United States Patent

[11] 3,563,147

[72] Inventor **Roger L. De Montebello**
165 E.66th St., New York, N.Y. 10021

[21] Appl. No. **674,440**
[22] Filed **Oct. 11, 1967**
[45] Patented **Feb. 16, 1971**

[54] **MASTER CAMERA FOR PRODUCING COMPONENTS FOR INTEGRAL PHOTOGRAPHY**
7 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **95/18,** 355/53, 95/36
[51] **Int. Cl.** **G03b 35/00**
[50] **Field of Search** 355/40, 53, 86, 95; 95/18P, 36, 37

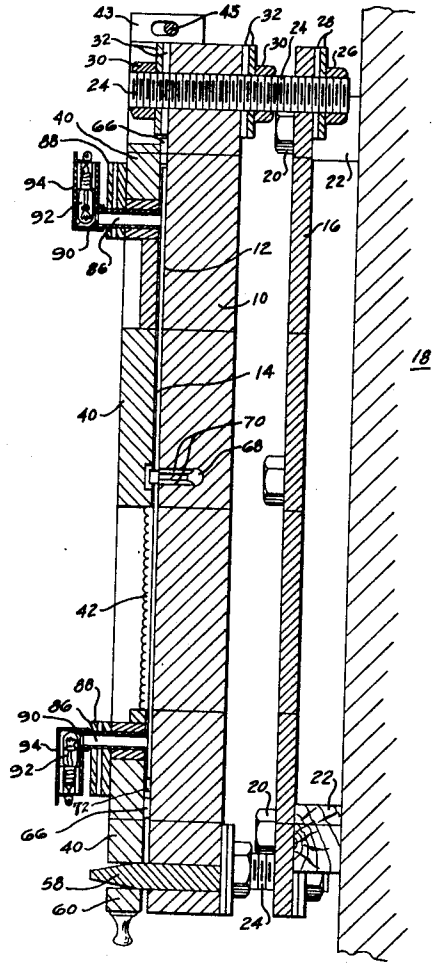
[56] **References Cited**

UNITED STATES PATENTS

2,382,988	8/1945	Garraway	355/19
1,846,972	2/1932	Koppe	355/53
2,622,472	12/1952	Bonnet	95/18P
2,643,187	6/1953	Linzell	355/40X
2,974,579	3/1961	Echelson	355/95
3,214,309	10/1965	Di Leo	355/86X
3,267,826	8/1966	Browning	95/18P

Primary Examiner—John M. Horan
Attorney—Morgan, Finnegan, Durham & Pine

ABSTRACT: The present invention provides a camera and process for the production of precision components for use in the process of integral photography in which the lenslets of a lenticular sheet have apertured diaphragm sheets and/or apertured field-limiting sheets forming part of the lens system, the apertures being uniformly arranged in square, or more preferably hexagonal array. The camera also includes means for providing a negative to be exposed therein with accurate registering indices which serve to locate the negative and its derivatives so that all apertures as may be accurately coaxially registered with other apertures as well as with the lenslets of the lenticular sheet with which they are to be used.



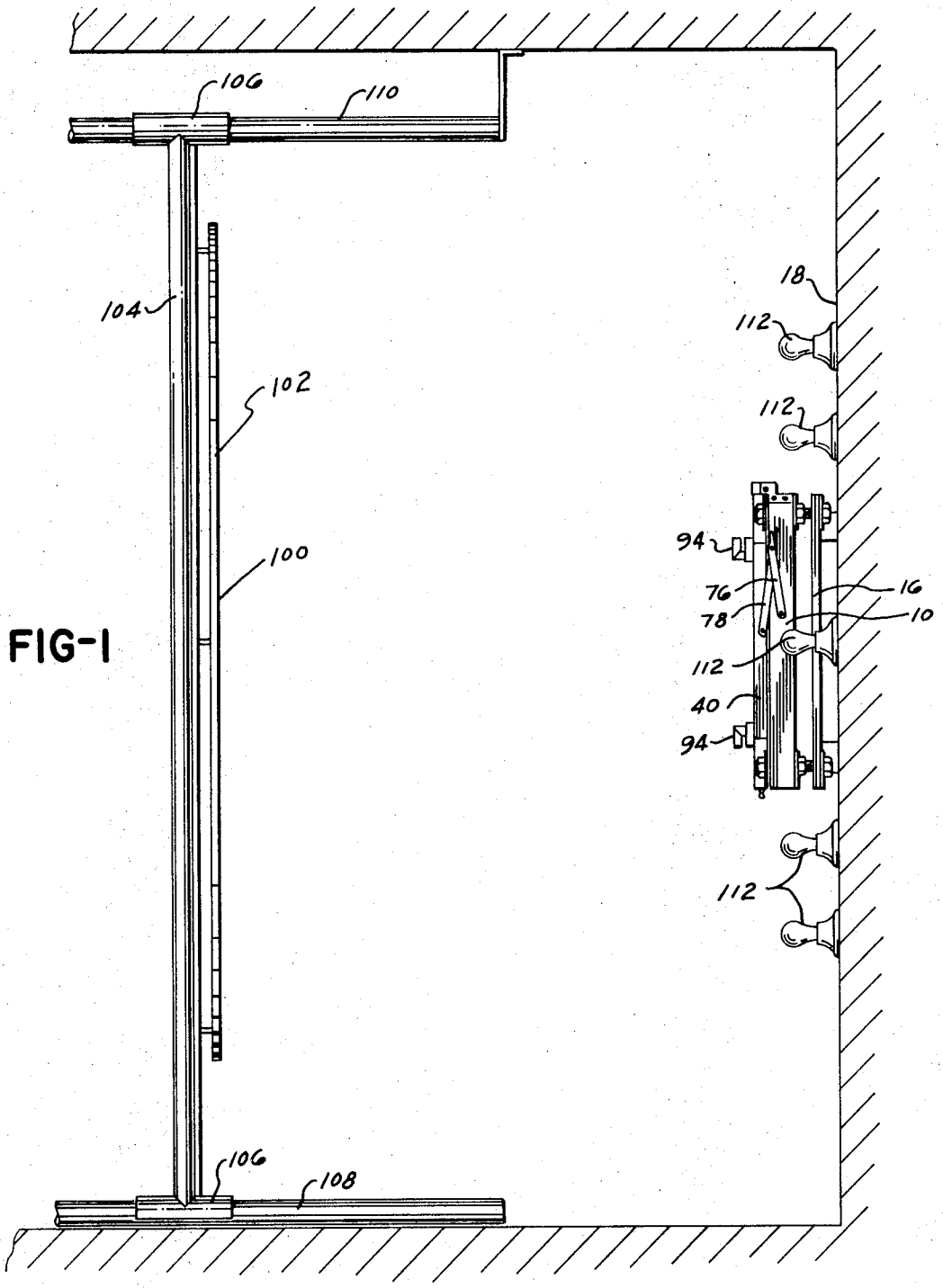


FIG-1

INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

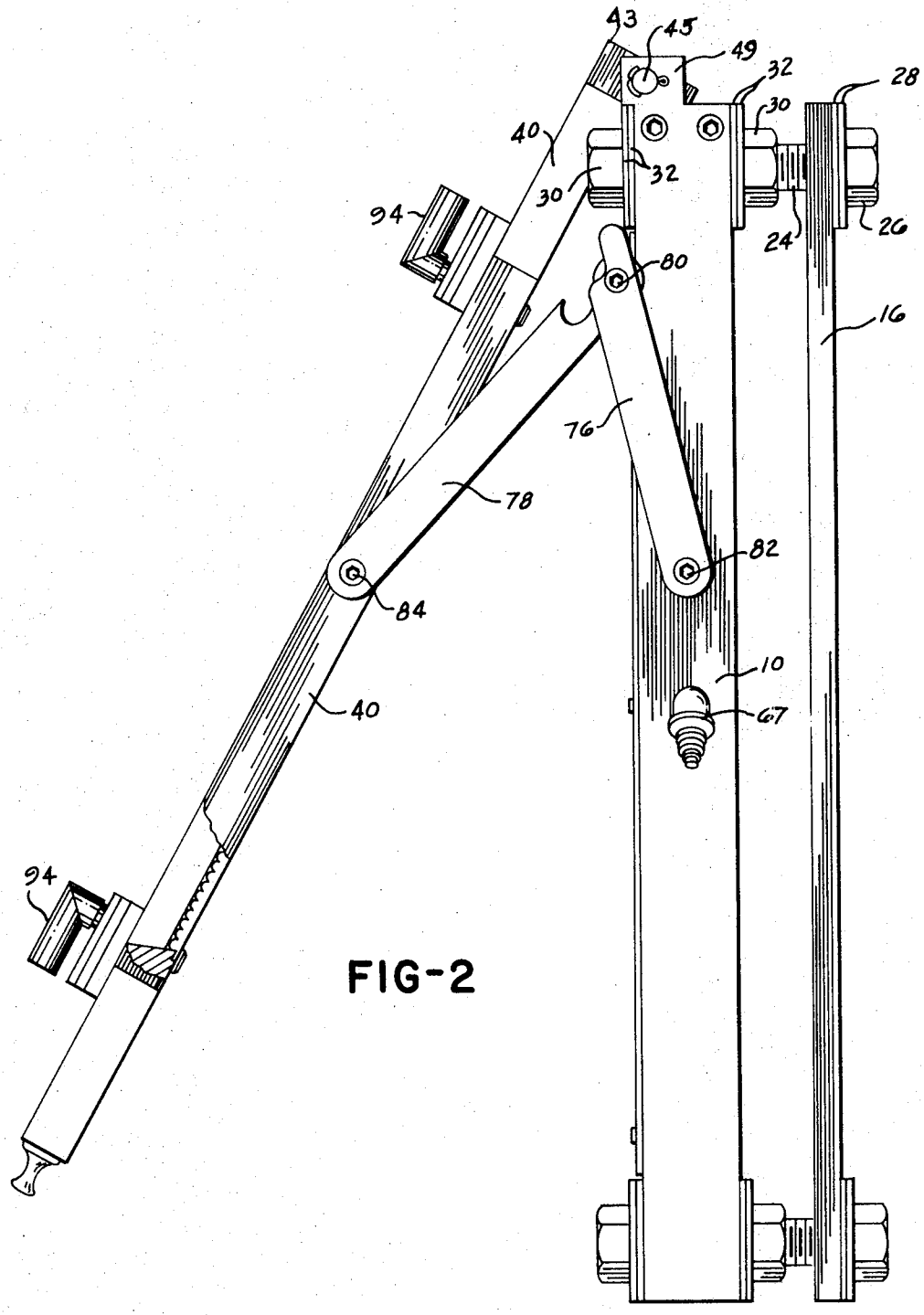


FIG-2

INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

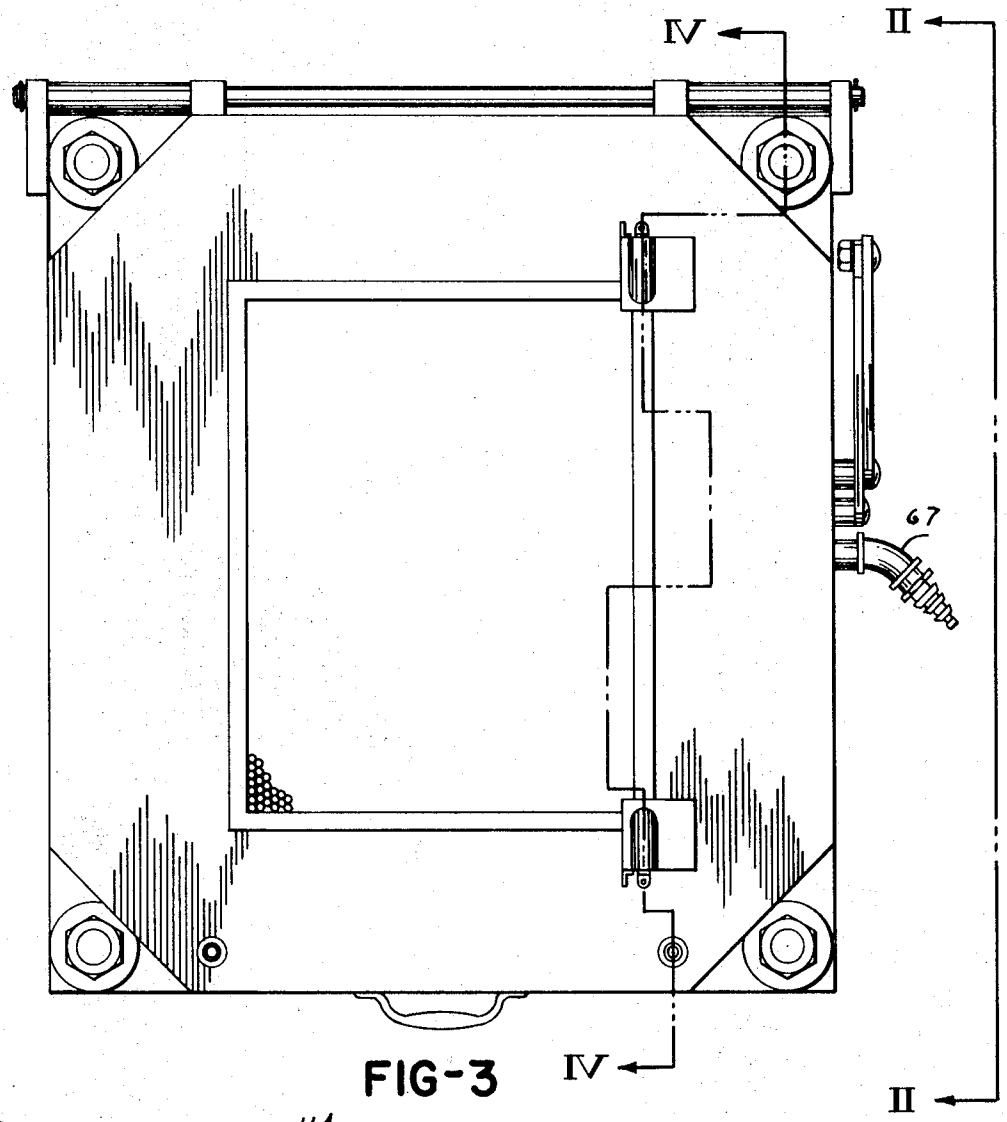


FIG-3

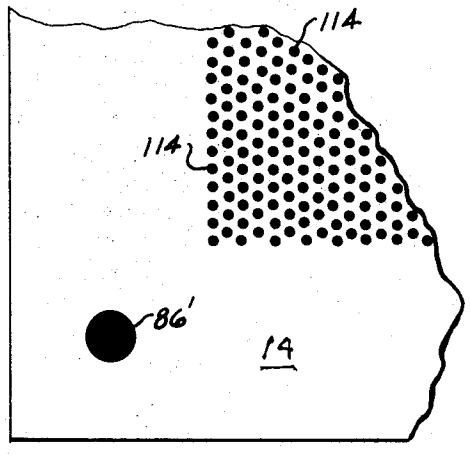


FIG-11

INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

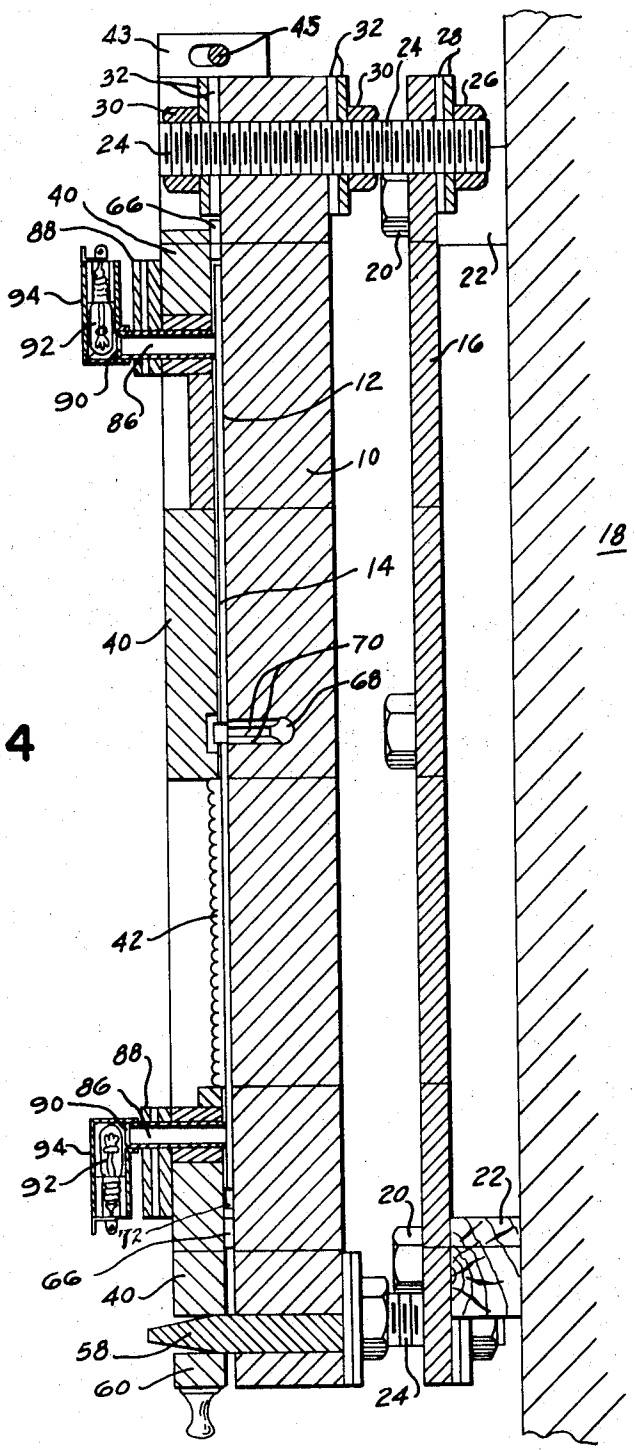
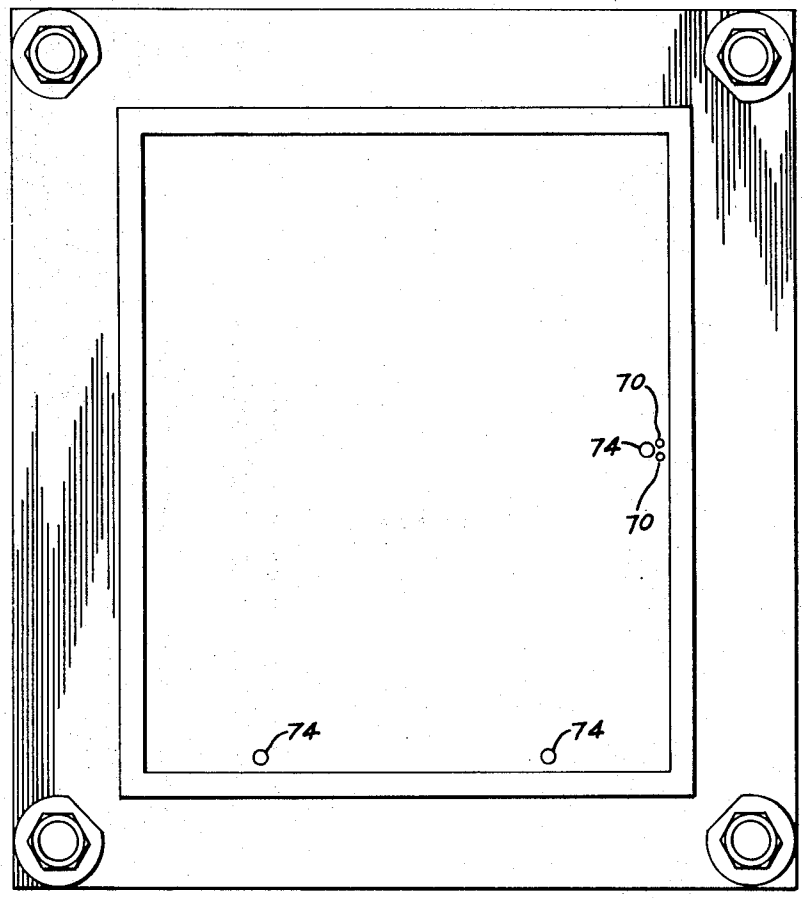


FIG-4

INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

FIG-5



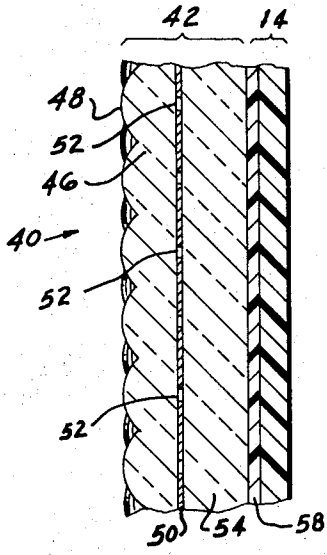


FIG-6

INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

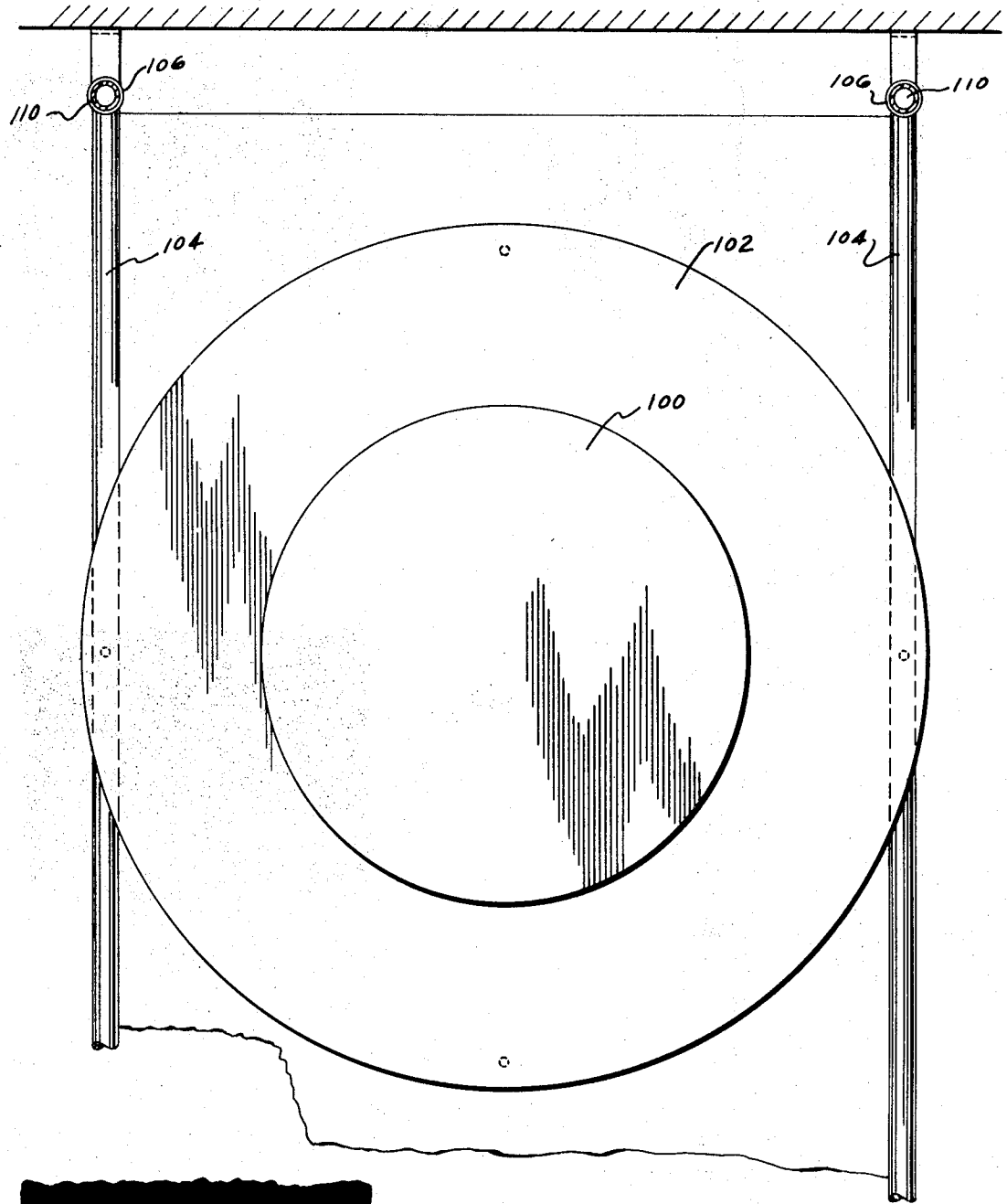


FIG-7

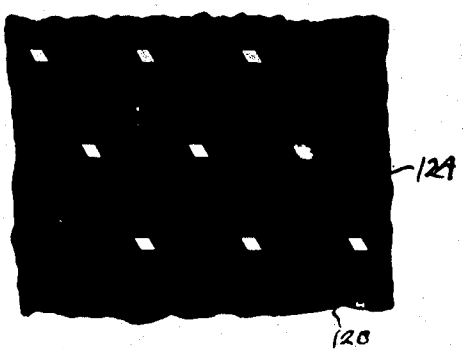


FIG-12

INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

FIG-9

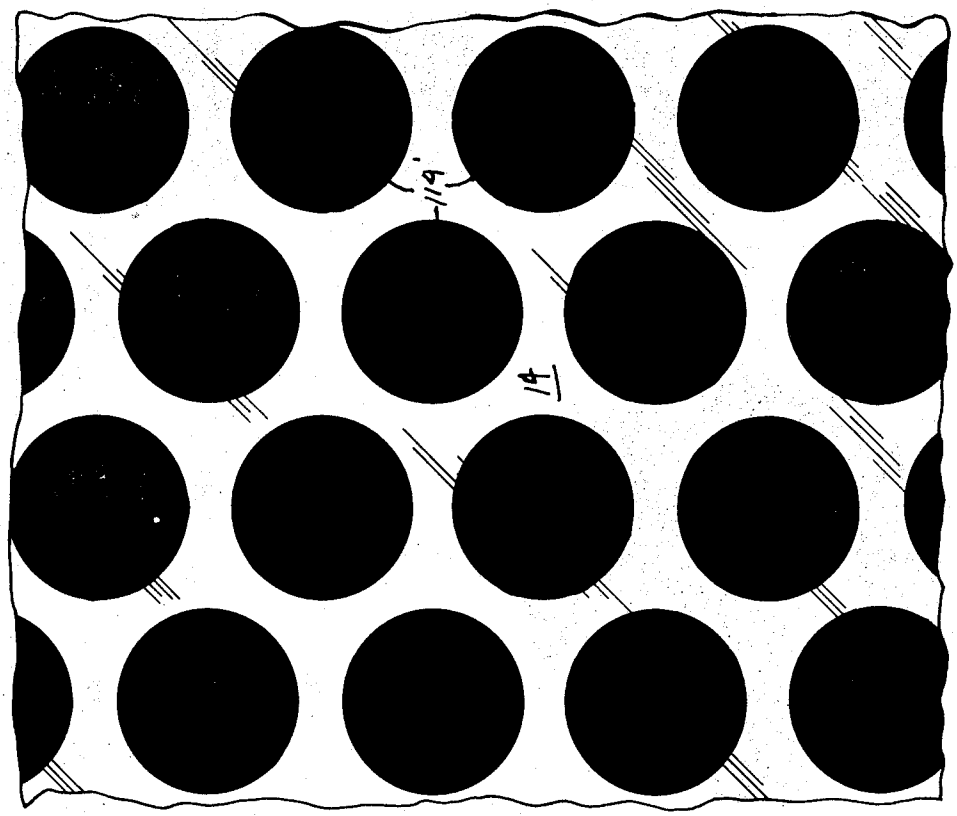
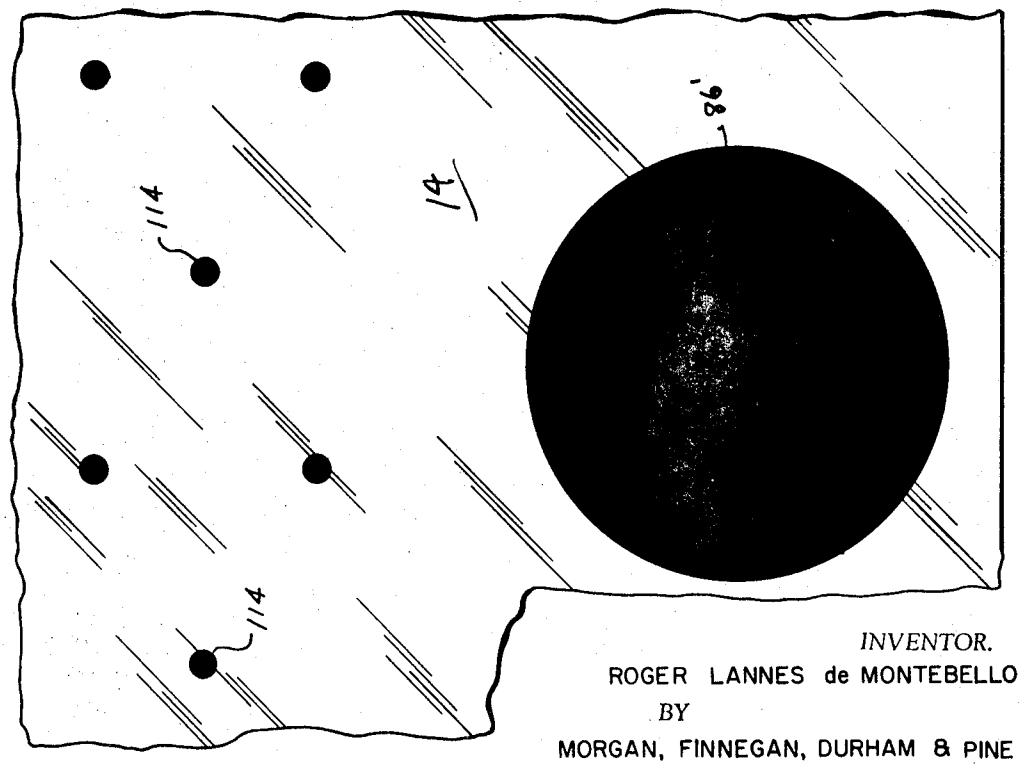
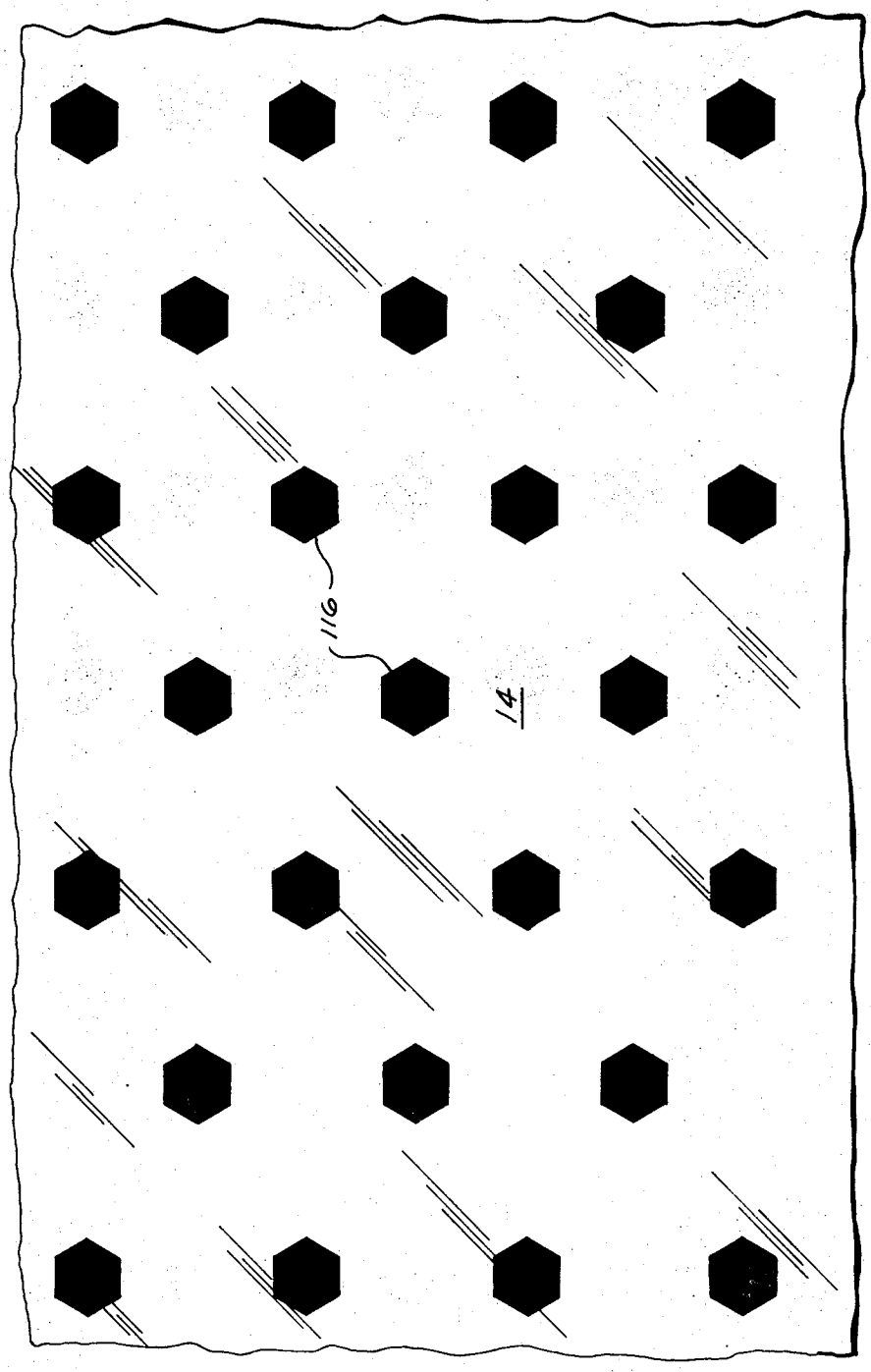


FIG-8



INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

FIG-10



INVENTOR.
ROGER LANNES de MONTEBELLO
BY
MORGAN, FINNEGAN, DURHAM & PINE
ATTORNEYS

MASTER CAMERA FOR PRODUCING COMPONENTS FOR INTEGRAL PHOTOGRAPHY

BACKGROUND OF THE INVENTION

In the making of integral photograms it is desirable and sometimes essential to supply opaque, usually metallic, sheets which are provided over their surface with a large number of uniformly spaced, regularly arranged apertures or transparent areas to serve illustratively as an apertured diaphragm sheet, an apertured field-limiting sheet, a member for locating molding elements to form a particular mold for forming a lenticular sheet, or as a supporting member for holding an embossed photographic material in a predetermined relation with a lenticular sheet. It is also of great importance that each of the apertured sheets and elements derived from them be capable of being accurately registered with each other so that the apertures may be coaxially registered with others on a different sheet or with lenslets of one or more lenticular sheets. Also, it is important that provision be made for producing apertures which are of the same size over the entire sheet and uniformly positioned with respect to registering indices, and that provision be made for widely varying the size of these apertures from sheet to sheet while maintaining their uniform spacing, preferably as a hexagonal array.

SUMMARY OF THE INVENTION

The camera of the present invention includes a base member for supporting a photographic plate or stable base film (hereinafter referred to as "plate"), a removable lenticular sheet having a large number of closely-packed small lenslets, preferably in hexagonal array and of uniform focal length, which are adapted to focus images of a target member on the radiation sensitive plate supported on the base member. Means are provided for initially bringing the lenticular sheet into proximity to the plate, and means (preferably vacuum means) are provided for bringing the rear face of the lenticular sheet into firm, uniform contact with the face of the plate, so that the lenticular sheet is held flat and the plate substantially in the focal plane of the lenslets of the lenticular sheet. For providing the plate, adjacent its margins, with accurately located indices or registering marks, the frame holding the lenticular sheet is provided with two or more widely spaced illuminated members, slidably movable toward and away from the surface of the plate, and adapted to be brought into firm contact with the face of the plate as suction is applied to the space between the lenticular sheet and the plate, the illuminated members also being moved toward the face of the plate, preferably by the applied suction, or less desirably by spring tension.

In front of the lenticular sheet of the camera is a copyholder adapted to support a circular or regular hexagonal target held accurately parallel to and centered on the lenticular sheet and sensitive plate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation of a preferred embodiment of the invention;

FIG. **2** is a fragmentary, detailed side elevation of the camera showing it in loading position;

FIG. **3** is a fragmentary, detailed front elevation of portions of the camera;

FIG. **4** is a sectional view taken on the irregular line **4–4** of FIG. **3**;

FIG. **5** is a front elevation of the back portion of the camera, with certain parts removed;

FIG. **6** is a fragmentary, detailed sectional view of a preferred form of lenticular sheet used in the preferred embodiment of the invention;

FIG. **7** is a fragmentary front elevation of the copyboard with a target or object to be copied in place;

FIG. **8** is a fragmentary, greatly enlarged plan view of a photographic negative produced according to the present invention;

FIG. **9** is a similar smaller, fragmentary view of a negative produced from a different target or copy;

FIG. **10** is a similar fragmentary view of a negative produced from a hexagonal target;

FIG. **11** is a fragmentary view on a still smaller, but enlarged scale, of a negative showing a typical relation of the dots and a register index to the edges of the negative at one corner thereof; and

FIG. **12** is a fragmentary plan view of a portion of an image-forming screen, on an enlarged scale, which screen may be used as a substitute for the lenticular sheet shown in FIG. **6**.

The foregoing general description and the following detailed description as well as exemplary and explanatory of the invention but are not restrictive thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The camera of the present invention according to the preferred and illustrative embodiment of the invention, comprises a rigid backing member **10**, having a flat front surface **12** on which a photographic plate **14** may be supported to be exposed.

The camera is rigidly mounted as on metal plate **16** which may be mounted in a permanent manner on a wall **18**. Plate **16** is rigidly mounted on wall **18** by means of lug screws **20** and spacing blocks **22**. Backing member **10** is adjustably spaced from the plate **16** by means of a plurality of widely spaced threaded members **24** which are threaded into plate **16** and are slidable within bore holes in the backing member **10**. Threaded member **24** is firmly held in plate **16** by means of a jam nut **26** and washers **28**, while the backing member **10** is positioned by means of the members **24**, their jam nuts **30** and washers **32**.

A frame member **40** carrying a lenticular sheet **42** is mounted in front of the backing member **10** so that the lenticular sheet **42** may be moved into and out of contact with the sheet or plate **14**.

The frame member **40** is an open rectangular frame having extension brackets **43** at its upper ends, which are pivotally mounted by pin and slot connections **45** to brackets **49** extending upwardly from the upper portion of the backing member **10**, so that the lenticular sheet **42** may be moved adjacent the plate **14** or to a position remote therefrom.

In the illustrative embodiment, the frame **40** carries the lenticular sheet **42**.

The lenticular sheet **42** comprises a multiplicity of minute lenslets **48** having spherically convex front surfaces to focus images of the copy on the surface of the plate member **14**.

Frame **40** is located with respect to the backing member by means of locating pins **58** which extend forwardly from the lower edge of member **10** and are adapted to pass through fitting apertures **60** at the lower edge of frame **40**, thus providing a coarse, approximate location of the lenticular sheet **42** with respect to plate **14**.

Lenticular sheet **42** preferably comprises a multiplicity of positive lenslets, each having a substantially spherical face **48**, with the lenslets all of equal focal length. The lenticular sheet is preferably formed of a clear, transparent plastic resin, such as polyester resin. While the lenslets may be of almost any size, depending upon the use of the resulting product, a usual size is is that the lenslets in hexagonal array have their centers spaced about three thirty-seconds inch from each other. The same preferred spacing would apply to the lenslets arranged in a square array.

Each of the lenslets of the lenticular sheet **42** used in carrying out the present invention is preferably provided with a diaphragm aperture to improve the quality of the image formed by the lenslet and to confer rigidity to the sheet and prevent dimensional changes between "takes." Such diaphragm aperture sheets may be prepared from an image produced by the present camera, but the initial lenticular sheet may be used even without such diaphragm apertures, especially where high contrast plates are used and provided that the lenticular sheet is dimensionally stable.

In closed position for exposing the plate **14**, a sealing gasket **66** is provided between the frame **40** and the backing member **10**, so that the space between the lenticular sheet **42** and the plate **14** and backing member may be subjected to suction to bring the back face of the lenticular sheet **42**, the plate **14** and the backing member **10** into firm flat contact, the flatness being provided by the backing member.

Means are provided for applying suction to the space between the lenslet sheet **42** and the backing plate **10**, and comprise the suction connection **67** which is connected by a passage **68** which communicates with apertures **70** on the edge of the surface of the backing member, communicating with the space **72** surrounding the edges of plate **14** to allow air to flow from the plate area to the suction connection **67**, so as to draw the lenticular sheet **42** into firm contact with the plate **14** and against the flat face **12** of the backing member **10**.

Toggle bracket means are provided for holding the frame **40** and the lenticular sheet **42** in raised position while the plate **14** is positioned against the face **12** of the backing member. The backing member **10** is provided with three plate locating pins **74** extending slightly above the face **12** and serving to engage two adjacent edges of the plate **14** so that it may be properly located on the backing member.

The toggle bracket means comprise a link **76** pivotally connected to link **78** by pivot bolt **80**. Link **76** is pivotally mounted by cap screw **82** on an edge of the base member **10**, while link **78** is pivotally mounted on an edge of frame **40** by means of cap screw **84**.

At least two widely spaced points in the frame **40** and overlying the margins of the plate **14**, are provided means for exposing the plate in limited areas to form register index marks on the plate, to be revealed as the plate is developed, and forming register indices which may be carried by the plate throughout all subsequent uses of the exposed and processed plate. In the two widely spaced places, frame **40** is provided with bores in which are slidably mounted metal tubes **86** having an inner chamfered end adapted to be seated on the face of the plate **14**. A portion of the tube **86** is mounted in an aperture in a block **88**. At its outer end, each tube **86** is provided with an airtight sealing disc **90** which is a translucent, light diffusing member, in front of which is mounted a small light bulb, in a housing **94**, so that the light from each lamp **92**, confined by the inner end of tube **86** exposes the plate **14** near its margin thus forming an exposed circle or large dot.

As suction is applied to the plate **14**, the tubes **86** are forced towards the surface of the plate **14** so that clean, sharp images of the tubes **86** are formed to serve as register indices in the further use of the plate **14** in making apertured sheets where these indices will be converted by etching using a photomechanical resist into holes to register the apertured sheets with each other on pins regardless of the size or shape of the apertures in the respective sheets.

The master camera is focused upon a target or copy object the image of which is to be focused upon the plate **14** by each of the lenslets of the lenticular sheet. The copy or target **100** is mounted on a copyboard **102**, parallel to and centered on the surface of the plate **14**, and spaced at the desired distance from the lenticular sheet, depending upon the image size and/or pitch required. The target **100** preferably comprises a circular piece of matte white cardboard, or a regular geometrical figure, such as a hexagon, while the copyboard **102** is preferably black.

The copyboard **102** is supported on a pair of upright members **104** which are mounted for slidable movement by means of sleeves **106** movable along the rails **108** and **110** supported on the floor or ceiling of the camera room.

The target **100** is illuminated for photographing by means of a circularly arranged series of lamps **112** uniformly spaced around the camera and preferably mounted on the wall **18**. The exposure is controlled by the switching on and off of the lamps, the room otherwise remaining safe lighted while the plate **14** is in the camera.

The size of the images formed by the lenslets of the target **100** may be varied widely from minute to relatively large dots all in the same positions with respect to each other and with respect to the register indices, regardless of the size of the dots.

The pitch between images is controlled by the distance of the target; and the size of the images formed by the lenslets is controlled by the size of the target. In addition, and considering that the minimum target distance is effectively equivalent to infinity relative to the lens size, the edge of a very small target will be imaged near the axis of each lenslet at a distance from the lenslets' principal point which is a function of the refractive index of the material, as is well known. However, the edge of a very large target will be imaged relatively far from the axis and therefore the path of the marginal rays forming the image of this edge will be longer, the larger the target. Since good focus is obtained at a given distance because the object is effectively at infinity the thickness of the lenticular sheet must be modified depending upon the size of the target. For this purpose the sheet is made to correspond to the largest possible target size requirements. For smaller target sizes, compensating clear sheets are added between the lenticular sheet and the emulsion of the plate **14**, and the target distance is modified so that its ratio to the image distance from the principal point of the lenslet remains constant. In this way the pitch remains constant. Finally, a relatively small adjustment in target size will compensate for the added or reduced target distance.

FIG. **8** illustrates on a greatly enlarged scale a negative produced by the camera of the present invention when photographing a circular target much smaller than **100**. As shown, the exposed and developed plate **14** is covered over most of its surface with an array of circular dots **114** arranged in a hexagonal pattern. These dots are of uniform size and like the lenslets, are arranged in a hexagonal pattern. Near one edge of the plate **14** is shown one of the index marks **86'** formed by one of the illuminated tubes **86**.

FIG. **9** is a plan view, on a greatly enlarged scale, of a central portion of an exposed and developed plate **14** in which the array of opaque dots **114'** are of relatively enlarged size.

FIG. **10** is a plan view of a negative on which are produced an array of hexagonal dots **116** produced by photographing a hexagonal target.

In each instance, the negatives include two or more register indices **86'** near an edge thereof, and preferably near an edge of the plate and outside of the field of the array of dots **114**, **114'** or **116**.

Thus, when the negative is reproduced in any of the subsequent reproductions of the negative, the dots in the negative are accurately registered with respect to the register indices **86'**.

The register indices **86'** control the subsequent use of the negative, regardless of the size of the dots **114**, **114'** or **116**, and enable the dots of one negative to be accurately registered coaxially with the dots of different size or shape on another negative produced in the same camera and with the same lenticular sheet **42**. Usually, the register indices **86'** serve to produce etched and/or electroformed apertures which may be engaged by register pins as various reproductions of the negative are assembled in a multilayer structure, as shown in FIG. **6**.

Other means than the lenticular sheet **42** may be provided as an image forming array of light passageways. One such alternative sheet may comprise a flat screen **120** (FIG. **12**) having uniform small transparent apertures arranged in a hexagonal array on an otherwise opaque field **124**, each of the apertures acting as in a pinhole camera to form an image on the photographic plate **14** against which the screen is mounted, with the apertures uniformly spaced from the sensitive surface of the plate **14**.

Preferably, the screen is formed similarly to a Levy halftone screen by two ruled sheets of glass each having relatively wide opaque lines parallel with and uniformly spaced from each

other, being separated by clear, transparent lines. While the width of the opaque and clear lines may vary widely, the opaque lines should be many times the width of the clear lines, usually about 9 or 10 times their width. Thus, the clear lines may each be about 0.010 inch in width while the opaque lines may each be about 0.100 inch in width, and each of the glass sheets forming the screen may be about 0.100 inch in thickness.

To form the hexagonal array of image forming elements, the two ruled glass sheets are placed with their ruled faces in contact with each other and with the rulings on one glass sheet extending at 60° to the rulings on the facing glass sheet. With the ruled glass sheets in this position, the sheets are bound together around their edges, thus providing an array of small, uniform, diamond shaped, image forming elements, each about 0.011 inch across or less, uniformly distributed over the entire area of the screen.

When positioned in the camera, in place of the lenticular sheet **42**, each of the clear spaces in the screen, spaced from the face of the plate **14**, forms an image of the target to produce a negative as shown in FIG. **8** or **9**, depending on the shape of the target **100**.

The invention in its broader aspects is not limited to the specific steps, processes, and mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

I claim:

1. A camera for producing a screen pattern with marginal register marks on a photographic plate comprising a plate supporting base member, a frame member to be moved toward and away from the plate, a sheet having an array of individual image-forming light passageways carried by the frame and to be brought into contact with the plate, means for forcing the photographic plate against the image-forming array sheet, and means on the frame to expose relatively small index marks spaced a fixed distance from each other and having fixed positions relative to the array contact with the plate, means for applying suction to the space between the plate holding base member and the lenticular sheet, means on the frame to expose relatively small index marks spaced a fixed distance from each other and having fixed positions relative to the array sheet upon an edge of the plate to provide register means thereon for the images formed by the array.

2. A camera for producing a screen pattern with marginal register marks on a photographic plate comprising a plate supporting base member, a frame member to be moved toward and away from the plate, a sheet having an image-forming array of light passageways carried by the frame and to be brought into sheet upon an edge of the plate to provide register means thereon for the images formed by the array.

3. A camera according to claim **2** in which the means to expose the index marks comprises illuminated tubes slidably carried by the frame and having their inner ends engageable with the surface of the plate, said tubes being subject to the suction, whereby the tubes are seated against the plate when suction is applied.

4. A camera according to claim **2** in which the light passageways are lenslets of the same focal length.

5. A camera according to claim **4** in which each light passageway is a lenslet provided with a diaphragm aperture at its principal point.

6. A camera according to claim **2** in which the light passageways are regularly spaced clear areas formed by two ruled screens in contact with each other.

7. A process for producing a screen pattern of a target on a set of photographic plates using a lens system having an array of individual image-forming light passageways carried by a frame and adapted to contact the surface of successive photographic plates, which comprises providing fixed means for exposing by contact the successive plates to fixed, widely spaced, register means adjacent the periphery of said plates, varying the size of the target or the distance of the target from the lens array and varying the distance of the plates from the lens array while maintaining the ratio of the distance of the target from the lens array to the distance of the plates from the lens array constant as the target size is varied, the target size being increased or decreased as the distances are respectively decreased or increased, whereby the pitch is accurately preserved while the size of the images is varied.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,563,147 Dated February 16, 1971

Inventor(s) Roger L. de Montebello

It is certified that error appears in the above-identified pate and that said Letters Patent are hereby corrected as shown below:

Title page, Inventor's Name "Roger L. De Montebello" shoul --Roger L. de Montebello--. Abstract, line 10 after "apertures" del "as". Column 2, line 1 after "similar" delete "smaller"; line 13 af "as well" delete "as" and insert --are--; line 62 after "is" delete Column 3, line 30 after "At" insert --at--. Column 5, line 39 after "array" delete "contact with the plate, means for applying suction t space between the plate holding base member and the lenticular sheet means on the frame to expose relatively small index marks spaced a f distance from each other and having fixed positions relative to the sheet upon an edge of the plate to provide register means thereon fo images formed by the array" and insert --sheet upon an edge of the p to provide register means thereon for the images formed by the array Column 6, line 11 after "into" delete "sheet upon an edge of the pla provide register means thereon for the images formed by the array" a insert --contact with the plate, means for applying suction to the s between the plate holding base member and the lenticular sheet, mean the frame to expose relatively small index marks spaced a fixed dist from each other and having fixed positions relative to the plate to vide register means thereon for the images formed by the array--.

Signed and sealed this 29th day of August 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Pate

FORM PO-1050 (10-69)