

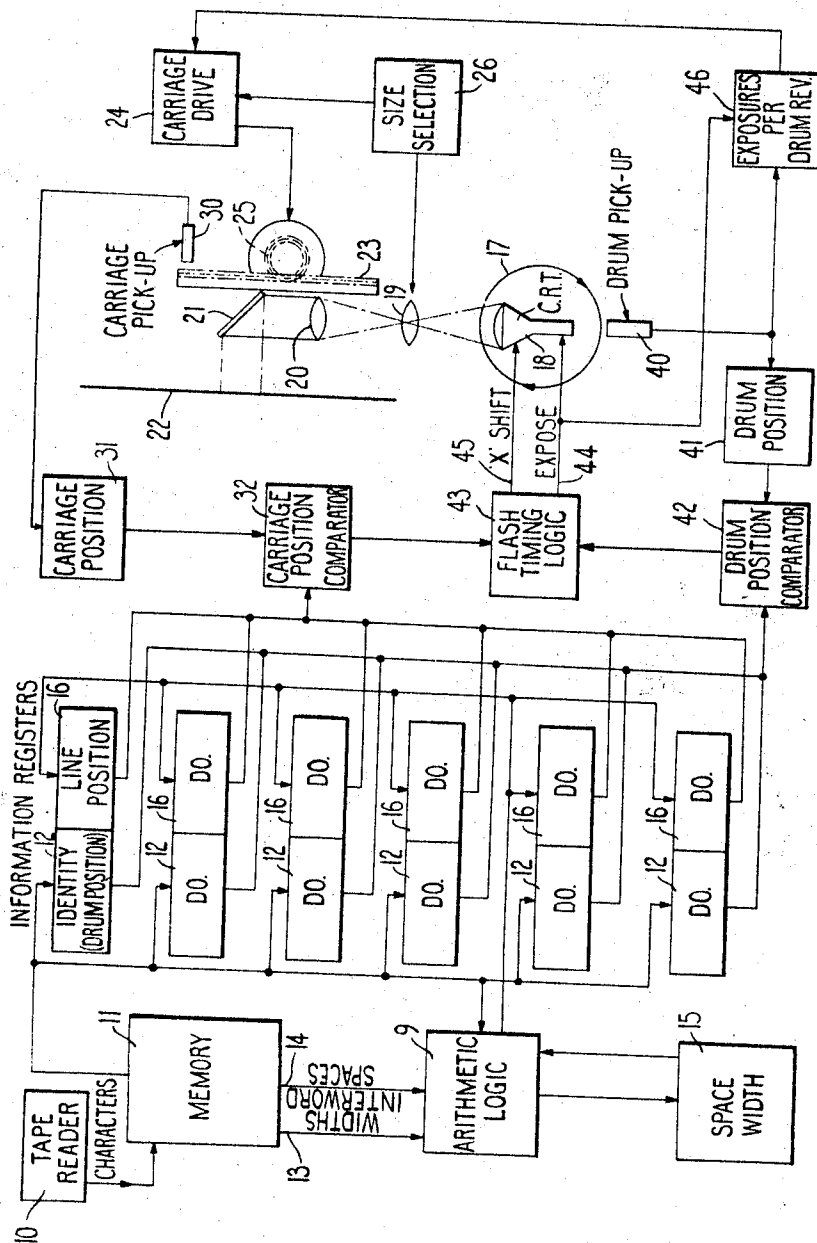
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OPTICAL SCANNERS

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OPTICAL SCANNERS

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ABSTRACT OF THE DISCLOSURE

In photocomposing apparatus, a continuously moving light deflector positions successively exposed characters, from a continuously moving matrix carrier, over a light-sensitive surface, the optical projection system having an exposure zone large enough to contain at least two characters at any time. A continuous comparison is made between the required position on the light-sensitive surface of each of a number of characters to be exposed and the instantaneous positions of the light-deflector and matrix carrier and when the comparison indicates a match for any of the characters under consideration a light flash is generated at that point of the exposure zone at which the character is located, thereby permitting characters to be flashed out of text order at high speed.

In some photocomposing machines, alphabets of characters are carried around the circumference of a rotating drum. As the drum rotates each character passes the optical axis of a lens assembly and if a given character is illuminated as it passes the optical axis that character is "exposed" on to a light-sensitive film. With the exposure of each character, a prism in the optical path is moved along so that succeeding exposures cause the characters to fall adjacent to each other, thereby forming a line of text.

By exposing characters a little way ahead of or a little way after the optical axis, the position on the film at which the character is exposed is laterally displaced and thus by illuminating successively required matrix characters at different positions in relation to the optical axis, two or more characters can be exposed on the film in laterally displaced positions without moving the prism.

According to the present invention, during the passage of a set of matrix characters on a carrier through an exposure zone, a prism or other light deflector in the optical path moves continuously so that a light beam from a fixed point in the exposure zone would sweep along a line of the light-sensitive surface; timing means responsive to the positions of the matrix carrier and the light deflector causes the illumination of a required matrix character by a light flash when the character is in a position within the exposure zone such that it will be exposed on to the required portion of the light-sensitive surface, taking into account the position of the light deflector at the instant of flash; means are also provided for restricting the exposure flash to that portion of the matrix character containing the required character.

In the preferred apparatus embodying the invention, characters from a tape reader are stored in a memory and a logic unit extracts the next series of characters and then computes the intervals before flashing, and the flash unit is a cathode ray tube which can illuminate any point in a predetermined sector of the matrix carrier.

Such an arrangement increases the speed of the photocomposing machine by exposing characters in a sequence which is not directly related to their sequence in the final line of text. This advantage can be illustrated by a consideration of the flashing of three characters X, Y and Z

in an existing machine and in a machine embodying the present invention.

Assume that there is a fixed point in the drum revolution which is called the starting point, that character Z is the tenth of one hundred characters equally spaced around the drum, that character Y is the fiftieth and that character X is the ninetieth. In order to expose X (the first letter in the text) one must allow both Y and Z to pass the optical axis. The time which passes during the drum revolution from its starting point to exposing X will, therefore, be 0.9 of one drum revolution. In order to expose Y (the next letter in the text), one has to allow Z to pass the optical axis. The time which passes between exposing X and exposing Y will be 0.6 of one drum revolution, this being made up of the last tenth of the first revolution and the first half of the second drum revolution. Z will finally be exposed, 0.6 of one drum revolution after exposing Y. The total time taken is, therefore $0.9 + 0.6 + 0.6 = 2.1$ drum revolutions. By utilising the present invention, in which the drum sweep and the prism movement together serve to position the characters on the film, the time required would only be 0.9 of one drum revolution, thus doubling the machine's speed. In the example given above Z would be exposed first, late in the drum sweep (i.e. late in the passage of the matrix letter Z through the exposure zone), Y would be exposed next, a little earlier in the drum sweep, X would be exposed last, early in the drum sweep.

In order that the invention may be better understood, one example will now be described with reference to the accompanying drawing.

In this example, characters are read from punched tape by the tape reader 10 and the electric signals representing these characters are applied to the memory 11 together with a number, representing the total line length, which need appear on the tape only one. The memory unit 11 is capable of storing at least one line of text. At the start of the "Read" cycle, the required line length is fed from the memory 11 to an arithmetic logic unit 9. As the tape reader reads character identities into the memory, the memory reads out the character width into the unit 9, where these widths are subtracted from the line length. When the number of characters entered is sufficient for a full line, all their widths will have been subtracted from the line length, leaving a remainder of, for example, twenty width units. At the same time as the character widths are being transferred to the unit 9 over channel 13, the interword spaces are being transferred to the unit 9 over channel 14. After the "Read" cycle, there follows the "justification" cycle, in which the remainder (twenty width units) is divided by the number of interword spaces in the line. The result of this division is transferred to the interword width store 15.

During the "expose" cycle, when an interword is required, it is obtained from the store 15.

During the expose cycle, the next six characters to be exposed are transferred from the memory to the six identity information registers 12, the data stored in these registers representing the position of the required character on the character drum 17.

The arithmetic logic unit 9 computes the wanted position of each of these characters in terms of basic width units, and applies this information for each character to a line position information register 16 corresponding to the identity information register in which the character itself is stored.

The exposure of characters is carried out by means of a character drum 17 on which is located one or more complete sets of characters and a light source 18 in the form of a cathode ray tube, which illuminates a selected character and, by means of an optical system (digrammatical-

ly represented by a lens 19 controlling the magnification, a lens 20 providing a parallel beam and a mirror 21) projects an image of the character on to the light-sensitive film 22. The mirror 21 is mounted on a carriage 23 formed with a rack, which is continuously driven by means of a motor 24 and pinion 25. By this means the area of the film within which a character can be exposed from the drum 17 moves steadily across the film until the end of the line is reached. The size of the character is controlled by a unit 26, which adjusts the lens 19 and which also influences the speed of the motor 24, so that for larger characters the mirror 21 will be traversed more quickly along the exposure line on the film 22.

It will be recalled that since the mirror 21 is continuously moving, it will not usually be in a position such that a character on the drum 17 can be flashed just at the moment when it reaches the optical axis of the system. In general, to ensure that the required character is exposed on to the required position on the film 22, the flash must occur a little before or a little after the optical axis, depending on the position of the mirror 21 at the instant of flashing. To enable the timing of the exposure to be computed, a carriage pick-up 30 generates electric signals representing carriage movement and applies these to a carriage position unit 31, the output of which is an electric signal representing the distance travelled by the mirror in basic width units. This signal is applied to the carriage position comparator 32. The comparator also receives signals from each of the line position information registers 16 and continually compares these with the actual carriage position. Thus, at any moment the comparator 32 will contain information indicating that, for example, the carriage position falls short of the required line position for the character in the first information register 16 by 98 units, falls short of the line position for the character in the second register 16 by 10 units, has passed the required position for the character in the third information register 16 by 85 units, and so on.

The other factor which it is necessary to know at any instant is the drum position and for this purpose a drum position pick-up 40 supplies electric signals to a drum position computer 41. The latter supplies electric signals representing drum position at any instant to a comparator 42. The comparator 42 receives signals from the six identity information registers 12. It indicates at any instant the relationship between the drum positions of the required characters and the actual drum position. For example, at a given instant it may indicate that the drum position of the character in the first identity information register 12 has reached the exposure zone, but falls short of the optical axis by 70 basic width units; that the drum position of the character stored in the second identity information register 12 has passed the optical axis and is now 10 basic width units beyond it; and so on.

A flash timing logic circuit 43 receives this information from the drum position comparator 42 and also receives the corresponding information from the carriage position comparator 32. If the total count of carriage pulses shows that a character exposed in the centre of the drum sweep will form an image exactly in the right position in the line of text on the film, an exposure flash is timed to take place when that character reaches the centre of the drum sweep. However, generally when the character is in the drum sweep, the mirror is not quite in the right place to project the centre of the drum sweep on to the required location on the film. If this is the case, the exposure flash must be timed to take place before or after the matrix character reaches the centre of the drum sweep, the displacement from the centre being sufficient to compensate for the error in position of the mirror. When the logic circuit 43 learns that a wanted character is in the exposure zone it checks the wanted position of that character with the actual position of the carriage. If the error is less than the total width of the exposure zone, the circuit 43 works out the position in the ex-

posure zone at which this character must be flashed in order to compensate for the carriage position error. In other words, as soon as there is a correspondence between the output of the carriage position comparator, for a given register 16, and the output of the drum position comparator, for the corresponding register 12, a flash pulse is generated and applied by way of conductor 44 to the grid of the cathode ray tube 18. At the same time, the circuit 43 generates a signal representing the position of the required character in the exposure zone of the drum 17 at the instant of flash and applies this signal to the X-shift conductor 45 in order to ensure that the light spot generated on the face of the tube 18 occurs immediately behind the required character and does not expose any other characters.

Since the prism is in continual motion and continuously indicates its position to the logic circuits, no time is lost in waiting for the correct position to be achieved.

As characters are exposed, the appropriate information register is cleared and new information is transferred from the memory to the cleared register. It is, therefore, possible to expose more than six characters on each drum revolution. To take full advantage of this the driving motor 24 may have its speed changed by a magnitude dependent upon the number of characters exposed during the previous drum revolution. In the apparatus shown, this is achieved by means of a circuit 46 which counts the exposure in each drum revolution and controls the speed of the motor 24. In this way, the machine will always be operating at its highest possible speed, which may be some five times faster than existing machines.

The use of a cathode ray tube as a light source permits rapid movement of the light spot within the area of the drum sweep. This is an advantage because two characters may have to be flashed in very rapid succession. A flash cathode ray tube of one inch diameter is suitable.

A turret of lenses is provided to enable a set of different magnifications to be obtained, for setting headlines etc.

I claim:

1. Photocomposing apparatus of the kind having a moving carrier on which is formed a matrix of characters and a support for a light-sensitive surface to be exposed, and further comprising in combination:

an optical system for exposing characters on the carrier on to the light-sensitive surface, the optical system defining an exposure zone through which the matrix characters pass and which is large enough to contain at least two characters at any time;

character-illuminating means including means for generating a light flash and means operable to position the light flash to occur at a point in the said exposure zone which may be displaced in either direction from the last light flash and may be located at any distance along the exposure zone;

continuously moving light deflecting means within the said optical system for scanning across the light-sensitive surface so that the position of an image of an illuminated matrix character on the light-sensitive surface will vary with the position of the light-deflecting means;

means for obtaining signals representing the required position of a character in a line of characters;

comparison means continuously comparing the signals representing the required character position with the instantaneous positions of the matrix carrier and the light deflection means;

first control means responsive to the said comparison means to actuate the illuminating means at a time when the required character on the matrix carrier and the light deflecting means are in such positions that the required character will be exposed at the required position on the light-sensitive surface;

and second control means responsive to the position of

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the required character on the matrix carrier when the illuminating means is actuated to position the exposure flash to occur behind the said character on the matrix carrier.

2. Apparatus in accordance with claim 1, in which the comparison means comprises electronic registers for storing for each of a number of characters to be exposed, the position of the character on the carrier and the required position of the character in the line, means indicating at any instant the matrix carrier position and the position of the light deflector, and comparators for providing electric signals representing the relationship between firstly, the required position of the character in the line and the light deflector position, and secondly the relationship between the position of the required character on the matrix carrier and the actual position of the latter, and means for indicating a correspondence between the outputs of the two comparators for a given required character.

3. Apparatus in accordance with any one of claim 1, in which the character-illuminating means for illuminating a matrix carrier is a cathode ray tube, the second control means including means for generating a deflection potential, for the cathode ray tube, representing the position of the required character on the matrix carrier at the instant of flash.

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4. Apparatus in accordance with claim 1, including a number of information registers, each storing the position of the required character on the matrix carrier and the required position of the character in the line to be exposed, the comparison means being connected to all the information registers and continuously comparing the contents of each with the instantaneous positions of the matrix carrier and light deflector, the apparatus further including means for clearing any information register of information relating to a character which has been exposed and introducing into that register a fresh character to be exposed.

5. Apparatus in accordance with claim 4, including means responsive to the number of characters exposed in each cycle of movement of the matrix carrier to control the speed of movement of the light deflector accordingly.

References Cited

UNITED STATES PATENTS

2,670,665	3/1954	Caldwell	95—4.5
2,933,990	4/1960	Higonnet	95—4.5
3,111,598	11/1963	Tatham	313—86
3,291,015	12/1966	Moyroud	95—4.5
3,336,849	8/1967	Broglie	95—4.5

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