July 5, 1966 G. A. BURDICK ETAL 3,259,038

LIGHT ATTENUATOR

Filed Dec. 27, 1963 4 Sheets-Sheet 1

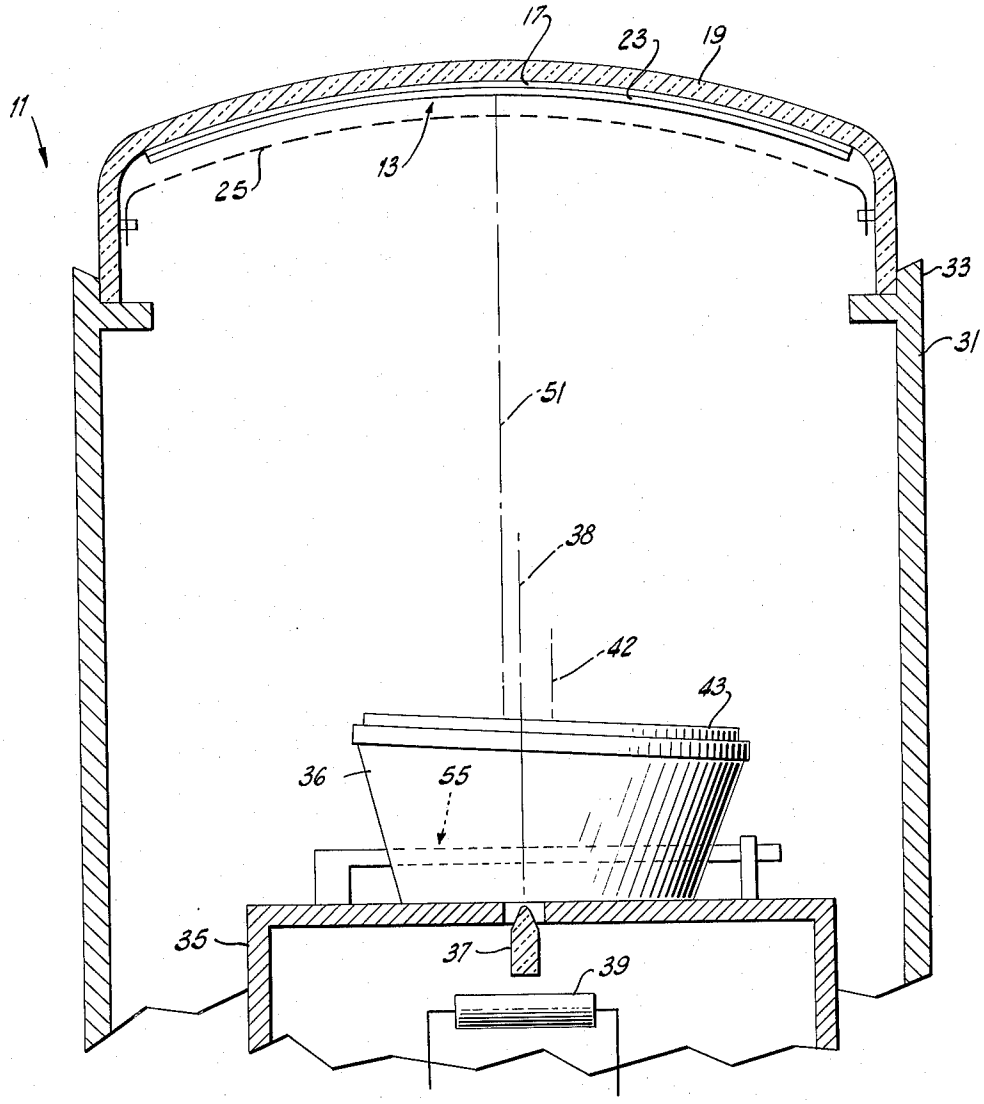


Fig. 1

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LIGHT ATTENUATOR

Filed Dec. 27, 1963 4 Sheets-Sheet 2

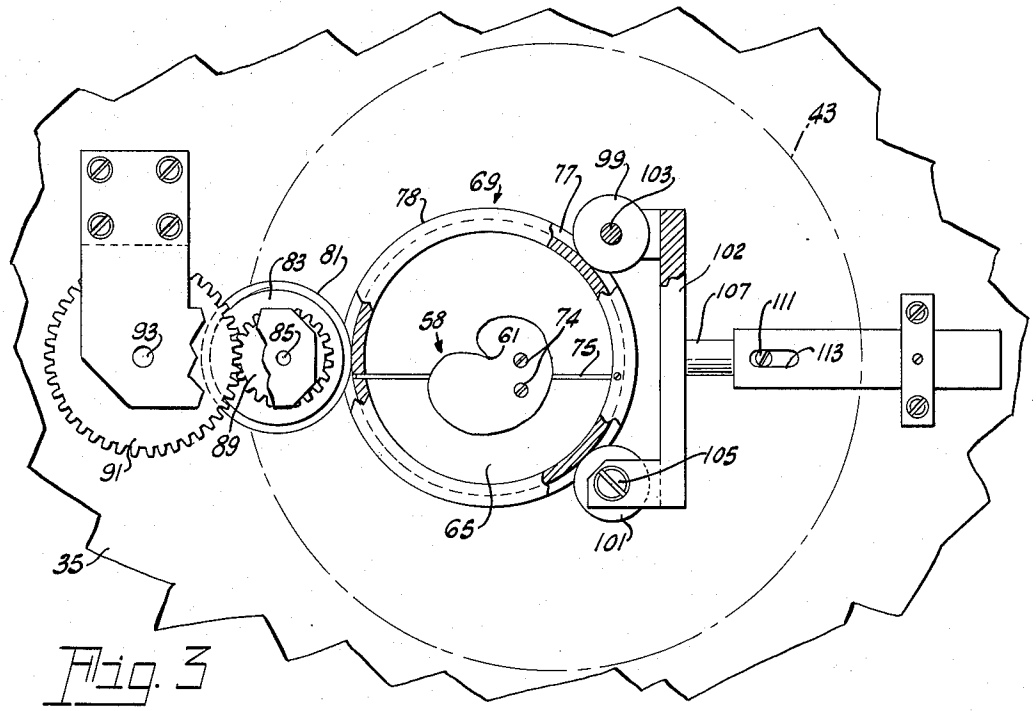


Fig. 3

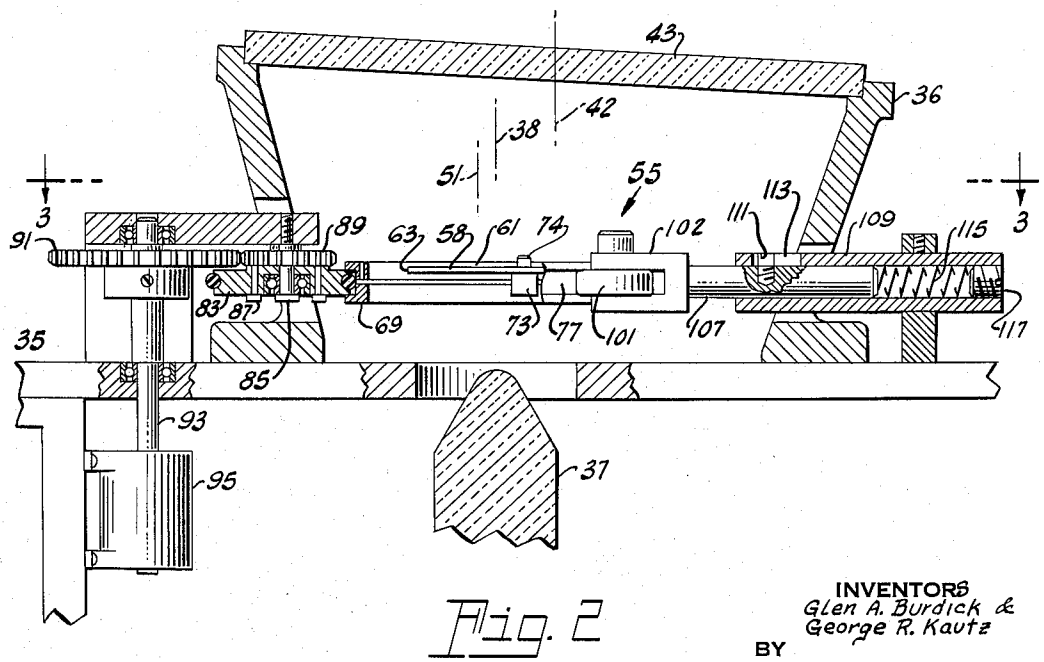


Fig. 2

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LIGHT ATTENUATOR

Filed Dec. 27, 1963 4 Sheets-Sheet 3

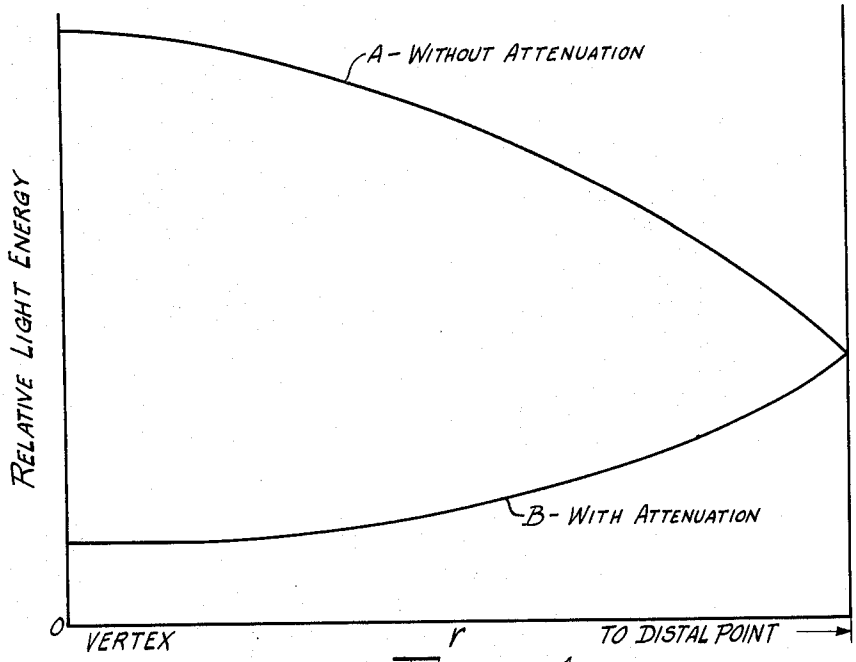


Fig. 4

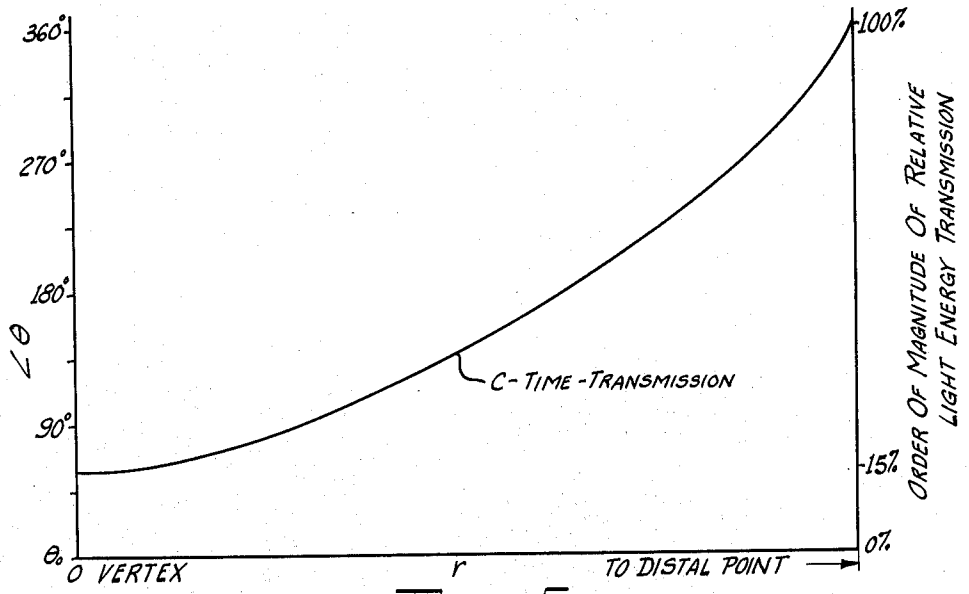


Fig. 5

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LIGHT ATTENUATOR

Filed Dec. 27, 1963 4 Sheets-Sheet 4

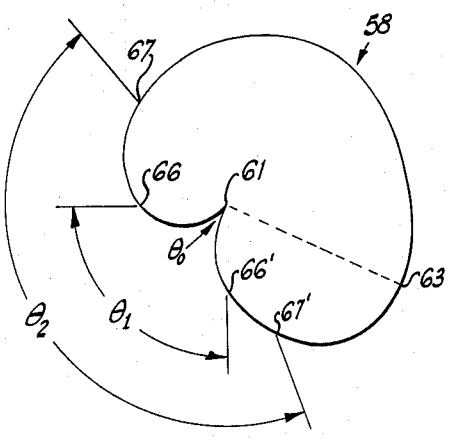
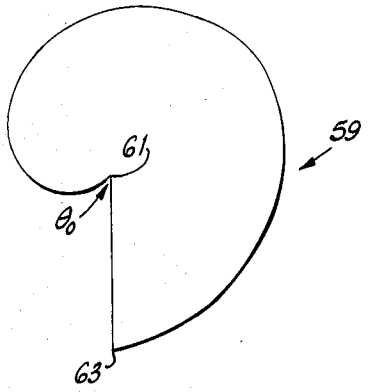


Fig. 6

Fig. 7



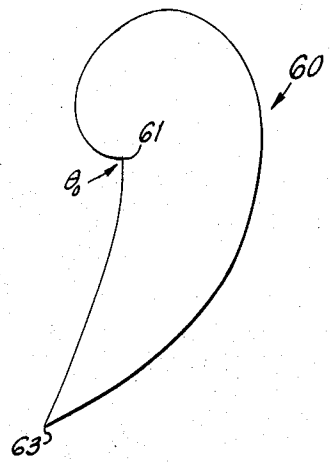


Fig. 8

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United States Patent Office 3,259,038 Patented July 5, 1966

3,259,038

LIGHT ATTENUATOR

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Filed Dec. 27, 1963, Ser. No. 333,914
12 Claims. (Cl. 95—1)

This invention relates to the control of radiant energy and more particularly to means for effecting discrete time variation attenuation of light energy in the process of exposing the light sensitive screen of a color cathode ray tube.

It is conventional practice in the manufacture of screens for certain types of color cathode ray tubes to attach multitudinous discrete areas of electron responsive color emitting phosphors to the interior surface of the tube face panel with a light sensitive adhering material. To properly consumate the adherence of specific areas or dots of each color phosphor, the face panel having the light sensitive material and a covering of phosphor disposed thereon, is spacedly mated with a suitable negative or foraminous shadow mask. This combination is placed on a screen exposure or "lighthouse" apparatus having an optical system comprising a light permeable refractive medium or corrective lens and a conjunctive light source relatively positioned to provide a sufficient amount of light energy for proper exposure activation of the light sensitive screen through the mask apertures during the processing procedure.

The activating light energy, from a predetermined off-center source, traverses the corrective light permeable refractive medium or lens and is directed thereby to pass through the individual openings in the foraminous mask and angularly impinge upon definite phosphor areas of the screen. Thus, these light impinged areas are activated to form phosphor adhering dots that are discretely oriented to receive electron impingement from a specific directed electron beam in the finished tube. In this manner, each of the separate color fields, i.e. green, blue, and red, comprising the color tube screen are individually activated by separate optical projection systems precisely positioned off-center from the axis of the screen thereby approximating the subsequent orientation of the separate electron beams associated with the respective colors. By this procedure, light energy emanating from each source traverses the same mask openings and thence angularly impinges upon a different set of screen areas for each color field. In each instance, the unexposed or unhardened screen areas are removed by subsequent processing development. This procedure is repeated for each of the dot color fields making up the screen of the tube.

In a conventional shadowmask color tube the desired color rendition and uniformity of the screen is efficaciously currently achieved by having the individual phosphor areas or dots at the edge of the screen diametrically smaller to some extent than the dots at the screen center with a gradual transition therebetween.

Several factors inherent in the tube mask structure and screen processing individually promote larger center dots than desired, and the situation becomes worse when the factors are considered collectively. For example, it is conventional for the apertures in the foraminous mask to be approximately two mils diametrically larger at the screen center than at the screen edge; the point source of light, being closer to the center of the screen, affords to the center area greater luminous irradiation which decreases radially therefrom; and the nature of the lens structure promotes greater light attenuation and divergence at the edge than at the center thereby further reducing screen edge illumination.

The above factors in addition to the intensity of the light source and the duration or time of exposure determine color dot formation on the light sensitive screen material. It is evident that compensating measures must be applied to control the several factors to effect dot growth of desired size at desired locations. It has been a common practice to compensate for the undesirable features of the above factors by providing a variable density filter coating on the lens. This filter medium is discretely disposed on the lens surface to afford a low level of light energy transmission at the center of the screen with a gradual decrease of attenuation radially therefrom. While the light attenuating lens coating serves the purpose, it has several disadvantages.

Since the light sensitive material or photoresist, such as polyvinyl alcohol sensitized with ammonium dichromate, has a light intensity threshold, a drop in illumination below the intensity threshold level results in incomplete polymerization of the phosphor dot areas and permits them to be washed away during the developing process. If the irradiation intensity is below the intensity threshold an increase of exposure time will not properly promote polymerization of the photoresist material. Thus, exposure is a function of light intensity and time, but not a function of intensity multiplied by time. This light intensity threshold becomes a problem whereby with certain photoresist-phosphor compositions, and available light sources, it may be impossible to achieve the desired dot size distribution without reducing the illumination below the threshold at the screen center.

It is difficult to apply a coating that will fully provide compatible attenuation for a respective light source for a period of time. The lens coating has no versatility for changes when once applied to the lens surface. A change in screen processing, such as using phosphor particles of different size or modifying the photoresist formulation, alters the dot growth characteristics which necessitates a change in illumination distribution. This requires a lens coating change that is inconvenient, time consuming, and costly. The inherent disadvantages of this coated lens type of attenuation has been found to reside in the fact that it is based upon light transmission variation for making optical exposures.

Accordingly, it is an object of the invention to reduce the aforementioned difficulties and to provide improved light energy attenuation means for color cathode ray tube screen processing.

A further object is to effectively provide variable light attenuation means that is independent of the surface of a refractive medium.

Another object is to provide animated means for producing predetermined levels of light energy attenuation.

A further object is to time vary the light transmission used in the production of color cathode ray tube screens.

An additional object is to provide pulsed light of constant source intensity and varied pulse lengths over at least certain areas of the screen to obtain the desired phosphor dot growth throughout the screen.

Still another object is to provide versatile light energy attenuation means capable of being programmed to effect predetermined levels of attenuation.

The foregoing objects are achieved in one aspect of the invention by the provision of a screen exposure process and apparatus for making a color picture tube screen wherein the formation of phosphor dots or dot growth is controlled and effected by time varying the light exposure in a differential modulated manner over at least discrete areas of the screen. Preferably, this is accomplished through the use of a modulated or pulsed light of constant source intensity with varied pulse lengths. One embodiment of a device capable of providing this time varia-

tion comprises an optical system of a cathode ray tube screen exposure apparatus using a configurative blade mounted within an oscillatory rotatable ring positioned intermediate the light source and the light sensitive screen. The moving blade provides modulated light distribution on the screen thereby producing the effects of discrete light attenuation thereon.

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the accompanying drawings in which:

FIGURE 1 is a cross-sectional view showing the parts of a color screen exposure apparatus;

FIGURE 2 is a cross-sectional enlargement of the light energy attenuating section of the exposure apparatus;

FIGURE 3 is a plan view of the light energy attenuating section taken along line 3—3 of FIGURE 2 with some parts omitted to facilitate clarity thereof;

FIGURE 4 is a curve illustrating typical light energy distribution;

FIGURE 5 is a light energy transmission curve;

FIGURE 6 is a plan view showing one configurative blade embodiment;

FIGURE 7 is a plan view illustrating another embodiment of a blade configuration; and

FIGURE 8 is a plan view showing still another blade configuration embodiment.

As used henceforth in this specification in reference to the invention, the terminology pertaining to "light energy attenuation" refers to modulated light energy distribution or time variation attenuation thereof rather than light intensity attenuation.

Referring to FIGURE 1, there is shown a "lighthouse" or screen exposure apparatus **11** utilized for photographically activating a typical foraminously masked light sensitive screen **13** of a color cathode ray tube. This apparatus is repetitively used to separately activate a plurality of specific color dot areas for each of the respective color fields constituting the screen.

In greater detail, screen **13** comprises a coating of a photoresist or light energy sensitive substance **17**, as for example, polyvinyl alcohol suitably sensitized with ammonium dichromate, disposed on the interior surface of the glass face panel **19** and overlaid with specific electron responsive fluorescent phosphor materials **23** as by dusting or spraying. If desired, the light energy sensitive substance **17** and the phosphor material **23** may be intermixed initially to form a slurry which may be subsequently deposited on panel **19**. Positioned adjacent screen **13**, in spaced relationship thereto, is a foraminous shadowmask **25** to provide discrete masking of the screen material so that only the desired areas of the screen will be exposed for any given color activation operation to provide a distinct field of discrete dots of the specific color. The glass face panel **19**, with screen **23** adheringly disposed thereon, and the conjunctive shadowmask **25** spacedly mounted therein, is placed upon the "lighthouse" frame **31** and aligned therewith radially and axially by means of cooperative projections **33** integral to the top surface of frame **31**. Positioned internally within the frame in an apertured enclosure **35** is a transmitting light rod **37** which collects the light energy emitted by the primary source **39** such as, for example, a mercury vapor lamp. The light rod **37** is diffusely ground and functions as a concentrator or point source of light energy directing light toward the screen **13**. Mounted on a suitable support **36** above the light rod **37**, and in spaced relationship thereto, is a light permeable refractive medium or lens **43** which refracts the light rays to provide for desired activation of the aforementioned discrete screen areas. Thus, the end points of the light rays employed in the exposure operation are directed to match the landing points of the electrons during subsequent tube operation. The point source of light **37** and the lens **43** are offset at predetermined distances from the axis **51** of screen **13** for each of the separate color exposures comprising the screen activation.

As previously mentioned, there is a difference in the intensity of light striking the lens; the most intense luminous irradiation being coincidental with the shortest distance from the terminal of the light rod **37** and diminishing radially outward therefrom in a differential pattern. To facilitate proper beam landing and phosphor dot locations when dynamic convergence is used, it has been found preferable to offset the lens **43** from the axis **38** of the light rod **37** and/or to tilt the lens relative to the light rod axis **38**. Accordingly, by tilting the lens **43**, the axis **42** of the lens **43** and the axis **38** of the concentrator light rod **37** are not coincident. Under such circumstances it can be seen that the intensity of the light rays emanating from lens **43** will not be symmetrical about the lens axis **42**.

To effect the desired modulation of light energy distribution, there is positioned within the lens supporting structure **36** a light energy attenuating device **55** which is shown in detail in FIGURES 2 and 3. In the embodiment shown, a configurative blade **58** is adapted to rotate about a vertex point **61** positioned to substantially coincide with the axis **38** of the concentrator **37** but having provisions for the point of rotation to laterally oscillate in a prescribed area surrounding the concentrator axis. As used in this specification, the term "vertex" will pertain to the axial point of the blade about which the blade rotates; that being the centrum from which the specific blade configuration is developed.

The blade **58** is mounted within a ring **69** wherein the vertex point **61** of the blade is coincident with the center or axis of the ring; which, as previously mentioned, is substantially coincident with the axis of the light concentrator **37**. Activating irradiation emanating from the concentrator or point light source **37** reaches the screen by passing through the area peripherally bounded by the ring **69** wherein there is centrally positioned the attenuator blade **58**. The blade is suitably attached by a bracket **73** and studs **74** to a diametrically positioned support rod **75** integrally affixed to the ring **69**.

The specific shapes of the blades **58**, **59**, and **60** as shown in FIGURES 3, 6, 7, and 8 and the required sizes thereof are influenced by a complexity of related items such as the optical exposure setup utilized, the geometry of the tube screen being activated, the location of the blade with reference to the screen and the light source, the area and irradiation pattern of the light source used, the thickness of glass due to lens configuration, the angles of incidence encountered, and the diametrical variation of the shadowmask apertures. Thus, the resultant contour of a specific blade may lend itself to a variety of composite compensative configurations developed from a basic formulation and subsequent experimentation. It should be clearly emphasized that the contour of a blade need not necessarily be that of the configurations shown. Fundamentally, the configuration should be such as to provide predetermined time attenuation of the light energy emanating from the concentrator **37** with provisions for gradually diminishing the attenuation as the radial distance from the screen axis **51** increases.

In the several embodiments illustrated in FIGURES 3, 6, 7, and 8 the shapes of the blades resemble various aspects of a modified cardioidal configuration. Since the differential contours of these various blade shapings **58**, **59**, and **60** are extremely difficult to describe, the terminology in this specification pertaining to a "modified cardioidal configuration" is intended to include a hybridity of modified cardioidal and Archimedean spiral configurations and related modifications thereof; each configuration having a progressively varying open angle Theta ($\angle\theta$) sequentially defined by specific pairs of ra-

dius vectors (r) of equal length extended from the vertex or axis point of rotation **61** to the periphery of the blade. As the radius vectors defining $\angle\theta$ become shorter, the open value therebetween approaches the asymptotic angle θ_0. Basically, $\angle\theta$ is a function of r: $\theta=f(r)$, which is determined experimentally to achieve the desired compensation for the aforementioned factors involved. A distal point **63** terminates the maximum radius in the configuration and, upon rotation, defines the bounds of light energy attenuation afforded by the blade.

FIGURE 4 illustrates a typical light energy distribution. Curve A shows that from the region of highest intensity light energy concentration at the blade vertex, the intensity value diminishes as the length of radius (r) from the vertex is increased. Thus, curve A is representative of the relative light energy distribution without added attenuation. What is desired is a modification of the available light energy by time varied attenuation means to provide a lesser degree of light transmission in the vertex region with provisions for desirably increasing the transmission as the blade radius (r) from the vertex increases. This is evidenced by curve B of FIGURE 4 which represents desired relative attenuated light energy.

The time-transmission curve shown in FIGURE 5 further clarifies achievement of the desired light energy attenuation. In developing the blade configuration to provide the desired ratio of attenuation and transmission, it is indicated from curve C that the open $\angle\theta$ is increased as r increases. The relative opening of $\angle\theta$ as shown in FIGURE 5 is determined by dividing the desired Relative Attenuated Light Energy (curve B) of FIGURE 4 by the Relative Light Energy w/o Attenuation (curve A). Thus,

$$\underline{/\theta}=\frac{\text{Attenuated Energy}}{\text{Energy w/o Attenuation}}\times 360°$$

The resultant blade configuration is such that for any given radius projecting from the vertex a certain percentage of the circumference is open. As the blade rotates about the vertex, a discrete area of the screen receiving light energy from a given point at a specific radius is irradiated during a desired percentage of the total exposure time and shielded by a portion of the blade for the remainder of the exposure cycle. In this manner, discrete areas of the screen receive timed pulses of activating light varying in accordance with the configuration of the blade. Thus, the effected light energy attenuation is a pulsed time attenuation of irradiation rather than an intensity attenuation. The open $\angle\theta$ is 360° beyond the distal point **63** or r max. of the blade, decreasing in a prescribed manner to a minimum asymptotic value θ_0 at the vertex **61**. Thus, the time varied light energy attenuation is of maximum value (but not total) at the vertex and diminishes therefrom as the value of $\angle\theta$ increases. For example, as shown in FIGURE 6, the circular zone portion of the light sensitive screen receiving light energy irradiation through the open area of the blade, characterized by the arc corresponding to θ_1, will be exposed during 25 percent of the exposure cycle; the arc corresponding to θ_1 being formed by equal radii **66** and **66'** extended .60 inch from the vertex to the periphery of the configuration wherein there is defined the $\angle\theta_1$ of 90 degrees. The screen portion receiving irradiation through the open blade area pertaining to the arc corresponding to θ_2 will have exposure during 45 percent of the exposure cycle. The arc corresponding to θ_2 is formed in a manner similar to that for θ_1 wherein equal radii **67** and **67'** are extended .93 inch from the vertex to the configuration periphery thereby defining the $\angle\theta_2$ of 162 degrees. The outer region of the screen beyond the distal point **63** which is 1.28 inches from the vertex is exposed 100 percent except for the attenuation effected by the width of the support rod **75**. The intervening areas affected by the discrete configuration of the blade will be proportionally attenuated. The resultant light pulsed exposure of the discrete areas of the screen is in the nature of light pulses lengthening in time as the radial distance from the screen axis increases.

Although not shown, the blades may be of a foraminous material containing perforations in accordance with a pre-determined attenuation pattern and shaped to compensate for the open area represented by the perforations.

The blade, which forms a light pulsing means regardless of its contour, rotates about a vertex point of the configuration in a lateral oscillatory manner by means to be fully described later. Basically, the continual lateral oscillatory movement of the point of rotation provides beneficial results by insuring proper exposure of the screen area influenced by the center or vertex **61** portion of the blade and provides smooth attenuation transition from the distal point **63** of the rotating blade to the surrounding lens region **65**.

The amount of graduated attenuation afforded by the moving blade of the light energy attenuator is significant in achieving desired color dot growth throughout the screen **13**. The glass composition of the lens **43**, such as water white, has a nominal light transmittance of approximately 90 percent in the near ultraviolet range. The heaviest attenuation effected in the region adjacent the vertex of the attenuator may be in the order of 75 percent (through asymptotic $\angle\theta_0$ thereby allowing a nominal transmittance of 25 percent which passes an amount of luminous irradiation that is slightly above the light energy threshold of the photoresist material comprising the color tube screen. Attenuation decreases radically from the point of heaviest attenuation to the outer edge of the blade, defined by distal point **63**, beyond which the only attenuation afforded is that afforded by the natural drop off in distance intensity and the attenutation of the lens varied by length of path therethrough. From an optimum consideration, the distal point of the blade should influence irradiation to the edge of the screen. Compensation is thereby achieved by holding back the light in the areas of intense illumination and the larger size shadowmask apertures. Thus, the configurative blade is formed to modulate the light transmission originating from the light source to provide time varied exposure of the discrete areas of the light sensitive screen, wherein the varied time of screen exposure lengths as the radial distance from the screen axis increases.

In greater detail for the embodiment shown in FIGURES 2 and 3, the blade supporting ring **69** has a circumferential recess **77** formed in its external peripheral rim **78**. The rubber-tired periphery **81** of eccentric drive wheel **83** is of a dimension to fit within the circumferential engagement recess **77** to provide friction drive engagement with the bottom of the recess. The terms "engaging" and "engagement" as used in this specification with reference to the peripheral rim **78** of the ring **69** and the periphery **81** of the eccentric drive wheel **83** are intended to include either friction or toothed contact therebetween.

The amount of oscillatory movement imparted to the ring **69** by the rotation of the eccentric drive wheel **83** in the axis of fixed spindle **85** is not of great magnitude. The off-center mounting of the eccentric drive wheel is nominally within the range of .015 inch to .065 inch. Upon rotation on spindle **85** this off-center range effects a resultant oscillation nominally ranging between .030 inch and .125 inch which is imparted to the rotating ring **69**.

The drive wheel **83** is affixed by pins **87** to an adjacent gear **89** which is also rotative on spindle **85**. Gear **89** compatibly meshes with a companion gear **91** affixed to a rotative shaft **93** and energized by an appropriate drive source, such as a low r.p.m. electric motor **95**.

It has been found that the rotational frequency of the blade containing ring **91** and the lateral oscillatory fre-

quency imparted thereto should not be synchronized in order to avoid having the rotating blade follow a repetitive pattern which could be evidenced on the exposed screen. It is also necessary that a reasonable number of rotations and oscillations, constant or varied in frequency, occur during the prescribed time of exposure; but the rate of rotation and oscillation should not be such so as to produce undesirable vibration of the apparatus. It has been found that satisfactory screen exposure of three or more minutes duration can be satisfactorily effected without undue vibration by utilizing a blade rotational frequency within a nominal range of 5 to 60 r.p.m. in conjunction with an oscillatory frequency nominally ranging within 2 to 10 times the rotational frequency. These aforementioned values are to be considered illustrative and not limiting. The constructional ruggedness of the exposure apparatus is also an influencing factor in vibration prevention.

On the opposite side of the ring **69** are positioned plural guide means such as two free moving rotative rollers or idle wheels **99** and **101** formed to engage and support the ring. These are shown as mounted in a yoke **102** on separate fixed spindles **103** and **105** respectively. The yoke support **107** is formed for sliding engagement within an encompassing tube **109** limited by stop **111** in slot **113**. An expensive metallic helix **115** positioned within tube **109** intermediate the end of yoke support **107** and a terminal plug **117** tensions the idle wheels **99** and **101** against the rim of ring **69** and insures the engagement of the ring with eccentric drive wheel **83**. Thus, the two spring-loaded idle wheels **99** and **101** in conjunction with the drive wheel **83** provide oscillatory rotational movement and positional support to blade-holding ring **69**. Although not shown, it is clearly evident that plural guide means other than the described idle wheels may be utilized in conjunction with the rim of the ring whereby at least one spring loaded means is positioned opposite the drive wheel.

An alternate embodiment (not shown) could utilize the light attenuating device suitably positioned between the lens and the screen. In this embodiment, the operation principle is the same but a larger diametered ring and a larger modified blade configuration are required.

Manifold advantages are evidenced from the use of time varied exposure to produce color cathode ray tube screens. Desired polymerization of the photoresist screen material is achieved without excessive dot growth. By modulating light transmission from the light source the total amount of light reaching the center of the screen in the form of timed pulses is reduced by a greater amount than before possible while still maintaining sufficient irradiation intensity to consummate desired color dot adhesion. Thus, the relative sizes of the resultant color dots in the center of the screen are more uniform relative to the dot sizes at the edge of the screen.

Use of this light energy attenuating device eliminates the need to dispose costly attenuating coatings on the surfaces of the lens. By a convenient change of blade configurations, the light energy attenuating device exhibits versatility capable of being programmed to effect a variety of predetermined levels of attenuation.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

What is claimed is:

1. An optical system having a refractive medium for exposing a light sensitive surface through a negative in an electron discharge device having an axis comprising:

a point light source of substantially constant intensity positioned opposite said negative and spaced therefrom to provide light transmission therethrough to said screen; and

a rotatable substantially modified cardioidal-shaped blade disposed between said light source and said surface and relative to said refractive medium to provide diminishing attenuation for a portion of the exposure light from said source as the radial distance from said axis increases; and

means for imparting predetermined rotation and lateral oscillatory movement to said blade.

2. An optical system for exposing the foraminously masked light sensitive screen of a color cathode ray tube having an axis comprising:

a point light source of substantially constant intensity positioned opposite said mask and spaced therefrom to provide light transmission therethrough to said screen;

a light permeable refractive medium positioned intermediate said light source and said screen;

a rotatable configurative blade disposed between said light source and said refractive medium to provide diminishing attenuation for a portion of the exposure light from said source as the radial distance from said axis increases; and

means for imparting predetermined rotation and lateral oscillatory movement to said blade.

3. An optical system for discretely exposing the foraminously masked light sensitive screen of a color cathode ray tube having an axis comprising:

a point light source of substantially constant intensity positioned opposite said mask and spaced therefrom to provide light transmission therethrough to said screen;

a light permeable refractive medium positioned intermediate said light source and said screen;

a rotatable configurative blade disposed between said screen and said refractive medium to provide diminishing attenuation for a portion of the exposure light from said source as the radial distance from said axis increases; and

means for imparting predetermined rotation and lateral oscillatory movement to said blade.

4. In a system wherein a source of light energy and a conjunctive refractive medium are utilized for exposing a foraminously masked light sensitive screen of a color cathode ray tube having an axis, an intermediately positioned device for time varying the light intensity from said source as the radial distance from said axis increases comprising:

a movable ring having an external peripheral rim and an internal diameter sufficient to permit passage therethrough of light energy from said source to said masked screen;

light pulsing means fixedly positioned on said ring in the path of said light energy, said means being formed to modulate the light transmission from said source;

means for positioning said movable ring; and

means for rotating and imparting lateral oscillatory motion to said ring to provide time varied exposure of the discrete areas of said screen, said varied time of exposure lengthening as the radial distance from said axis increases.

5. In a system wherein a substantially constant intensity source of light energy is utilized for exposing a foraminously masked light sensitive screen of a color cathode ray tube having an axis, an intermediately positioned device for diminishingly attenuating the light from said source as the radial distance from the axis increases comprising:

a movable ring having an external peripheral rim and an internal diameter sufficient to permit passage therethrough of light energy from said source to said masked screen;

a configurative blade positioned on said ring in the path of said light energy;

means for positioning said movable ring; and

means for rotating and imparting lateral oscillatory

motion to said ring to provide for predetermined discrete attenuation of said light energy.

6. In a system wherein a substantially constant intensity source of light energy is utilized for exposing a foraminously masked light sensitive screen of a color cathode ray tube having an axis, an intermediately positioned device for diminishingly attenuating the light from said source as the radial distance from the axis increases comprising:

a ring having an external peripheral engaging rim and an internal diameter sufficient to permit passage therethrough of light energy from said source to said masked screen;

a configurative blade fixedly positioned on said ring in the path of said light energy to provide for predetermined discrete attenuation of said light energy;

an eccentric drive wheel formed to engage said external peripheral rim of said ring and impart an oscillatory rotation thereto;

means for energizing said drive wheel; and

a plurality of guide means positioned in spaced relationship to said ring, at least one of said guide means being spring loaded and substantially oriented in apposition to said drive wheel, said guide means being formed to provide contact enegagement with said peripheral rim to insure engagement of said drive wheel with said peripheral rim.

7. In a system wherein a substantially constant intensity source of light energy is utilized for exposing a foraminously masked light sensitive screen of a color cathode ray tube having an axis, an intermediately positioned device for diminishingly attenuating the light from said source as the radial distance from said axis increases comprising:

a ring having an external peripheral engaging rim and an internal diameter sufficient to permit passage therethrough of light energy from said source to said masked screen;

a perforated configurative blade fixedly positioned on said ring in the path of said light energy to provide for predetermined discrete attenuation of said light energy;

an eccentric drive wheel formed to engage said external peripheral rim of said ring and impart an oscillatory rotation thereto;

means for energizing said drive wheel; and

at least two spring-loaded idle wheels positioned in spaced relationship substantially opposite said drive wheel being formed to provide contact engagement with said peripheral rim to insure engagement of said drive wheel with said peripheral rim.

8. In a system wherein a source of light energy is utilized for exposing a foraminously masked light energy sensitive screen of a color cathode ray tube having an axis, an intermediately positioned device for diminishingly attenuating the light from said source as the radial distance from said axis increases comprising:

a movable ring capable of rotation having an external peripheral rim formed with an engaging surface thereon and an internal diameter sufficient to permit passage therethrough of light energy from said source to said masked screen;

a configurative blade, having an open asymptotic angle formed at a vertex thereof, fixedly positioned on said ring in the path of said light energy to provide maximum irradiation attenuation decreasing radially therefrom, said vertex being oriented at the center of said ring;

an eccentric drive wheel formed to engage said engaging surface of said external peripheral rim of said ring and impart a lateral oscillatory rotation thereto and provide a point of support therefor;

means for energizing said drive wheel; and

at least two tensioned idle wheels positioned in spaced relationship substantially opposite said drive wheel being formed to provide contact engagement with said engaging surface of said peripheral rim to insure engagement of said drive wheel with said peripheral edge and provide opposed points of support for said ring.

9. In a system wherein a source of light energy is utilized for exposing a foraminously masked light energy sensitive screen of a color cathode ray tube having an axis, an intermediately positioned device for diminishingly attenuating the light from said source as the radial distance from said axis increases comprising:

a movable ring having an external peripheral rim formed with an engaging surface thereon and an internal diameter sufficient to permit passage therethrough of light energy from said source to said masked screen;

a modified cardioidal-shaped blade, having an open asymptotic angle formed at a re-entrant vertex thereof, fixedly positioned on said ring in the path of said light energy to provide for predetermined discrete attenuation of said light energy, said re-entrant vertex being oriented at the center of said ring;

an eccentric drive wheel rotative on a fixed axis and formed to engage said engaging surface of said external peripheral rim of said ring and impart a lateral oscillatory rotation thereto and provide a point of support therefor;

means for energizing said drive wheel; and

at least two spring-loaded idle wheels positioned in spaced relationship substantially opposite said drive wheel being formed to provide contact engagement with said engaging surface of said peripheral rim to insure engagement of said drive wheel with said peripheral rim and provide opposed points of support for said ring.

10. The process for exposing the foraminously masked light sensitive screen of a color cathode ray tube having an axis, wherein a portion of the exposure light transmission from a point light source of substantially constant intensity is time varied by light modulation means of an oscillataory rotatable nature having a distal boundary, said exposure process comprising the steps of:

positioning said light sensitive screen opposite said light source in spaced relationship to the masked side thereof with said light modulation means therebetween; and

exposing said light sensitive screen to said light transmission in a manner that a portion of said screen, radially extensive from said axis, receives modulated light transmission through said oscillating modulation means to provide time varied exposure to said screen portion, said modulated time-varied exposure lengthening as the radial distance increases from said axis to said distal boundary wherebeyond said screen exposure is unattenuated by said modulation means.

11. An optical system having a light source for exposing a light sensitive surface having an axis in an electron discharge device comprising:

a blade formed for rotation about a vertex point thereof to provide predetermined attenuation of the light from said source and having provisions for supplying diminishing attenuation radially therefrom as the radial distance from said axis increases; and

means for imparting predetermined rotation and lateral oscillatory movement to said blade in a manner that the oscillatory frequency be greater than the rotational frequency.

12. An optical system for exposing the foraminously masked light sensitive screen of a color cathode ray tube having an axis comprising:

a point light source of substantially constant intensity positioned opposite said mask and spaced therefrom to provide light transmission therethrough to said screen;

a rotatable blade disposed between said light source and said screen and formed to modulate the light transmission originating from the point source to provide time varied exposure of the discrete areas of said screen, said varied time of exposure lengthening as the radial distance from said axis increases; and

means for imparting both rotation and lateral oscillatory movement to said blade in a manner to provide non-synchronized predetermined rotational and oscillatory frequencies to the same.

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