Sept. 22, 1953 R. HIGONNET ET AL 2,652,755

PHOTOGRAPHIC COMPOSING APPARATUS

Filed March 16, 1950 5 Sheets-Sheet 1

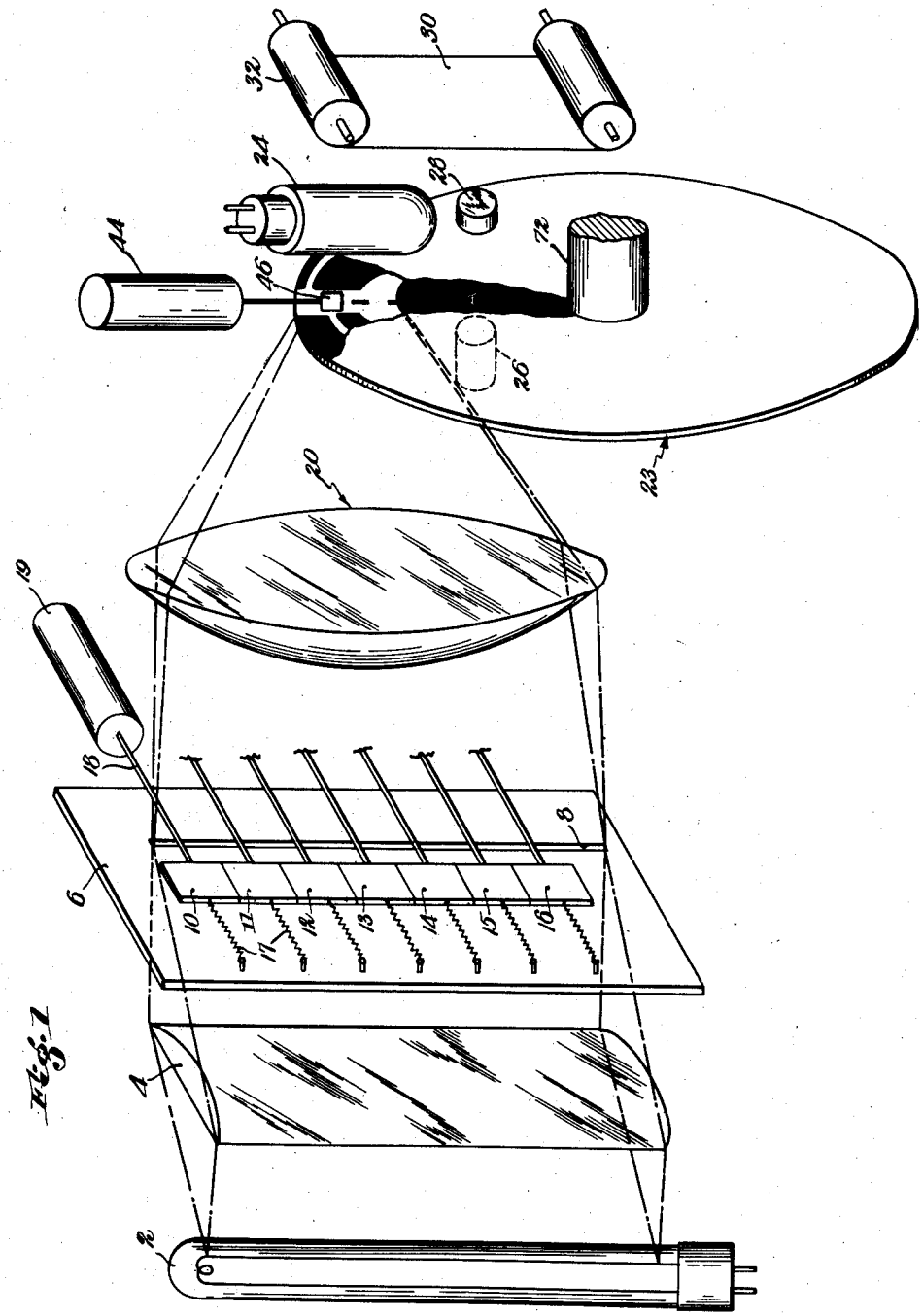


Fig. 1

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PHOTOGRAPHIC COMPOSING APPARATUS

Filed March 16, 1950 5 Sheets-Sheet 2

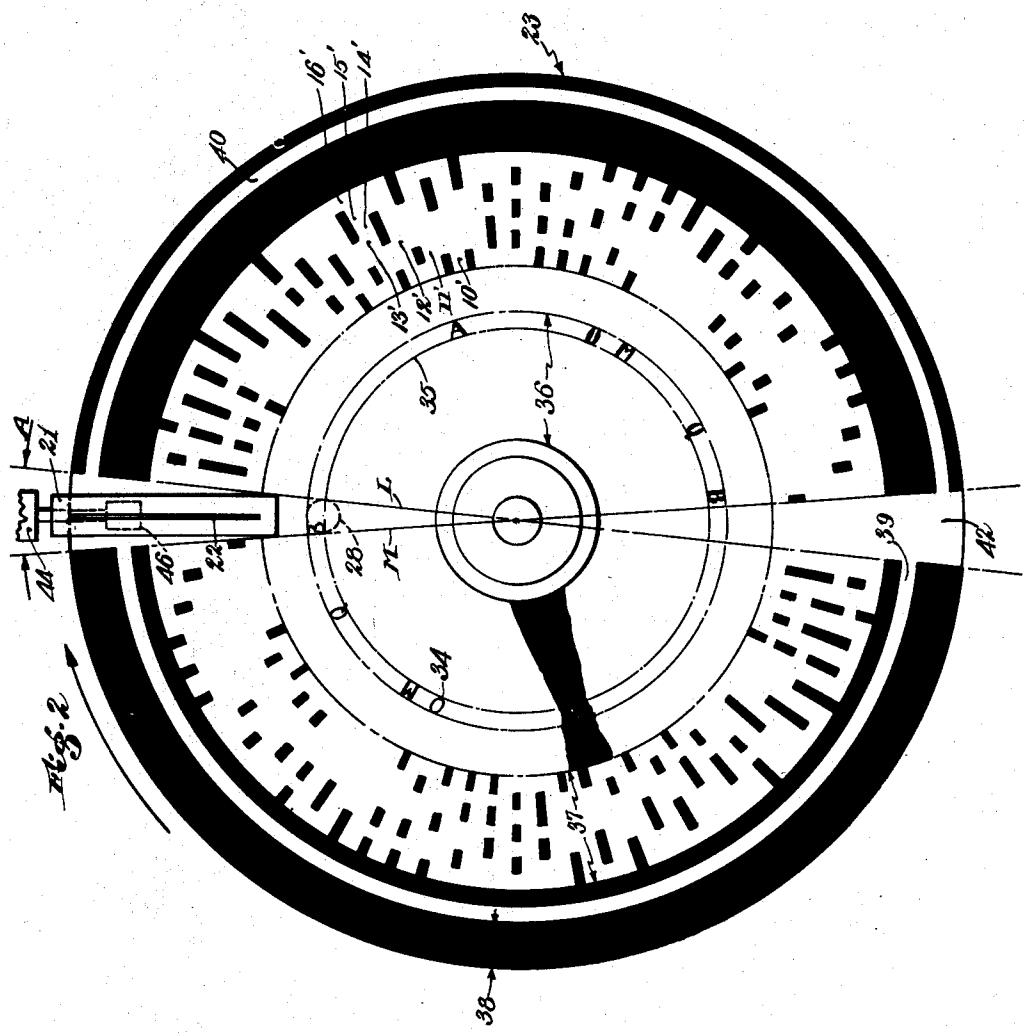


Fig. 2

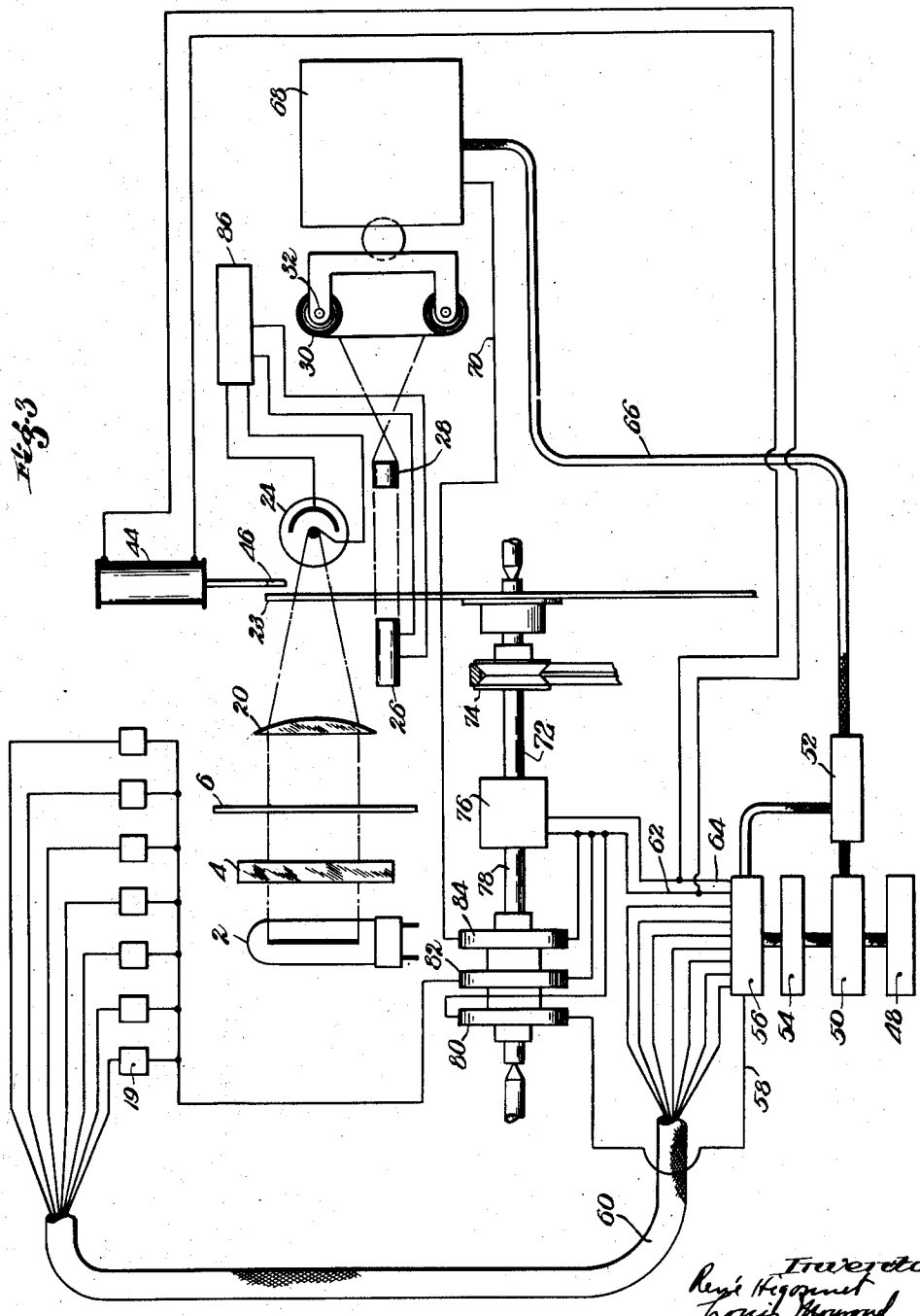
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Fig. 3



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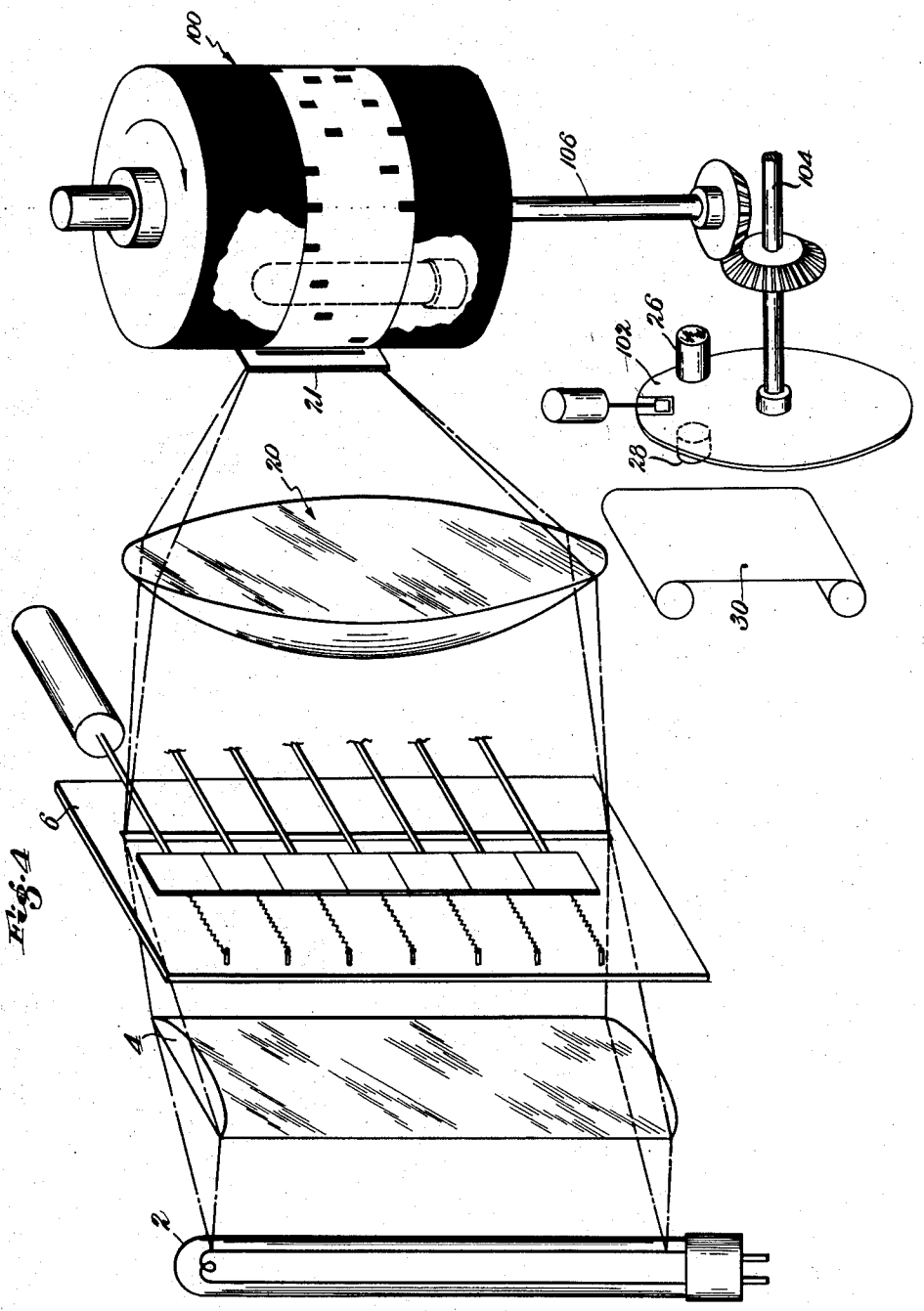


Fig. 4

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PHOTOGRAPHIC COMPOSING APPARATUS

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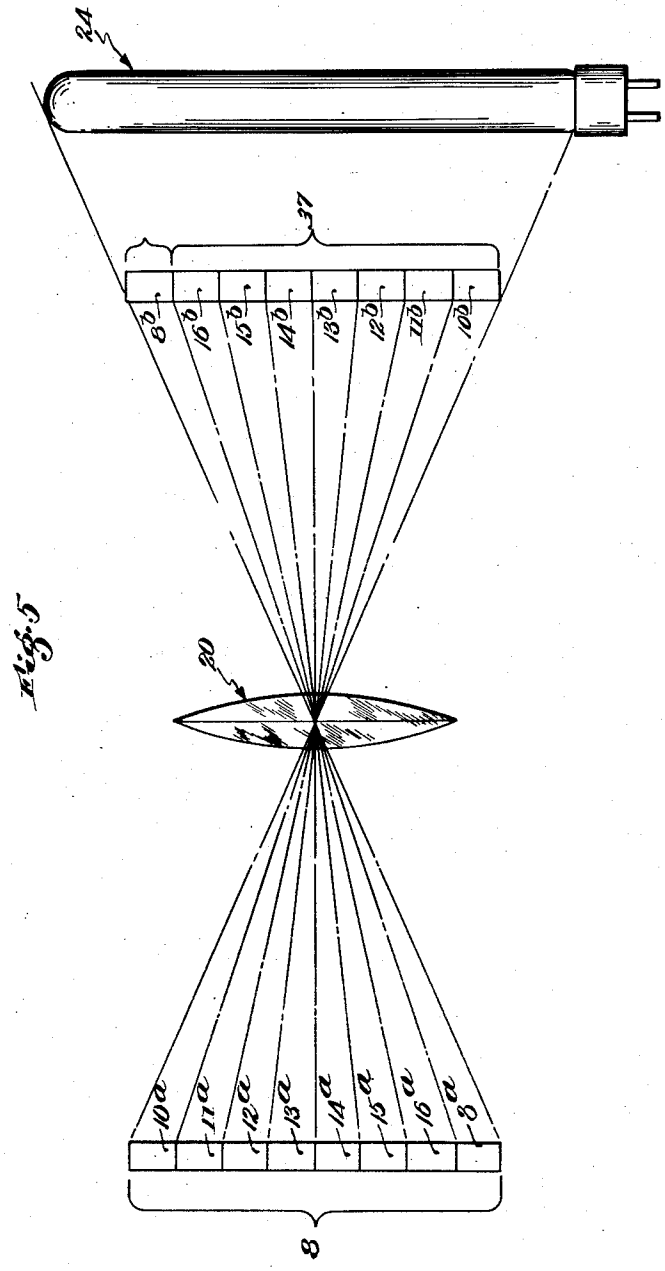


Fig. 5

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UNITED STATES PATENT OFFICE

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PHOTOGRAPHIC COMPOSING APPARATUS

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Application March 16, 1950, Serial No. 150,024
In France March 17, 1949

7 Claims. (Cl. 95—4.5)

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The present invention relates to photographic composing apparatus and particularly to a means for actuating the character illuminating device according to the character selected for projection.

A feature of the invention described herein is a continuously movable character carrier upon which the characters are disposed in such a manner that they are consecutively moved through a projection position. When a character selected for projection is thus moved into the projection position, an illuminating device is actuated to project the image of the character upon a sensitized material. The invention relates to the means for actuating the illuminating device at a precise instant to position the projected character image correctly upon the sensitized material.

Heretofore, numerous methods for accomplishing this result have been proposed. For instance, a series of stationary electrical contacts, one for each character, may be arranged in a circle. A rotatable character carrier in the form of a matrix disk or drum may be provided, and a wiper may be arranged to sweep the contacts, the wiper being rigidly fastened to the character carrier. A source of potential may then be provided to the particular contact which is swept by the wiper at the instant that the selected character is in the projection position. The illuminating device may be energized through a circuit which is closed by the contact and wiper.

There are several refinements of this basic device, including decoding drums in place of rotary contacts, as described in our copending application Serial No. 770,320 filed August 23, 1947, and these variants may be so arranged as to become operative either when a circuit is closed or opened through the decoding device.

A further refinement is disclosed in the above-mentioned application, whereby a form of the contact device just described is used to provide a coarse selection of the characters, and additional means are mounted on the character carrier to provide the precision adjustment in the timing of the projection. The precision means there employed comprise slits which are precisely positioned with respect to the characters, and which admit to a photoelectric cell a beam of light which impinges constantly upon the other side of the character carrier. In such an arrangement a projection does not occur until the coarse control circuit corresponding to the selected character is operative simultaneously with the circuit of the photoelectric cell.

An object of the invention is to provide improvements in the means for timing the projection of characters moving continuously through the projection position.

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A further object is to provide means for changing fonts of projected characters rapidly which involves the use of a photoelectric signal operative upon the same photoelectric cell which is used for timing the projection of selected characters.

A further object of the invention is to provide means for timing the selection of projected characters which are readily adapted to use in photographic composing apparatus producing justified lines of written matter.

With these objects in view, a principal feature of the present invention comprises means for timing the projection of selected characters by the use of a photoelectric cell, a code-controlled beam of light and coded areas of opaque material mounted on the character carrier.

Other features of the present invention comprise the features of construction hereinafter to be described and claimed.

In the drawings, Fig. 1 is a schematic representation of the apparatus associated with the illumination of the photoelectric cell; Fig. 2 is an elevation of the preferred form of character carrier; Fig. 3 is a diagrammatic representation of a complete photographic composing machine incorporating the invention; Fig. 4 is a schematic representation of alternative apparatus for performing the same general function as the apparatus in Fig. 1, and Fig. 5 is a diagrammatic representation of the optical coding elements.

Referring to Fig. 1, a lamp 2 with an elongated filament is provided, and is continuously illuminated. A cylindrical condenser lens 4 is placed in position to collect a portion of the light and to cause it to be converged in a line parallel to its own axis. A shutter frame 6, which is made of an opaque material containing a thin slit 8, is placed so that the slit lies in substantial coincidence with the aforesaid line. Mounted upon the shutter frame are seven shutters 10, 11, 12, 13, 14, 15 and 16, each attached to a spring 17 which is fixed at one end to the shutter frame. Each shutter 10 is also fixed to a rod 18 which is connected at one end to the movable core of a magnet 19. When the magnet is energized the corresponding shutter moves to a position in which it covers a segment of the slit 8. The slit 8 is slightly longer than the combined widths of the shutters; therefore, even if all of the magnets 19 were to be simultaneously energized a portion of the slit 8 at the lower end would remain uncovered.

The magnets 19 provide the means for controlling the light beam emerging from the slit 8 according to the identity of the character selected for projection. The possible number of different controls which may be placed upon the

beam is ascertained in accordance with conventional theory, and is equal to the number 2, raised to a power equal to the number of shutters. The number of shutters here employed has been found to produce sufficient combinations. The method of energizing the magnets 13 is hereinafter more fully described.

Adjacent to the shutter-frame 6 is a converging lens 20 which inverts and collects the code-controlled light beam and again causes it to be converged in a fixed line. The beam impinges upon an opaque plate 21 containing an alignment slit 22 in substantial coincidence with this line. For clarity, the plate 21 is omitted from Fig. 1, but is shown in Fig. 2. A continuously rotating character carrier 23, in the form of a matrix disk, is mounted on a fixed axis so that one surface of the disk is as close as practicable to the plate 21. The disk is constructed of a transparent or translucent material, upon the above-mentioned surface of which are disposed areas of opaque material. It is apparent that some portion of the light beam impinging upon the disk through the slit 22 will always be transmitted through the disk except when the impinging portions of the beam impinge only upon opaque material. At such times the beam is interrupted by the disk. We provide a photoelectric cell 24 in position to receive any light which is transmitted through the disk, and to initiate an exposure of a character when the beam is interrupted.

The physical relation between the above-mentioned areas of opaque material is fixed with respect to a ring of translucent characters 34 and 35, which are disposed upon an opaque background. For convenience, these characters are shown in black in Fig. 2. This relationship, cooperating with the means for controlling the light beam, provides the means for defining the instant when a flash is to occur. A fixed illuminating device 26 is placed opposite a projection position in such a manner that its energization will cause the projected character images to be focused by a focusing lens 28 upon a sensitized surface 30. This surface is preferably a film wound over rollers 32 which turn axially for line spaces, and which move in the axial direction for spacing between successive characters in a particular line. A film carriage meeting this description is disclosed in our above-mentioned application Serial No. 770,320.

A more detailed view of the disk 23 is shown in Fig. 2. As above mentioned, the characters are arranged in a circle, and comprise two fonts, each font being arranged in a half-circle. For example, it is assumed herein that the left-hand font 34 comprises a roman font, and that the right-hand font 35 comprises a bold-face font. As shown, the order of succession of the characters in either direction around the disk is the same for each font. For reasons which will hereinafter become more evident, this arrangement produces an economy of equipment, while still providing for interchangeability of the fonts. The characters are, as mentioned, translucent upon a wide opaque ring 36, although they are represented for convenience as black on a translucent ring in Fig. 2.

Outside of this opaque ring there is a translucent ring 37 which contains coded areas partly comprised of opaque material. Each coded area is disposed with its leading edge (assuming motion in the direction of the arrow) on a radius line at a fixed angle with respect to a radius line passing through the left edge of a particular character on the disk. This angle is shown as zero degrees, but it may be any other fixed angle which is desired. Each coded area contains seven sub-areas 10', 11', 12', 13', 14', 15' and 16', sub-area 10' being nearest the center of the disk. The sub-areas are of equal length, and are either opaque or translucent according to the code designation of the particular character with which the code area is associated. Each sub-area, if made opaque, prevents the light admitted by the particular shutter 10, 11, 12, 13, 14, 15, 16, of which its own number is the prime, from passing through the disk 23.

It is to be noted that it is not necessary to cause the radius angles subtended between successive characters or coded areas to be exactly equal. As will be evident from the description to follow, requisite precision of projection is achieved simply by causing the angle subtended between each character and its corresponding coded area to be uniform in every case.

Therefore, the width of the translucent ring 37 is such that the entire length of the light beam passing through the shutters 10, etc., may also be transmitted through this ring, but the portion of the beam which emerges below the shutters in the slit 8 will not pass through it. The last-mentioned portion of the beam is caused to impinge upon an opaque ring 38 which is outside of the translucent ring 37. This opaque ring contains two translucent half-circle strips, each subtending the same radial angle as the set of coded areas representing a font. Corresponding to the roman font 34 there is a translucent strip 39 at one radius distance, and corresponding to the bold-face font 35 there is a similar translucent strip 40 at a different radius distance.

For convenience, a line L is defined as the line which passes through one end of each of the fonts and also through the center of the disk as shown in Fig. 2. A line M is defined as the line which passes through the other end of each font and the center of the disk. Subtended between these lines are angles A, hereinafter called the "dead angles."

A cycle of the disk 23 is defined as the period of one revolution of the disk. This cycle is divided into two half-cycles. Assuming that the disk rotates continuously in a clockwise direction, as shown by the arrow in Fig. 2, the "roman half-cycle" designates the period measured from the passage of the line L through the projection position, to the succeeding passage of the line L through the projection position, during which period the disk passes through a dead-angle A and then the entire font of roman type characters passes through the projection position. Similarly, the "bold-face half-cycle" designates the remaining half of the period of the disk 23.

The outer opaque ring 38 contains two translucent segments 42 within the dead angles A, as shown in Fig. 2.

Referring to Figs. 1 and 2, a magnet 44 is provided with a movable core, at the end of which is fastened an opaque shutter 46. When the magnet 44 is not energized the shutter is in position to prevent light from passing through the strip 39 and impinging upon the photoelectric cell 24; when the magnet is energized the shutter 46 prevents light passing through the strip 40 from impinging upon the photoelectric cell.

Referring to Fig. 2, it will be observed that the right edge of the alignment slit 22 is coincident with a radius line of the disk 23. By this con-

struction the instant at which any given character is projected is substantially fixed as the instant at which the leading edge of the corresponding coded area reaches the right edge of the slit. At this instant the character is exactly positioned in the projection position in front of the lens **28**.

As the character approaches the projection position the light transmitted to the photoelectric cell **24** is progressively reduced. Eventually, it reaches a low threshold value which causes the photoelectric cell **24** to actuate the illuminating device **26**.

Since the construction employed necessitates the progressive reduction of the transmitted light toward a threshold value the precision with which the character position is fixed at the instant of projection is increased by causing the rate of change of transmitted light to be a maximum as it passes through the threshold value. This is achieved by the construction described above since the leading edges of the opaque sub-areas are caused to reach the right edge of the slit **22** simultaneously.

There are two limitations upon the order of arrangement of the characters and coded areas around the disk. The first limitation arises by virtue of the fact that for a typical character the coded areas entirely interrupt the corresponding code-controlled beam several times during each one of the half-cycles. For instance, assume that it is desired to project the letter "Q." As shown in Fig. 2, the coded area for this character is opaque only in sub-areas **11'** and **16'**. Accordingly, the shutters **10**, **12**, **13**, **14** and **15** must be closed to interrupt the light to the photoelectric cell in combination with this coded area. But, observe that if these shutters are closed the light to the photoelectric cell is also interrupted by the coded areas of the letters "O" and "A."

To prevent the mistaken projection of such additional characters the characters are arranged so that the coded area of the selected character will be the first to interrupt the light beam. The electronic circuit which energizes the illuminating device **26** is constructed so that it is actuated by the photoelectric cell only at the first instant of light interruption.

If, then, it is desired to project the letter "O," only the shutters **10'**, **12'**, **13'**, and **15'** are closed. Also, the letter "O" is arranged to follow the letter "Q" and to precede the letter "A." As shown in Fig. 2 the first light interruption will occur in this case when the letter "O" is in projection position, and this will be the only light interruption on which a projection will occur.

It follows from the above that the possibility of several successive light interruptions necessitates the arrangement of the coded areas on the disk **23** so that the number of opaque sub-areas per coded area increases or remains the same for successive characters. That is, all combinations of a single opaque sub-area are arranged first; then, all combinations of two opaque sub-areas; then, all combinations of three opaque sub-areas, and so forth, according to the direction of rotation of the disk **23**. If, then, the minimum combination of the shutters **10**, etc., which will interrupt the light in combination with the coded areas of any selected character is closed, it is assured that the first light interruption will occur when that character is in the projection position.

It is to be noted that the above limitation does not require any particular order of arrangement of coded areas which have the same number of opaque sub-areas. For example, as shown in Fig. 2 the coded areas of the letters "Q" and "M" each have two opaque sub-areas. These two coded areas, together with their associated characters, may be interchanged without causing erroneous projections.

As to the second limitation on the order of arrangement, for reasons more directly associated with the requirements of justification we find it convenient to use four of the seven sub-areas in each coded area to designate the width of the selected character. These are sub-areas **10'**, **11'**, **12'** and **13'**. A unit of width measurement is selected such that the widest characters do not exceed sixteen units in width. For each character its width is written in the form of a binary number. The above-mentioned sub-areas are then made opaque or clear according to whether a particular digit column of this number, to which it is assigned, is opaque or clear. The zero power of two columns corresponds to the sub-area **10'**, the first power of two columns to the sub-area **11'**, and so on, for each of the four sub-areas. In the binary system only the digits "1" and "zero" are possible. If the digit is "1" the corresponding sub-area is clear; if it is "0," the corresponding sub-area is opaque. Thus, for example, as shown in Fig. 2, the width of the letter "M" is seen to be 15 units. If there are more than one character of the same width, the sub-areas **14'**, **15'** and **16'** are differently coded to distinguish between the characters.

As shown in Fig. 2, the disposition of a particular character upon the disk is dependent upon two factors: first, as mentioned above, the left edge of the character, when it passes through the projection position, is on the same radius line as the leading edge of its corresponding coded area; second, the bottom edge of the character falls on a common circle with the other characters. We locate the central axis of the lens **28** so that the point of intersection of this radius line and common circle is exactly in the axis of the lens at the precise instant that the character reaches the projection position.

The resultant use of only the first quadrant of the lens circle for projection relates to changes in the sizes of projected characters. By this means we may replace the lens **28** with a lens of different focal length, but of common optical axis, even to change the type sizes of two successive characters on the same line, without causing the bottom edge of the larger projected character to fall below that of the smaller; nor is the left edge of the larger character caused to fall further to the left than it would have fallen had the character been projected with smaller size. The inherent advantage in this relates to the use of mechanism for spacing the sensitized surface **30**. The movement of this mechanism normally follows the projection of a character and corresponds to its width. Since the left edge of each character is fixed, regardless of size, this movement is not partly offset by changing the lens **28** between two successive projections.

The foregoing description of the optical system may be briefly summarized by reference to Fig. 5 as follows. The slit **8** may be considered as an "object," uniformly illuminated by means of the lens **4** which may be considered in the nature of a condenser lens. The slit **8** is considered as divided into sections **8a**, **10a**, **11a**, **12a**, **13a**, **14a**,

15a and 16a. Each of these sections, excepting 8a, is adapted to be covered by a shutter; for instance, the section 10a is covered by the shutter 10, as shown in Fig. 1, and likewise for the other sections 11a through 16a.

The lens 20 is a projection lens which makes an image of the slit 8 on the character carrier 23. The portion of the image representing the sections 10a through 16a of the slit impinges upon the ring 37 and the portion representing the section 8a impinges upon the ring 38. The image is considered as divided into sections 8b, 10b, 11b, 12b, 13b, 14b, 15b and 16b. Each of these sections corresponds with the equal-numbered section of the "object." And further, any of the sections 10b to 16b of the image may be darkened by closing the shutter of the corresponding section of the object.

Such portions of the light as form the image on a translucent or transparent portion of the disk 23 are admitted through the disk to the photoelectric cell 24.

Each coded area in the ring 37 is divided into sub-areas corresponding to the image sections 10b to 16b, and each sub-area, if opaque, blocks an equal-numbered section of the image 10b to 16b.

The section 8a of the "object" is continuously imaged upon the ring 38 of the disk. Depending upon whether or not its magnet is energized the shutter 46 blocks the light admitted through either of the strips 39 or 40.

Therefore, it wil be seen that it is possible to reduce the illumination of the photoelectric cell to zero at some instant of time by a combination of (a) selective blocking of sections of the object, (b) selective blocking of illuminated sections of the image, and (c) positioning of the shutter 46 to block the light admitted through the strip 39 or 40. At the instant at which light is completely blocked from the photoelectric cell the illuminating device 28 is energized to project the selected character onto the sensitized material.

Alternatively, the shutter 46 may be moved to the section 8a of the slit and used to block the upper or lower portion of the section 8a of the "object" itself. Viewing Fig. 1 in this form, it is evident that the third requirement for reducing the illumination of the photoelectric cell to zero, namely the movement of the shutter 46 to block the light admitted through the strip 39 or 40, may be seen merely as a restatement of the first two requirements.

Having thus described the principal features of the invention which relate to the ascertainment of the precise instant for energizing the illuminating device 26, we turn now to a description of a complete photographic composing machine which may embody the invention.

Referring to Fig. 3, a standard keyboard 48 is provided with a set of permutation bars 50 which are preferably of the type commonly employed in the telegraphic art. Connected with the permutation bars is a justifier 52 and a register 54. As the key of a selected character is depressed the corresponding permutation bar completes electrical circuits which transmit to the justifier information relating to the width of the character and to the register information relating to both the identity and to the width of the character. A justifier of the type described in our application Serial No. 70,472, filed January 12, 1949, is suitable for this purpose. A register of the type described in our application

Serial No. 770,320, filed August 23, 1947, may also be used.

The permutation bars are provided with "writing" means, that is, means for actuating pins or other information storage devices in the register, in a particular combination uniquely describing each of the selected characters in the form of a code. In the form of embodiment here shown it is assumed that each stored character is represented in the register by a character storage position containing a combination of eight of such storage devices, seven devoted to character designation, and one to font designation. The register is normally provided with means for storing a complete line of characters at a time, during what we shall refer to as a "storage cycle." After the storage cycle there is a "transcription cycle," during which the characters stored in the register are successively projected as hereinafter described.

It is to be noted that the operator not only selects each character but also the font in which the character is to be projected. In the embodiment shown, it is assumed that the storage device which is devoted to font designation is caused to be actuated when the character is to be in bold-face, and not actuated when the character is to be in roman type.

The register 54, in addition to its means for storing information as above described, is provided with a "reading" unit 56. During the transcription cycle the reading unit is provided with means for indexing from one character storage position to the next upon the application of an electrical potential to a wire 58. The reading unit is also adapted to connect any combination of a group of projection control wires 60 to a supply lead 62 which is supplied with a direct current potential. Each of the wires 60 corresponds to one of the seven storage devices in a character storage position which are devoted to character designation. The combination of the wires 60 connected to the supply lead 62 corresponds with the combination of storage devices which is actuated in the particular character storage position in which the reading unit finds itself at any particular time.

The eighth storage device which is devoted to the font designation is not used with one of the wires 60, but is used to connect a wire 64 with the supply lead 62 when the reading unit finds this storage device in the actuated condition.

Thus, it is evident that upon the connection of the wire 58 with the supply lead 62 the reading unit 56 moves to the next character storage position in the register and thereupon energizes the particular combination of the wires 60 designating the character stored in the new position of the reading unit 56, and also energizes the wire 64 if the character is to be projected in bold-face.

During the storage cycle, as mentioned above, the justifier 52 receives information relating to the character widths from the permutation bars. During the transcription cycle the justifier receives information from the reading unit 56 corresponding to the characters which are being read to the wires 60. From the previous description it is evident that the justifier is actuated by the four wires 60 which energize the magnets 19 associated with the width of the characters. The corresponding shutters of these magnets are 10, 11, 12 and 13. This information enables the justifier to provide for the space needed for the particular character which is being read, and

also takes into account the justification requirements for the particular line, these requirements having been pre-computed by the justifier during the storage cycle. The spacing control is transmitted over a spacing control cable 66 to a carriage 68, adapted to cause variable axial displacement of the rollers 32. Such circuits are not complete however, except through a wire 70, which must in turn be connected to a source of electrical potential as hereinafter described.

It is evident that, for the transcription of any given character from the register 54 to the sensitized surface 30, the projection of the character and the spacing of the carriage 68 must take place successively. As mentioned above, in this embodiment the projection occurs first.

To produce the required timing of character projections and carriage spacing, a continuously rotating shaft 72, driven by a pulley 74, is provided. The disk 23 is secured to the shaft 72 and also rotates continuously. Also secured to the shaft 72 is a font control escapement 76. This escapement is adapted to connect the shaft 72 with a second shaft 78. The escapement is so constructed that when the circuit between the wires 62 and 64 is either closed or opened it allows the shaft 78 to stop while the shaft 72 rotates through a full 180 degrees, at which time it again reconnects the shafts.

Secured to the shaft 78 are timing cams 80, 82 and 84. The cam 80 is provided with a pair of contacts which connect the wire 58 with the supply lead 62, and is thus associated with the indexing of the reading unit 56 from one character storage position in the register to the next. The cam 82 is provided with a similar pair of contacts which connect the common leads of the shutter magnets 19 with the supply lead 62, and is thus associated with the projection control wires 60 in causing the operation of the shutters 10, etc. The cam 84 is provided with contacts to connect the wire 70 with the supply lead 62, and is associated with the spacing control cable 66 in causing the variable movement of the carriage 68.

Each of the cams 82 and 84 closes its contacts for the duration of one-half of a revolution of the shaft 78; however, the contacts of the cam 82 are closed during one half and those of the cam 84 during the other half of the revolution. The cam 80 closes its contacts only while the shaft 78 turns through an angle approximately equal to the dead-angle A, shown in Fig. 2, and the instant of closure of these contacts is the same as the instant of closure of the contacts of the cam 82.

The disk 23 and the cams 80, 82 and 84 are secured to the shafts 72 and 78 in fixed relation to the font control escapement 76. Thus, when the line L of the disk is in the projection position and a roman half-cycle is just beginning, the contacts of the cams 80 and 82 are simultaneously closed.

In order to describe the operation of the apparatus during the projection of a particular character stored in the register, assume that the line L of the disk 23 is in the projection position and a roman half-cycle is beginning. As the disk continues to rotate through the dead-angle A the reading unit 56 of the register is indexed to the next character storage position through the closure of the contacts of the cam 80 and arrives in that position well before the disk has completed its rotation through the dead-angle A.

Assume first that the character stored in the new position of the register is to be projected in roman type. On this assumption the wire 64 will not become connected with the supply lead 62; hence, the connection of the shafts 72 and 76 will not be disturbed.

Before the disk 23 has rotated through the dead-angle A the projection control wires 60 are energized according to the character in the new position. The shutters 10 etc. are actuated accordingly since the contacts of the cam 82 are closed. Since, by assumption, this is the roman half-cycle the characters of the roman font 34 pass successively through the projection position for the remaining part of the first 180 degrees of rotation of the disk 23. As previously described, the character which is in the projection position at the instant that the photoelectric cell 22 receives no light through the disk 23 is projected by the illuminating device 26, this device being energized by an electronic supply circuit 86, for which the photoelectric cell 24 serves as a trigger.

During the succeeding, or bold-face half-cycle, it will be noted that the strip 40 will not be covered by the shutter 46; hence, at no time during this half cycle will the light beam be interrupted completely. Since the circuit of the cam 82 is open, the shutters 10 return to their unactuated positions during this half-cycle. Since the circuit of the cam 84 is closed, the carriage 68 moves the sensitized surface 30 under the control of the justifier, as described above. At the end of this half-cycle the spacing control circuit also opens.

Thus, within one complete cycle of the disk 23, both the projection and spacing of a stored character are produced.

Assume next that the character stored in the next position of the register is to be projected in bold-face. On this assumption, after the reading unit 56 reaches the next position, a connection is produced between the wire 64 and the supply lead 62. The font control escapement 76, which is immediately energized through this connection, disengages the shaft 78 from the shaft 72, thereby preventing the further rotation of the cams 80, 82 and 84. The disk 23 then rotates through exactly 180 degrees, at the end of which time the escapement reconnects the shafts 78 and 72.

Simultaneously with the energization of the font control escapement, the magnet 44 is energized. This causes the shutter 46 to move to a position in which it covers the strip 40 on the disk. Thus, during the period in which the cams are motionless, which includes the remainder of the roman half-cycle, the light is never completely excluded from the photoelectric cell 24 because the strip 39 is not covered, and no projection can occur.

Upon the completion of the 180 degree turn of the disk 23, the escapement 76 reconnects the shaft 72 and the shaft 78. It is evident that this reconnection takes place within the dead-angle A of the bold-face half-cycle, and that since the shutter 46 now covers the strip 40 on the disk, the projection will be produced in the bold-face half-cycle.

Upon the completion of the bold-face half-cycle the disk 23 will have moved through 360 degrees since the reading unit 56 moved into the particular character storage position, and the cams will have moved through only 180 degrees. Since the cams govern the timing of the reading unit steps, these cams must rotate through

an additional 180 degrees before the reading unit can be moved to the next character storage position. During this remaining half-cycle the carriage **68** is actuated through the contacts of its cam **84** which are then closed.

Upon the completion of this period, which is a roman half-cycle, the reading unit is again indexed to a new position by the closure of the contacts of the cam **80** In moving from the old position it necessarily opens the connection between the wire **64** and the supply lead **62**. As previously explained, this results in an actuation of the font control escapement **76** and causes the cams to stop while the disk **23** rotates through 180 degrees. Since this occurs during a bold-face half-cycle of the disk **23**, and since the magnet **44** is de-energized at the same instant that the font control escapement is actuated, the strip **40** is not covered and a projection cannot occur. At the completion of this half-cycle the machine is prepared to project the next character.

An alternative form of the present invention is shown in Fig. 4. In this embodiment the coded areas corresponding to only one font are mounted around the entire circumference of a drum **100**. The characters are not mounted in this drum, but on a separate disk **102**. This disk, aside from the absence of the coded areas, is substantially identical with that of Fig. 2. A shaft **104** corresponds to the shaft **72** shown in Fig. 3. The gear ratio between the shaft **104** and a shaft **106** bearing the drum **100** permits the drum to rotate at twice the speed of the disk. The connection between the disk **102** and the drum **100** is such that the coded areas pass the alignment slit in the opaque plate **21** in the same order as in the embodiment of Fig. 1. An advantage inherent in this type of arrangement is that, by increasing the diameter of the drum **100**, the lineal speed of the code strips is increased. This in turn increases the precision of flash timing.

A variation of the drum embodiment would be to mount the characters directly on the drum **100** and to mount the illuminating device **26** inside of the drum. This arrangement takes advantage of the drum construction while at the same time obviating the need for gears or analogous linkages.

In any of the embodiments above discussed certain other variations in particular elements of the invention may be employed. For instance, in place of using a single elongated coded area on the character carrier with a plurality of contiguous sub-areas, as assumed throughout the above discussion, a plurality of separate beams of light may be used. In that event neither the shutters **10**, etc., nor the sub-areas **10'**, etc. of the coded areas need be contiguous. An advantage arising from the variation is that it eliminates an element of uncertainty arising from diffraction of light around the edges of the shutters **10**, as well as from the focusing of the lens **20**, and causing portions of the code-controlled beam to overlap upon adjacent sub-areas.

Again, we may replace the shutters **10**, etc., shown in Fig. 1, with other means for effectuating the desired control of the light beam. One such means is an opaque strip of material with punches representing the desired code combinations. This opaque strip may simply be indexed across the slit **8** from one set of punches to the next, in place of using the circuit of Fig. 3 to energize the shutter magnets **19**. The production of such punched strips or tapes by means of apparatus controlled by the machine operator has been systematically dealt with in the calculating machine and related arts.

Having thus described our invention, we claim:

1. In photographic type composing apparatus, the combination of a rigid character carrier, continuously rotatable in one direction and bearing the characters to be photographed and corresponding code areas, each code area comprising a representative combination of transparent and opaque sub-areas and having an edge in precise spatial relation to a point in a corresponding character, a fixed illuminated object, means for focusing on the character carrier a stationary image of said object corresponding substantially in size and shape to a code area and having an edge in position to become coincident with said edges of each of the code areas successively, means for selectively blocking sections of the object corresponding to the combination of sub-areas representing a single selected character, a single photo electric device to receive light passing through the transparent sub-areas, and projection means actuated by the photoelectric device when said light is reduced substantially to zero by reason of said edges of the selected code area and image reaching coincidence, to project the code-selected character on to a sensitized surface.

2. In photographic type composing apparatus, the combination of a rigid character carrier, continuously rotatable in one direction and bearing characters of variable width to be photographed and corresponding code areas, each code area comprising a representative combination of transparent and opaque sub-areas and having an edge in precise spatial relation to a point in a corresponding character, a fixed illuminated object, means for focusing on the character carrier a stationary image of said object corresponding substantially in size and shape to a code area and having an edge in position to become coincident with said edges of each of the code areas successively, means for selectively blocking sections of the object corresponding to the combination of sub-areas representing a single selected character, a single photoelectric device to receive light passing through the transparent sub-areas, a support for a sensitized surface, means actuated by the photoelectric device when said light is reduced substantially to zero by reason of said edges of the selected code area and image reaching coincidence, to project the code-selected character on to the sensitized surface, and means for moving the support by a distance corresponding to the width of the selected character.

3. In photographic type composing apparatus, the combination of a register for storing coded information corresponding to selected characters in a line of written matter and the widths of said characters, a rigid character carrier, continuously rotatable in one direction and bearing characters of variable width to be photographed and corresponding code areas, each code area comprising a combination of transparent and opaque sub-areas representing the character and the width of said character, a fixed illuminated object, means for focusing on the character carrier a stationary image of said object corresponding in size and shape to a code area, means actuated by the register for selectively blocking sections of the object corresponding to the combination of the code area of a single selected character, a single photoelectric device to receive

light passing through the transparent sub-areas, a support for a sensitized surface, means actuated by the photoelectric device to project the code-selected character on to the sensitized surface, and spacing means actuated by the register for moving the support by a distance corresponding to the width of the selected character.

4. In photographic type composing apparatus, the combination of a register for storing coded information corresponding to selected characters in a line of written matter, each character being represented by combinations of a number of code elements divided into a group representing the width and a group for distinguishing said character from characters of like width, a rigid character carrier, continuously rotatable in one direction and bearing characters of variable width to be photographed and corresponding code areas, each code area comprising a representative combination of transparent and opaque sub-areas corresponding to the code elements of the register, a fixed illuminated object, means for focusing on the character carrier a stationary image of said object corresponding in size and shape to a code area, means actuated by the register for selectively blocking sections of the object corresponding to the combination of the code area of a single selected character, a single photoelectric device to receive light passing through the transparent sub-areas, a support for the sensitized surface, means actuated by the photoelectric device to project the code-selected character on to the sensitized surface, and spacing means actuated by the group of code elements of the register representing the width for moving the support by a distance corresponding to the width of the selected character.

5. In photographic type composing apparatus, the combination of a rigid character carrier, continuously rotatable in one direction and bearing the characters to be photographed and corresponding code areas, each code area comprising a representative combination of transparent and opaque sub-areas and having an edge in precise spatial relation to a point in a corresponding character, a fixed illuminated object, means for focusing on the character carrier a stationary image of said object corresponding substantially in size and shape to a code area and having an edge in position to become coincident with said edges of each of the code areas successively, means for selectively blocking sections of the object corresponding to the combination of sub-areas representing a single selected character, a single photoelectric device to receive light passing through the transparent sub-areas, and projection means actuated by the photoelectric device to project the code-selected character on to a sensitized surface, said projection means including an intermittent flash device and an optical system having an axis passing through the paths of said points in the characters.

6. In photographic type composing apparatus, the combination of a rigid character carrier, continuously rotatable in one direction and bearing the characters to be photographed and corresponding code areas, each code area comprising a

representative combination of transparent and opaque sub-areas and having an edge in precise spatial relation to a point in a corresponding character, a fixed illuminated object, means for focusing on the character carrier a stationary image of said object corresponding substantially in size and shape to a code area and having an edge in position to become coincident with said edges of each of the code areas successively, means for selectively blocking sections of the object corresponding to the combination of sub-areas representing a single selected character, a single photoelectric device to receive light passing through the transparent sub-areas, and projection means actuated by the photoelectric device to project the code-selected character on to a sensitized surface, said projection means including an intermittent flash device and focusing means in position to cause a side and bottom edge of the selected character to fall on perpendicular lines intersecting in the optical axis at the precise instant of projection.

7. In photographic type composing apparatus, the combination of a rigid character carrier, continuously rotatable in one direction and bearing the characters to be photographed and corresponding code areas, each code area comprising a representative combination of transparent and opaque sub-areas and having an edge in precise spatial relation to a point in a corresponding character, the number of opaque sub-areas per code area increasing or remaining constant for code areas successively passing through a given position, a fixed illuminated object, means for focusing on the character carrier a stationary image of said object corresponding substantially in size and shape to a code area and having an edge in position to become coincident with said edges of each of the code areas successively, means for selectively blocking sections of the object corresponding to the combination of sub-areas representing a single selected character, a single photoelectric device to receive light passing through the transparent sub-areas, and projection means actuated by the photoelectric device at the first occurrence of substantial absence of light on the photoelectric device to project the code-selected character on to a sensitized surface.

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