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(54) METHOD OF, AND APPARATUS FOR, OPTICALLY PROJECTING A PATTERN OF SUBSTANTIALLY CIRCULAR APERTURES ONTO A PHOTSENSITIVE LAYER

(71) We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED, of Abacus House, 33, Gutter Lane, London, E.C.2., a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 THIS INVENTION relates to a method of, and apparatus for, optically projecting a pattern of substantially circular apertures by means of a lamp onto a photosensitive layer present on a support.

15 Such a method may be used in the manufacture of colour image display screens for cathode-ray tubes, in which a pattern of substantially circular apertures in a mask is optically projected onto a photosensitive binder layer provided on a support, usually the viewing window of the cathode-ray tube. This hardens certain parts of the binder layer and enables substances which luminesce in different colours upon excitation by electrons to be provided successively on the window. The luminescent substance may either already be present in the binder layer or may be caused afterwards to adhere to the hardened parts. In either case patterns of phosphor dots for each colour are ultimately formed.

20 During operation of the cathode-ray tube, a number of electron beams is produced which corresponds to the number of differently luminescing substances. Due to the presence of the (shadow) mask in the tube, each beam impinges on only one of the luminescent substances; the parts of each beam which would impinge on the other substances are intercepted by the mask. Although the same mask is used during the provision of the dots as during the operation of the tube, the impact areas of each beam on the corresponding dots are usually required, in practice, to be smaller than the actual dots. The dots are made larger than the impact areas because it is not possible to cause the centres of the impact areas

to coincide with the centres of the dots over the whole display screen. Because of the larger dots the corresponding luminescent substance will then be energized even if the impact areas are not exactly centred on the dots. This implies that, during the optical projection of the substantially circular apertures in the mask onto the photosensitive binder layer, the resulting hardened parts of the binder layer should be larger than the apertures in the mask, (which latter determine the size of the impact areas). Such an enlargement of the hardened parts occurs naturally be penumbral effects and because the light is scattered in the binder layer especially if the luminescent substance is already present in the binder layer, as is usual.

During operation of such a cathode-ray tube, which usually comprises three differently luminescent substances (red, green and blue), other colours are displayed by varying the relative contributions of the three luminescent substances by controlling the intensity of the relevant electron beams. The cross-sectional area of each electron beam passed by the mask determines the sizes of the resulting luminescing surface areas of the screen.

During said optical exposure the effective emissive area of the lamp used therefor has an effect on which parts of the binder are hardened. (Such an effective emissive area may be, for example, the filament of a filament lamp or that part of the discharge lamp in which the discharge actually takes place, i.e. that part of the discharge space of a gas discharge tube which coincides with the arc). A gas discharge lamp is usually particularly suitable for hardening a binder layer because of its spectral energy distribution and the intensity thereof. If a substantially circular aperture is optically projected onto a photosensitive binder layer, a substantially circular part of the binder layer will theoretically be hardened only if a point light source or at least a substantially rotationally symmetrical light source is used. Since the arc of a gas

[Price 25p]

Price 75p

5 discharge tube tends to be ribbon-shaped, it is
usual to incorporate, between the lamp and
the binder layer, a conical element the
vertex of which points towards the layer, and
the base of which points towards the lamp.
10 Part of the light entering the base of the cone
is concentrated at the vertex by reflection
at the walls of the cone; the vertex of the
cone then serves effectively as a light source
and its shape determines the shape of the
effective source. One of the drawbacks of
15 using such a conical element is that its optical
efficiency tend to be low since absorption of
light will occur therein and part of the light
may leave the cone via its walls. As a result
of this the required exposure time tends to
be rather long.

20 A correction lens is normally also provided
between the light source and the binder layer,
so as to ensure that the centres of the hardened
parts coincide as accurately as possible with
the centres of the impact areas during opera-
tion of the tube. As has already been men-
tioned, complete coincidence of said centres
25 over the whole display screen cannot be
realised in practice.

It is known to separate the phosphor dots
by a light-absorbing material. A picture dis-
30 play screen constructed in this manner has
the advantage that the same contrast can be
obtained without tinting the window glass, or
at least with a substantial reduction in the
tinting normally employed. As a result of
35 this the observed brightness of the display is
increased. Such a display screen is described
in United States Patent Specification No.
3,146,368. An additional feature of this dis-
closure is that the apertures in the mask are
40 larger than the apertures in the light-absorb-
ing material in which the phosphor dots are
situated. During operation of the tube with
the same potential on the mask and the display
screen, the impact areas of the electron beams
45 are larger than the corresponding phosphor
dots. Part of the cross-section of a given
electron beam passing through a given aper-
ture in the mask impinges upon the associated
phosphor dot, while the remainder impinges
upon the light-absorbing material around the
50 dot. In contrast with the cathode-ray tube
previously described, the size of the phos-
phor dots, rather than the size of the impact
areas now determines the size of each
luminescing surface area.

55 A layer of light-absorbing material may be
manufactured in various ways, and it may be
provided either prior to or after the lumines-
cent substances are provided. If the light-
absorbing layer is provided first, which is to
60 be preferred, a layer of the light-absorbing
substance has to be formed on the support
with apertures where the luminescent sub-
stances are to be stuck to the support after-
wards. In this case the apertures in the light-
65 absorbing layer determine which parts of the

phosphor dots lie directly on the support
and hence are capable of contributing to the
display of a picture. Since in the tube dis-
closed in the aforesaid Specification the effec-
70 tive size of a phosphor dot determines the
size of the area which will luminesce in oper-
ation, the size of the apertures in the light-
absorbing layer determines the size of the
luminescing surface area in the present case.
75 The apertured light-absorbing layer should
therefore be provided with very great care.

The fact that the apertures in the mask of
the tube disclosed in the aforesaid Specifica-
tion are larger than the effective sizes of the
phosphor dots implies that the mask aper-
80 tures are larger than the apertures in the light-
absorbing layer. The apertured light-absorb-
ing layer is said to be obtained by means
of a photographic process, by optically pro-
jecting the pattern of substantially circular
apertures in the mask onto a photosensitive
85 binder layer present on the tube window. If
three luminescent substances are to be pro-
vided this must be carried out three times.
Said Specification says little regarding the
realisation of apertures in the light-absorbing
layer which are smaller than the apertures in
the mask. It simply says that the size of
the light source is chosen to be such that a
90 suitable size of the exposed area can be ob-
tained by controlling the exposure time, taking
into account penumbral effects which are
known in photographic engraving technology.

95 An apertured light-absorbing layer can be
manufactured by optically projecting a pattern
of substantially circular apertures in a mask
onto a photosensitive binder layer present
on a support, in various ways. One way is to
use a photosensitive binder which has the
property that a sufficiently exposed part
100 thereof is soluble in a given solvent in which
an insufficiently exposed part is not soluble.
The light-absorbing layer is formed at the
parts of the binder layer which are insuffi-
ciently exposed, by sticking a light-absorbing
substance to those parts. Another way is to
use a photosensitive binder which has the pro-
105 perty that a sufficiently exposed part there-
of is insoluble in a given solvent in which
parts which are insufficiently exposed are soluble.
The binder layer is then hardened by exposure
where the apertures should be present in the
light-absorbing layer, after which the parts
which are insufficiently exposed are dissolved.
110 Hardened binder dots are left on the sup-
port where the apertures should be present
in the light-absorbing layer. A suspension of
a light-absorbing substance is then provided
on the support which carries the hardener
115 binder dots, this substance readily adhering
to the uncovered parts of the support and
possible also to the hardened binder dots. The
hardened binder dots are then chemically re-
120 moved together with the light-absorbing sub-

stance present thereon, to leave an apertured light-absorbing layer.

The "Journal of the Society of Motion Picture and Television Engineers" Vol. 65, No. 8, August 1956, pages 407 to 410 discloses that during the optical projection of a substantially circular aperture onto a binder layer present on a support, the size of the sufficiently exposed surface depends upon the dimensions of and the distribution of the light from the light source used therefor, penumbral effects product a gradual transition from a part exposed to the complete light source to an unexposed part. When a circular light source is used, the size of the part exposed to the complete light source decreases with increasing diameter of the light source, a transition region which is exposed to an ever decreasing part of the light source being present around the part exposed to the complete source. A pyramid-like intensity distribution is produced behind the aperture.

The desired hardening can be obtained for a given part of the binder layer by controlling the exposure time with a given intensity from the light source. In order to realise a light-absorbing layer having apertures which are smaller than the apertures in the mask, a circular light source having a comparatively large diameter should be used. It is known that the size of the hardened region is very sensitive to the exposure conditions when using such a light source. Using an annular light source of suitable dimensions produces larger light intensity gradients in the penumbral region, as a result of which the size of the hardened area is less sensitive to alternations in the exposure conditions. With such an annular light source having a constant outside diameter, a sharper transition occurs from the region exposed to the complete light source to the unexposed region with increasing inner source diameter.

A light source having a large diameter and the desired properties cannot be formed by means of a conical element, (in addition to the aforesaid fact that the use of such a conical element has the drawback of necessitating a rather long exposure time). This is because, if the cone vertex has a large diameter, the peak of the intensity distribution behind the aperture to be projected optically (which distribution will be termed the microscopic light distribution) cannot be made sufficiently narrow. Furthermore, the macroscopic light distribution behind the mask holes, measured round a circle having the centre of the screen as centre, is then not sufficiently uniform; deviations from the mean of 10 to 40% may occur. In other words the light distribution over the mask is not sufficiently rotationally symmetric. It is of great importance that this macroscopic light distribution be rotationally symmetric, since it is then possible to obtain the ulti-

mately desired homogeneous macroscopic light distribution by means of a filter the transmissivity of which varies as a function of distance from its centre. If the macroscopic light distribution without filter were not rotationally symmetric, a non-rotationally symmetric filter would have to be used which, of course, has great drawbacks. It should also be mentioned that an annular light source cannot in any case be realised by means of a conical element.

It is an object of the invention to provide a method and device with which both the desired rotationally symmetric macroscopic light distribution and the desired microscopic light distribution having a large light intensity gradient in the penumbral region and a narrow top can be obtained. The invention provides a method of optically projecting a pattern of substantially circular apertures onto a photosensitive layer present on a support by means of a lamp having an elongate light-emissive area, in which method the lamp is rotated about an axis which is substantially perpendicular to the support in such manner that the geometrical relationship of the lamp axis to the axis of rotation is maintained substantially constant to form an effectively annular or circular light source the light distribution from which is rotationally symmetrical about said axis.

The rotation of the lamp can result in the microscopic distribution behind a mask hole being also substantially rotationally symmetric. It is very important to obtain a rotationally symmetric macroscopic energy distribution when manufacturing a layer of a light-absorbing substance having apertures which determine the contribution to a display of a luminescent substance provided afterwards in said apertures.

If a light source is used the emissive area of which it cut by the axis of rotation, a circular light source will be effectively realised, whereas if a light source is used the emissive area of which is not cut by the axis of rotation, an effectively annular light source will be realised. In order to restrict the size of the effective emissive area it is possible, if desired, to arrange an intermediate member between the lamp and the support, which member has a substantially circular aperture. Light from the emissive area of the lamp to the aperture to be projected then can pass through the aperture in the intermediate member.

The light source formed, which will be effectively larger than the actual light source and in certain cases will be annular, can give a microscopic light distribution behind the mask holes which is very suitable if a pattern of substantially circular exposed areas smaller than the mask holes has to be realised. Moreover, the type of light source thus formed is of advantage when a pattern of substantially

circular apertures has to be projected optically a number of times from different positions onto the same photosensitive layer. This occurs during the manufacture of an apertured light-absorbing layer for a colour picture display screen for a cathode-ray tube, as described hereinbefore. If the display screen comprises three differently luminescing substances, the pattern of apertures in the mask has to be projected optically onto the same photosensitive binder layer three times during the manufacture of the apertured light-absorbing layer. This layer then has a very large number of hardened parts which are each surrounded by a part which is partly exposed but insufficiently hardened. These insufficiently hardened parts must be prevented from becoming sufficiently hardened during a subsequent optical projection of the pattern of apertures in the mask onto the layer, which subsequent exposure would not result in sufficient hardening in itself. There is a danger of this happening due to the cumulative effect of the exposures. This imposes a requirement upon the microscopic light distribution behind each mask hole, namely that the total amount of radiation incident on the intermediate regions should be considerably less than the amount which is required to give sufficient hardening.

The lamp may be provided with a co-rotatable screen which is concave towards said lamp and has an elongate aperture the centre line of which extends in a plane substantially normal to the longitudinal axis of the lamp emissive area.

A macroscopic light distribution which is highly rotationally symmetric can be obtained by using a rotating lamp with co-rotating screen. (The effective light distribution is the average over the exposure time which normally lasts for many revolutions of the lamp). It is also possible to then obtain a microscopic light distribution behind the various mask holes which has the desired narrow peak and large intensity in the penumbral regions.

The screen apertures preferably widens on going from its centre towards the two ends thereof. If this aperture had a constant width parts of the sensitive layer which are located at some distance from its centre would see less of the light source on an average than parts in the neighbourhood of the centre. Widening the aperture towards its ends can result in parts of the layer at some distance from the centre thereof receiving more light, without changing the light received by the parts in the neighbourhood of the centre (viewed from which the light source is substantially behind the centre of the gap). As a result of this a much more homogeneous macroscopic light distribution can be obtained and a much weaker filter may be used, which can considerably reduce the exposure time.

Such apparatus also preferably includes a cylindrical lens the axial direction of which is substantially parallel to the longitudinal axis of said emissive area. Since the emissive area is not actually in the screen aperture, varying screening of the emissive area would otherwise occur during the rotation of the lamp, as viewed from a given point on the pattern of apertures. The result of this would be that, if a line connecting said point and the centre of the screen aperture lies in a plane which contains the centre line of the screen aperture, the light illuminating said point would come from a part of the emissive area lying directly behind the screen aperture. If now the lamp and screen are rotated through 90° the light illuminating said point would come from a part of the emissive area lying obliquely behind the screen aperture. These variations in the position of the effective part of the emissive area would be both radial and tangential to the axis of rotation of the lamp, and would seriously disturb the rotational symmetry of the microscopic light distributions. This can be obviated by effecting a small apparent displacement of the emissive area towards the centre of the screen aperture by means of the cylindrical lens as far as light rays travelling in planes perpendicular to the longitudinal axis of the lamp are concerned.

In order that the invention may be readily carried into effect, embodiments thereof will now be described in greater detail, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a cross-sectional view of an exposure apparatus;

Figure 2 is a plan view of part of the apparatus of Figure 1;

Figure 3 is a cross-sectional view of a second exposure apparatus;

Figure 4 shows the microscopic light distribution behind a mask hole; and

Figure 5 shows the microscopic light distribution behind a mask hole for two exposures.

In Figure 1, a housing 1 has a top 2 having an aperture 3. A cathode-ray tube window 4 bears on the top 2 over the aperture 3. The window 4 is located on the top 2 by studs (not shown). The side of the window 4 facing the aperture 3 is covered with a layer of photosensitive binder (not shown). An assembly 5 including a high-pressure mercury vapour discharge lamp 6 is arranged in the housing 1. Light from this lamp passes through a circular aperture 8 in a diaphragm 7 to a correction lens 9. Light emerging from the lens 9 passes through the aperture 3, then through apertures 11, 11', 11'' etc. in a mask 10, to the layer of photosensitive binder present on the window 4. The lamp 6 is secured to a platform 12 which is mounted for rotation about its axis

13, as is denoted by an arrow 14. The axis 13 is substantially perpendicular to the window 4. The lamp 6 is arranged eccentrically relative to the axis of rotation 13. The lamp 6 has an elongate emissive area to which the cross-section shown is perpendicular. The axis of rotation 13 passes through the centre of the circular aperture 8 in the diaphragm 7.

Figure 2 is a plan view of part of the apparatus shown in Figure 1, taken in the direction denoted by II—II in Figure 1. Part of the lamp 6 is visible through the circular aperture 8 in the diaphragm 7. The centre line 15 of the lamp 6 coincides with the axis of the elongate emissive area. During rotation of the lamp about the axis 13, the axis 15 of the lamp is always tangential to the circle 16. It will be evident that the effective light source produced by rotation of the actual source will produce a macroscopic light distribution which is rotationally symmetrical about the axis 13.

In a particular example the discharge length of the lamp was 17 mm. and its width was 2 mm. (which was also the inside diameter of the lamp). The outside diameter of the lamp at its centre was 16 mm. The circular aperture 8 had a diameter of 4.5 mm. and consequently restricted the effective size of the effective light source, this being necessary because the discharge had a length of 17 mm. The centre line of the lamp was 3.5 mm. below the aperture 8. The eccentricity of the light source, i.e. the distance between the centre line 15 of the lamp and the axis of rotation 13, was 1.2 mm. The distance from the aperture 8 to the window 4 was 350 mm. at the centre, while the distance between the window and the mask was 14.7 mm at the centre. The speed of rotation of the platform 12 was two revolutions per second and exposure times varying from 2 to 5 minutes were used.

Figure 3 shows a preferred embodiment in which a lamp 6 has an elongate emissive area and is surrounded by a diaphragm 25 having an elongate aperture 26 normal to the axis of the emissive area, the diaphragm being secured to the platform 12 and hence rotating with the lamp 6. A negative cylindrical lens 27 produces a virtual image of the lamp 6 so that the lamp is effectively displaced in the plane of the drawing approximately into the aperture 26. The strength of the cylindrical lens 27 is substantially zero in planes perpendicular to the plane of the drawing, i.e. its axis is substantially parallel to the emissive area of the lamp 6. The aperture 26, which is narrow in a direction perpendicular to the plane of the drawing, has a shape such that the desired macroscopic and microscopic light distributions are obtained. For that purpose, the gap widens on going from its centre towards its ends 28 and 29.

Again it will be evident that the effective light source produced by rotation of the actual source will produce a macroscopic light distribution which is rotationally symmetrical about the axis 13.

Figure 4 shows three microscopic light distributions which can be obtained by means of the exposure apparatus of Figure 3, behind a mask hole in the centre of the mask and having a diameter of 430 microns. The distance from the axis of the hole is plotted in the horizontal direction and the relative brightness, i.e. the brightness relative to that which is obtained behind and on the axis of the mask hole, is plotted in the vertical direction. The broken line 19 relates to an eccentricity, i.e. an amount by which the axis of the emissive area of the lamp is offset from the axis of rotation, of 0.4 mm, the dotted line 20 relates to an eccentricity of 2.4 mm. and the solid line 21 relates to an eccentricity of 1.8 mm. The light distributions are rotationally symmetric and it will be seen that, as the eccentricity is increased, the peak of the light distribution becomes narrower while it widens in the neighbourhood of its base. The actual base always remains the same because this is determined by the size of the aperture in the diaphragm.

Figure 5 shows the combined microscopic light distribution obtained behind one mask hole in the centre of the mask for two different positions of the assembly 5 relative to the mask. This distribution is that which was obtained along a line joining the two correspondingly exposed parts of the window 4 in the exposure apparatus shown in Figures 1 and 2. The diaphragm had a circular aperture of 5 mm. diameter, the eccentricity of the light source was 0.6 mm., the distance from the aperture in the diaphragm to the centre of the window was 270 mm., the distance between the centres of the window and the mask was 10 mm., and the mask hole had a diameter of 330 microns. The distance along said line is plotted for each light distribution in the horizontal direction and the relative brightness is plotted in a vertical direction. The solid line 22 denotes the microscopic light distribution arising during one exposure and the solid line 23 denotes the microscopic light distribution arising during the other exposure. The broken line 24 denotes the light distribution obtained by combining distributions 22 and 23. The reason that the shape of the curves 22 and 23 in Figure 5 differs from that of the curves 19, 20 and 21 of Figure 4 (which means that the microscopic light distributions are different) is that there was a difference in geometry.

WHAT WE CLAIM IS:—

1. A method of optically projecting a pattern of substantially circular apertures onto a photosensitive layer present on a support



13, as is denoted by an arrow 14. The axis 13 is substantially perpendicular to the window 4. The lamp 6 is arranged eccentrically relative to the axis of rotation 13. The lamp 6 has an elongate emissive area to which the cross-section shown is perpendicular. The axis of rotation 13 passes through the centre of the circular aperture 8 in the diaphragm 7.

Figure 2 is a plan view of part of the apparatus shown in Figure 1, taken in the direction denoted by II—II in Figure 1. Part of the lamp 6 is visible through the circular aperture 8 in the diaphragm 7. The centre line 15 of the lamp 6 coincides with the axis of the elongate emissive area. During rotation of the lamp about the axis 13, the axis 15 of the lamp is always tangential to the circle 16. It will be evident that the effective light source produced by rotation of the actual source will produce a macroscopic light distribution which is rotationally symmetrical about the axis 13.

In a particular example the discharge length of the lamp was 17 mm. and its width was 2 mm. (which was also the inside diameter of the lamp). The outside diameter of the lamp at its centre was 16 mm. The circular aperture 8 had a diameter of 4.5 mm. and consequently restricted the effective size of the effective light source, this being necessary because the discharge had a length of 17 mm. The centre line of the lamp was 3.5 mm. below the aperture 8. The eccentricity of the light source, i.e. the distance between the centre line 15 of the lamp and the axis of rotation 13, was 1.2 mm. The distance from the aperture 8 to the window 4 was 350 mm. at the centre, while the distance between the window and the mask was 14.7 mm at the centre. The speed of rotation of the platform 12 was two revolutions per second and exposure times varying from 2 to 5 minutes were used.

Figure 3 shows a preferred embodiment in which a lamp 6 has an elongate emissive area and is surrounded by a diaphragm 25 having an elongate aperture 26 normal to the axis of the emissive area, the diaphragm being secured to the platform 12 and hence rotating with the lamp 6. A negative cylindrical lens 27 produces a virtual image of the lamp 6 so that the lamp is effectively displaced in the plane of the drawing approximately into the aperture 26. The strength of the cylindrical lens 27 is substantially zero in planes perpendicular to the plane of the drawing, i.e. its axis is substantially parallel to the emissive area of the lamp 6. The aperture 26, which is narrow in a direction perpendicular to the plane of the drawing, has a shape such that the desired macroscopic and microscopic light distributions are obtained. For that purpose, the gap widens on going from its centre towards its ends 28 and 29.

Again it will be evident that the effective light source produced by rotation of the actual source will produce a macroscopic light distribution which is rotationally symmetrical about the axis 13.

Figure 4 shows three microscopic light distributions which can be obtained by means of the exposure apparatus of Figure 3, behind a mask hole in the centre of the mask and having a diameter of 430 microns. The distance from the axis of the hole is plotted in the horizontal direction and the relative brightness, i.e. the brightness relative to that which is obtained behind and on the axis of the mask hole, is plotted in the vertical direction. The broken line 19 relates to an eccentricity, i.e. an amount by which the axis of the emissive area of the clamp is offset from the axis of rotation, of 0.4 mm, the dotted line 20 relates to an eccentricity of 2.4 mm. and the solid line 21 relates to an eccentricity of 1.8 mm. The light distributions are rotationally symmetric and it will be seen that, as the eccentricity is increased, the peak of the light distribution becomes narrower while it widens in the neighbourhood of its base. The actual base always remains the same because this is determined by the size of the aperture in the diaphragm.

Figure 5 shows the combined microscopic light distribution obtained behind one mask hole in the centre of the mask for two different positions of the assembly 5 relative to the mask. This distribution is that which was obtained along a line joining the two correspondingly exposed parts of the window 4 in the exposure apparatus shown in Figures 1 and 2. The diaphragm had a circular aperture of 5 mm. diameter, the eccentricity of the light source was 0.6 mm., the distance from the aperture in the diaphragm to the centre of the window was 270 mm., the distance between the centres of the window and the mask was 10 mm., and the mask hole had a diameter of 330 microns. The distance along said line is plotted for each light distribution in the horizontal direction and the relative brightness is plotted in a vertical direction. The solid line 22 denotes the microscopic light distribution arising during one exposure and the solid line 23 denotes the microscopic light distribution arising during the other exposure. The broken line 24 denotes the light distribution obtained by combining distributions 22 and 23. The reason that the shape of the curves 22 and 23 in Figure 5 differs from that of the curves 19, 20 and 21 of Figure 4 (which means that the microscopic light distributions are different) is that there was a difference in geometry.

WHAT WE CLAIM IS:—

1. A method of optically projecting a pattern of substantially circular apertures onto a photosensitive layer present on a support



by means of a lamp having an elongate light-emissive area, in which method the lamp is rotated about an axis which is substantially perpendicular to the support in such manner that the geometrical relationship of the lamp axis to the axis of rotation is maintained substantially constant to form an effectively annular or circular light source the light distribution from which is rotationally symmetrical about said axis.

2. A method as claimed in Claim 1, wherein said pattern is so projected a number of times onto different parts of said layer, and wherein the longitudinal axis of said emissive area does not intersect the axis of rotation.

3. A method of optically projecting a pattern of substantially circular apertures by means of a lamp onto a photosensitive layer, substantially as herein described with reference to Figures 1 and 2 or Figure 3 of the accompanying drawings.

4. Apparatus for carrying out a method as claimed in Claim 1 or 2, comprising a lamp having an elongate emissive area and which

is mounted for rotation about an axis, said lamp being provided with a co-rotatable screen which is concave towards said lamp and has an elongate aperture the centre line of which extends in a plane substantially normal to the longitudinal axis of said emissive area.

5. Apparatus as claimed in Claim 4, wherein said aperture widens on going from its centre towards the two ends thereof.

6. Apparatus as claimed in Claim 5, including a cylindrical lens the axial direction of which is substantially parallel to the longitudinal axis of said emissive area.

7. Apparatus for optically projecting a pattern of substantially circular apertures onto a photosensitive layer, substantially as herein described with reference to Figures 1 and 2 or Figure 3 of the accompanying drawings.

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