United States Patent

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[54] **PHOTOTYPESETTING MACHINES**
12 Claims, 2 Drawing Figs.

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B41b 17/00, B41b 17/34
[50] **Field of Search** 95/4.5

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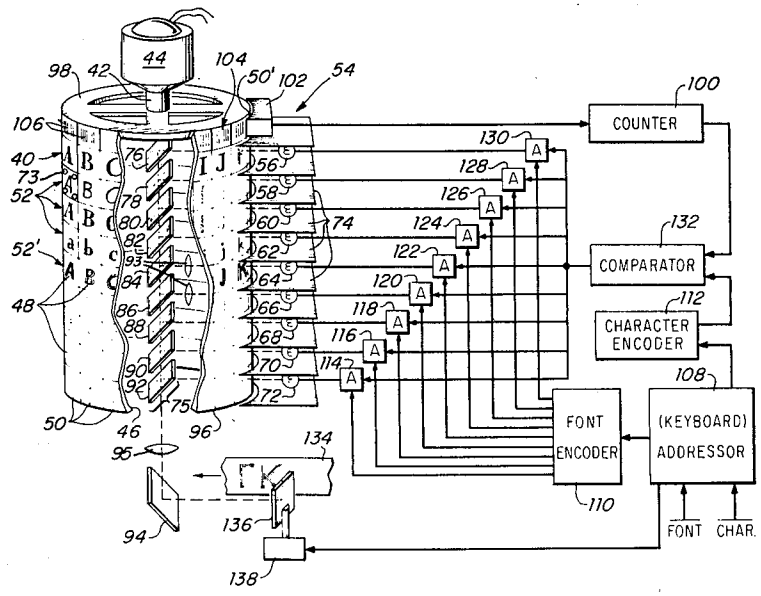
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ABSTRACT: Photocomposing device having a matrix of image-forming master characters on the surface of a rotatable cylinder, all master characters of a single font being in one circumferential band and master characters in each font being aligned in axial columns with the same master characters in other fonts. Several lamps are positioned external to the surface of the cylinder and are aligned with the axial columns on the surface of the cylinder. One lamp corresponds to each circumferential band. A projection system within the cylinder surface is provided for selectively receiving light from individual lamps and transmitting it to a light-sensitive medium. A selection control system is provided for energizing the lamp associated with the circumferential band containing the selected font at the time when the axial column containing the particular master character selected is between the lamps and the projection system.



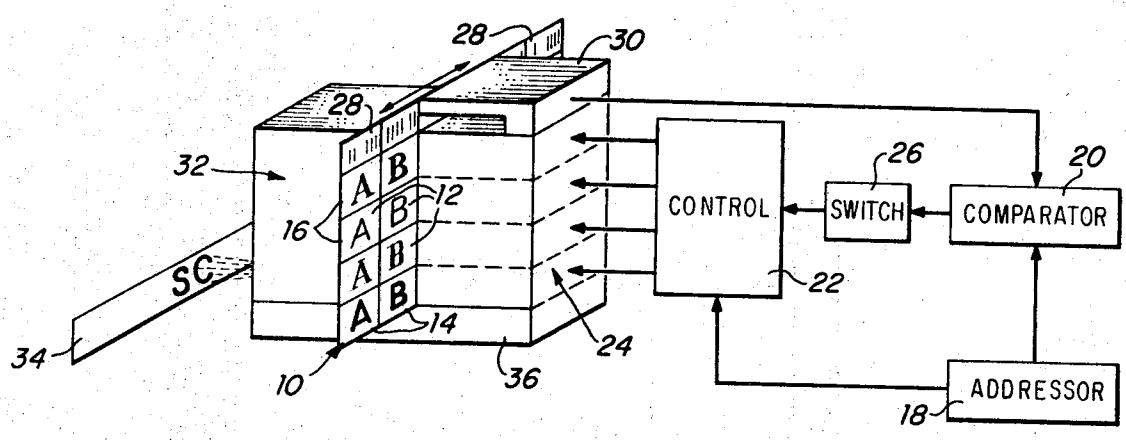


FIG. 1.

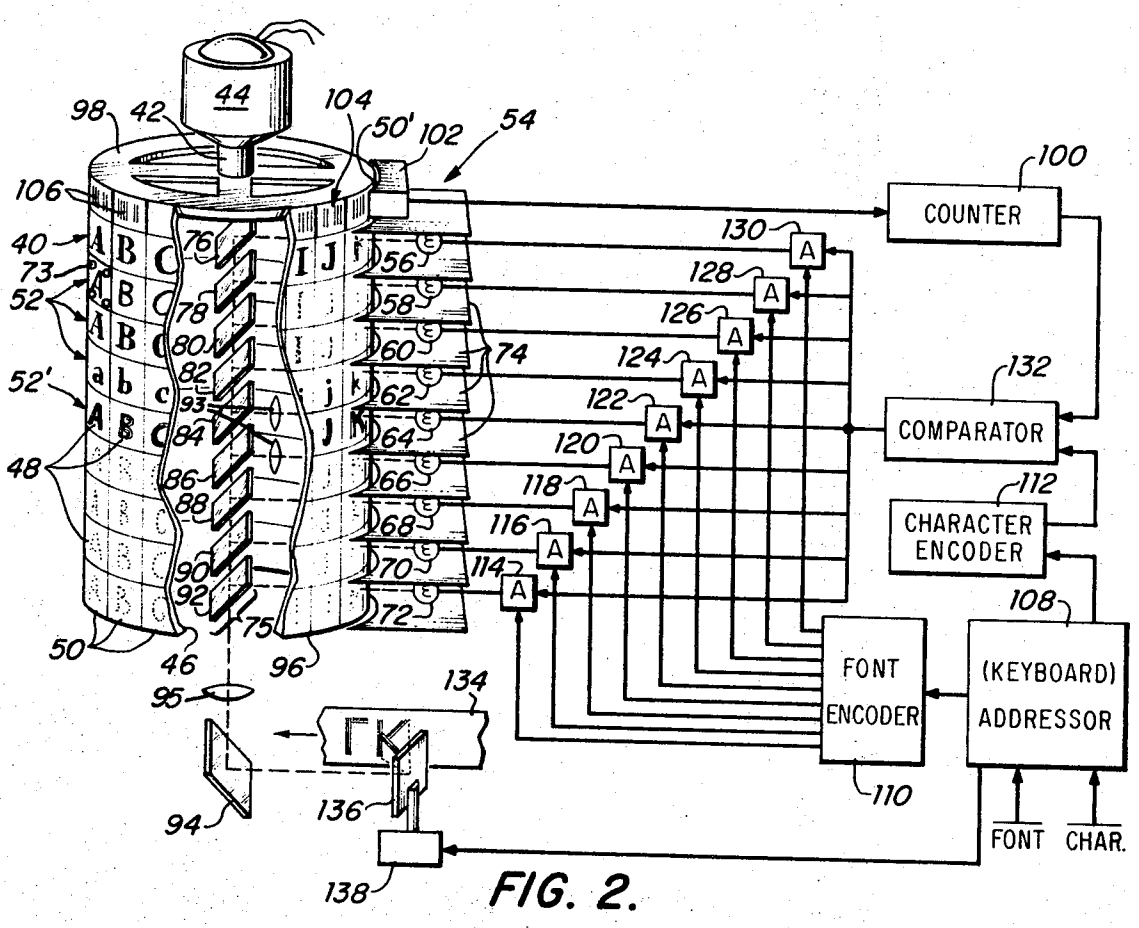


FIG. 2.

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PHOTOTYPESETTING MACHINES

CHARACTERIZATION OF INVENTION

This invention is characterized in photocomposing apparatus for providing a plurality of equally accessible fonts, each having a plurality of image-forming master characters, comprising a support member having a plurality of fonts disposed in a matrix on its surface, irradiating means on one side of the surface for irradiating any one of the master characters along a particular column of the matrix, a projection system alined with the irradiating means on the other side of the surface for receiving the radiant flux in the form of the irradiated master character from any of the master characters in that particular column, sensing means for sensing the position of a column relative to the irradiating means, addresser means for selecting a particular character of a particular font and identifying the column and row which together uniquely locate the master character of that particular character, comparing means, responsive to said sensing means and addresser means, for indicating when the column on which that particular master character is positioned is between the projection system and said irradiating means, and switching means, responsive to identification by the addresser means of the column on which the particular master character is positioned, and to the comparing means, for directing the irradiating means to irradiate the unique location of that particular master character on the matrix and cause radiation in the shape of that particular character to be delivered to the projection system.

BACKGROUND OF INVENTION

This invention relates to type composing apparatus, and more particularly to such apparatus having an improved system for accessing image-forming master characters.

Early typesetting machines were limited in their ability to switch between fonts and did so only with great expense of time. More recently, photocomposing systems have improved the versatility and speed of typesetting operations. Some such systems provide a speed of five to ten characters per second at moderate expense and produce fair quality printing. Another type provides typesetting speeds of the order of one thousand characters per second but are quite expensive and often produces poor quality printing. But, regardless of the specific attributes such systems display, generally they lack the ability to provide very fast switching between a number of fonts while preserving good quality printing at high speed and at reasonable cost. Thus, supposedly high speed systems often operate at speeds of low speed systems, and economical systems become uneconomical when their overall operation times, including limitations imposed by required switching among a plurality of fonts, are considered.

Available prior art systems include static systems and systems utilizing spinning character bearing disks which are flash illuminated to print a line of type generally along a radial line. In these systems it is difficult to accurately position fresh indicia upon the indicia bearing member. A positional accuracy of 1 percent of the height of the character may be required so that the use of larger characters sharply reduces the difficulty of accurately positioning the indicia. Larger characters have inherently greater precision in detail formation which is important in typographic work. The indicia bearing members employed in the present invention provide for the easy addition or substitution of relatively large indicia. The problem of positional accuracy is readily surmounted by providing, for example, rectangular frame elements mounted upon the character drum for accurately mounting the relatively large rectangular transparencies bearing individual characters. A fresh character may be substituted for a character previously present by merely slipping the rectangular transparency bearing the old character out of the frame and replacing it with a rectangular transparency bearing the fresh character to be added. In the alternative, projecting pins may be mounted upon the character bearing member and the rectangular transparency, having pinholes at two or more corners thereof, may be mounted by alining the pins with the transparency pinholes and pushing the transparency toward the drum so that the transparency is accurately positioned and mounted upon the drum.

SUMMARY OF INVENTION

Thus, it is desirable to have available type-composing apparatus having a plurality of equally accessible fonts for rapid composition of printed matter using many different fonts.

It is also desirable to provide such apparatus which is operable at intermediate speeds to provide quality printing at modest cost.

It is also desirable to provide a matrix of fonts, each font having a plurality of image-forming master characters, each of which is uniquely addressable and equally accessible for being irradiated to form an image of its shape projectable on a radiation-sensitive medium.

The invention may be accomplished by a support member having a plurality of master characters disposed in a matrix of columns and rows on its surface, each character being uniquely located at the intersection of a column and a row. An addresser provides one signal indicative of the column containing a selected character to a comparator and a second signal indicative of the row containing that selected character to a control means which connects the lamp adjacent the indicated row to an energizing switch. Coded magnetic indicia identifying each column are sensed by a magnetic sensor as the support and light source are moved relative to each other and signals from the sensor are delivered to the comparator. When the signal from the sensor is the same as the signal from the addresser corresponding to the column in which an addressed character is located, the comparator provides a signal to the energizing switch which energizes the lamp adjacent the proper row through the control means, and illuminates the selected master character precisely when the column of that character is alined with the light source.

In preferred embodiments, the invention includes a projection system for receiving the light flux in the shape of the illuminated character and focusing it on a light-sensitive medium to be used in further photocomposing operations.

DISCLOSURE OF PREFERRED EMBODIMENT

Other objects, features, and advantages will appear from the following description of a preferred embodiment of the invention, taken together with the attached drawings, in which:

FIG. 1 is a diagram of a planar support member with a matrix of characters on it and an irradiating source controlled by an addresser according to the invention;

FIG. 2 is a diagram of another embodiment having a rotatable cylindrical member with a matrix of characters on its surface and an irradiating source controlled by addressing means.

In accordance with one embodiment of the invention as shown in FIG. 1, a support member 10 carries a plurality of master characters 12 disposed in a matrix on its surface, the vertical columns 14 being one set of ordinates of the matrix, and the horizontal rows 16 being another set of ordinates of the matrix. For added ease in accessing individual master characters 12, all the master characters of a font may be disposed in a single row and the master characters in each font may be arranged so that each column contains all the font styles of a particular character.

Addresser 18 provides one signal indicative of the column containing a selected character to comparator 20 and a second signal indicative of the row containing that selected character to control 22. This second signal causes control 22 to connect the lamp in light source 24 adjacent the indicated row to energize switch 26.

Coded magnetic indicia 28 identifying each column are sensed by magnetic sensor 30 as support 10 and light source 24 with sensor 30 fixed to it are moved relative to one another,

and signals from sensor 30 are delivered to comparator 20. When the signal from sensor 30 is the same as the signal from addresser 18, corresponding to the column in which an addressed character is disposed, comparator 20 provides a signal to switch 26 which energizes the lamp in the proper row through control 22, and illuminates the selected master character precisely when the column of that character is alined with light source 24.

On the opposite side of support 10 is a projection system 32 for receiving the light flux in the shape of the illuminated character and focusing it on a light-sensitive medium 34 to be used in a further photocomposing operation. Projection system 32 may include mirrors, lenses, or both, and it is fixed to light source 24, such as by member 36, so that they are maintained in proper alinement.

Another embodiment is shown in FIG. 2 where a drum or cylinder 40 is connected to shaft 42 rotated by motor 44. On the surface 46 of cylinder 40, a number of image-forming master characters 48, such as masks, are disposed in a matrix. The axial columns 50 may correspond to one set of matrix ordinates and circumferential rows 52 to another. For added ease in accessing individual characters 48, all the master characters of a single font may be disposed on one ordinate of one set of ordinates and the master characters in each font may be similarly arranged so that each ordinate of the other set of ordinates includes all the font styles of a particular character.

In the specific embodiment shown in FIG. 2, each circumferential band 52 contains all the master characters of a single font and each axial column 50 contains the master characters of a particular character in all of its font styles. But, of course, this specific arrangement is not necessary for this invention in either the embodiment of FIG. 1 or that of FIG. 2 and is not limiting: each font may contain master characters of different characters so that no similarity in columns occurs; one or more rows may contain only punctuation characters, mathematical signs and symbols, chemical formulae signs, Greek or other writing forms, decorative elements, or music signs and symbols; master characters may be arranged randomly without respect to font or any other ordered arrangement; the two sets of ordinates used need not be perpendicular to each other nor need either of them be alined either vertically or horizontally with support member 10 or with cylinder 40. Further, the support member is not restricted to planar or cylindrical shapes. For example, polygonal members may be used, or discs with the characters disposed on radial columns and circumferential rows may be used. With such a disc arrangement, projection system 75 and source 54 would be disposed radially.

An irradiating source 54 extends adjacent to the outside of surface 46 along an entire axial column 50 of master characters so that it can irradiate all the master characters in a column. Source 54 may produce visible or invisible radiation. In this specific embodiment it produces visible light. Source 54 includes a separate lamp 56, 58, 60, 62, 64, 66, 68, 70, and 72 for each of the nine circumferential rows. The lamps may be set in baffles 74, shown for clarity in incomplete form, which aid in selectively directing light only to that master character in the column 50 alined with source 54 within the circumferential row 52 containing that master character. Source 54 need not include a separate lamp for each circumferential band but may as well have a single lamp or surface controlled by a positioning device to aim the light from the lamp at the selected circumferential row.

A projection system 75 includes mirrors 76, 78, 80, 82, 84, 86, 88, 90, and 92, one for each circumferential row 52, which are alined in a direction parallel to an axial column 50 for receiving the image of a master character illuminated by a corresponding one of the lamps of source 54. The mirrors of system 75 reflect light received from light source 54 through any intervening mirrors of system 75 onto mirror 94. Light directed in the direction in which mirrors 76, 78, 80, 82, 84, 86, 88, 90, and 92 are alined is transmitted unreflected by them. Other means may be used in place of mirrors 76, 78, 80, 82, 84, 86, 88, 90, 92 to provide the function of a space division radiation multiplex device: to receive an image from any one of a number of spaced positions and deliver it to a single position. And the projection system may include lenses for focusing the radiation received in the shape of an illuminated character. Of course, whatever mirrors or lenses used must be capable of functioning with the type of radiant energy being produced by source 54. And there need not be a separate mirror for each circumferential row: a single mirror or element may be aimed by a positioning device to receive light through a selected circumferential row. The positions of mirrors 76, 78, 80, 82, 84, 86, 88, 90, and 92 may be interchanged with source 54 and they may be rotated while the cylinder is held stationary.

It is important that source 54 and the mirrors be alineable with ordinates which would be extended reach the edges 96 and 98 of cylinder 40. This arrangement is necessary to insure that source 54 and mirrors 76, 78, 80, 82, 86, 88, 90, and 92 can be successively alined with each ordinate in a set of ordinates as a function of the rotation of either cylinder 40 or the source or the mirrors. Since the characters are arranged in a two-dimensional matrix which, by definition, cannot have the ordinates of one set of ordinates parallel to the ordinates of the other set of ordinates, one of the sets must extend toward interception of edges 96 and 98: only one set could be circumferential. If source 54 and the mirrors are arranged to be alineable with skewed ordinates, they and the ordinates will define helical paths.

Each master character on surface 46 of cylinder 40 is equally accessible because each has a unique location which may be selectively illuminated by energizing the lamp cooperating with the circumferential row of a selected master character at the time when the axial column of that selected master character is between the mirrors and source 54.

Preferably, collimating lenses 93 (only two of which are shown) are positioned between mirrors 76 through 92 and the inside surface of drum 104 so that the light transmitted by the mirror array within the drum is collimated thereby to eliminate focusing problems which might otherwise exist due to the difference in optical path lengths. With this arrangement a single reimaging lens 95 would preferably be positioned between mirror 92 and mirror 136. Of course, should mirror 136 be stationary and the photosensitive media 134 be moved, the imaging lens could be positioned between mirror 136 and media 134. Individual transparencies each bearing a given character may be accurately mounted upon the drum by means of pins 73 which project from the drum and are fitted within pinholes formed within outer portions of the transparencies such as the corner portions.

The positions of the axial columns 50 are monitored as cylinder 40 is continuously rotating by a counter 100 which counts pulses developed by magnetic sensing head 102 as magnetic indicia on circumferential row 104 are driven past head 102. There is a separate segment 106 on row 104 for each axial column 50 and each such segment has a distinct set of magnetic indicia on it containing the numerical code identifying a particular column.

Since this embodiment contains fonts in circumferential rows and the master characters within each font are similarly, orderly, arrayed, upon the selection of a particular master character, as for example by manual operation of a keyboard associated with addresser 108, a signal is provided to font encoder 110 and character encoder 112. Font encoder 110 immediately provides a signal to that one of AND circuits 114, 116, 118, 120, 122, 124, 126, 128, and 130 corresponding to the circumferential row of the selected character. Character encoder 112 supplies to comparator 132 a signal representative of the numerical code identifying the particular column of the selected master character. As each column arrives at head 102, counter 100 delivers the column's numerical code to comparator 132. When this code is the same as that from character encoder 112, a signal is provided by comparator

132 to all of the AND circuits simultaneously. The signal AND circuit receiving a signal from font encoder 110 now produces an output to energize its associated lamp which is alined with the font of the selected master character. Light flux in the form of the selected master character is therefore projected to one of the mirrors in system 75 within cylinder 40, and then reflected down to mirror 94. From mirror 94 the image, now inverted, is reflected onto the surface of film 134 by mirror 136. If the film is held stationary the desired spacing of the character on film 134 may be effected by a servomechanism 138 controlled by suitable circuitry in addresser 108 to rotate mirror 136. Or, film 134 may be placed directly beneath cylinder 40 to receive the image directly beneath cylinder 40 to receive the image directly from the mirrors of system 75, thereby eliminating the need for mirror 136, servomechanism 138 and mirror 94.

In operation, a particular master character of a particular font is selected through addresser 108, for example the letter 'K' in axial column 50' of the font and in circumferential row 52'. Immediately upon selection, font encoder 110 provides a signal to AND circuit 112 associated with lamp 64, and character encoder 112 provides the numerical code identifying axial column 50' to comparator 132. As cylinder 40 rotates, head 102 senses the magnetic indicia on segments 106 and supplies signals representative thereof to counter 100. Counter 100 accumulates those signals to compose the numerical code identifying each column, each of which identifying codes is submitted to comparator 132. When axial column 50' reaches source 54 and its segment 106 reaches head 102, the output of counter 100 produces the code identifying column 50'. The identity of the two inputs to comparator 132 causes an output to be produced by it to each of AND circuits 114, 116, 118, 120, 122, 124, 126, 128, and 130. The one AND circuit 122 which also receives a signal from font encoder 110 provides an output which energizes lamp 64, illuminating the unique location at the intersection of circumferential row 52' and axial column 50' where the master character of the selected character 'K' is situated. The image produced by the master character 'K' is reflected by mirror 84, and passes through system 75 to be projected on film 134.

It should be appreciated that the control circuits for the light source comprise but one effective arrangement which may be used to accomplish the invention and are in no way a limitation on the invention. It should be understood that the term "font" as used in the specification and the claims generally refers to various styles or sizes of characters. However, the designation "font" should be interpreted broadly to include any group of indicia; even a group having indicia therein which do not have a common characteristic. The term "character" is intended to include virtually any type of indicia such as mathematical symbols or musical notations. Thus, one aspect of the invention involves providing columns or rows of indicia having some common characteristic. However, another aspect of the invention is to provide an indicia bearing member which is preferably a drum having mounting means thereon for selectively mounting or replacing indicia, which indicia has relatively large dimensions to provide positional accuracy and ease of character formation as discussed hereinabove. The cylinder or drum configuration is preferred since the circumference or length of the drum may be readily increased to provide for the mounting of relatively large indicia thereon.

I claim:

1. Photocomposing apparatus for providing a plurality of equally accessible fonts each having a plurality of image-forming master characters comprising:

a support member having a plurality of fonts disposed in a matrix of rows and columns on its surface;

irradiating means on one side of said surface for irradiating any one of said master characters along a particular column of said matrix;

a projection system alined with said irradiating means on the other side of said surface for receiving the radiant flux in the form of the irradiated master character from any of the master characters in that particular column, said projection system including a radiation reflector element corresponding to each row of said matrix, said reflector elements being alined in a direction parallel to the columns for receiving radiation from said irradiating means through a master character and transmitting that radiation in the direction in which said elements are alined;

sensing means for sensing the position of a column relative to said irradiating means;

addresser means for selecting a particular character of a particular font and identifying the column and row which together uniquely locate the master character of that particular character;

comparing means, responsive to said sensing means and addresser means, for indicating when the column on which that particular master character is positioned is between said projection system and said irradiating means; and,

switching means, responsive to identification by the addresser means of the column on which the particular master character is positioned, and to said comparing means, for directing said irradiating means to irradiate the unique location of that particular master character on said matrix and cause radiation in the shape of that particular character to be delivered to said projection system.

2. The apparatus of claim 1 in which master characters of the same font are disposed along rows of said matrix.

3. The apparatus of claim 1 in which similar master characters of the dissimilar fonts are disposed along the columns of said matrix.

4. The apparatus of claim 1 in which said columns and rows are perpendicular to each other.

5. The apparatus of claim 1 in which said support member is movable and said irradiating means and said projection system are stationary.

6. The apparatus of claim 1 in which said support member is a cylinder and said projection system is inside, and said irradiating means is outside, of said cylinder.

7. The apparatus of claim 1 in which said irradiating means provides visible light.

8. The apparatus of claim 1 in which said irradiating means includes a separate radiation source for each of the rows of said matrix.

9. The apparatus of claim 1 in which said sensing means includes coded indicia associated with said support member for distinguishing each of the columns, transducer means for sensing said coded indicia and providing signals representative of the indicia sensed, and encoding means, responsive to said transducer means, for providing a signal representative of the column sensed.

10. The apparatus of claim 1 in which said addresser means includes a first encoder for providing a signal representative of the particular font selected and a second encoder for providing a signal representative of the particular character selected.

11. The apparatus of claim 10 in which said addresser means further includes manually operable means for selecting characters and fonts.

12. The apparatus of claim 1 in which said projection system further includes collimating lens means positioned between said reflector elements and said other side of said surface for maintaining focus at an imaging plane upon which said radiation is projected.