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LENSLET ASSEMBLY FOR PHOTOCOMPOSING MACHINES

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3 Sheets-Sheet 1

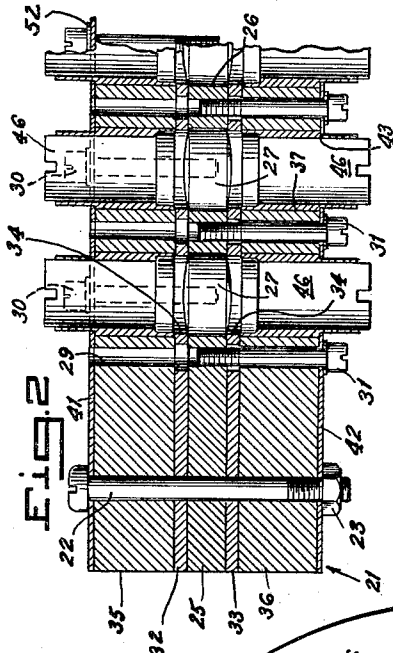


Fig. 2

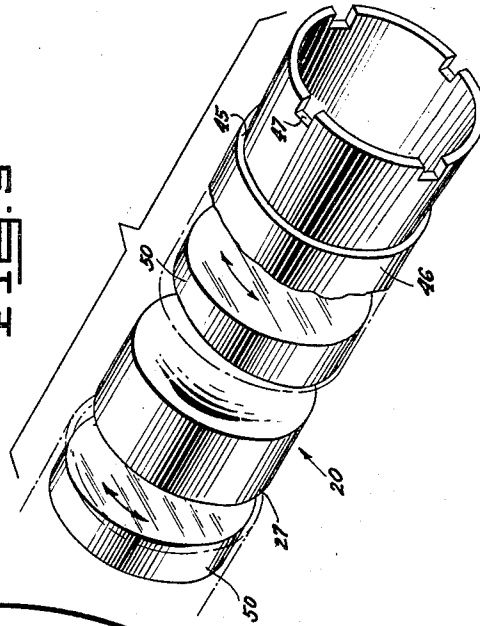
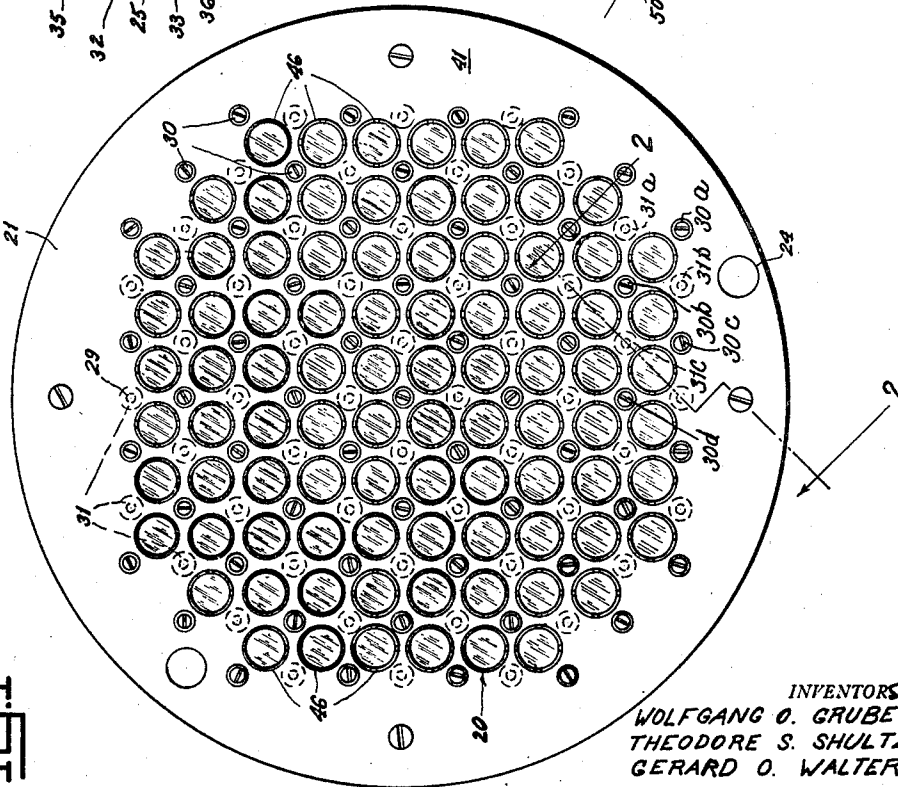


Fig. 1



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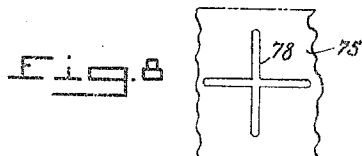
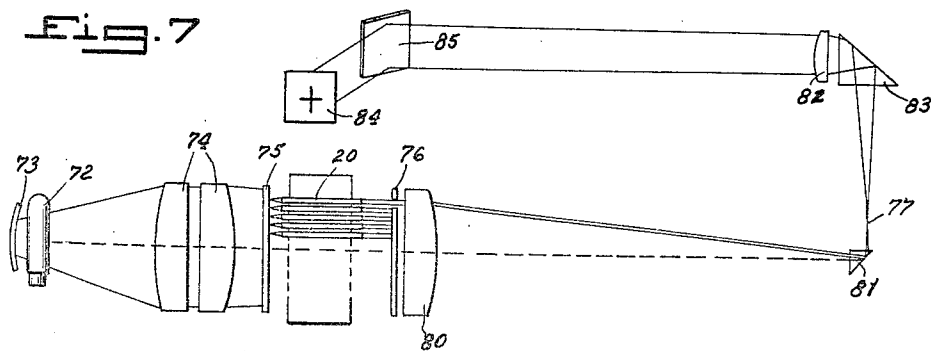
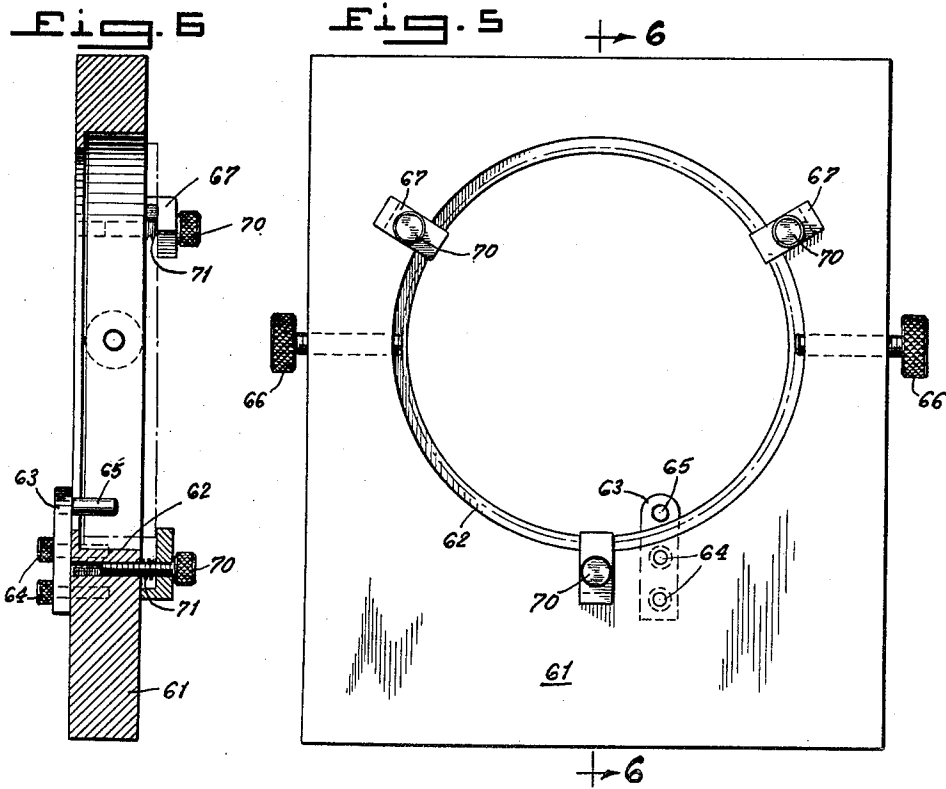
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3 Sheets-Sheet 3



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LENSLET ASSEMBLY FOR PHOTOCOMPOSING MACHINES

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Application December 30, 1955, Serial No. 556,744

10 Claims. (Cl. 95—4.5)

This invention relates to an optical lenslet assembly for photocomposing machines and particularly to one having means for readily adjusting each individual lenslet to a predetermined position in a fixed array.

In copending application Serial No. 354,826, filed May 13, 1953, assigned to the assignee of the present invention, there is disclosed a character presentation apparatus which utilizes, in part, a plurality of collimating lenslets suitable for and especially useful in a photocomposing machine. The lenslets are disposed in a plane array forward of and parallel to a character font plate, the latter being preferably an opaque sheet or film with transparent characters positioned thereon. There is a single lenslet for each and every character on the font plate and each one is displaced from its associated character the focal distance of the lenslet. In this manner light passing through the transparent character is collimated and thereafter passed through other lens assemblies until it is focused on a sensitized sheet, where the image of the selected character is recorded. As disclosed in the aforementioned application, images of each of the characters of the font plate are formed in the same position relative to the optical system. More specifically, images of the characters are formed in the same position relative to the optical axis of the system. Hence, by suitable relative movement between the optical system and the image receiving sheet, the selected characters can be arranged in side by side relationship to provide text composition even though the character font plate remains stationary.

Of course, in a character presentation system as outlined above, each individual character on the font plate is located in a fixed position which bears a predetermined relationship with the system optical axis for that particular character. This relationship is assured in the photographic process by which the character font is formed.

In the character presentation system as actually mechanized, the character font plate will be suitably mounted, as will the lenslet assembly. Since each character of the font plate will be physically located with respect to the optical axis of the overall system, the optical axis of each individual lenslet must coincide with the "optical axis" of its associated character. This required result cannot be achieved by the mere alignment of the geometric axis of each lenslet with the optical axis of the character on the font plate inasmuch as the geometric axis of the lenslet generally does not coincide with the optical axis thereof, and any other result would place intolerable restrictions on manufacturing procedures.

It has heretofore been proposed that in order to "match up" the optical axes of the lenslet assembly with the corresponding axes of the character font plate, the font plate itself be formed by photographing back through the optical system including the lenslet assembly with which it is to be used. In this method, a character is placed at the imaging location where the sensitized sheet would normally be placed and then this character is

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photographed through the system to the character font plate which now is the sensitized sheet. The location of the image on the font plate is controlled by selective shuttering of the lenslet assembly. A second character is next photographed back through the system and imaged on the font plate, the location of the image being again controlled by proper shutter operation. The process is continued until all of the desired characters are imaged on the font plate, which is thereafter developed to fix the latent images. For a more detailed description of this method of providing a character font plate in which the optical axes of the various characters coincide with the optical axes of the associated lenslets, see copending application Serial No. 399,534 filed December 21, 1953.

Perhaps the most serious drawback to the above method is that each character font is tailored to a specific lenslet assembly. Thus, modern production techniques cannot be utilized and the extremely desirable attribute of interchangeability of parts cannot be achieved. In practical aspects, this means that if a photocomposing machine is operating in the field and a character font plate is destroyed or a font of different type face is desired, in order to provide the required font plate it would be necessary to recall the lenslet plate from the field and use it for producing the new font plate.

It is, therefore, the object of the present invention to provide a lenslet assembly wherein each individual lenslet can be adjusted to cause the coincidence of the optical axis of the lenslet and the geometric center of the aperture in which the lenslet is mounted.

In carrying out the invention, there is provided a base member having a plurality of apertures symmetrically disposed to accord with the desired lenslet array, each aperture being equidistant from adjoining apertures, a lenslet fixedly mounted in each aperture, a light refractor for modifying the optical axis of the combined assembly of said refractor and the lenslet, means for adjusting the light refractor, and means for locking the optical member in its adjusted position.

Features and advantages of this invention can be gained from the foregoing and the description of a preferred embodiment thereof which follows:

In the drawings:

Fig. 1 is a view in front elevation of the lenslet plate; Fig. 2 is a partial sectional view taken along line 2—2 of Fig. 1;

Fig. 2A is an enlarged sectional view showing the structural details of the lenslet plate at each lenslet;

Fig. 3 is an isometric view showing the optical elements of an individual lenslet assembly;

Fig. 4 is a schematic representation of the lens system showing a light ray passing through the optical elements;

Fig. 5 is a view in front elevation showing the fixture in which the lenslet plate is mounted during the adjusting procedure;

Fig. 6 is a sectional view taken along line 6—6 of Fig. 5;

Fig. 7 is a schematic representation of the apparatus utilized in adjusting the lenslet plate; and

Fig. 8 is an enlarged detail showing a portion of the target plate.

In Fig. 1, a plurality of individual lenslet assemblies 20 are shown mounted in lenslet disc 21 in the configuration which has been found desirable for use in a photocomposing machine. As will be seen hereinafter, lenslet disc 21 comprises several laminations and these are secured together by suitable means such as screws 22 and nuts 23. Openings 24 provided in each lamination are in alignment when the laminations are secured together to form disc 21 and collectively they form an aperture for cooper-

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ation with a locating pin or dowel, which again, will be referred to later.

Each individual lenslet assembly is shown in detail in Figs. 2 and 2A and attention is now directed to those views. The central plate 25 of lenslet disc 21 is provided with a plurality of apertures 26, one for each lenslet 27 to be accommodated, and a plurality of holes 29, one for each of locking screws 30 and 31. The holes 29 are internally threaded for engagement with the screws 30 and 31. The lenslets 27 are secured in plate 25 by a suitable optical thermosetting cement such as Arsenal 1057, Eastman Kodak HE2 or Pittsburgh Plate Glass CR39. The plate itself may be formed of any desired stable material but aluminum has been selected to reduce the weight of the lenslet disc or unit.

Sandwiching central plate 25 are the backing plates 32 and 33 which are formed of half hard brass. It will be noted that these plates are provided with holes and apertures corresponding to those of plate 25 with the exception that the openings through which locking screws 30 and 31 pass are slightly oversize to provide proper clearance for the screws, while the apertures 34 through which the light will pass in the finished assembly are of lesser diameter than aperture 26 in plate 25. Although, as will be noted from Fig. 1, the forwardmost plate requires clearance holes only for those locking screws 30 which enter lenslet disc 21 from the forward side thereof and the rearmost plate requires clearance holes only for those locking screws 31 which enter lenslet disc 21 from the rear side thereof, the provision of similar plates is resorted to in order that the number of different parts in the overall assembly be reduced to a minimum.

Placed adjacent backing plates 32 and 33 are the bearing plates 35 and 36 which are fabricated of hard aluminum in order to reduce the weight of the lenslet assembly. Here again, the number and location of holes and apertures are the same as those for the backing plates even though, as in the case of the backing plates, front bearing plate 35 requires clearance holes only for those locking screws 30 which enter the central plate 25 from the forward side thereof and rearmost plate 36 requires clearance holes only for those locking screws 31 which enter central plate 25 from the rear side thereof. The apertures 37 through the bearing plates are of slightly greater diameter than those through the backing plates 32 and 33 in order that, when all of the elements are assembled, an annular shoulder 40 be provided to limit the movement of the light refractor mounts as hereinafter described.

A pair of clamping plates 41 and 42 are also provided, these having locking screw holes and apertures similar to the backing and bearing plates except that the apertures 43 are of slightly less diameter than the apertures 37 of the bearing plates. In this manner an annular retaining rim 44 is provided which will serve to engage the shoulder 45 of the refractor mount and thereby permit clamping the light refractor carried therein in adjusted position. The final clamping action is accomplished by tightening of locking screws 30 and 31.

The refractor mount itself is a short tubular member 46, the outside surface of which is provided with a peripheral shoulder 45 (Fig. 3) which as seen above is engaged by a clamping plate. One end of the mount is provided with a plurality of circumferentially spaced notches 47 which are engageable by a specially provided tool for adjusting the wedge mounts and the optical wedges carried therein. At the other end of member 46, the internal surface thereof is machined to provide a suitable receptacle for the light refractor 50 which is secured therein by an optical thermosetting cement of the type heretofore disclosed. The refractor 50 is secured within member 46 with its "flat" surface engaging shoulder 51 to minimize skewing of the refractor.

In fitting together the various components of the optical lenslet assembly, the light refractors 50 are cemented into the tube members 46 and the lenslets 27 are similarly

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cemented into the central plate 25. Having thus secured the optical elements to their respective mountings, one half of the light refractors are inserted in the apertures 37 of one of the bearing plates 35 while the remaining tube mounted light refractors 50 are inserted in the apertures of the other bearing plate 36. It will be observed that the distance from the end of tubular member whereat light refractor 50 is secured to the shoulder 45 of the member is slightly greater than the thickness of the bearing plates 35 and 36. As will hereinafter be seen, this affords an opportunity to clasp the refractor mounts in their adjusted positions.

The backing plate 32 is brought into position adjoining the central plate 25, and the bearing plate 35 carrying the mounted light refractor 50 is placed against backing plate 32. As was before noted, the apertures 34 in backing plate 32 are of slightly less diameter than the apertures 37 in the bearing plate 35. In this manner, movement of the tube member 46 in bearing plate 35 is restricted to engagement of the wedge end surface of member 46 with the surface 40 of the backing plate 32. After the aforementioned plates are positioned together, clamping plate 41 is slipped over the protruding notched ends of the refractor tubes 46. The same assembly procedure is followed for the rear plates 33, 36 and 42, and the entire assembly is then fastened together by screws 22 and nuts 23. Flat fillister machine locking screws 30 and 31, which pass through clearance holes in the clamping, bearing and backing plates, are then threaded into the central plate 25. Lock washers 52 are provided to fulfill their usual purposes. As will be noted in Fig. 1, on one side of the entire assembly, the screws 30 will be provided in every other screw hole, while on the reverse side of the assembly, the screws 31 will be provided in the alternate screw holes. The net result will be that there is provided a total number of screws equal to the total number of apertures for screws passing through the entire assembly. In the embodiment shown an odd number of screws are provided and one half of this total plus one are found on one side of the lenslet assembly while the remaining screws i.e. one half of the total minus one, are found on the other side of the lenslet assembly.

Reference will be made to Fig. 1 for an illustrative procedure of adjusting the optical system to correct for decentering of the optical axis of the lenslets. Consider first the lenslet which is shown in the lower right-hand corner of the figure. Using a technique, hereinafter described, the light refractor in the mount in front of the assembly, i.e. nearer to the observer, is adjusted to the desired position and screw 30^a tightened. Tightening of this screw causes clamping plate 41 to grasp shoulder 45 of the refractor mount and thereby prevent any random motion of the mount. However, such tightening only effects the refractor mount for the lenslet referred to since the clamping action is limited to the area around the particular screw due to the thinness of the clamping plate. When the mount at the rear of the lenslet being corrected is in its adjusted position, screw 31^a is tightened with the effects just described. When the front mount for the next horizontally adjacent lenslet is in adjusted position, screw 30^b is tightened and screw 31^b is tightened when the rear mount for this particular lenslet is fully adjusted. The procedure is continued for the third lenslet, that is, screw 30^c is tightened after the front mount is adjusted and screw 31^c is tightened after the rear mount is adjusted. After all of the refractor mounts for the first or lower horizontal row of lenslets are adjusted to "center" the optical axes of the lenslets, the second horizontal row of screws, i.e. screws 30^b, 30^d etc. and 31^a, 31^c etc. are loosened in order that the refractor mounts for the second row of lenslets may be adjusted. It is apparent that the screws located in the first row are adequate for maintaining the adjusted positions of the refractor mounts in the first row. For example, screw 30^c locks both the second and third front refractor mounts

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and screw 31^b locks both the first and second rear refractor mounts which are disposed rearward of the first and second front refractor mounts. It is further apparent that the entire lenslet assembly can be adjusted and locked in adjusted position by following the procedure outlined.

Adjustment of refractor mounts and the light refractors carried thereby has been described as effective as a "centering means" for correcting optically decentered lenslets, that is, lenslets in which the optical axis does not coincide with the geometrical axis. It is now incumbent to explain how the combination of light refractors, before described in structural detail, effect the desired result.

Reference will be made to Fig. 4 wherein there is schematically shown, in a transposed order, the optical elements of the present invention. Assuming that the light entering the present system first enters the collimating lenslet and that this light defines a photographic object in the primary focal plane of the lenslet, then it is clear that the light exiting from the lenslet will be collimated light. This means that all the light entering the lenslet from a single point of the object image will leave the lenslet in a bundle of self-parallel rays. Therefore all of the light entering the lenslet from every point of the photographic object can be considered to leave the lenslet in a great number of bundles of self-parallel light. It might be added that these bundles will not themselves be parallel one to another. However, present consideration will be given to a single such bundle of light which now will be traced through the two light refractors.

If a single ray 53 of that bundle of light approaches the first refractor 54 normal to the first intercepting surface 55 thereof, the ray will enter refractor 54 undeviated. However, upon leaving the refractor, the ray approaches the refractor surface 56 obliquely and is refracted or bent in a direction away from the normal 57 to the refractor surface since the light ray is passing from a medium having a relatively high refractive index to one having a lower refractive index. If the ray, as shown, enters the center of the light refractor, rotation of the refractor about an axis passing transversely through that center will cause the emerging ray to describe the surface of a cone with its apex at the point of ray emergence from the refractor, which point for the central ray will remain fixed in position. All other rays of the bundle of light under consideration will emerge from the refractor parallel to the central ray since they entered the refractor as parallel rays. It follows, therefore, that the light rays of the bundle of self-parallel light entering the light refractor can be given a controlled directivity simply by controlling the rotation of the refractor. Once a desired directivity is achieved, rotation of the refractor is arrested and its position fixed.

The bundle of self-parallel light rays thereupon enter the second light refractor 60 and are refracted thereby to give the bundle a new directivity which again is determined by the rotary position of the second refractor. It is further clear that the total shift or translation of the self-parallel bundle of light rays will be the resultant of the shifts introduced by each of the two light refractors and that the direction and distance of the shift is controlled by the conjoint rotation of the refractors. The total shift will also be dependent on the separation of the refractors, but as in the present case, due to the small refractor angle the shift introduced by this factor is negligible.

The foregoing explanation covered a single bundle of self-parallel light emanating from a single point of the photographic object, but it is obvious that the same explanation suffices for all of the bundles of self-parallel light.

It is, of course, known that the linear arrangement of the system elements is unimportant and has no effect on the results obtained. Thus, while the explanation covered the circumstances of the light beam passing through the lenslet and thereafter traversing the two light refractors,

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the preferred structure is to provide the lenslet between the two light refractors. In this manner a simple arrangement is realizable for the facile adjustment of the light refractors and in addition correct for possible displacement of the optical axis of the collimating lens due to inaccuracy in manufacture or placement in mount.

The light refractors provided, two for each lenslet, are all of the same character and specification and are capable of correcting decentered lenslets in which the decentering, i.e. the disparity between the geometrical and optical axes, is within a predetermined tolerance. Thus even though the decentering varies from lenslet to lenslet, by proper adjustment of the light refractors a uniform spacing of the optical centers of the lens systems, each lens system being a lenslet plus its associated pair of light refractors, can be obtained. The two refractors rotatable with respect to each other are the equivalent of a single refractor with a variable refractor angle wherein the maximum angle is the sum of the angles of the two refractors and the minimum angle is the difference between the angles of the two refractors.

Therefore, as an alternative means of correcting decentering of the lenslet, one can provide a single refractor with each lenslet. However, in this case, the refractor must have an angle which is a function of the decentering of the lenslet, i.e. the disparity between the optical axis and the physical axis of the lenslet. It is obvious that since the decentering for the individual lenslets may vary from lenslet to lenslet, a wide variety of light refractors, each having a different refractive angle, would be required. The advantages of the preferred arrangement heretofore described (wherein a pair of light refractors each having a fixed refractive angle is used) are believed obvious inasmuch as it never becomes necessary to associate a particular refractive angle to a particular lenslet nor is it necessary to provide many different refractors having a wide variety of refractive angles.

Another alternative means to correct decentering of the lenslet is to provide a system comprising the lenslet and a glass plate having parallel surfaces. In this case, any light beam entering the glass plate will emerge therefrom parallel to the entering beam but offset a distance and direction dependent on the orientation of the glass plate. The mechanism for mounting the plate and orienting the plate becomes fairly complicated since the motion imparted to the plate must be three dimensional. That is, it must be capable of pivoting the plate about a single point rather than about an axis as in the preferred embodiment.

The mounting fixture in which the lenslet assembly is positioned when the adjustments for correcting the individual lenslets are made is shown in Figs. 5 and 6. A frame 61 is provided having an aperture 62 therethrough. From one side of the frame, the aperture is of a diameter less than that of the lenslet assembly 20, while from the opposite side of the frame the aperture is of a diameter greater than that of the lenslet assembly so that the assembly may be accommodated therein. A bracket 63, held to frame 61 by a pair of thumbscrews 64, carries a dowel 65 which accurately locates the lenslet assembly by determining the location of the opening 24 in the lenslet assembly. With lenslet assembly 21 mounted in frame 61, a pair of set screws 66 threaded through opposite sidewalls of the frame lock the assembly in position and prevent its pivoting about dowel 65. The assembly is held within frame 61 by three angle members 67 equally spaced around the periphery of the lenslet assembly and secured by thumbscrews 70. Springs 71 are provided between the surface of frame 61 and the angle members 67 to maintain the members in contact with the underside of the thumbscrew 70.

The lenslet assembly adjustment and final inspection device is shown schematically in Fig. 7. A light source 72 (which may be a mercury vapor lamp) is shown posi-

tioned before a reflector unit 73 which serves to direct the major portion of the light produced by the light source in a direction forward of the source to a pair of condenser lenses 74, which concentrate the light beams and provide a uniform light pattern over the target array 75. The target array is an opaque member having a plurality of transparent figures 78 corresponding in number to the number of lenslets in lenslet assembly 21. The figures are accurately located on the opaque member such that the figures are spaced in accordance with the desired spacing of the optical axes for the lenslets or, in other words, with the spacing of the geometric centers of the apertures in which the lenslets are mounted. While any configuration might be used, since a point, i.e. the optical axis of a lenslet, is to be precisely spaced from another point, the figure selected should reasonably define a point. Thus, a suitable target figure 78 is that shown in Fig. 8, namely, a pair of intersecting bars in which the point of intersection corresponds to the optical axis.

The light beams, after passing through target array 75, pass through the lenslet assembly 21, and then a shutter mechanism 76. The shutter is selectively operable so that the light passing through a desired lenslet can be transmitted to the remainder of the adjusting and inspecting device. In substance, the system herein considered is similar to the system disclosed and claimed in the aforementioned co-pending application Serial No. 354,826. Therefore, the light passing through a single lenslet is collimated light due to the fact that the target array is placed in the primary focal plane of the individual lenslets. The collimated light representing the light passing through a single transparent target will be focused and an image of the target formed at the primary focal point 77 of a decollimating lens 80. The free aperture of this latter lens 80 is such as to encompass all lenslets in the lenslet assembly. The light from any target, regardless of its position in the target array, will be focused at this common point. In the preferred embodiment, a reflecting prism 81 is utilized in order to keep the dimensions of the adjustment and inspection device at a minimum. The real image of the target formed at 77 then becomes the object for projection lens 82, a reflecting prism 83 again being interposed between the position of the image and the lens, which produces an image of the target on the projection screen 84. A front surface mirror 85 is provided for the same purpose of minimizing the space requirements of the adjusting and inspecting device. Magnification of the image size on projection screen 84 can be controlled by varying the distance between projection lens 82 and screen 84.

In operation, the adjustment and inspection device is arranged as above and the shutter for the first lenslet is actuated to pass the light from the first lenslet and produce a target image on screen 84. The light refractors for the first lenslet are then locked in position by tightening the appropriate screws 30^a and 31^a. The first shutter corresponding to the first lenslet remains open throughout the adjustment of the lenslet assembly. Next, the shutter corresponding to the second lenslet is opened and an image of the second target appears on screen 84. The light refractors associated with the second lenslet are rotated until the image of the second target coincides with the image from the first target. When this is accomplished, the refractors associated with the second lenslet are locked in position by tightening of appropriate screws 30^b and 31^b. The shutter for the second lenslet is closed and that for the third lenslet opened. The light refractors for the third lenslet are rotated until the image of the third target coincides with the image of the first target at which time the refractors are fixed in position, and the process continued for succeeding lenslets.

Having thus described the invention it is to be understood that many modifications could be made to the above preferred arrangement for carrying out this in-

vention and many apparently widely different embodiments of this invention could be made without departing from the scope thereof. It is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a photocomposing machine having a phototypographical font in which each character is located with respect to a reference point according to the typography of the character and in which the reference point for each character is spaced one from another a predetermined distance, a lens system to project images of selected characters at a common position for recording on a sensitized sheet one at a time in line composition, said lens system including a plurality of lenses, one for each character of the font, a mounting plate for said lenses having a plurality of apertures in which the lenses are rigidly mounted, a first plate having a plurality of apertures corresponding to the apertures in said mounting plate, said first plate being secured relative to said mounting plate with the apertures of both plates in alignment, a plurality of light refractors rotatably mounted in the apertures of said first plate, means for locking said light refractors against further rotation when they are in an adjusted position, a second plate having a plurality of apertures corresponding in number to the number of apertures in said mounting plate, said second plate being secured relative to said mounting plate with the apertures of both plates in alignment, a plurality of light refractors rotatably mounted in the apertures of said second plate, and means for locking said light refractors against further rotation when they are in an adjusted position.

2. In a photocomposing machine having a phototypographical font in which each character is located with respect to a reference point according to the typography of the character and in which the reference point for each character is spaced one from another a predetermined distance, a lens system to project images of selected characters at a common position for recording on a sensitized sheet one at a time in line composition, said lens system including a plurality of lenses, one for each character of the font, a mounting plate for said lenses having a plurality of apertures in which the lenses are rigidly mounted, said apertures being spaced one from another a predetermined distance corresponding to the spacing of the reference points of the phototypographical font, a first plate having a plurality of apertures corresponding to the apertures of the mounting plate, said first plate being connected to said mounting plate with the apertures in both plates in alignment, a plurality of light refractors, individual mounting members in which said light refractors are supported, said mounting members being located in the apertures of said first plate and free for rotation, means for locking said mounting members against rotation whereby said members may be rigidly held in an adjusted position, a second plate having a plurality of apertures corresponding to the apertures of the mounting plate, said second plate being connected to said mounting plate with the apertures in both plates in alignment, a plurality of light refractors, individual mounting members in which said light refractors are supported, said mounting members being located in the apertures of said second plate and free for rotation, and means for locking said mounting members against rotation whereby said members may be rigidly held in an adjusted position.

3. In a photocomposing machine having an array of phototypographical characters located with respect to fixed reference points, an optical system to project images of selected characters at a common position for recording on a sensitized sheet, one at a time, for line composition, said optical system including a fixed collimating lens for each character, a pair of rotatably

mounted light refractors having plane non-parallel faces associated with each collimating lens, and means for orienting each light refractor separately with reference to the collimating lens by rotating said light refractors about an axis passing through said collimating lens and light refractor whereby the optical axis of the combined collimating lens and light refractors is caused to coincide with the reference point of the corresponding typographical character as well as with the main optical axis of the system.

4. In a photocomposing machine having an array of phototypographical characters located with respect to fixed reference points, an optical system to project images of selected characters at a common position for recording on a sensitized sheet, one at a time, for line composition, said optical system including a fixed collimating lens for each character, a pair of rotatably mounted light refractors having plane non-parallel faces, said light refractors being located on opposite sides of said collimating lens, and means for orienting each light refractor separately with reference to the collimating lens by rotating said light refractors about an axis passing through said collimating lens and light refractors whereby the optical axis of the combined collimating lens and light refractors is caused to coincide with the reference point of the corresponding typographical character as well as with the main optical axis of the system.

5. In a photocomposing machine having an array of phototypographical characters located with respect to fixed reference points, an optical system to project images of selected characters at a common position for recording on a sensitized sheet, one at a time, for line composition, said optical system including a collimating lens mounting member, a collimating lens fixedly mounted in said member, a pair of rotatably mounted light refractors having plane non-parallel faces, and means for supporting said light refractors, one on each side of said collimating lens, for orienting each light refractor separately with reference to its associated collimating lens by rotating said light refractors about an axis passing through said collimating lens and light refractors whereby the optical axis of the combined collimating lens and light refractors is caused to coincide with the reference point of the corresponding typographical character as well as with the main optical axis of the system.

6. In a photocomposing machine having an array of phototypographical characters located with respect to fixed reference points, an optical system to project images of selected characters at a common position, for recording on a sensitized sheet, one at a time, for line composition, said optical system including a collimating lens mounting member, a collimating lens fixedly mounted in said member, a first light refractor, means for supporting said first light refractor for rotatable movement, said means being located on one side of said collimating lens mounting member, a second light refractor, means for supporting said second light refractor for rotatable movement, said last named means being located on the opposite side of said collimating lens mounting member from said first named means, and independent means for rotating the two light refractors with reference to the collimating lens as well as with reference to each other whereby the optical axis of the combined collimating lens and light refractors is caused to coincide with the reference point of the corresponding typographical character as well as with the main optical axis of the system.

7. In a photocomposing machine having an array of phototypographical characters located with respect to fixed reference points, an optical system to project images of selected characters at a common position for recording on a sensitized sheet, one at a time, for line composition, said optical system including a collimating lens mounting member, a collimating lens fixedly

mounted in said member, a first light refractor, means for supporting said first light refractor for rotatable movement whereby the apparent position of the optical axis of the aforementioned collimating lens is shifted in position relative to said collimating lens mounting member, means for locking said means in a desired position, a second light refractor, means for supporting said second light refractor for rotatable movement whereby the apparent position of the optical axis of the aforementioned collimating lens is shifted in position relative to said lens mounting member, and means for locking said last named means in a desired position, the optical axis of the combined collimating lens and light refractors in the locked positions of the light refractors coinciding with the geometrical axis of the collimating lens and with the reference point of the corresponding typographical character as well as with the main optical axis of the system.

8. In a photocomposing machine having a phototypographical font in which each character is located with respect to a reference point according to the typography of the character and in which the reference point for each character is spaced one from another a predetermined distance, an optical system to project images of selected characters at a common position for recording on a sensitized sheet, one at a time, for line composition, said optical system including a plurality of fixed collimating lenses, one for each character of the font, means for mounting said lenses, said means having a plurality of apertures, at least one for each lens, in which the individual collimating lenses are rigidly secured, said apertures being spaced one from another a predetermined distance corresponding to the spacing of the reference points of the phototypographical font, a pair of light refractors associated with each lens of said plurality, and means for supporting said light refractors for rotatable motion whereby each refractor may be independently rotated to cause the optical axis of each single collimating lens and its associated light refractors to coincide with the reference point of the corresponding character as well as with the main optical axis of the whole system.

9. In a photocomposing machine having a phototypographical font in which each character is located with respect to a reference point according to the typography of the character and in which the reference point for each character is spaced one from another a predetermined distance, an optical system to project images of selected characters at a common position for recording on a sensitized sheet one at a time in line composition, said optical system including a plurality of collimating lenses, one for each character of the font, means for mounting said collimating lenses, said means having a plurality of apertures, at least one for each lens, in which the individual lenses are rigidly secured, said apertures being spaced one from another a predetermined distance corresponding to the spacing of the reference points of the phototypographical font, a pair of light refractors associated with each collimating lens of said plurality, means for supporting said light refractors for rotatable motion whereby each element may be independently adjusted to cause the optical axis of each single collimating lens and its associated light refractors to coincide with the geometrical axis of said collimating lens, and means for locking the light refractors associated with each collimating lens in their adjusted positions.

10. In a photocomposing machine having a phototypographical font in which each character is located with respect to a reference point according to the typography of the character and in which the reference point for each character is spaced one from another a predetermined distance, a lens system to project images of selected characters at a common position for recording on a sensitized sheet, one at a time, for line composition, said optical system including a plurality of col-

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limating lenses, one for each character of the font, means for mounting said lenses, said means having a plurality of apertures, at least one for each lens, in which the individual lenses are rigidly secured, said apertures being spaced one from another a predetermined distance corresponding to the spacing of the reference points of the phototypographical font, a pair of light refractors associated with each collimating lens of said plurality, means for supporting one refractor of each pair of light refractors on one side of said collimating lens mounting means, means for supporting the remaining light refractor of each pair of light refractors on the other side of said collimating lens mounting means, adjusting means associated with each light refractor whereby said refractor may be independently rotated relative to its associated collimating lens to cause the optical axis of the

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combined collimating lens and light refractors to coincide with the geometrical axis of the collimating lens, and means for locking each such adjusting means in its adjusted position.

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