

Jan. 3, 1961

R. A. HIGONNET ET AL
TYPE COMPOSING APPARATUS

2,966,836

Filed Feb. 24, 1959

3 Sheets-Sheet 1

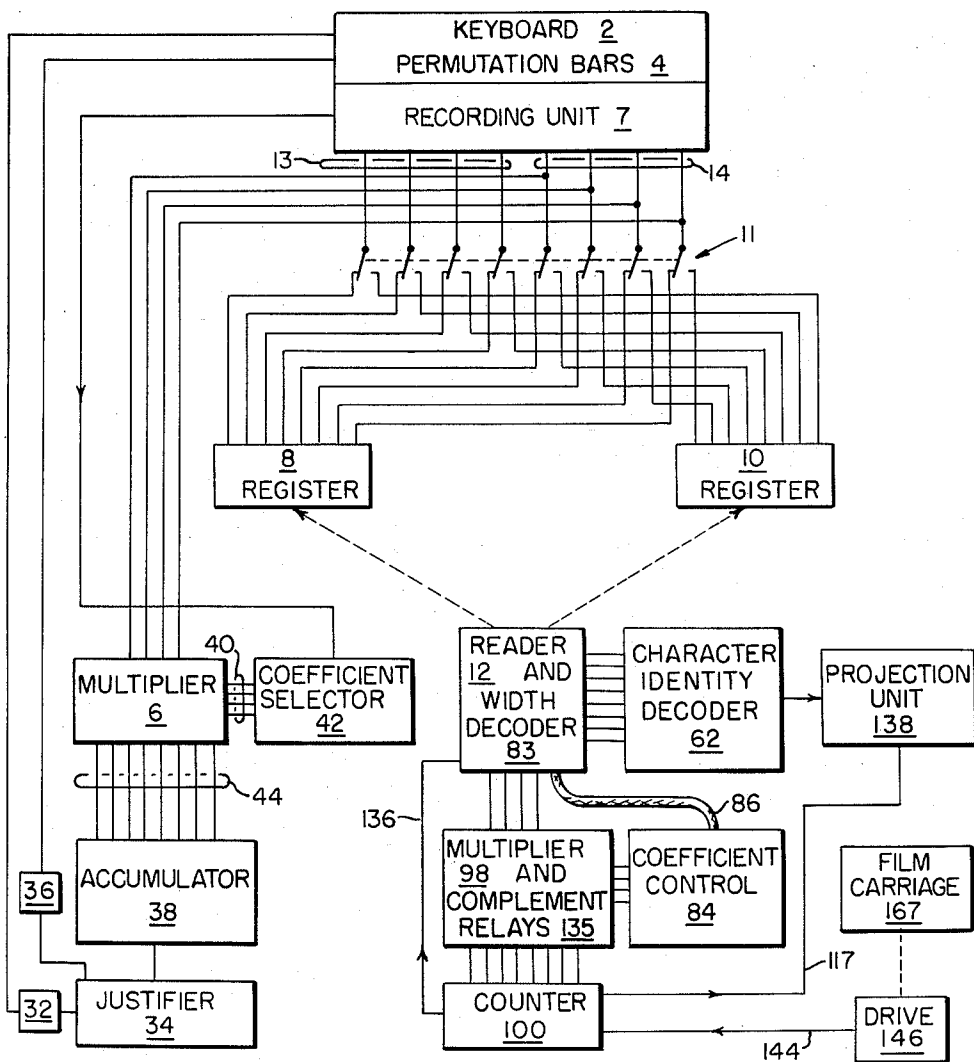


FIG. 1

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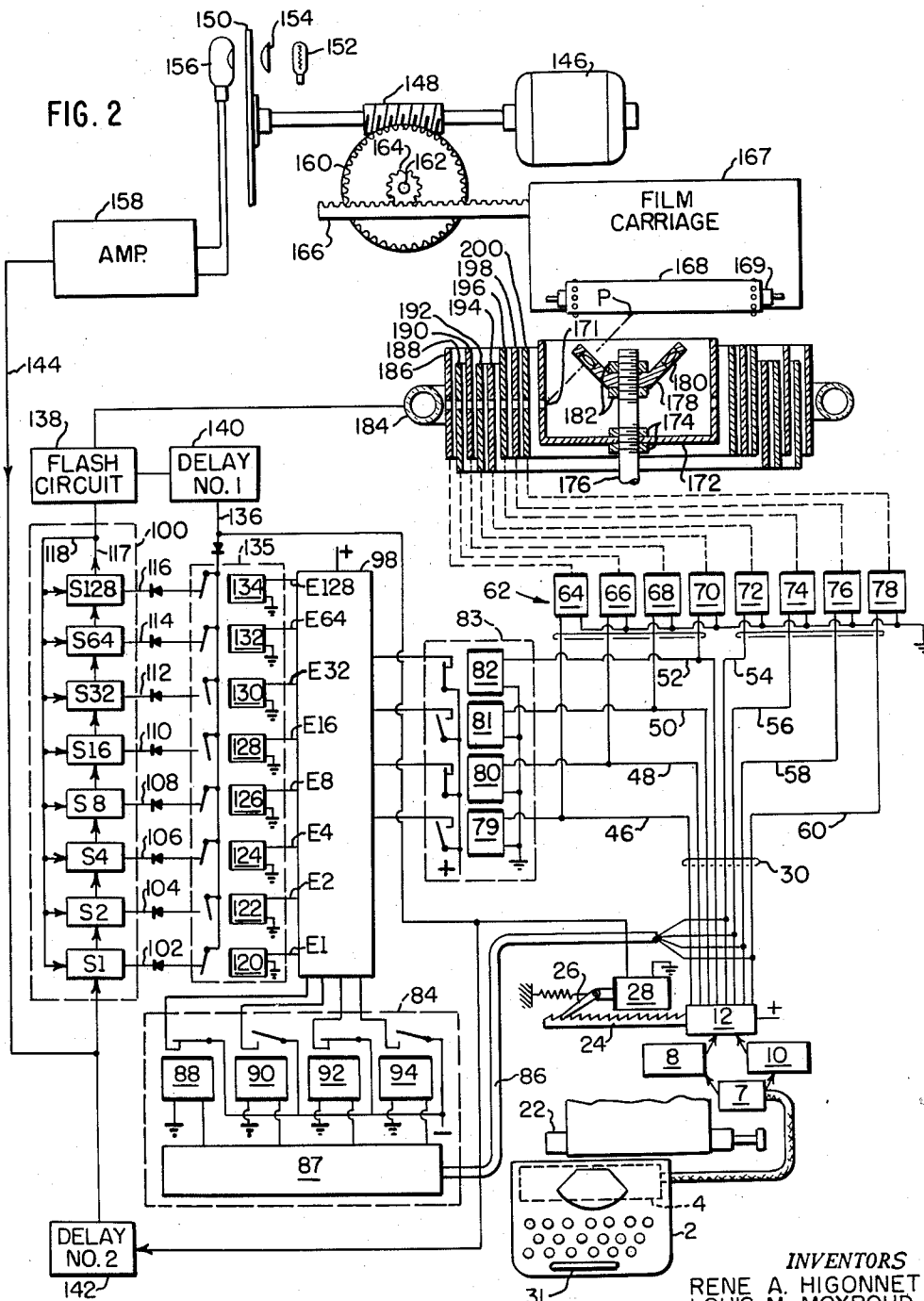
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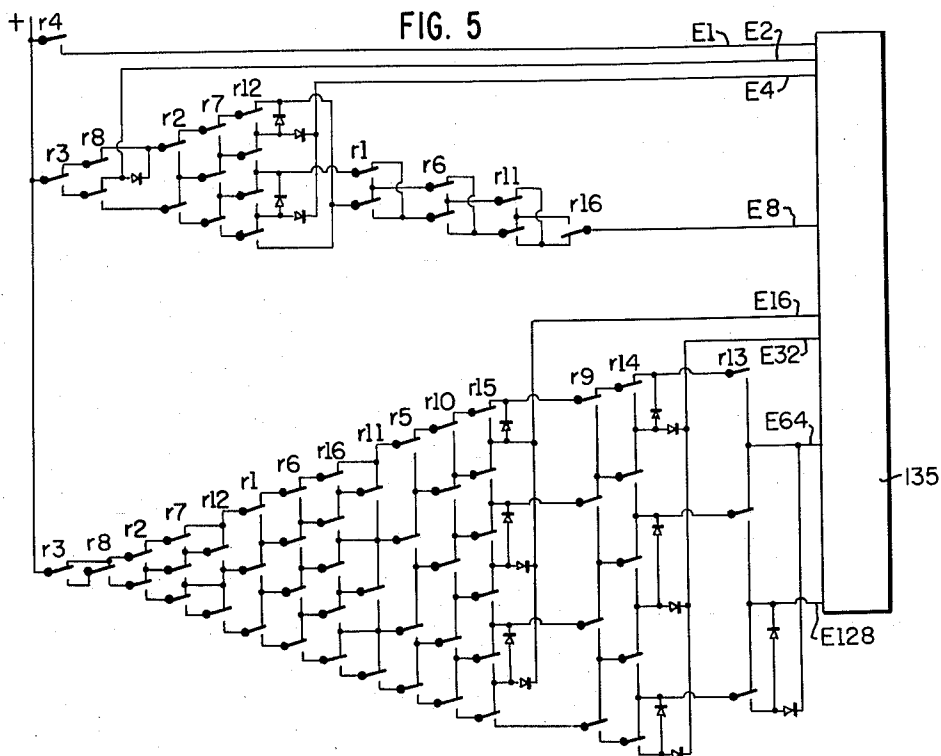
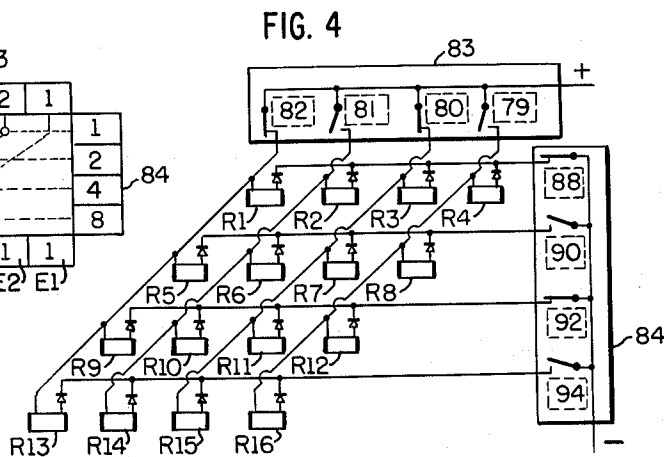
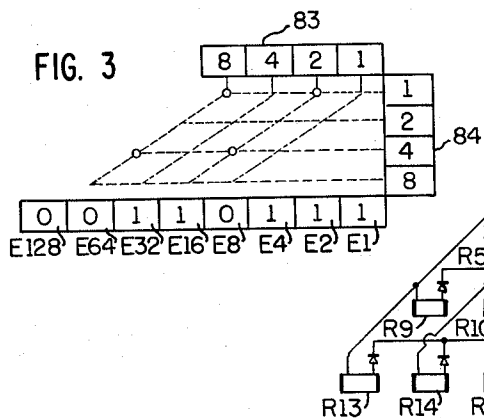
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1

2,966,836

TYPE COMPOSING APPARATUS

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Filed Feb. 24, 1959, Ser. No. 795,004

13 Claims. (Cl. 95—4.5)

The present invention relates generally to photographic type composition, and more particularly to a composing machine characterized by the consecutive formation of the images of the characters in a line in a common image position and the movement of a sensitized sheet at a uniform speed in relation to said position. The time intervals between successive projections are made proportional to the spaces allocable to the corresponding characters. This application is a continuation-in-part of our copending applications Serial No. 295,284, filed June 24, 1952, now Patent No. 2,876,687, and Serial No. 627,501, filed December 10, 1956, the latter application in turn being a continuation of our application Serial No. 332,312, filed January 21, 1953, now abandoned.

This invention contemplates the use of a stationary support bearing a plurality of characters to be photographed with optical means to present the image of each selected character in the common image or photographing position. In accordance with recognized typographical standards the characters and spaces are of variable widths and the lines of type may be justified, quadded left or right, or centered.

An important object of the present invention is to provide a machine of the above type which further includes provision for changing the point size, point set and style of the characters within a single line of type. By the term "point size" we refer to the dimensions of the characters to be composed. The term "point set" is a constant for all characters in an alphabet and has reference to the spacing of the characters in the line. Each point size has a corresponding normal point set, but the set can be varied to obtain "expanded" or "condensed" type.

It will be useful to describe in general terms the principles upon which the actual space to be allocated to each character is determined. It is obvious that the characters of each available size and style of alphabet, being of different relative dimensions, require different amounts of the set-wise line width. Therefore the actual space allocated to a given character may be represented conveniently as the product of two factors, the first being a number (hereinafter referred to as "relative width value") proportional to the space required by the character in an arbitrarily selected point set, and the second being a coefficient (also hereinafter referred to as "point set") by which the relative width value of each character in the alphabet may be multiplied to produce a product proportional to the normal space allocated to the character in the line. It will be further recognized that the typographical characteristics of different fonts or styles require different relative width values for certain characters in the various fonts or styles.

A second and related object of the invention is to provide a character spacing device for a machine of the above kind which produces spacing proportional to the product of a pair of inputs, namely, a relative width value input and a coefficient input.

A further object is to provide suitable multiplying means as a part of the character spacing device, the

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multiplier being for alternate operation with, and control of, the character projection apparatus.

With the foregoing and other objects in view, the features of this invention include the provision of a multiplier adapted for operation by a register or memory device containing character width information to present a character spacing control counter stepped by a train of uniform timing impulses, the counter being of the type described in our above-mentioned application Serial No. 627,501. The multiplier as hereinafter described is of a type disclosed in our above-mentioned copending application Serial No. 295,284. As described in Serial No. 627,501, the counter is preset to a value whereby it reaches a predetermined count and energizes the projection apparatus after counting a number of timing impulses proportional to the space allocated to a corresponding character.

A second feature resides in the provision for operation of the multiplier to prepare to preset the counter for each character during the same interval in which the counter is advancing to count the space allocable to the preceding character to be projected. By this means the multiplier may be operated without slowing down the successive projections of the characters, whereby a machine having a rapid speed of operation is made possible.

Other features of the invention reside in certain details of construction, circuit arrangements and modes of operation which will become evident from the following description of a preferred embodiment thereof, having reference to the appended drawings, in which

Fig. 1 is a block diagram illustrating the main components of the machine according to this invention;

Fig. 2 is a schematic diagram, partly in block form, illustrating certain of the parts in greater detail; and

Figs. 3, 4 and 5 are schematic and circuit diagrams illustrating a particular form of multiplier circuit.

GENERAL ORGANIZATION

Fig. 1 shows the general organization of a photographic composing machine embodying the invention. However, the invention is not limited to the particular arrangement shown. A keyboard 2 similar to that of a common typewriter is provided with a set of permutation bars 4 (Fig. 2) of the type commonly used in telegraphy. The permutation bars are coupled with the keys to close electrical circuits leading to a multiplier 6, and through a recording unit 7 either to a register 8 or to a register 10, the registers being used for alternate lines. The selective connection of the recording unit to the registers is schematically illustrated in Fig. 1 as being provided by transfer contacts on a switch 11. However, it is preferably accomplished by an equivalent mechanical device, as described below. The registers may each comprise columns of pins, eight pins for each column which represents a single character, the pins being selectively depressable by hammers according to a code, with a reader 12 for sensing the depressed pins of the selected register. The circuit for entering information in the registers comprises eight leads in two groups 13 and 14. The permutation bars apply an electrical supply voltage to these groups according to a code corresponding to the selected key. The set of four leads 14 is connected with one input of the multiplier 6 which forms a part of the justification computing apparatus and receives voltages representing the relative width value of each character in binary notation, whereby it is apparent that a maximum relative width value of 15 and a minimum relative width value of zero may be represented.

When one of the leads 14 is energized the corresponding binary digit is assumed to be "1", and when the lead is unenergized the digit is assumed to be "0."

In the embodiment of the invention herein disclosed it

is therefore assumed that each alphabet has fifteen available relative width values to be assigned to the characters. The matter of assigning an appropriate value to a particular character is largely an esthetic question, reflecting various factors of type design including the style and shape of the character. Of course, more than one character may be assigned the same relative width value. It will be seen, however, that apparatus having different numbers of selectable relative width values may nevertheless fall within the scope of the invention.

In this embodiment the procedure is first to store a single line in the register 8, and then to store the succeeding line in the register 10 while the register 8 is connected with the reading unit, by means of which the stored line is then transcribed in justified form. Thus, as a line of selected characters is typed the leads 14 receive successive groups of impulses from the permutation bars, each group of impulses representing in binary form the relative width value of a selected character or space. In addition, the selected register is connected with the four leads 13, by means of which characters of like widths may be distinguished, and coded information representing a change in the point set may be stored for later use during transcription.

The recording unit 7 preferably comprises eight vertically disposed magnetically depressable hammers adapted to register with the pins in one column of the selected register at a time. A mechanical device may be provided, as described in our Patent 2,790,362, to move the hammers from operative relation with one register to the other, alternately for successive lines. A similar arrangement may be provided for the reading unit 12 to bring it into operative relation with either register. There is a column of eight pins for each character and space in the line. Refinements of the construction of the recording unit also include sensing means and means for retracting selected pins for the purpose of correcting erroneously typed characters prior to their transcription. After a line has been recorded the reading unit 12, which is provided with feelers and sensing contacts for operation by the pins and which is movable by a ratchet 24 and pawl 26 linked with the movable core of a solenoid 28, is moved independently of the recording unit to sense the depressed pins and send the corresponding information to the transcribing apparatus over a cable 30. The reading unit 12 is adapted to read or sense the characters one at a time, and to retract the pins to their "zero" positions after they have been sensed to permit the later recording of new characters therein.

The keyboard and register assembly heretofore described may be constructed substantially as described in our copending application Serial No. 610,336, filed August 11, 1945, now abandoned, and our Patent No. 2,790,362.

Referring to Fig. 1, the keyboard 2, through a space bar 31, is connected with a word counter 32, by means of which a justifier 34 is supplied with the number of interword justification increments to be supplied to the particular line. Depression of the space bar also enters a minimum relative width value of predetermined size in the register together with a code indicating a word space. Similarly, a character counter 36 supplies the justifier with information which is used where justification increments are to be inserted between each of the characters.

In order that the lines will be justified during transcription, the justifier must be supplied, during the storage of the line, with information corresponding to the cumulative total of the widths of the selected characters and minimum word spaces, by means of which the "line deficit," or additional justifying length needed, may be computed. This information is received from a line length accumulator 38. The accumulator 38 may be a conventional binary counter comprising a number of stages, eight in the assumed embodiment, each stage being capable of reaching two states or conditions of equilibrium. Carry-over means from one stage to the next, such as are ordi-

narily included in a counter of this type, are incorporated within the accumulator.

When a particular character is selected, impulses or voltages reach the multiplier 6 over the leads 14. Voltages are also connected with the multiplier over a set of leads 40 from a coefficient selector 42, by means of which the operator may select a particular number from one to fifteen representing the before-mentioned coefficient for introducing changes in the point set. The multiplier 6 may be constructed in the manner of the multiplier shown in Figs. 4 and 5. A set of eight binary product leads 44 connect the multiplier 6, with each of the eight stages of the accumulator 38. By means of the leads 44, the accumulator 38 receives successive groups of voltages or pulses, and accumulates the total of the widths of the selected characters and spaces, taking into account any changes in the point set that may have been introduced by the operator at any place in the line. After the line is typed, the justifier computes the justification increments to be added between the words and characters to justify the transcribed line, based on the total reached by the accumulator. Details of the operation of the justifier are not given herein as they form no part of the present invention. An appropriate form of justifier is described in our Patent 2,682,814.

Counter control circuits

Referring to Fig. 2, the cable 30 comprises leads 46, 48, 50, 52, 54, 56, 58 and 60 which are connected respectively with a set 62 of eight electromagnets 64, 66, 68, 70, 72, 74, 76 and 78 comprising a character identity decoder. Each of these electromagnets is grounded at one terminal. These electromagnets form a part of the character selection and projection apparatus hereinafter more fully described. The leads 46, 48, 50 and 52 are also connected with a set of relays 79, 80, 81 and 82 comprising a width decoder 83. Each of these relays is also grounded at one terminal. The leads 46, 48, 50 and 52 represent the binary relative width value of the character which has been sensed by the reading unit 12. The lead 46 represents the lowest order digit "1" and the lead 52 represents the highest order digit "8." The respective functions of the relays and electromagnets are further described below.

We also provide a coefficient control 84 which is connected by a connection 86 to the reading unit 12. The connection 86 is energized by a code in the register to represent a coefficient corresponding to the point set selected for the characters to be transcribed. It will be understood that a code indicating such a coefficient is indicated in a separate column of pins and is recorded in the register only at positions where the coefficient is changed. The code representing the new coefficient may be any convenient code, and this code is translated into a binary number by a conventional relay circuit 87. The unit 84 includes a set of relays 88, 90, 92 and 94. These relays comprise an input circuit 96 for a multiplier 98, hereinafter more fully described with reference to Figs. 3, 4, and 5.

We also provide a binary counter 100 having eight stages and preset leads 102 to 116 connected therewith. Any suitable binary counter may be employed for the illustrated purpose. It should be provided with the ordinary carry-over connections from stage to stage and with a lead 118 from the last stage to a reset circuit in each stage to cause the counter to be reset to "0" upon a carry-over from the highest order stage, when the counter advances its count from "255" which represents its maximum capacity. After the counter has been reset in this fashion it is preset by means of the leads 102 to 116 which are associated with the multiplier 98 through relays 120 to 134 referred to below as complement relays 135. The circuits of selected stages of the counter are preset to the "1" position by a signal voltage applied to a lead 136. The preset circuit to each stage is connected through the

closed contacts of the corresponding relay 120 to 134. If the contacts are opened by energization of the relay, the corresponding stage remains in its reset or "0" position after the signal voltage reaches the lead 136. Thus it may be seen that the effect of the relays is to preset the counter upon the arrival of a signal impulse on the lead 136, entering into the counter the number which is the difference between "255" (the highest number which can be recorded in the counter) and the width of the particular character represented by the energized relays 120 to 134. These relays represent in binary form the product of the relative width value of the character entered in the relays 83 and the coefficient last sensed in the register 12 as represented by the relays 88, 90, 92 and 94. (It is assumed throughout this description that the presence of a voltage on one of the leads 102 to 116 represents the digit "1," while the absence of a voltage indicates the digit "0.")

Multiplier

We next turn to a more detailed description of the multiplier 98. The multiplier entry circuits 83 and 84 have already been described, and it is useful to describe the multiplier itself by means of an example. If the relative width value of a character is ten units, the parts take the positions illustrated in Fig. 2. The reading unit 12 will connect a voltage to the leads 48 and 52, representing respectively "2" and "8." This will cause energization of the relays 80 and 82 and the closing of their corresponding contacts, as shown in the drawing. At the time of reading this width signal in the reading unit 12, the coefficient control 84 will already have caused actuation of the relays 88, 90, 92 and 94 in accordance with the coefficient signal last sensed in the register. In the above example, we may assume that the particular coefficient is "5," and that corresponding relays 88 and 92 have been energized, closing their contacts.

As shown in Fig. 4, the entry circuits 83 and 84 are associated with multiplier relays R1 to R16, the contacts of which are shown in Fig. 5. For the sake of clarity, the contacts of Fig. 5 are all shown in the positions reached when the corresponding relays are unenergized.

The operation of the multiplier 98 may be described in principle with reference to Fig. 3. The entry circuits 83 and 84, representing respectively the relative width value and the coefficient, are represented schematically by blocks showing the binary orders of the respective leads. The horizontal dotted lines communicate with the relays 84, while the diagonal dotted lines communicate with the relays 83. Assuming the given character with a relative width value of "10" and a point set, or coefficient, of "5," the circles appearing at the intersections of the dotted lines communicating with the energized input leads are indicated in black. The values to be represented at the output of the multiplier, that is, on the leads E1 to E128 in Fig. 5, are found by binary addition of the vertical columns of black circles. Thus, starting at the right, a voltage appears on each of the leads E2, E16 and E32. The lead E8 remains unenergized, while sending a carry-over to the lead E16. It may readily be verified that the number indicated by the energized leads E1 to E128 is "50," that is, $32 + 16 + 2$.

Referring to Fig. 4, the particular "partial product" relays R1 to R16 to be energized by the relative width value and coefficient entries are determined in the same manner as the black circles of Fig. 3. Thus in the indicated example, by closure of the appropriate entry relay contacts the relays R1, R3, R9 and R11 are energized.

It may be readily verified from Fig. 5 that voltages are then applied to the same leads E1 to E128, connected with the complement relays 135, as are indicated diagrammatically in Fig. 3. In Fig. 5, each column of transfer relay contacts bears, at the head of the column, a numerical designation, and corresponds with the relay

bearing the same arabic numeral. Thus the two columns of contacts headed R12 belong to relay R12.

As previously stated, the leads E1 to E128 are connected to complement relays 135 which permit the counter 100 to be preset to a number equal to its capacity, less the product. Taking the given example in which the product is "50," the operation of the relays 135 will open the break contacts in all circuits except those for the leads 102, 106, 108, 114 and 116, representing "205."

Character photography

Carry-over signals from the highest order stage of the counter are connected to a flash circuit 138, which is in the nature of a power amplifier, amplifying the carry-over signal and transmitting it to the projection apparatus. The amplified signal is also connected to a delay circuit No. 1 labeled 140 which delays the signal and transmits it to the lead 136. The lead 136 is also connected to the solenoid 28, which advances the register reading unit 12 upon receiving the signal as heretofore described. Impulses on the lead 136 are further delayed by a delay circuit No. 2 labeled 142, which provides a path to the input circuit of the lowest order stage of the counter.

Input impulses for advancing the counter are applied to a lead 144 by impulse generating means, illustrated in this instance by a photoelectric arrangement, including a motor 146 continuously driving a worm 148 rigidly secured to its shaft and an opaque disc 150 having equally spaced translucent slits arranged in a circle. A continuous light source 152 and condenser lens 154 transmit light through each slit in succession to a photocell 156 connected with an impulse amplifier 158. The amplifier sends the amplified impulses to the lead 144. Various other arrangements for accomplishing the same purpose will occur to those skilled in the art, the particular form being a matter of choice in the practice of the invention.

The same motor 146 which drives the slit disc 150 is also preferably coupled through the worm 148 with a gear 160, the gear being secured to a stud shaft 162 having secured thereto a pinion 164 engageable with a rack 166. The rack 166 is secured to a movable film carriage 167. The film carriage is preferably constructed in the general manner described in our Patent 2,790,362, and supports a strip of sensitized film 168 having perforations near the edges wound over a pair of rollers, of which only an upper roller 169 is illustrated in the drawing. Mechanism is provided for rotating the rollers to space the lines of type, while movement of the film carriage in a direction parallel to the lines of type produces the spaces between the successive characters in each line. Thus it will be seen that the film carriage is moved at a uniform rate during the transcription of each line by the motor 146, and that the impulses generated by the photocell 156 in synchronism therewith are continuously supplied to the counter 100 through the lead 144.

The characters 171 to be projected are mounted in an annular ring preferably as transparencies upon an opaque drum 172. The drum is rigidly secured by threaded nuts 174 to a pedestal 176 upon which is also supported a lens support 178 having as many lenses 180 mounted therein as there are characters in the ring. The lens support 178 is rigidly secured to the pedestal by the threaded nuts 182. The optical axes of the lenses 180 pass through their respective characters and also through a point P, designated as the "common photographing position," wherein the images of the characters are formed in the plane of the sensitized film 168. The planes of the character transparencies and the film are at right angles, and each forms an angle of 45° with the optical axis of the lens. Since the planes of the object and image are in the same angular relationship with the optical axis, it will be apparent to those skilled in the optical art that every point of the image will be in focus upon the film, but that the image will be distorted with respect to the character transparency, since certain parts of the image

will be magnified to a greater extent than others. This results from the tilt of the object with respect to the optical axis. To compensate for the distortion of the image, the character transparencies themselves are distorted from their true appearance in an opposite fashion to produce characters of the true size and shape upon the film 168. Various refinements of the projection system may include provision for a plurality of annular rings of characters on the drum 172, and means for shifting the drum axially to present to the lenses a desired ring of characters, thereby permitting a rapid change of font. Also, a lens turret or equivalent structure (not shown) may be interposed at the point P to provide means for changing magnification of the images in accordance with the required changes in the point size of the characters.

It will be understood, however, that the particular form of projection apparatus represented in the figure merely illustrates one possible embodiment of the transcription apparatus and the invention in its essential aspects is not limited thereto. Any character transcription apparatus adapted to select a particular character in the font, and to project or otherwise transcribe its image at a fixed point P when the exposure flash is initiated, may be used. In the described embodiment the exposure flash is produced by an annular-shaped flash tube 184 surrounding the character drum 172, and being separated therefrom by eight code cylinders 186 to 200 concentric with the pedestal 176. Each of these cylinders is opaque except for a number of small holes arranged circumferentially in two adjacent rings in a pattern according to a code. Each cylinder is movable axially to either of two positions by reason of a mechanical connection with one of the solenoids 62. Thus, the outer cylinder 186 is in the "upper" position as shown in the figure, a position which it occupies when the solenoid 64 is unenergized. The adjacent cylinder 188 is in its "lower" position, corresponding to the energized condition of the solenoid 66. The figure illustrates the previously mentioned example in which the solenoids 66 and 68 are energized by the binary leads indicating the relative width value, the assumed character further having a signal on the lead 54 which energizes the solenoid 72.

As previously stated, each of the code cylinders 186 to 200 contains two annular rings or holes. One ring is in line with the characters on the drum 172 when the code cylinder is in its upper position, while the other is in line with the characters when the code cylinder is in its lower position. Thus it may be seen that by properly encoding the transparent holes in the cylinders it is possible to arrange that a continuous path from the annular lamp 184 to a particular character transparency 171 is provided only when a corresponding combination of the solenoids 64 to 78 is energized. Thus, when the exposure flash occurs the only character which is projected is that for which the condition illustrated in the figure obtains, namely that a continuous light path from the tube to the character is created by the coded holes in the cylinders 186 to 200.

Character spacing

The operation of the apparatus in relation to character spacing will next be described.

It may be assumed for purposes of explanation that the operator has recorded a complete line of characters and word spaces by typing the same on the non-justifying typewriter 2 and has viewed the line as typed by said typewriter, making any necessary corrections in the register 8 or 10 as described in our said Patent 2,790,362.

Transcription is initiated with the reading unit 12 positioned at the extreme right-hand end of the register 8 or 10 in which the line is recorded, this being the position in which the first character of the line is recorded. Sensing means in the reading unit 12, operating as described in the last-mentioned patent, connect a voltage to a selected combination of the leads in the cable 30 corresponding to the character. It is assumed that the volt-

age is sustained on the leads until the reading unit moves to the next character position which happens at a later time in the operation as described below. This may be accomplished, if desired, by an alternative circuit including intermediate holding relays in a manner well understood in the art. The corresponding combination of the solenoids 64 to 78 is energized, thereby moving a certain combination of the code cylinders 186 to 200 to their lower positions. This prepares the projection apparatus to form the image of the selected character at the point P upon the film 168 when the flash tube 184 is subsequently energized.

Photoelectric impulses passing over the lead 144 to the counter 100 cause the counter to progress up to "255," with the following or 256th impulse causing a carry-over from the highest order stage to the flash circuit 138, thereby triggering the flash tube 184 to project the selected character, and resetting the counter. The code cylinders 186 to 200 will have reached their positions as heretofore described, and the exposure flash projects the selected character upon the film at the photographing position P. This flash may be of appreciably longer duration than that which is required in the types of character projection apparatus in which the characters are continuously moving at considerable speed through the projection position when photographed, as in said Patent 2,790,362.

Following a brief delay caused by the circuit 140, the flash signal is sent to the lead 136 where it energizes the solenoid 28 to advance the reading unit 12, and travels through the selected combination of the presetting contacts of the complement relays 135 to the respective stages of the counter. In the assumed example, the relays 122, 123 and 130 are energized to open their contacts, whereby the other stages of the counter are each preset to "1," causing the counter to read "205."

A further delay follows the preset operation, after which the impulse on the lead 136 passes through the circuit 142 to the lowest order stage of the counter 100, causing it to advance to the count "206." It is assumed that the delay circuits 140 and 142 are so designed that the advancement of the counter 100 by reason of the impulse from the circuit 142 will occur before the first photoelectric impulse following the exposure flash. Since characters of only one unit of width do not exist in the ordinary font, it would be possible to have the delay extend beyond the arrival of this impulse, but erroneous results would be produced if the delayed impulse were coincident with it, and in any case appropriate steps to avoid this possible occurrence must be taken.

The fiftieth succeeding photoelectric impulse again causes the counter 100 to send an impulse to the flash circuit. In the meantime, the film carriage 167 will have moved during the interval between the flashes through a multiple of the distance moved between two successive photoelectric impulses, this multiple being equal to the number of impulses needed to cause the succeeding flash.

It will be apparent that the advancement of the reading unit 12 of the register to the next position will have been initiated before the previous character is spaced, thereby allowing sufficient time to permit the energization of the new combination of the solenoids 186 to 200. The speed requirement is even greater if the preceding character is one of small width, such as the lower case "i." According to one system this character is assigned a relative width value of "5" units which means that if the coefficient has been selected as "1," the fifth succeeding photoelectric impulse after the character "i" is projected will produce the succeeding flash.

In the case of a word space, after the last character of a word is projected, the counter counts a number of impulses corresponding to the width of the character, after which the reading unit 12 will have reached a position in the register corresponding to a word space.

The code representation for a word space is such the the corresponding combination of the solenoids 64 to 73 preferably does not open any light path through the code cylinders 186 to 200. Thus, when the counter 100 produces a carry-over signal after measuring the width of the last preceding character, the flash circuit energizes the tube 184 but no character is projected. The additional space is added while the counter counts the minimum width of the word space stored in the register each time the space bar 31 was struck, this minimum value being, for example, four units of width.

As heretofore mentioned, provision may be made to adapt the device to a machine in which the lines are justified. This entails an extra step in the transcription of each word space, whereby the projection of a character following a word space is delayed not only by the recorded width of the preceding character and the minimum word space, but also by a further value represented in binary form in the justifier 34. An arrangement is provided whereby the next carry-over impulse from the highest order stage of the counter following the counting of a word space width is switched from the flash circuit to a circuit in the justifier, not shown, whereby the counter is preset from the justifier in a manner similar to that heretofore described, and an additional count corresponding to the desired justification increment is made before a carry-over impulse again reaches the flash circuit 138 to expose the first character of the next word.

In certain special instances, it is desired to project a character having zero width. A square outline surrounding the capital letter at the start of each paragraph for purposes of decoration may serve as an example. Because of the continuous motion of the film carriage it is not possible to project the capital letter and the square outline successively unless two image positions such as "P" are provided. This would entail considerable expense. Another solution would be to have a separate set of characters on the drum 172 consisting of each of the capital letters surrounded by the square outline. This is also undesirable because of the required increase in the dimensions of the drum and the number of lenses 180. According to a simpler arrangement, the code system is modified to project both the square outline and the selected characters simultaneously by providing two light paths through the code cylinders, rather than only one as is usually the case.

It will be seen from the foregoing that important advantages reside in the provision of means for mixing sizes and styles of type within the lines, as in advertising and classified copy. This is made possible by the described arrangement in which the register records information reflecting both the relative width value and the point set of the characters. When the information is read from the register for a particular character, the relative width value and the corresponding coefficient are multiplied in the multiplier 98, and the flash circuit 138 is prepared to energize the flash tube 184 after counting a number of impulses proportional to the product. Thus the coefficient may be changed any desired number of times within a line of type. Furthermore, the justification is based upon computing the space allocable to each character considering both its relative width value and the corresponding point set. Thus the lines containing different point sizes, styles or set widths may be readily justified.

It will be understood that other modifications and arrangements of the described apparatus, as well as variations and details of the design and additions to or alterations thereof in a manner familiar to those skilled in the art, can be made in accordance with specific requirements without departing from the spirit or scope of the invention.

Having thus described our invention, we claim:

1. In photographic type composing apparatus, the combination of a register for information corresponding to

a line of type characters including width values for said characters in numerical form and coefficients for said width values, reading means for the register adapted to sense said information a character at a time, a stationary support bearing the characters to be photographed, a support for a sensitized sheet, mechanism to move the sheet at a uniform speed past a photographing position, and character projection means associated with the reading means and adapted to project the characters in said line on to said sheet, said projection means including impulse generating means synchronized with said mechanism, a counter having a circuit to energize said projection means and provision to count the impulses, and a multiplier associated with the reading means and adapted to multiply said width values and coefficients and to preset said counter after each projection to cause it to energize said projection means when the number of counted impulses corresponds to the product of said multiplication.

2. In photographic type composing apparatus, the combination of a register for information corresponding to a line of type characters including width values for said characters in numerical form and coefficients for said width values, reading means for the register adapted to sense said information a character at a time, a stationary support bearing the characters to be photographed, a support for a sensitized sheet, mechanism to move the sheet at a uniform speed past a photographing position, a flash device to illuminate the characters, character selection means associated with the reading means and having provision to cause the image of a selected character to be formed in said position, and means to energize the flash device including impulse generating means synchronized with said mechanism, a counter having a circuit to energize said flash device and provision to count the impulses, and a multiplier associated with the reading means and adapted to multiply said width values and coefficients and to preset said counter after each character is photographed to cause it to energize said flash device when the number of counted impulses corresponds to the product of said multiplication.

3. The combination according to claim 1, in which the width values of the characters are stored in the register in binary form.

4. The combination according to claim 1, in which the width values of the characters are stored in the register in binary form and the counter is a binary counter.

5. In photographic type composing apparatus, the combination of a register for information corresponding to a line of type characters including width values for said characters in numerical form and coefficients for said width values, reading means for the register adapted to sense said information a character at a time, a stationary support bearing an array of characters to be photographed, individual optical means for the characters arranged to form their images in a common photographing position, a support for a sensitized sheet, mechanism to move the sheet at a uniform speed past said position, and character projection means associated with the reading means and adapted to project the characters in said line on to said sheet, said projection means including impulse generating means synchronized with said mechanism, a counter having a circuit to energize said projection means and provision to count the impulses, and a multiplier associated with the reading means and adapted to multiply said width values and coefficients and to preset said counter after each projection to cause it to energize said projection means when the number of counted impulses corresponds to the product of said multiplication.

6. In photographic type composing apparatus, the combination of a register for information corresponding to a line of type characters including width values for said characters in numerical form and coefficients for said width values, reading means for the register adapted to

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sense said information a character at a time, a stationary support bearing an array of characters to be photographed, individual optical means for the characters arranged to form their images in a common photographing position, a support for a sensitized sheet, mechanism to move the sheet at a uniform speed past said position, a flash device to illuminate the characters, shutter means associated with the reading means and having provision to cause the image of a selected character to be formed in said position, and means to energize the flash device including impulse generating means synchronized with said mechanism, a counter having a circuit to energize said flash device and provision to count the impulses, and a multiplier associated with the reading means and adapted to multiply said width values and coefficients and to preset said counter after each character is photographed to cause it to energize said flash device when the number of counted impulses corresponds to the product of said multiplication.

7. In photographic type composing apparatus, the combination of a support for a plurality of characters to be photographed, optical projection means to present the image of any selected character in a common photographing position, a support for a sensitized sheet, mechanism to move the sheet at a uniform speed through said position, impulse generating means synchronized with said mechanism, a counter having a circuit to energize said projection means and provision to count the impulses, and a multiplier having a character width input, a coefficient input and means to multiply the values applied to said inputs, the multiplier further including means to preset the counter after each projection to cause it to energize said projection means when the number of counted impulses corresponds to the product of said multiplication.

8. Apparatus according to claim 7, in which the counter is provided with binary stages and the multiplier is provided with binary input and output connections.

9. Apparatus according to claim 7, in which the counter is provided with binary stages and the multiplier is provided with binary input and output connections, the multiplier being adapted to preset a value in the counter equal to the difference between its capacity and said product.

10. In photographic type composing apparatus, the combination of a support for a plurality of selectable characters of different widths to be photographed, projection means for the characters to present the image of any selected character in a common photographing position, means to support a sensitized sheet to receive an image formed in said position, a carriage having means to cause continuous movement of the sheet relative to the

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images formed thereon, a counter, impulse generating means synchronized with said last-mentioned means to advance the counter, a multiplier having a character width input, a coefficient input and means to multiply the values applied to said inputs, selection means associated with the projection means and adapted to enter a width value corresponding to a selected character in the width input, connections from the multiplier to the counter to cause the counter to generate a signal when the number of counted impulses corresponds to the product of the width of said character and a coefficient, and connections to cause said signal to operate the projection means.

11. The combination according to claim 10, in which the counter is provided with binary stages and the multiplier is provided with binary input and output connections.

12. In photographic type composing apparatus, the combination of memory means in which coded information corresponding to a line of type is stored, said information including a numerical representation of the width of each character and space, reading means for the memory means, means to advance said reading means relative to the memory means and into operative relation with successive portions therein representing successive selected characters and spaces in the line, a support for a plurality of selectable characters of different widths to be photographed, projection means for the characters to present the image of any selected character in a common photographing position, means to support a sensitized sheet to receive an image formed in said position, a carriage having means to cause continuous movement of the sheet relative to the images formed thereon, a counter, impulse generating means synchronized with said last-mentioned means to advance the counter, a multiplier having a character width input, a coefficient input and means to multiply the values applied to said inputs, connections from the reading means to the projection means and adapted to enter a width value corresponding to selected characters in the width input, connections from the multiplier to the counter to cause the counter to generate a signal when the number of counted impulses corresponds to the product of the width of said character and a coefficient, and connections to cause said signal to operate the projection means.

13. The combination according to claim 12, in which the memory means contains information corresponding to a selectable coefficient and the reading means is connected with the coefficient input of the multiplier.

No references cited.