

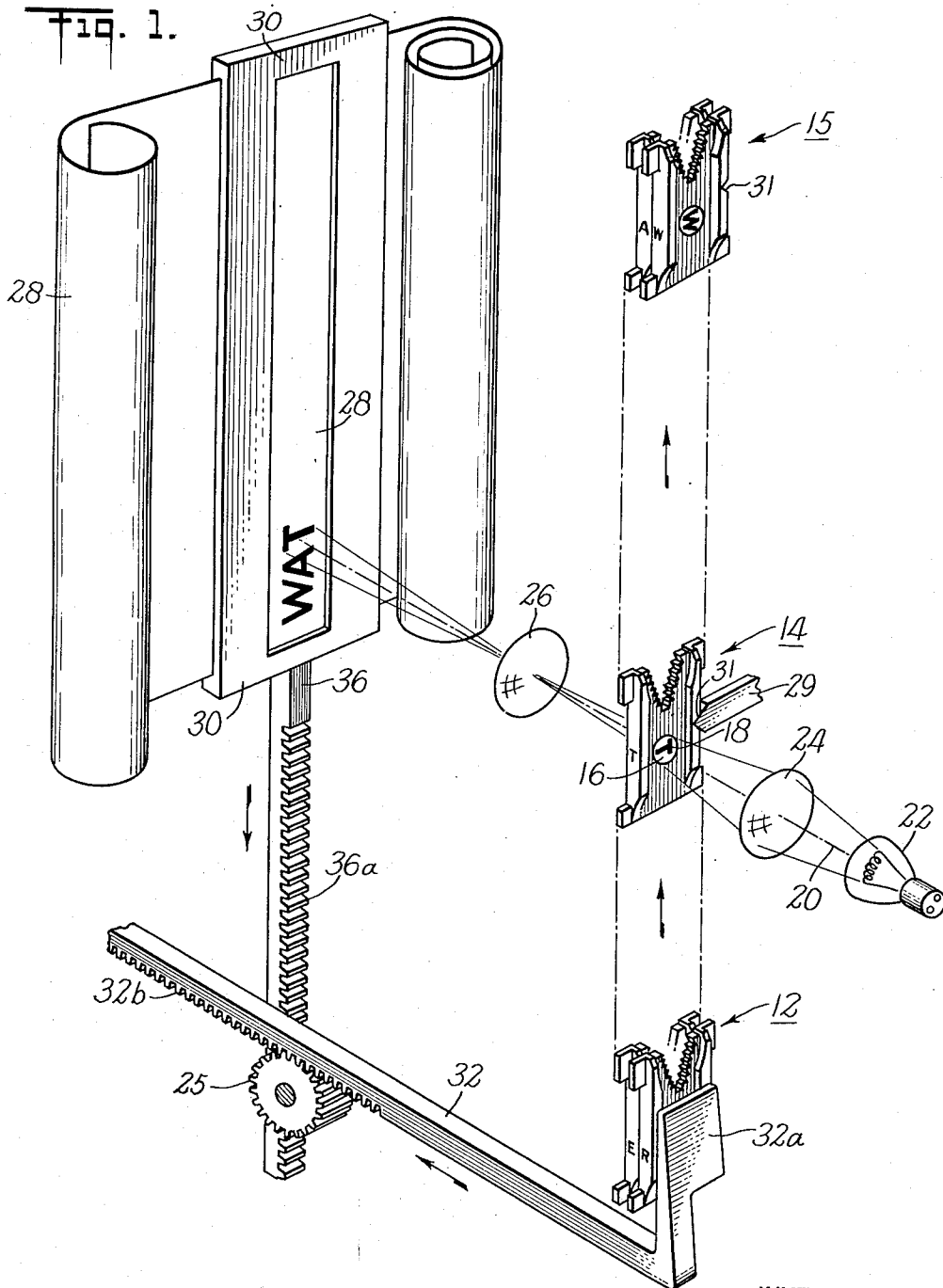
March 23, 1954

H. R. FREUND
FONT OF MATRICES FOR KERNING OR PRODUCING
COMPOSITE TYPE CHARACTERS

2,672,794

Filed June 8, 1950

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

Fig. 2.

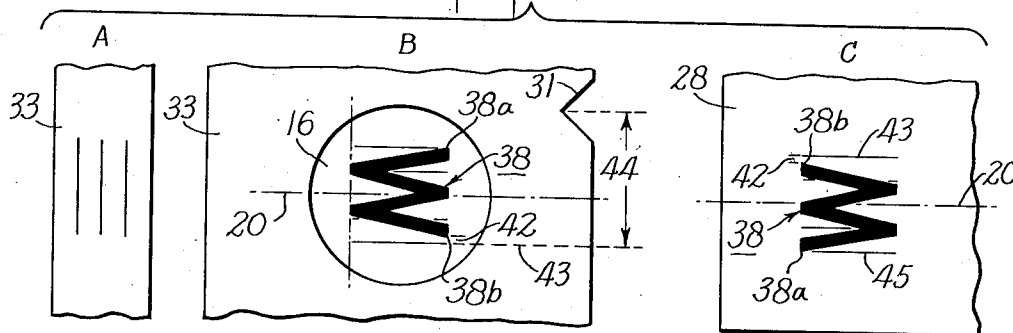


Fig. 3.

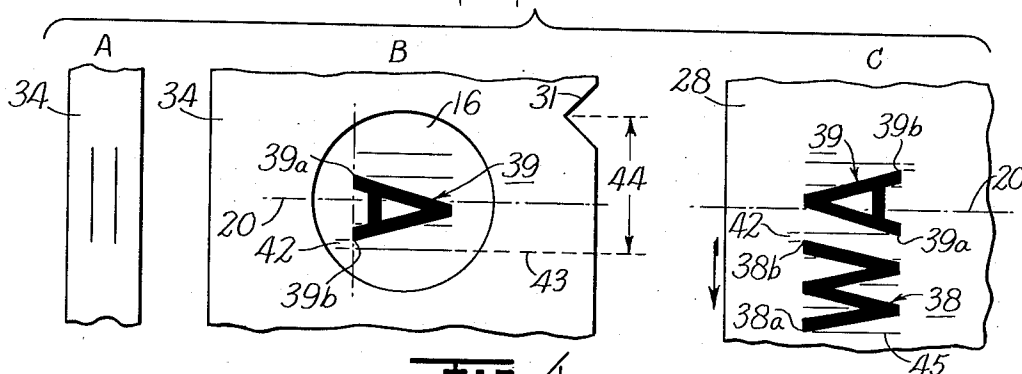


Fig. 4.

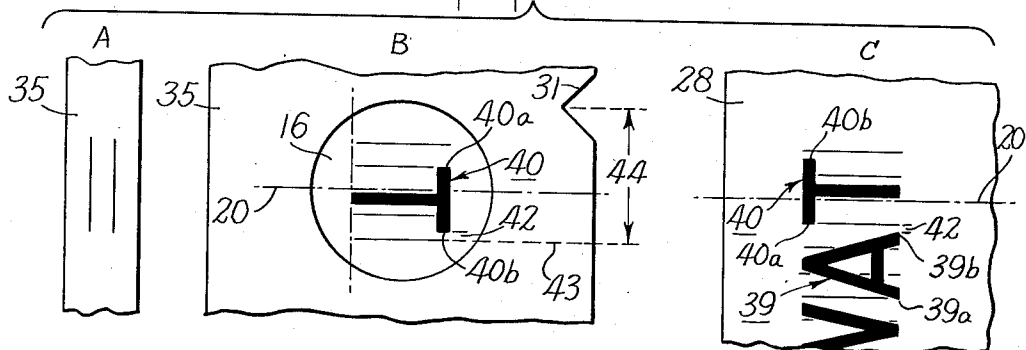
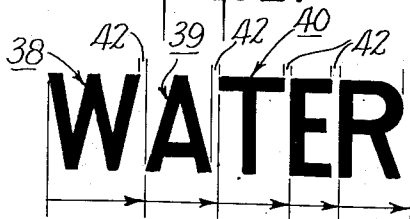


Fig. 5.



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Fig. 6.

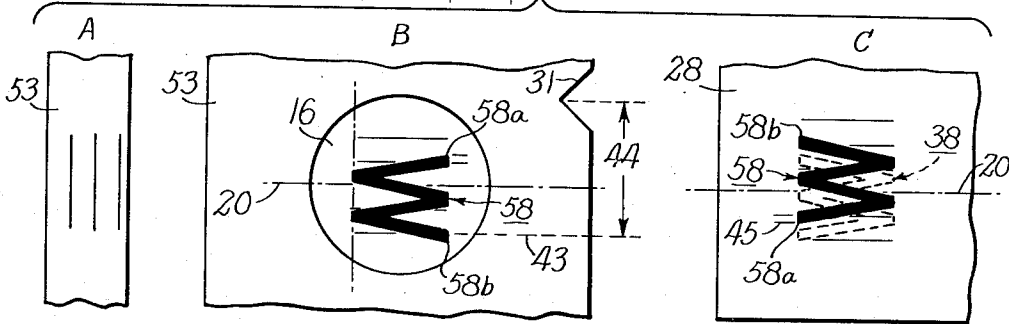


Fig. 7.

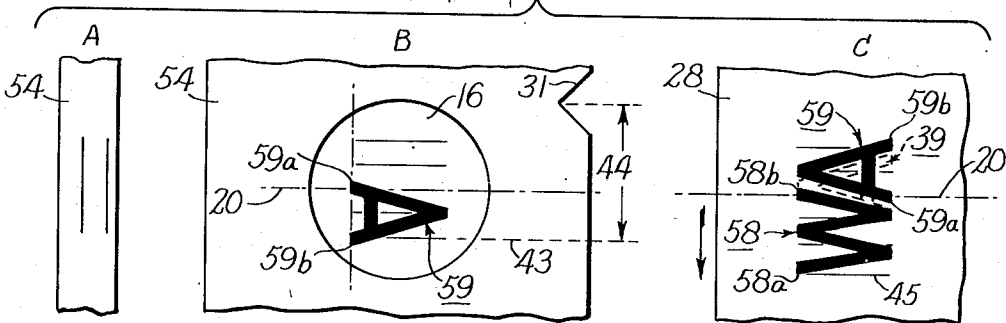


Fig. 8.

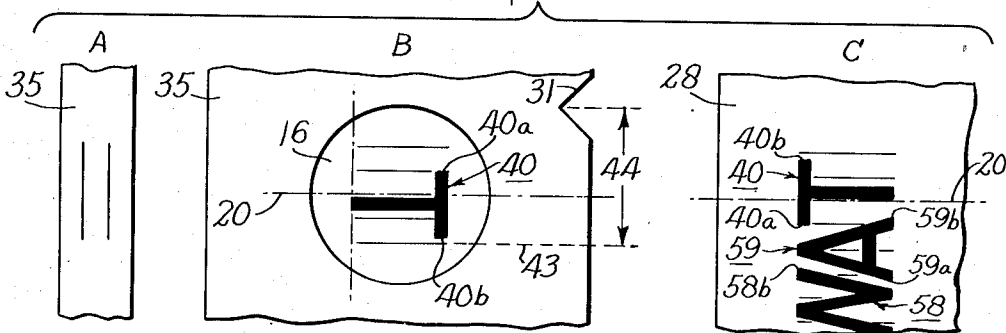
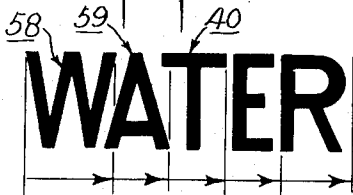


Fig. 9.



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Fig. 11.

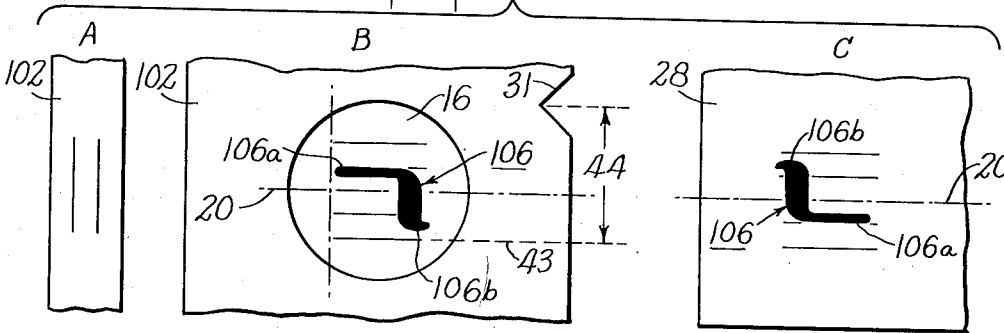


Fig. 12.

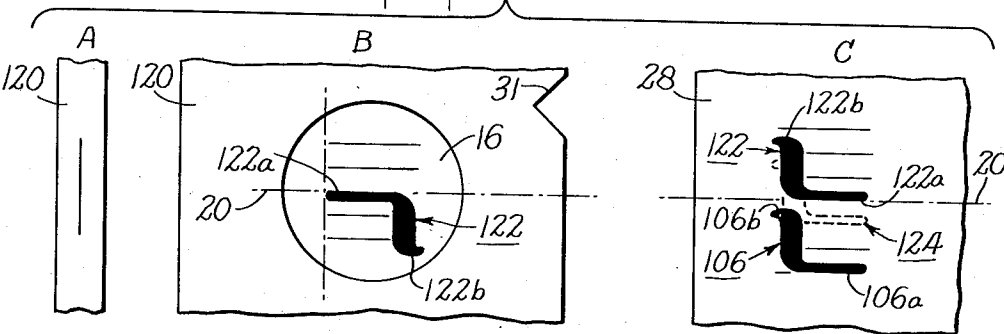


Fig. 13.

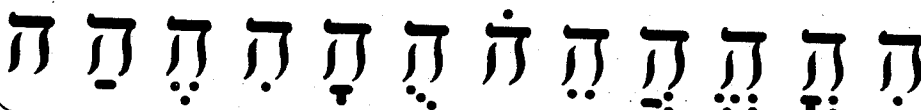
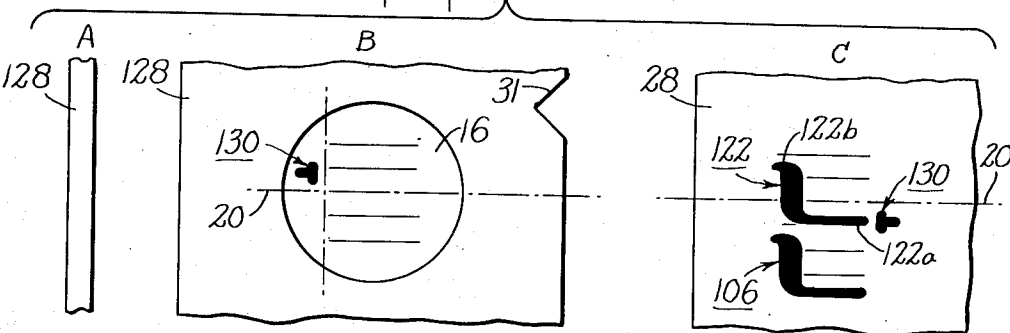


Fig. 10.

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UNITED STATES PATENT OFFICE

2,672,794

FONT OF MATRICES FOR KERNING OR PRODUCING COMPOSITE TYPE CHARACTERS

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Application June 8, 1950, Serial No. 166,924

4 Claims. (Cl. 95—4.5)

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This invention relates to character-bearing elements or so-called matrices and fonts thereof for use in photographic line-composing machines, for example, of the class described in the copending U. S. patent application Serial No. 94,766, filed May 23, 1949, and commercially known under the registered trade-mark "Foto-setter," now U. S. Patent No. 2,552,882, issued May 15, 1951. In such machines, lines of type matter are produced on a photosensitive surface such as photographic film or paper by exposing individually and successively thereto the photographable type characters of some basic or "master" point-size borne or represented by circulating elements or matrices, the film being indexed between successive exposure distances generally equal to the setwise width of the master characters (including, of course, the usual inter-character space), or proportional to the character width when enlarging or reducing. This is accomplished by providing each matrix with a dimension, for example, a body thickness, which is equal to or proportional to the setwise width of the character borne thereby, and controlling the advance of the sensitized medium in accordance with this dimension of the matrices.

The invention provides for the first time mechanical means by which successively photographed characters may be caused partially to overhang or "kern," or may be produced in fully overhanging or superposed relation, whereby to accomplish, for example, formation of the composite or accented characters or symbols of many foreign languages such as Hebrew, Arabic and others.

A well-known shortcoming of mechanical type composition as heretofore produced has been the inability to close up, beyond a normal minimum limit, the setwise clearance or spacing between adjacent characters, so as to achieve the typographically pleasing appearance of relatively even spacing in respect to all character combinations. For example, in the roman capital letter combination "NA" the "A" is customarily spaced from the "N" just to the extent that the two letters do not impinge upon one another, that is, so that between the left-hand extremity of the "A" and the right-hand extremity of the "N" there is a normal minimum clearance. However, when the same letter "A" follows a roman capital "W," if the "A" is so spaced from the "W" that the left-hand extremity of the "A" stands clear of the right-hand extremity of the "W" the usual extent, as above described, the spacing between the two letters appears inordinately great and

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gives any word in which such letter combination occurs a gaping or uneven appearance, as so often seen in such printed words as "WATER" and "AWAY." It accordingly is desirable to be able selectively to "kern" and thus close up the space between certain letter combinations to achieve the appearance of even spacing. This has not been possible in machine composition heretofore.

In commercial line-casting machines, for example, since the matrix or molding depression in which each type character is cast is recessed in one edge of the matrix body, the matrix body has a minimum edgewise thickness equal to the setwise width of the character plus the thin wall necessary at either side to close the casting recess. The minimum spacing between adjacent characters produced in such a machine is accordingly equal to the sum of the setwise widths of the two characters plus the included side-walls.

On the other hand, in photocomposing machines of the aforementioned class, the advance of the film between successive exposures is controlled in accordance with the edgewise thickness dimension of the matrix bodies, and in conventional matrix fonts as heretofore known in the thicknesses of the various matrices has been made equal to the setwise widths of the "master size" characters respectively borne thereby and all matrices bearing the same characters have had the same thickness. It has accordingly been impossible to alter the advance of the film relative to the setwise width of a character, for example, to reduce the advance of the film in instances when it was desired to "kern" and thus cause a character partially to overhang the next succeeding character.

It has likewise been impossible heretofore to achieve full overhanging or superposition of characters or component parts thereof borne by different matrices, such result requiring, according to previous practice, holding the film stationary between exposures of adjacent elements or matrices. Obviously this is impossible where advance of the film is controlled by the thickness of the matrices, since the second character would have to be borne on a matrix of zero thickness.

Accordingly, in order to form a foreign-language composite character comprising two or more superposed components such as the Hebrew character

it has been necessary in the past to provide on a single matrix both the basic consonant portion

"7"

and the supplementary or vowel portion

" "

It will therefore be appreciated that a complete font of matrices for composing such a language has required a separate group of matrices bearing each different complete composite character of the language. Since the number of composite characters necessary for the printed expression in full detail of many foreign languages is extremely great, machines and methods heretofore proposed for composing such languages have been necessarily too complex and costly to be commercially practicable.

The partial overhanging or "kerning" of adjacent characters in accordance with the present invention is accomplished by providing a font of typographical elements or matrices wherein some of the elements representative of a particular character have a given body dimension, for example, thickness, equal or proportional to the setwise width of the character, and other elements representative of the same character have a lesser thickness.

When it is desired to cause a character to "kern" or overhang the succeeding character in the produced line of type matter, the compositor uses one of the thinner matrices in composing the first or kerning character. The advance of the film for the first character, which is determined by the thickness of its matrix, is accordingly less than that normally required to provide a fresh film field for a character of such setwise width, and the reproduced image of this character thus partially overhangs the image of the succeeding character. As will appear more clearly hereinafter, since the movement of the film to provide a fresh film field for the image of each character takes place before the character is photographed, this less-than-normal film advance prior to photographing of the first or kerning character may not be sufficient to prevent the image of such character from impinging upon the preceding character or from violating the starting margin of the line or the preceding interword space. In order to prevent this, the photographable character is offset in line-reading direction from the normal position on the thinner or kerning matrix by a distance corresponding to the deficiency in thickness of such matrix, thereby causing the image of the character to be projected upon the film in the same position as if the film advance had been normal.

Thus, the formation of a kerned character combination is accomplished by providing the elements representative of the adjacent characters to be kerned with a total thickness less than that normally attributable to the combined setwise width of the particular characters by the amount of overhang or kern that is desired.

The formation of composite characters comprising component parts which must be fully superposed (above, below or otherwise positioned relative to one another as the language may require), as distinguished from partial superposition or overhang of portions of characters as in kerning, is similarly accomplished by providing the elements representative of the component parts with a total thickness equal to that normally attributable to only one of the parts. Also,

for the reason above described in respect to kerning, the location on its matrix of the first character component of a composite character is displaced setwise on the character plaque a distance corresponding to the amount that the thickness of the matrix is less than that normally appropriate for a character of such setwise width.

It will of course be appreciated that the invention may be used equally well in photocomposing systems wherein the photographable characters are not borne by the elements which control the movement of the film. For example, in U. S. Patent No. 1,901,013 to Edmond Uher, Jr., a font of photographable characters are borne upon a unitary rotatable drum, while the advance of the film is under the control of a composed and justified line of elements representing the respective characters, and having thicknesses providing a gauge of the setwise widths thereof. To apply the present invention to such a system, for example, to accomplish kerning, such characters of the font as are susceptible of kerning would be represented by elements of less than normal thickness, and these characters would be offset on the drum, relative to the optical axis of the machine, by a distance proportional to such reduction in thickness.

It will also be apparent that the invention may be used in conjunction with other forms of photographic type-line composing machines employing unitary character supporting means and in which feeding of the sensitized medium between successive exposures is governed by a dimension or equivalent gauging means representing the setwise widths of the different characters. To realize the advantages of the invention it is only necessary that the relation between the character width-representing dimension and the location of the characters relative to the optical axis of the machine be so coordinated as to reduce the normal advance of the sensitized medium in correspondence with the extent to which it may be desired to cause the images of adjacent characters to overlap.

In the drawings:

Figure 1 is a diagrammatic perspective view showing the method and relative arrangement of apparatus involved in reproducing on sensitized film, in a photo-composing machine of the aforementioned class, the characters borne by a composed line of matrices;

Figures 2, 3 and 4 are diagrammatic illustrations on an enlarged scale of successive steps in the composition of type matter in a machine of the type shown in Figure 1, according to previous practice;

Figure 5 illustrates the roman capital word "WATER" as produced by the method illustrated in Figures 2, 3 and 4;

Figures 6, 7 and 8 are diagrammatic illustrations on an enlarged scale of successive steps in composing type matter in accordance with present invention in order to accomplish kerning;

Figure 9 illustrates the word "WATER" as produced by the method illustrated in Figures 6, 7 and 8;

Figure 10 illustrates a basic Hebraic character or consonant and a group of composite Hebraic characters, each comprising this basic character component or consonant with a different supplemental character or vowel; and

Figures 11, 12 and 13 are diagrammatic illustrations on an enlarged scale of successive steps in the composition of type matter in accordance with the present invention to achieve superpo-

sition of successively photographed character components, thus to form a composite Hebraic character.

Figure 1 illustrates schematically the means employed in a photocomposing machine of the aforementioned class for advancing the film between exposures by distances corresponding to the setwise width of the successively reproduced characters and under control of the edgewise thickness of the respective elements or matrices in a composed line thereof, as designated by the numeral 12. The line of matrices may be composed in any known manner, that is, by hand, or by operating a conventional keyboard as with the machine of the aforementioned application for patent. From the position of the composed line as shown in Figure 1, the matrices are removed individually and successively from the left-hand or starting end of the line and are carried upwardly to the position indicated at 14 at which the type character 18 on the character-bearing plaque 16 of the matrix is in line with the optical axis 20 of the machine. Along this axis are positioned a source of light, such as the incandescent bulb 22, and a lens system including a condensing lens 24 and an objective lens 26. The arrangement is such that an image of the character 18 is projected and brought to focus upon a sheet of photographic film 28 in a vertically movable holder 30. The proper vertical positioning of the matrix relative to the optical axis 20 of the machine is insured by a reciprocable register slide 29 cooperating with a notch 31 in a vertical edge of the matrix.

Upon the removal of each matrix from the composed line 12, a follower or slide 32 having an upstanding arm 32a engaging the last matrix at the right-hand end of the line under the urging of spring means (not shown), causes the remaining matrices in the line to be moved bodily to the left to take up the space vacated by the removed matrix. The distance of movement of the remaining matrices and of the follower 32 is, of course, equal to the thickness of the matrix removed, and as previously noted, such thickness corresponds to the setwise width of the "master" size character borne by said matrix.

The follower 32 is coupled to the film holder 30 by means of a pinion 25 engaging racks 32b and 36a respectively formed upon the follower 32 and on an upright post 35 upon the upper end of which the film holder 30 rests, so that leftward movement of the follower 32 produces downward movement, with the aid of gravity, of the post 35 and film holder 30. Such downward movement of the film holder upon each removal of a matrix from the line 12 to the photographing position 14 accordingly serves to effect advance of the film 28 in a line-reading direction, a distance corresponding to the setwise width of the character borne by the removed matrix. It will thus be seen that before each character is photographed, the film is advanced a distance sufficient to present to the optical axis a fresh film field of proper width to receive the successive images and provide between them the usual setwise clearance. After each character is photographed, its matrix is carried farther upwardly to a discharging position 15 from which it is removed and stored for eventual recirculation.

Figure 5 illustrates the roman capital word "WATER" as heretofore produced by conventional photocomposing machines of the type above described, and Figures 2, 3 and 4 diagram-

matically illustrate the steps heretofore employed in producing this word. In Figures 2, 3 and 4 (as well as in the similar sets of Figures 6, 7 and 8 and 11, 12 and 13) the portion A of each figure is an edgewise view of a fragment of the matrix photographed, the portion B is a fragmentary facewise view of the matrix showing the plaque containing the photographable character, and the portion C shows a fragment of the film with the character images thereon in their proper setwise positions relative to one another and to the optical axis of the machine.

It has heretofore been found convenient, in order to minimize the number of different thicknesses of matrix blanks required for making a complete font of matrices to divide the letters of the alphabet into several groups according to their setwise widths and to provide matrices of a single thickness for the letters of each group. To illustrate, the roman capital letter "W," which is the first letter of the word "WATER" in Figure 5, has been arbitrarily designated as a four unit-width character and its matrix 33 (Figure 2A) has a thickness of four units, as indicated by the vertical lines dividing the edge of the matrix into four equal parts. The roman capital letters "A" and "T" have both been designated as three-unit characters and their matrices 34 and 35 (Figures 3A and 4A) accordingly have thicknesses of three units, as shown. The letters "E" and "R" have been designated as two-unit and three-unit characters respectively and their matrices (not shown) have appropriate thicknesses.

As seen in Figure 2B, the photographable character 38 is located upon the plaque 16 of the matrix 33 so that its leading edge 38a is a distance of two units above the optical axis 20 of the machine when the matrix is in photographing position. The arbitrary horizontal reference lines are drawn upon the plaques and upon the film 28 in each figure solely for the purpose of facilitating understanding of the drawings. As shown, the letter "W," although it is assigned a setwise field on the film equal to four units of width, has an actual setwise width of slightly less than four units to provide the usual inter-character space 42 between adjacent letters of the produced word, as may be seen in Figure 5. Thus, the trailing edge 38b of the character 38 in Figure 2B falls just short of the reference line 43 which is two units below the optical axis 20 of the machine when the plaque is in photographing position. As may be seen in Figures 2B, 3B and 4B, this reference line 43 is always a fixed distance 44 below the notch 31 of the matrix, so that the trailing edge of each of the photographable characters always bears a fixed relation to the optical axis of the machine when the matrix bearing the character is in photographing position.

When the four-unit matrix 33 bearing the first letter "W" of the word "WATER" is removed from the left-hand or starting end of the composed line of matrices 12, shown in Figure 1, and carried upwardly to the photographing position, the film 28 is advanced downwardly, as shown in Figure 2C, so that the starting margin 45 of the line to be produced is two-unit widths below the optical axis 20 of the machine. When the image of the character 38 is projected from the plaque 16 to the film 28, and subjected to the normal reversal by such projection, its leading edge 38a, which on the plaque 16 is two units above the optical axis 20, appears upon the film 28 two

units below the optical axis and accordingly just touches the starting margin 45. Its trailing edge 38b falls short of two units above the optical axis 20 to the extent of the usual intercharacter spacing.

When the three-unit matrix 34 bearing the next letter "A" is removed from the composed line 12 and carried upwardly to photographing position, the film 28 is advanced downwardly, as shown in Figure 3C, a distance of three units, so that the trailing edge 38b of the preceding letter "W" is now slightly more than one unit below the optical axis 20. Thus, when the image of the character 39 is projected upon the film, its leading edge 39a, which on the plaque 16 was one unit above the optical axis 20, falls upon the film a distance of one unit below the optical axis, so that the usual inter-character spacing 42 is provided between the images of the letters "W" and "A," as seen more clearly in Figure 5.

When the three-unit matrix 35 bearing the third letter "T" is removed from the line 12 and brought to photographing position, the film 28 is again advanced a distance of three units so that the trailing edge 39b of the image of the letter "A" is now just over two units below the optical axis. When the image of the letter "T" is now projected upon the film, its leading edge 40a is two units below the optical axis, leaving the usual inter-character space 42 between it and the trailing edge 39b of the preceding letter "A" (see also Figure 5).

Similar operations are performed in producing the remaining letters of the word so that as each successive matrix is brought into photographing position the film is advanced a distance sufficient to present a fresh film field for the image of the character borne by said matrix plus the usual inter-character spacing. Figure 5 illustrates the complete word as produced, with equal spaces 42 between each pair of adjacent letters. However, due to the conformation of the letters, the spacing between the "W" and the "A" and between the "A" and the "T" appears greater than the spacing between the "T" and the "E" and between the "E" and the "R," giving the produced word the objectionable appearance of being disproportionately expanded between the first several letters of the word. In mechanical type composition heretofore, this defect has been unavoidable.

As above mentioned, the present invention provides means for allowing selective reduction of intercharacter spacing, so that when the conformation of adjacent characters is such as would ordinarily result in the foregoing objectionable condition, such characters may be caused to "kern" and thus produce the appearance of even spacing. Figures 6, 7 and 8 diagrammatically illustrate the successive steps in accomplishing kerning of adjacent type characters in accordance with the invention. As may be seen in Figure 6A, the special kerning matrix 53 which bears the first letter "W" of the word "WATER," has thickness less than the normal four-unit thickness for such a letter (compare matrix 33 in Figure 2A). Thus, when the thinner matrix 53 is removed from the composed line 12, the film 28 is not advanced to the extent shown in Figure 2C where the line starting margin 45 was disposed two units below the optical axis 20, but only to the extent that the starting margin 45 is slightly more than one unit below the optical axis. Accordingly, if the character 58 were located upon the thinner kerning matrix 53 in

the same position as was the character 38 upon its full thickness matrix 33 (Figure 2B), so that the leading edge of the image projected on the film would be two units below the optical axis, as shown in Figure 2C and as indicated in dotted lines in Figure 6C, the leading edge 58a of the character 58 would violate the starting margin 45.

In order to compensate for this deficiency in film advance due to the reduced thickness of the kerning matrix 53, the character 58 borne by this matrix is offset upon its plaque 16 by a distance corresponding to the amount by which the film advance was deficient, in other words a distance equal to the reduced thickness of the matrix, or slightly less than one unit. As shown in Figure 6B, this places the leading edge 58a of the character 58 just over one unit above the optical axis 20, so that when its image is projected upon the film, the leading extremity 58a of the image just touches, and does not violate, the starting margin of the line. In turn, the trailing edge 58b of the character image on the film is disposed a distance just over two units above the optical axis 20.

Since the next letter "A" is also susceptible of kerning with respect to the succeeding letter "T," its matrix 54 is also a kerning matrix and may be seen in Figure 7A to have a thickness less than the normal three-unit thickness (compare matrix 34 in Figure 3A). Thus, when the matrix 54 is removed from the composed line 12 and the film 28 is advanced to the extent of the matrix thickness, as shown in Figure 7C, the trailing extremity 58b of the preceding letter "W," which in Figure 6C was just over two units above the optical axis 20, is brought into line with the optical axis.

Here again, if the character 59 were positioned upon its plaque 16 at the same position as was the character 39 in Figure 3B (in which position the leading edge 39a of the image on the film would be one unit below the optical axis 20, as shown in Figure 3C and in dotted lines in Figure 7C), its image would impinge upon the preceding letter 48. In order to prevent this, the character 59 is offset upon its plaque 16 a distance corresponding to the reduction in thickness of the kerning matrix 54 and consequent deficiency in film advance. This places the leading edge 59a of the character 59 just above the optical axis 20. Thus, as shown in Figure 7C, the projected image of the character 59 will not impinge upon the image of the preceding character 58.

Since the third letter "T" of the word is not susceptible of kerning with respect to the succeeding letter "E," a matrix 35 of normal thickness is used in composing the third letter. This matrix, as shown in Figures 8A and 8B, is identical in all respects with the matrix shown in Figures 4A and 4B, and its projected image, as shown in Figure 8C, falls in the same position on the film with respect to the optical axis as did the image shown in Figure 4C. In such position, the leading edge 40a of the image is one unit below the optical axis 20 at which position it slightly overhangs the trailing edge 59b of the preceding letter "A." The trailing edge 40b is in the same position as was the trailing edge 40b of the image shown in Figure 4C, and the production of the fourth and fifth letters of the word may likewise be accomplished using matrices which are normal in thickness and otherwise for these letters. The complete produced word will then appear as shown in Figure 9, wherein the spacing between the "W" and the "A" and between "A" and the "T" has been reduced to the extent that the

matrices 53 and 54 were reduced in thickness in order to effect partial overhanging or kerning of these letters and thus the appearance of even spacing throughout the word.

It will thus be appreciated that selective kerning of letters may be accomplished by providing a font of matrices including a primary group of conventional matrices having thicknesses proportional to the setwise width of the "master" size characters borne thereby and a secondary group of matrices bearing the same characters as certain of the matrices of the primary group, but having lesser thicknesses than corresponding matrices of the primary group. When it is desired to kern, i. e., when a combination of characters susceptible of kerning occurs in the matter to be printed, it is only necessary for the compositor to utilize, in composing the first character of the combination, a matrix of the secondary group. If the composition is done with the aid of a keyboard, the operator simply actuates selectively the keys thereof which release appropriate matrices of the primary and secondary groups of the font, both of which groups may be contained in a conventional matrix storage magazine of well-known form.

As will be understood from the illustrations hereinabove, only certain characters are susceptible of kerning, and even these are not susceptible of kerning in all combinations. Broadly speaking, only those roman capital letters are susceptible of kerning which have offset or generally slanted or inclined profiles at either side. The capital letters which have this characteristic are "A," "F," "L," "P," "T," "V," "W" and "Y." None of these letters, however, is susceptible of kerning except in combination with a letter whose adjacent profile is either offset or inclined in the opposite direction. For example, although both "T" and "W" form kerning combinations with an adjacent letter "A," as in the combination "TA," "AT," "WA," and "AW," the letters "T" and "W" do not form a kerning combination with each other. There are thus fourteen principal combinations of capital letters which are susceptible of kerning, namely, "AT," "AV," "AW," "AY," "FA," "PA," "TA," "VA," "WA," "YA," "LT," "LV," "LW" and "LY." It will be appreciated that the six capital letters "F," "P," "T," "V," "W" and "Y" are also susceptible of kerning when followed by certain lower case letters, for example, by "a" as in "Fa," "Pa," etc.

Since only the first letter of a kerning combination is kerned, i. e., since the film movement for the second letter of the combination is normal, special kerning matrices need be provided for only those eight different capital letters which appear as the first letters of the above fourteen kerning combinations, namely, "A," "F," "P," "T," "V," "W," "Y," and "L." Thus, by providing within a complete font a primary group of conventional matrices (matrices of normal thickness) for all twenty-six of the capital letters and in addition, for the eight kerning characters "A," "F," "P," "T," "V," "W," "Y," and "L," a secondary group of matrices having thicknesses somewhat less than the thicknesses of the primary matrices bearing such characters, it is possible to effect kerning in all situations where kerning is normally desirable.

It is convenient, though by no means necessary, to reduce the thickness of all matrices bearing the kerning letters by an amount equal to one unit of thickness (or to any other integral number of units of thickness). In other words, tak-

ing the letter "A" as an example, the kerning "A" may be borne upon a matrix of two-unit rather than the normal three-unit thickness. This obviates any increase in the number of different thicknesses of matrix bodies required for a font of matrices. It will of course be understood, however, that the invention comprehends reduction of the thickness of the kerning matrices by any amount, as determined by such varying considerations as the characteristics of design of the type characters, etc.

Turning now to the formation, according to the invention, of composite characters for foreign languages such as Arabic, Hebrew and the like, Figure 10 illustrates a group of composite characters in the Hebrew language. As seen, each complete character comprises the same basic or consonant component

"7"

with a different supplemental component or vowel sign. It will be readily understood that if a separate matrix were provided for each of the twelve forms of the composite characters illustrated in Figure 6, and for twelve similarly constituted forms of composite character for each of the other twenty-seven basic consonants in the Hebrew language, a great number of different matrices (well in excess of 300) would be necessary for composing type matter in this language, and to this number would be added, of course, the matrices bearing numerals, punctuation marks and many special characters. According to the present invention, individual matrices are provided for each of the twenty-seven basic or consonant components and for each of the twelve supplemental or vowel components, and means are provided for forming the composite characters by fully superposing the image of the latter upon the film field of the former during reproduction of the components which form a desired composite character.

In order to accomplish such superposition of the vowel components upon the consonants, it might at first be thought necessary that the film remain stationary between exposures of a basic consonant and a supplemental vowel. This, of course, is impossible, for it would require that the matrix bearing one of the characters have zero thickness. According to the present invention, the desired superposition of the character components is achieved by providing for the separate matrices bearing the basic and the supplemental character components a total thickness equal only to that of a standard single matrix for the basic component. This provides for the two successive exposures a total movement of the film normally attributable to the consonant component only, so that the images of both characters occupy or fall within the same setwise field upon the film. The deficiency in film advance prior to photographing of the basic or consonant portion of the character is compensated by offsetting the consonant upon its matrix at distance sufficient to dispose its image on the film at the same position as if the film had been advanced a normal distance for a character of such setwise width. Figures 11, 12 and 13 illustrate this principle.

The sequence illustrated in these figures is the sequence of operations performed in composing the portion of a word or line of type matter which may be seen upon the film in Figure 13C.

As indicated by the arbitrary horizontal lines on the plaque 16, the character 106 has a set-

wise width of three units; likewise the matrix 102, Figure 11A, has a normal thickness of three units, since the basic character borne by this matrix is intended to be used as a "pure" consonant, that is, a Hebrew character which alone has full meaning and is not associated with a supplemental sign or vowel (see Figure 13C). The character 106 is so positioned relative to the optical axis 20 that its leading extremity 106a is one unit above the optical axis, and its trailing extremity 106b is short of two units below the axis by the normal amount of inter-character space. When this character is reversed by optical projection from the matrix to the film 29 (Figure 11C) the leading extremity 106a of its image falls one unit below the optical axis and its trailing extremity 106b just short of two units above the axis. Since the Hebrew language is read from right to left and is accordingly most conveniently composed in the same order, it is customary, in using a conventional photographic composing machine, to develop the film as a photographic negative and to make a positive contact print of this negative by exposing through the negative with its emulsion side down, thereby accomplishing the necessary reversal of the line.

As may be seen from Figure 13C, the next character to be composed is a composite character comprising the same basic consonant

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as that of Figure 11, in combination with the supplementary component or vowel sign

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Since to form the composite Hebrew character, the consonant and vowel components must be superposed, that is, projected onto a common field of film, the matrix 120 (Figure 12A) which bears the basic or consonant component 122 is of only two-unit rather than the normal three-unit thickness (compare Figure 11A). Thus, prior to photographing of the character 122, the film 28 is advanced downwardly, as may be seen in Figure 12C, a distance equal to the two unit thickness of the matrix 120, so that the trailing extremity 106b of the image of the character 106 previously photographed is moved from the position shown in Figure 11C (at which it was slightly less than two units above the optical axis 20) to the position shown in Figure 12C (where the extremity 106b is just below the optical axis).

It will be understood that if the consonant component 122 for producing the following composite character were located upon its matrix 120 in the same position as the "pure" consonant 106 is located upon its matrix 102, the projected image of the component 122 would fall in the same relative position upon the film as the image 106 in Figure 11C where it would impinge upon the preceding image 106, as shown by the image 124 in broken lines in Figure 12C. To avoid this, the character component 122 is offset or displaced on its matrix a setwise distance equal to one unit (the amount of reduction in thickness of the matrix 120), so that the leading extremity 122a of the character is in line with the optical axis 20. Accordingly, when the image of this character 122 is projected upon the film 28, and reversed about the optical axis in projection, the leading extremity 122a falls in line with the optical axis 20 so that it does not violate the preceding character 106.

After the consonant character component 122 has been photographed, its matrix is removed

from the photographing position and the matrix 128 bearing the supplemental component or vowel sign 130 is brought into photographing position. The matrix 128 has a thickness of one unit, which is the difference between the thickness of the matrices 102 and 120. Accordingly, when the matrix 128 is removed from the composed line of matrices, the film 28 is advanced, as shown in Figure 13C, a distance corresponding to one unit. This places the leading extremity 122a of the character image 122 one unit below the optical axis 20. The supplemental component 130 is located upon the matrix 128 so that its image (Figure 13C) when reversed by optical projection is properly disposed below the vertical stroke of the character image 122, thus completing the desired composite character.

As will be understood by those familiar with the Hebrew language, the vowel signs are associated differently (regarding relative setwise disposition) with different consonant components. For example, while the supplemental character or vowel sign

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is properly positioned directly under the vertical stroke at the left of the consonant component

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in Figure 13, such vowel when used in conjunction with the consonant character

"ך"

as shown in Figure 10, should be centered beneath such character. This difference in positioning of the supplemental vowel components relative to the different consonant components is accomplished by providing separate groups of matrices having the supplemental vowel signs located thereon in such different positions as may be required for proper positioning of their images in combination with any of the consonant characters.

After completion of the photographing of the composite character (122, 130), the position of the film is such that the image 122 (Figure 13C) is in the same position relative to the optical axis 20 as was the image 106 (Figure 11C) after it had been photographed and before movement of the next two matrices 120 and 128 into photographing position. Thus, the machine is in condition for photographing the next character whether it be a "pure" consonant borne by a matrix of full thickness or a composite character involving component parts borne by separate matrices having a total thickness equal to that normally attributable to only one of the components.

It is accordingly seen to be possible to produce all of the composite Hebraic type character (over 300 combinations of basic and supplementary character components) by providing the 27 basic consonants and the 12 supplementary vowel signs on separate matrices and reproducing such components in superposed relation to form any required combination. Thus, the invention enables composition in the Hebrew language to be accomplished with a type font of ordinary size and well within the practical limits of standard composing machines, instead of requiring a font of over 300 different composite characters. Also, it will be understood that the relative disposition of the associated components which form a complete composite character may be varied to suit the requirements of different languages, it being simply a

matter of establishing the proper relation between the matrix thickness and the setwise width and location of the components on their respective matrices. Thus it will be evident to those skilled in the art that the invention applies with equal advantage to many other foreign languages than Hebrew and which employ two or more components associated in various combinations, for example, languages involving complex combination symbols either in full superposed relation or merely joined together setwise, or both, such as Arabic, Syriac, Burmese, Siamese, Devanagari, Bengali and Egyptian, to mention only a few.

As many possible embodiments may be made of the above invention, and as many changes may be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative only and not in a limiting sense.

I claim:

1. For use in a photocomposing machine wherein the type characters are borne on individual matrices, and wherein the feed of the film between successive exposures thereof to said characters is controlled according to the thickness of said matrices, a font of matrices including a group of primary matrices bearing photographable type characters located thereon in the same relative setwise positions, and having thicknesses proportional to the setwise widths of said characters, and a group of secondary matrices bearing the same type characters as certain of said primary matrices, but having lesser thicknesses than the corresponding primary matrices, and the characters thereon being displaced in a setwise direction distances proportional to the differences in thickness between corresponding primary and secondary matrices.

2. For use in a photocomposing machine wherein the type characters are borne on individual matrices, and wherein the feed of the film between successive exposures thereof to said characters is controlled according to the thickness of said matrices, a font of matrices including a group of primary matrices bearing photographable type characters located thereon in the same relative setwise positions, and having thicknesses proportional to the setwise widths of said characters, a group of secondary matrices bearing the same type characters as certain of said primary matrices, but having lesser thicknesses than the corresponding primary matrices, and the characters thereon being displaced in a setwise direction distances proportional to the differences in thickness between corresponding primary and secondary matrices, and a group of tertiary matrices bearing type characters to be juxtaposed in the produced copy in predetermined relation to certain characters of said secondary group of matrices, said tertiary matrices having thicknesses equal to the differences in thickness between corresponding primary and secondary matrices.

3. For use in a photocomposing machine wherein the type characters are borne on individual matrices which are successively exposed to a photographic film and wherein the feed of the film between successive exposures is con-

trolled according to the thickness of said matrices, a font of matrices including a group of primary matrices bearing photographable type characters in the same relative positions and having thicknesses proportional to the setwise widths of the characters respectively borne thereby, a group of secondary matrices bearing the same characters as certain of said primary matrices but having lesser thicknesses than the corresponding primary matrices, and the characters on said secondary matrices being displaced in a setwise direction thereon from the positions of such characters on the corresponding primary matrices by distances proportional to the differences in thickness between corresponding primary and secondary matrices, and a group of tertiary matrices bearing photographable character portions the images of which are to be juxtaposed on said film in a predetermined relation to the images of the characters on said secondary group of matrices, said tertiary matrices having thicknesses equal to the difference between the thicknesses of corresponding primary and secondary matrices and the character positions being located thereon in the same position relative to the position of the characters on said primary matrices as the juxtaposed relation to be established on the film between images of the characters on the secondary and tertiary matrices.

4. The method of photocomposition of typographical characters which comprises providing a plurality of matrices including primary matrices bearing photographable characters and having thicknesses bearing a certain ratio to the setwise widths of the characters respectively borne thereby and secondary matrices bearing the same characters as said primary matrices, but having thicknesses bearing a lesser ratio to the setwise widths of said characters, removing and assembling a plurality of said matrices, said primary matrices being included in such assembly when it is desired to obtain normal spacing between the images of adjacent characters, and said secondary matrices being included in such assembly when it is desired to cause the images of the characters borne thereby to overhang at least partially the adjacent character images, individually and successively exposing the assembled matrices to a photographic film to project images of said characters onto said film, and advancing said film between successive exposures by incremental distances controlled according to the thickness of the matrices assembled and photographed.

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