Feb. 19, 1957 R. A. HIGONNET ET AL 2,781,706

PHOTOGRAPHIC COMPOSING APPARATUS

Filed May 21, 1953 2 Sheets-Sheet 1

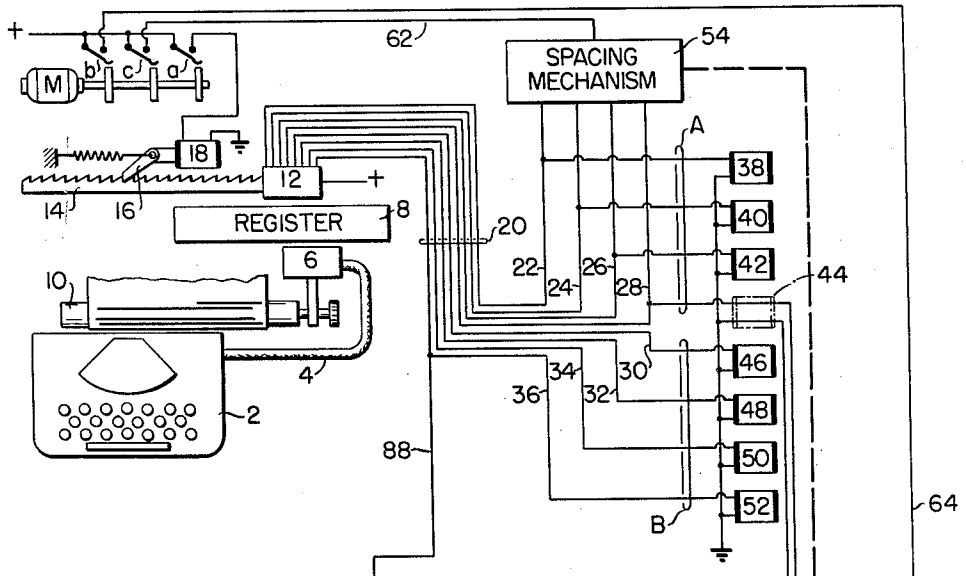
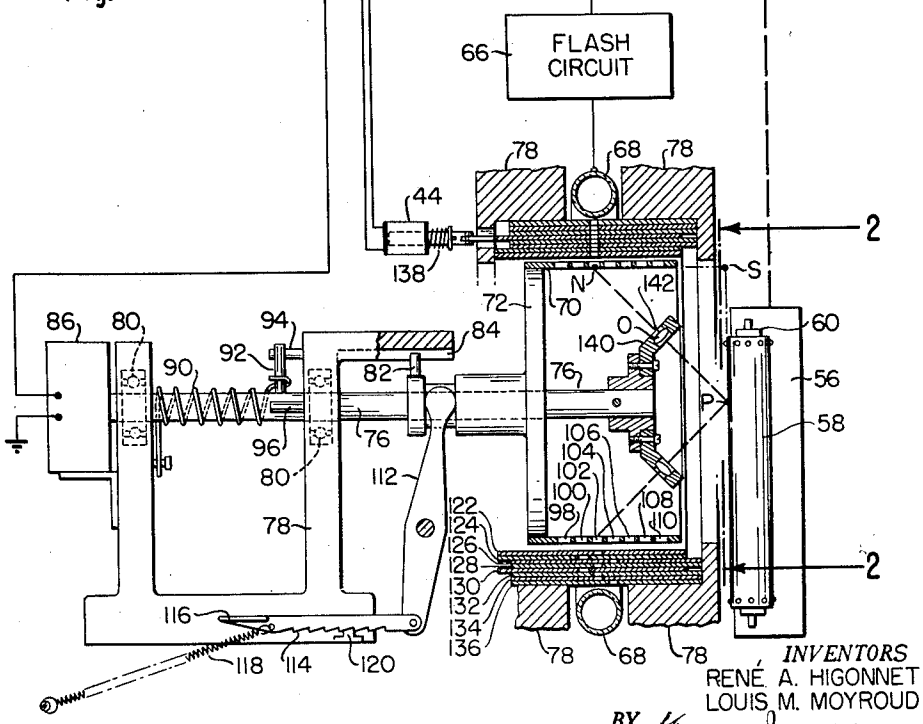


Fig. 1



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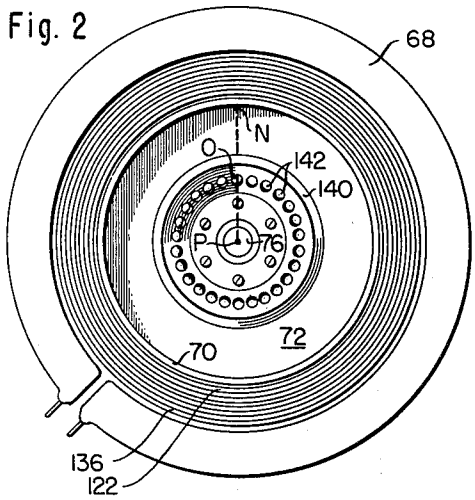
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PHOTOGRAPHIC COMPOSING APPARATUS

Filed May 21, 1953 2 Sheets-Sheet 2

Fig. 2



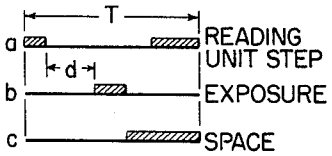


Fig. 3

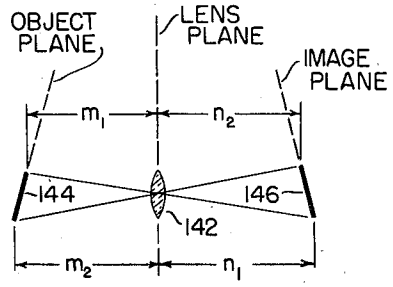


Fig. 4

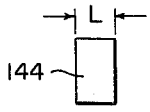


Fig. 5

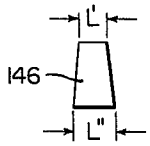


Fig. 6

Fig. 7

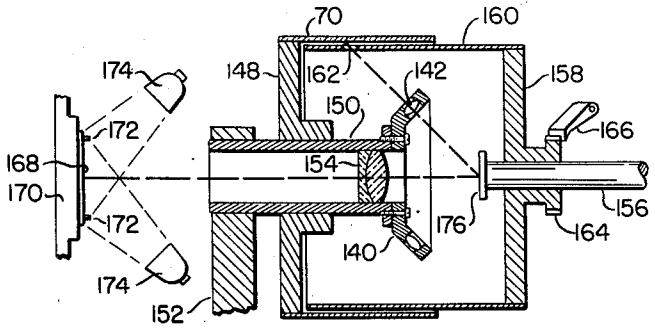
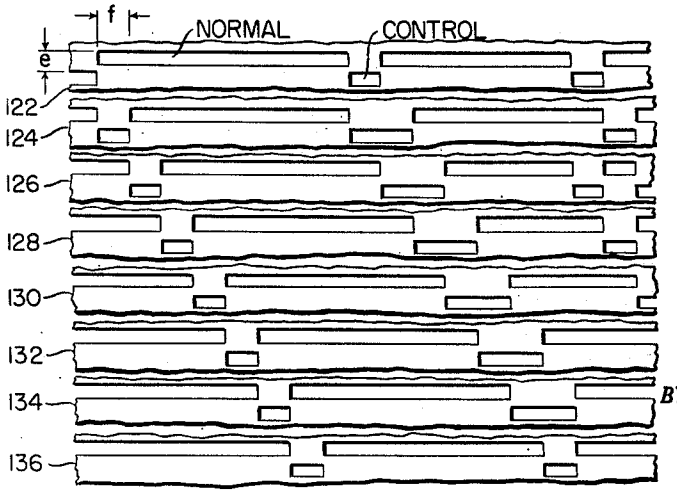


Fig. 8



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2,781,706

PHOTOGRAPHIC COMPOSING APPARATUS

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Application May 21, 1953, Serial No. 356,512
Claims priority, application Great Britain June 9, 1952
4 Claims. (Cl. 95—4.5)

The present invention relates to photographic type composition, and more particularly to apparatus for rapid, successive projection of selected characters upon a sensitized sheet, the characters being stationary during the time of exposure. In addition, the invention relates to a method for disposing the characters to be projected upon a suitable support adapted for use in conjunction with said apparatus.

In our copending application, Serial No. 610, 336, filed August 11, 1945, we have disclosed a photographic type composing machine having a continuously revolving character carrier which causes the characters to be moved successively through a projection position. Means are disclosed whereby an intermittent flash device is illuminated for an extremely brief interval of time when a selected character is momentarily aligned in said position. Because of the extremely brief duration of the flash, the method of projection is termed a "stroboscopic" or "stop-motion" flash exposure. The flash circuit for energizing the illuminating device must accordingly be designed so that this interval produces negligible blur due to the motion of the character, and such design must be consistent with great dependability of performance, whereby many projections may be made successively without missing a single character or projecting it in improper register with the adjacent characters.

In our copending application, Serial No. 354,162, filed May 11, 1953, we have disclosed another type of composing machine, in which we are enabled to use appreciably longer time intervals for exposing the moving characters without a sacrifice in the speed of the machine. This is accomplished by using continuously moving optical projection means which compensate for the motion of the characters. Thus, a character which is continuously in motion may be projected through a moving optical system which, in effect, "stops" the image which is focused upon the sensitized sheet or film.

It is a principal object of the present invention to provide apparatus for type composition by successive projection of selected characters according to a procedure generally similar to that employed in said applications, but in which the characters, the sensitized sheet upon which they are composed, and the optical projection means are held stationary during the exposure.

A second object is to provide apparatus of the above type having provision for convenient and rapid selection of any one of a large number of characters in various fonts.

Still another object is to provide apparatus having the properties heretofore mentioned, yet being of relatively uncomplicated design, and satisfying the stringent requirements of the printing art with respect to precision of definition and alignment, yet having relatively inexpensive components which can be readily assembled together.

With the above objects in view, one of the features of the present invention resides in the use of multiple lenses for projecting selectively illuminated characters to a fixed

projection position, the lenses and characters being stationary at the time of exposure.

According to one embodiment of this invention, the characters are arranged upon a cylindrical surface. They are projected through a plurality of lenses, each character being projected through a particular corresponding lens. The optical axes of the lenses are arranged in a conical configuration.

According to another feature, we utilize distorted characters in conjunction with the optical system to produce undistorted character images upon the sensitized sheet.

Another feature resides in the possibility of operating the apparatus at extremely great speed commensurate with, and even in excess of, the fastest speeds attainable by a keyboard operator.

Another feature resides in a method of disposing the characters upon the support which utilizes the same lens that projects the character, thereby substantially obviating the need for using expensive, highly corrected lenses to achieve requisite definition and precision in positioning the image.

Other features of the invention reside in certain structures, relationships, methods and modes of operation hereinafter described with reference to a preferred embodiment, and more particularly defined in the claims.

In the drawings,

Fig. 1 is a partially diagrammatic drawing of a photographic type composing machine incorporating the invention, the projection apparatus being shown by an elevation in section;

Fig. 2 is an end elevation on line 2—2 of the projection apparatus in Fig. 1;

Fig. 3 is a timing diagram for the cam-operated contacts of Fig. 1;

Fig. 4 is a diagram illustrating the optical principles of the projection apparatus;

Figs. 5 and 6 are diagrams to be used with reference to Fig. 4;

Fig. 7 is an elevation in section of a preferred form of apparatus for disposing the characters upon the support in the manufacture of said support; and

Fig. 8 is a fragmentary developed view of the code drums.

Referring to Fig. 1, we provide a non-justifying typewriter 2 of the type commonly in use, and preferably having an electrically operated key mechanism. To this typewriter we connect a set of coded permutation bars similar to those employed in teleprinter circuits, as described in our copending application, Serial No. 770,320, filed August 23, 1947. These permutation bars are connected through a cable 4 with a recording unit 6, movably disposed in relation to a register 8 by reason of a physical connection with the platen carriage 10 of the typewriter, as schematically illustrated. The register may be of any suitable type, but the illustrated form is assumed to consist of a flat vertical bed supporting rows and columns of depressable and retractable spring-retained pins. The recording unit 6 comprises a series of vertically-disposed, magnetically depressable hammers adapted to register with the pins in one column of the register at a time. There is a column 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 a reading unit 12, which is movable by a ratchet 14 and pawl 16 linked with a movable core of a solenoid 18, is moved independently of the recording unit to sense the depressed pins and send the corresponding information to the transcribing apparatus over a cable 20.

The entire assembly heretofore described may be constructed substantially as described in our above-mentioned

copending application Serial No. 770,320. As stated, the characters are preferably recorded in the form of a code. In the illustrated embodiment, each character is represented by a combination of eight code digits, each digit being in a binary form, that is, having two discrete conditions designated as "0" and "1." Four of the digits, designated as the "A" group, characterize the width of the character in the form of a binary number. It will be apparent that the four digits permit representation of any character width from zero to fifteen units. The remaining four digits of the representation, designated as the "B" group, are used for the purpose of distinguishing between the several characters of like width as well for auxiliary purposes. One of these purposes is to control the case of each projected character, as hereinafter further described.

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 recording of new characters in a succeeding line. The reading unit is connected through leads **22** to **36** to a set of eight electromagnets **38** to **52**, each of which is grounded at one terminal. These electromagnets form a part of the character selection and projection apparatus hereinafter more fully described. The leads **22** to **28** are also connected with a spacing mechanism **54**, which is in turn mechanically connected with a film carriage **56**. The film carriage is preferably constructed in the general manner described in said application Serial No. 770,320, in which the sensitized film **58** takes the form of a strip with perforations near the edges, wound over a pair of rollers of which only the upper roller **60** is illustrated in the figure. 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 spacing between the successive characters in each line. The spacing movement is intermittent and is controlled by the mechanism **54**. The spacing mechanism may be of any suitable type, one example being described in our said application Serial No. 610,336. Depending upon the combination of the leads **22** to **28** which are energized, it produces in the carriage **56** multiples up to fifteen of a unit movement. This movement is initiated by a voltage on a lead **62**, as hereinafter described.

After an entire line of characters and word spaces has been recorded in the register **8** by typing the same on the non-justifying typewriter **2**, and after the line has been viewed as typed by said typewriter, and any necessary corrections have been made by the method described in our said application Serial No. 770,320, the transcription may be initiated.

Transcription begins with the reading unit **12** positioned at the extreme right end of the register **8**, which is 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 application, connect a voltage source with a selected combination of the leads **22** to **36** corresponding to the character in the first position. It is assumed that the voltage is sustained on these leads until the reading unit moves to the next character position, which may be accomplished if desired by means of intermediate holding relays in a manner well understood in the art. The corresponding combination of the solenoids **38** to **52** is energized, thereby preparing the projection apparatus, hereinafter more fully described, for projection of the selected character.

The transcription of each successive character is carried out in a sequence of three steps under the control of a timing motor M having cam-operated contacts "*a*," "*b*" and "*c*." Fig. 3 is a diagram showing the timing relationships between these contacts. "T" represents one revolution of the motor M. At the beginning of a given period, a voltage source has been connected through

the "*a*" contacts to the solenoid **18**. When this voltage is removed, the reading unit advances to a new position to be read. A time interval "*d*" is allowed within which the reading unit advances and the new combination of the electromagnets **38** to **52** is energized. At the end of the interval "*d*" the character selected by the electromagnets is projected to a point P on the film by connection of a voltage through the "*b*" contacts and a lead **64** to a flash circuit **66** connected with an annular lamp **68**. Finally, after the exposure the carriage **56** is spaced by a distance corresponding to the character just projected by connection of a voltage through the "*c*" contacts to the lead **62**. In the next revolution of the motor M the above cycle is repeated for the next character in the line.

We next turn to a more detailed description of the character projection apparatus. As above stated, this apparatus is adapted to project any character selected by a corresponding unique combination of the electromagnets **38** to **52** upon the occurrence of a voltage illuminating the lamp **68**.

The character support is preferably a glass cylinder **70** supported at one end by a circular member **72** integral with a sleeve portion **74**. The sleeve is slidably supported on a shaft **76**, the shaft being rotatable in the frame **78** on ball bearings **80**. The cylinder **70** is prevented from rotating about the axis of the shaft by a projection **82** extending from the sleeve and engaging with a slot **84** in an extension of the frame.

At the end of the shaft is a rotary solenoid **86** connected by a lead **88** with the reading unit of the register. When the solenoid is not energized, the shaft is urged by a spring **90**, the spring being secured to an extension **92** of the shaft, until the extension **92** reaches an abutment **94** on the frame. When energized, the solenoid rotates the shaft until the extension **92** reaches a second abutment **96** on the frame. This motion relates to the changing of the case as hereinafter described.

The cylinder **70** is provided with a number of spaced annular rings of character transparencies **98** to **110**, each ring corresponding to a particular font. The font is selected manually by means of a lever **112** engageable with an annular groove in the sleeve **74**. The lever is linked with a ratchet arm **114** having a handle **116** and a spring **118** urging the arm into engagement with an extension **120** of the frame. It will be obvious that, if desired, this arrangement can be made automatic by using any known mechanism operable electrically from a voltage on a combination of the "B" group of leads **30** to **36**, to rotate the arm **112** until the selected font reaches the position designated "N" in the figure.

The cylinder **70** is surrounded by a set of eight concentric drums **122** to **136** having coded slots, these drums being supported upon one another and by the frame **78**. Each drum has a "normal" position, as illustrated by the drum **136**, and a "control" position, as illustrated by the drum **130**. Each drum is connected with one of the identical solenoids **38** to **52**, the solenoids being each constructed as illustrated for the solenoid **44**. A spring such as **138** urges the drum into its "normal" position abutting against the frame **78** at its right extremity as viewed in the figure. Energization of the solenoid moves the drum until it reaches its "control" position abutting against the frame at its left extremity. The distance moved is represented by "*e*," as shown in Fig. 8, which is a fragmentary view of the drums showing the slots adjacent to, rather than superimposed upon, one another. Each drum has two annular rings of complementary coded slots, a "normal ring," and a "control" ring. The "normal" ring is over the point N when the drum is in its "normal" position, and the "control" ring is over the same point when the drum is in its "control" position.

The circumference of each drum is divided into units "*f*," each unit corresponding to one of the characters on

the ring or font selected for projection. Thus, each unit "*f*" corresponds to a particular unique combination of the drums **122** to **136** which must be brought into the "control" position to create an aperture at the corresponding point in the circumference of the drum **70**. The annular lamp **68**, when energized, transmits light through any aperture which is formed by alignment of the slots in the drums, and by this means illuminates the selected character.

A lens support **140** bears a number of lenses **142** and is supported upon the shaft **76**. The number of lenses equals the number of characters in one case of the font. Each lens has a corresponding character and is so disposed that its optical axis passes through the point N in the character and also the point P on the film **58**, in which all of the optical axes intersect. The optical axes fall in a conical surface with the point P at the apex. Since each character is of small size compared to the diameter of the drum **70**, it may be considered for practical purposes as lying in a plane. For a given character, this plane, the plane of the film **58**, and the plane of the corresponding lens intersect in a line. In the illustrated instance, this line passes through the point S and is perpendicular to the drawing. The plane of each character and the plane of the film are at right angles, and are conjugate planes of focus of the corresponding lens.

Fig. 4 illustrates the relationships within the optical system. In general, for any lens there is a conjugate image plane for every object plane. If the optical axis intersects the object plane at an angle, the conjugate image plane will be at such an angle that the object and image planes and the lens plane will intersect in a single line in the lens plane. In this case, while the image will be entirely in focus in the image plane, the various parts of the image will be magnified by different amounts. If an object **144** (Fig. 5) were disposed opposite the lens **142** at an angle as shown in Fig. 4, an image **146** would be formed. The magnification of the line L at one edge of the object would be equal to n_1/m_1, while the magnification of a line of the same length at the opposite edge would be equal to n_2/m_2.

It will be observed that in the described arrangement each character lies close to the optical axis of its corresponding lens. The need for using highly corrected lenses is therefore eliminated, as will be understood by those skilled in the optical art.

If desired, a ground glass may be placed at the point P, and a supplementary lens may be placed behind the ground glass to focus an image upon the film at a more remote position. Also, we may use a lens turret to place selected lenses behind the ground glass. Such a turret is described in said application Serial No. 610,336, wherein the turret is adapted to bring lenses of different magnifications into operative position for changes in the point size. Alternatively, we may utilize a prism arrangement like that described in the copending application of Caldwell, Serial No. 148,901, filed March 10, 1950, now Patent No. 2,670,665, behind the ground glass, as an alternative to the movable film carriage arrangement above described.

To change the case, the shaft **76** is rotated as aforesaid by energization of the solenoid **86**. This brings each lens to a new position opposite a character which is the same as that to which it previously corresponded, but in the opposite case. For example, if a particular lens corresponded orginally with the lower case "*a*," it would move into correspondence with the capital "A." In this way, we are able to use fewer lenses than characters.

We may also have more than two positions for the shaft **76**, which will enable us to further multiply the number of characters without increasing the number of lenses. For example, we may have a third case for numerals, punctuation marks, special symbols, etc.

It will be further observed that in some instances it may be desired to project more than one character to the point P in a single exposure. For example, a letter may be printed within a square or circle for a special symbol. We may dispose the letter, the square and the circle as three distinct characters upon the drum **70**. We may then arrange the code combinations in such a manner that two or more openings through the drums will occur simultaneously and a composite character will be projected upon the film for certain of said combinations.

Referring to Fig. 7, we next describe a method and apparatus suitable for preparation of the character cylinder **70**. We mount the cylinder upon a circular member **148** which is fixed securely upon a hollow cylindrical extension **150** of a frame **152**. The lens support **140** is secured to the end of the cylinder **150**. Inside the cylinder is a lens **154**. A fixed shaft **156** having the same axis as the cylinder **150** supports a circular member **158** to which is secured a shutter cylinder **160**. The shutter cylinder has a single aperture **162** and means consisting of a ratchet wheel **164** and pawl **166** for turning it by discrete amounts.

The cylinder **70** is first coated with a photosensitive material. Each character to be photographed is then disposed upon a plate **168** having two registration holes by which it may be assembled on to a fixed support **170** by pins **172**. Lamps **174** illuminate the character, and the lens **154** focuses the image upon a screen or surface **176** at the end of the shaft **156**. The image is again projected through one of the lenses **142** to the drum **70** through the aperture **162**. The character on the sheet **168** and the image on the screen **176** are undistorted, but the image on the drum, which is preferably of reduced size, is distorted. However, when the drum is used in the apparatus of Fig. 1, the distortion is such that an image made by the same lens at the point P is undistorted. Moreover, since we use the same lens to dispose the character upon the drum as is used to project it onto the film, we automatically compensate for any optical peculiarities in the lens.

The ratchet is preferably arranged to produce as many steps in a complete revolution as there are lenses **142** on the support. If there are two cases as in Fig. 1, all of the characters in one case are photographed in one revolution of the shutter drum. Then the cylinder **70** is rotated in a suitable manner upon the support **148** by an angle corresponding to that through which the lens support moves in Fig. 1 for a change of the case. The cylinder **70** is then held fixed while the cylinder **160** is again rotated through a second revolution and the characters of the second case are similarly photographed.

According to another method which is similar to that described in our copending application Serial No. 354,162, filed May 11, 1953, we prepare a test drum having reference marks in place of characters. The first step may be performed in a single exposure through all of the lenses **142** simultaneously, by removal of the drum **160**. The reference marks such as two lines crossing at right angles, are mounted on the plate **168** and projected as previously described. In the second step, after development the reference mark images are projected back to the plate **168** one at a time through a special lens substituted successively for each of the lenses **142**, this lens having a precisely fixed position. A record is made of the deviation of each image thus formed on the sheet **168** from the original reference marks. To prepare the support **70**, it is then unnecessary to have the lens support **140** available. The procedure is simply to project the characters using the special lens and to dispose each of them upon the plate **168** with the same deviation previously recorded for the corresponding lens.

In the embodiment of Fig. 1, the composed matter has provision for variable spacing of the characters, but no provision for justification of the lines. Accordingly,

the right-hand margins will be uneven. However, it will be apparent that we may select any one of the many appropriate justification devices presently known to the art, and adapt it to the described machine by appropriate modification thereof. Such additions or modifications, however, form no part of the present invention, and are not further described.

It will be understood that various other modifications in the foregoing methods or structures, or in the relationships of the parts may be effected without departing from the spirit or scope of the invention. Some of these modifications have been mentioned above, and others will occur to those skilled in this art.

Having thus described the invention, we claim:

1. Photographic type composing apparatus including, in combination, a support for a number of characters arranged annularly in a cylindrical surface, a support bearing a circle of lenses coaxially with said surface, each lens having a corresponding character and the lens axes being disposed in a conical surface intersecting the characters and having its apex in the cylinder axis, a support having an image receiving surface passing through the apex in a plane at right angles to the cylinder axis, the plane of each lens having a common line of intersection with the planes of its corresponding character and the image receiving surface, means to illuminate all of the characters to project their images toward the apex, means to mask the characters selectively to permit only the image of a selected character to be formed in the image receiving surface, the characters being distorted in inverse fashion to the distortion of their images in projection, and mechanism to move the image receiving surface after each projection to space the characters in a line.

2. Photographic type composing apparatus including, in combination, a character cylinder bearing a number of fonts of characters to be photographed, said characters being disposed in a number of rings about the cylinder axis, there being a ring for each font, a support bearing a circle of lenses centered in said axis, the lens axes being disposed in a conical surface intersecting a selected ring and having its apex in the cylinder axis and each lens having a corresponding character in said ring, means to shift the cylinder axially to change the selected font, a support having an image receiving surface passing through the apex in a plane at right angles to the cylinder axis, the plane of each lens having a common line of intersection with the planes of its corresponding character and the image receiving surface, means to illuminate all of the characters in the selected ring to project their images toward the apex, means to mask the characters selectively to permit only the image of a selected character to be formed in the image receiving surface, the characters being distorted in inverse fashion to the distortion of their images in projection, and mechanism to move the image receiving surface after each projection to space the characters in a line.

3. Photographic type composing apparatus including, in combination, a support for a circle of characters including a plurality of cases arranged in a cylindrical surface, a support bearing a circle of lenses coaxially with said surface, each lens having an axis intersecting a corresponding character in a single case, the lens axes lying in a cone having its apex in the cylinder axis, means to rotate the lens support relative to the characters to change the case intersected by the lens axes, a support having an image receiving surface passing through the apex in a plane at right angles to the cylinder axis, the plane of each lens having a common line of intersection with the planes of its corresponding character and the image receiving surface, means to illuminate all of the characters to project their images toward the apex, means to mask the characters selectively to permit only the image of a selected character to be formed in the image receiving surface, the characters being distorted in inverse fashion to the distortion of their images in projection, and mechanism to move the image receiving surface after each projection to space the characters in a line.

4. Photographic type composing apparatus including, in combination, a support for a number of characters arranged annularly in a cylindrical surface, a support bearing a circle of lenses coaxially with said surface, each lens having a corresponding character and the lens axes being disposed in a conical surface intersecting the characters and having its apex in the cylinder axis, a support having an image receiving surface passing through the apex in a plane at right angles to the cylinder axis, the plane of each lens having a common line of intersection with the planes of its corresponding character and the image receiving surface, and means to illuminate a selected character to project its image on to the image receiving surface, the shapes of the characters being distorted in inverse fashion to the distortion of their images in projection.

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