficient length to illuminate an entire line at a time. A condensing lens 220 is provided to gather the light from the source 218 and concentrate it upon one line at a time. The carriage 196 also supports a suitable mask 222 and suitable shutters or diaphragms which admit the light from only a narrow width of the film 12 to the lens 208, preferably equal to the approximately one-half the width of the narrowest character in the alphabet and excluding the marks 14. This light is reflected by the right angle reflectors through the lenses 206 and 208 and is projected with the characters in erect position on the film 202. It will be apparent that in order to project an entire line upon the film, the carriage 196 is translated relative to the carriage 198.

The manner in which the lines are transcribed in justified form upon the film 202 is next described with reference to FIG. 4. The film 12 is first positioned in the stationary magazine 204 opposite the mask 222, and suitable punch reading means, not shown, read the binary "line deficit" appearing at 16 (FIG. 2) in the margin opposite the line and enter this value in a unit AC. The lens carriage 196 is then in the position illustrated in solid lines while the carriages 194 and 198 are held stationary in opposite relationship as shown. The carriage 196 is adapted to be moved by means of a rack 224 secured to the carriage 196, and a pinion 226 operated by a mechanism 228.

The carriage 196 is then caused to make a first pass to a position 230 indicated by broken lines, in which it closes contacts 232. A photocell 234 (FIG. 3) is situated opposite a right angle reflector 236 in position to detect the indicia 14 (FIG. 2) each time they appear through the mask 222 during this movement. The photoelectric impulses thus generated by the interword spaces are sent to an interword counter CI (FIG. 4).

Closure of the contacts 232 initiates operation of a justification computer CP to which information is supplied by the units CI and AC. The computer CP completes a cycle of computation automatically and sends information to units PR and SZ as described in detail, for example, in said Patent 2,682,814. The units CI, AC, CP, PR and SZ are all constructed as described in the last-mentioned patent. The unit SZ receives the whole number quotient of the line deficit divided by the number of interwords, and the unit PR receives the remainder.

The completion of this computation and the entries to the units PR and SZ automatically starts the second pass of the carriage 196. In this pass the carriage 196 returns at a constant speed from the position designated at 230 to the position illustrated in solid lines in FIG. 4 and the line is photographed. The entire line of characters is thus

uniformly and progressively projected from the film 12 to the film 202. The carriage 198 remains stationary throughout this movement. The carriage 194 also remains stationary, except for a brief interval when each photoelectric impulse is generated by an interword mark 14. This impulse is sent through contacts 238, which are closed only during the second pass of the carriage 196, to the unit PR. This impulse sends a signal through a circuit designated by a cable 240 from the units PR and SZ to a variable escapement VE which may be constructed in any suitable manner, for example like the variable escapement 40 in FIG. 1. The unit VE moves a discrete distance and drives a pinion 242. The pinion 242 drives a rack 244 connected to the carriage 194. The movement of the carriage 194 takes place very rapidly and is equal to the incremental space which is to be added to the interword in order that the line will be justified. The movement of the carriage 194 is downwardly as viewed in FIG. 4. As stated above, the movement of the lens carriage 196 is continuous and at a constant velocity. The time required to complete the incremental movement of the carriage 194 is such that it has stopped before the lens carriage 196 arrives in a position to initiate exposure of the first character of the next word following the mark 14.

It will be understood, in accordance with said Patent No. 2,682,814, that the interword increment spaces to be added are equal in total exactly to the line deficit, even though the aforementioned quotient is not a whole number. If the division of the line deficit by the number of interwords produces a remainder, as is usually the case, a number of the interword increments equal to this remainder are assigned a value equal to the quotient, plus one. The remaining word increments are assigned a value equal to the quotient.

In the foregoing description the carriage 198 is normally held stationary while the carriage 196 is moved at a constant speed and the carriage 194 is moved intermittently. In certain cases, it may be desired to edit or correct the lines appearing on the film 12 before they are transcribed. To accomplish this, another carriage 246 similar to the carriage 198 is supported on the same tracks therewith. A film on the carriage 246 is prepared with lines to be substituted for corresponding lines on the film 12. The carriages 198 and 246 are then interchanged according to the line to be selected. The carriage selected is accurately located on the frame 192 by a spring-pressed ball detent 248.

It will be readily understood by those skilled in this art that numerous changes and adaptations in the methods and apparatus herein described will be evident upon a reading of the foregoing specification, and that such adaptations and changes may be effected without departing from the spirit or scope of the invention as defined by the appended claims.

Having thus defined the invention, we claim:

1. The method of type composition which includes the steps of photographing on a first sensitized sheet variable-width, variable-spaced characters and space indicia in unjustified lines in direct response to operation of a keyboard, transferring said first sheet to a first support, supporting a second sensitized sheet parallel to said first sheet, moving an erect image forming optical system continuously between and parallel to said sheets and to a line of characters on said first sheet while permitting only a progressively moving portion of the line image

to be formed on the second sheet, whereby said line is progressively projected on to said second sheet, and intermittently relatively moving said sheets parallel to the direction of said line at the instants when said indicia are in position for projection to effect incremental changes in the spaces between said characters on said second sheet.

2. The method according to claim 1, wherein the space indicia are photographed in spaced relation to the line of characters opposite the positions where space increments are to be added, and said indicia are sensed optically to cause corresponding intermittent relative movements of said sheets when said indicia are opposite the portion of said line in position for projection.

3. The method of type composition which includes the steps of photographing on a first sensitized sheet variable-width, variable-spaced characters and space indicia in unjustified lines, mounting said first sheet on a first support, supporting a second sensitized sheet parallel to said first sheet, optically forming a stationary image of the first sheet upon the second sheet, optically scanning the indicia in a line on the first sheet and counting said indicia, providing a measure of the line deficit, computing from the line deficit and number of indicia the size of justification increments, causing a progressively moving portion of the line image to be formed on the second sheet, whereby said line is progressively projected on to said second sheet, and intermittently relatively moving said sheets parallel to the direction of said line by an amount proportional to said increment at the instants when said indicia are in position for projection to effect incremental changes in the spaces between said characters on said second sheet.

4. The method of type composition which includes the steps of photographing on a first sensitized sheet variable-width, variable-spaced characters and space indicia in unjustified lines, mounting said first sheet on a first support, supporting a second sensitized sheet parallel to said first sheet, optically forming a stationary image of the first sheet upon the second sheet, causing a carriage to be transported a first time between the sheets while optically scanning the indicia in a line on the first sheet by means of said carriage, counting the scanned indicia, providing a measure of the line deficit, computing from the line deficit and number of indicia the size of justification increments, causing the carriage to be transported a second time between the sheets to cause a progressively moving portion of the line image to be formed on the second sheet, whereby said line is progressively projected on to said second sheet, and intermittently relatively moving said sheets parallel to the direction of said line by an amount proportional to said increment at the instants when said indicia are in position for projection to effect incremental changes in the spaces between said characters on said second sheet.

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