Feb. 15, 1966 R. M. LEVY 3,235,658

IMAGE RECORDING SYSTEM USING ELECTRONIC LIGHT AMPLIFICATION AND ULTRAVIOLET SENSITIVE RECORD

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Fig. 1

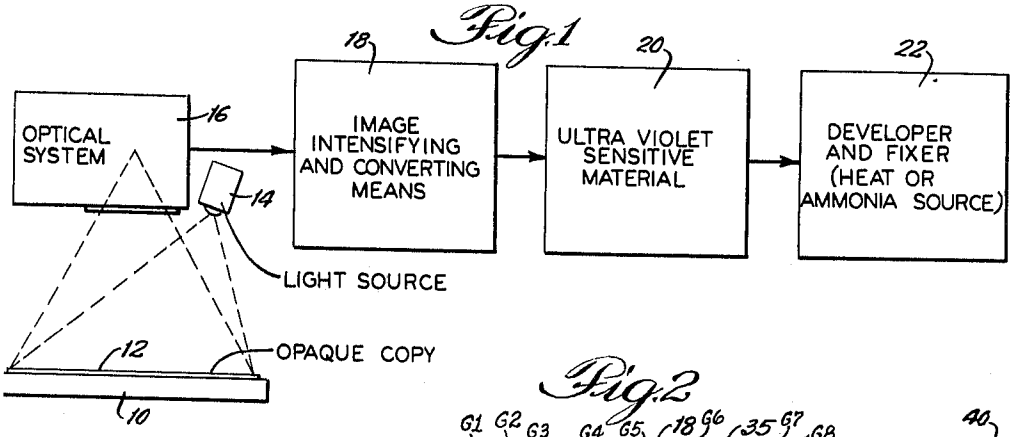


Fig. 2

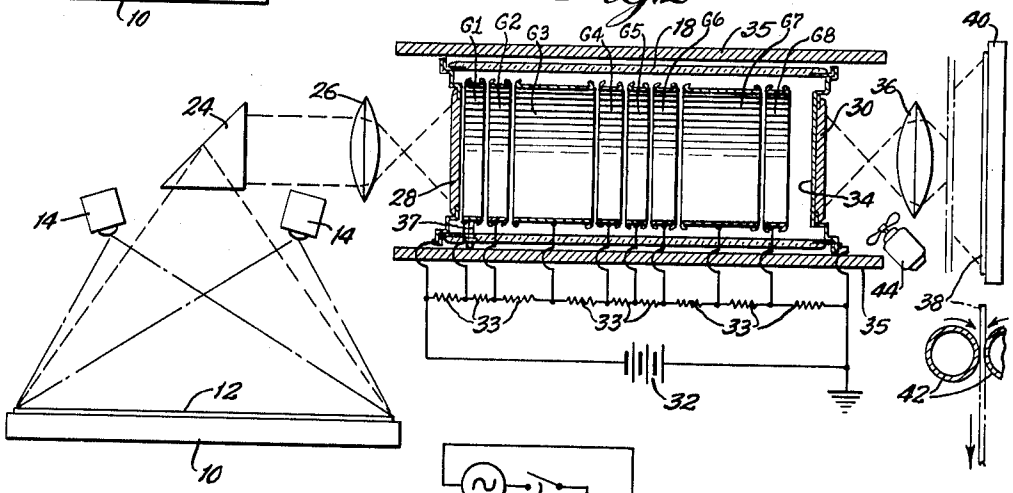
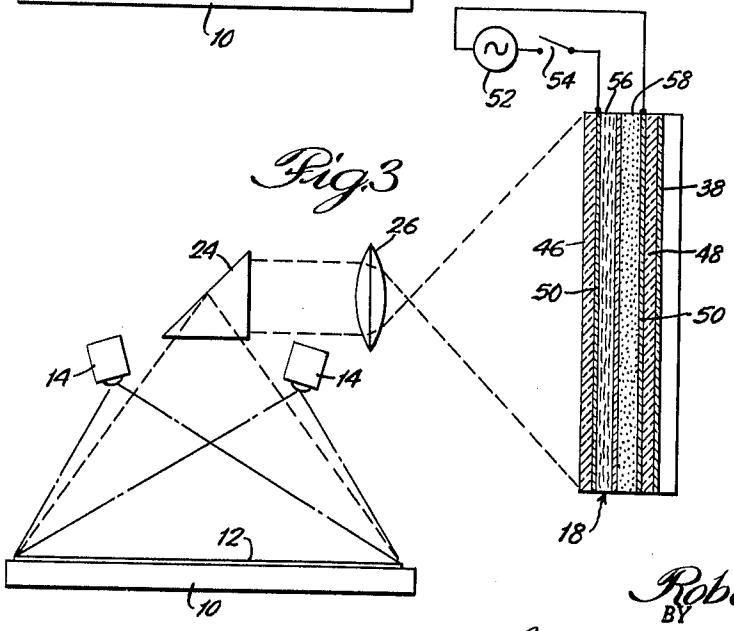


Fig. 3



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IMAGE RECORDING SYSTEM USING ELECTRONIC LIGHT AMPLIFICATION AND ULTRAVIOLET SENSITIVE RECORD

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This application relates generally to reproduction methods, systems and apparatus and more particularly to new and improved reproduction methods, systems and apparatus adapted to provide rapid direct positive copies from various types of subject matter on ultraviolet sensitive materials.

Those skilled in the art are familiar with the present techniques utilizing ultraviolet sensitive materials such as diazo-type, blueprint, "Kalfax," bichromated colloids, "Dyril" and the like. These materials are all characterized by being extremely slow when judged by normal photographic standards. For this reason, they generally are not utilized in projection-reflection copy techniques, even with the most intense ultraviolet radiation energy sources. They also are characterized by the fact that they are not useful in contact reflex copy techniques. Hence, their utility has been restricted heretofore to contact copy methods using only translucent or transparent original graphic matter.

These ultra-violet sensitive materials, on the other hand, do possess many advantages. In particular, they are relatively inexpensive to produce, they produce direct positive copies, they are relatively unaffected by visible light, X-rays and nuclear radiation, and they require only exceedingly simple development processing following exposure. Cumbersome darkroom methods therefore, are not required.

Other prior art techniques for copy reproduction utilizing different sensitized materials are useful in actual practice, but they are characterized by inherent disadvantages which limit their desirability or range of use. For example, normal photographic techniques first require the making of a negative and then a positive copy therefrom. In addition, conventional silver sensitized materials normally used in such photographic techniques are wet processed, requiring complex liquid chemicals for development and fixing, and are sensitive to nuclear radiation, X-rays, and the like as well as visible light, thereby requiring the exercise of considerable care in storing, handling and processing.

In addition to the wet photographic techniques utilized for photocopy and other image reproduction, other techniques are known which are characterized by dry, electronic operation. The most commonly used of such prior techniques include electrostatic printing systems of the xerographic type and heat sensitive printing systems of the thermographic type. Electrostatic printing systems form a latent electrostatic image by the selective dissipation of a uniform electrostatic charge previously placed upon a photoconductive surface, which latent image is developed by the application of suitable resin-based powders of opposite charge that subsequently are fixed, either upon the photoconductive surface or upon a substrate to which the powder image is transferred. Thermographic printing systems form an image by direct exposure of a heat sensitive substrate to high intensity irradiation and must be protected from heat both prior and subsequent to the formation of the image. Such prior art techniques have not proved entirely satisfactory as they are burdened by relatively high degrees of complexity and cost in construction and operation, or by an inability to make complete facsimile reproductions of objects of all types and colors, or by their sensitivity to visible light and heat radiation which requires special handling procedures.

Accordingly, it is a general object of this invention to provide a new and improved general purpose reproduction method, system and apparatus which overcomes the disadvantages characteristic of the prior art techniques.

It is a more specific object of this invention to provide a unique method, system and apparatus for making facsimile reproductions which are characterized by their relative simplicity and their flexibility in making rapid, and accurate facsimile reproductions of objects, documents, or the like, whether transparent, translucent or opaque.

In accordance with the features of one illustrative embodiment of the present invention, subject matter to be copied is illuminated by low intensity visible radiations, as for example, from an ordinary tungsten lamp and the reflected image is transmitted by suitable optics to an electronic image intensifying and converting apparatus. Such apparatus, in one preferred embodiment, may take the form of a high vacuum tube having an input photocathode sensitive to the visible light and emitting photoelectrons to form an electron beam corresponding to the visible light image. The electron beam is focused and intensified by acceleration of the photoelectrons in a high potential field and impinges upon a phosphor screen photoanode adapted to convert the electron image into an ultraviolet image. This ultraviolet image then is used to expose ultraviolet sensitive material having a corresponding spectral sensitivity to form a latent positive image of the object to be copied. This latent positive image then is developed, as by heat, ammonia, or other means depending upon the sensitized material, to provide an accurate, facsimile copy of the object.

Thus, it is another object of this invention to provide a new and improved reproduction method, system and apparatus which converts a visible light image to an electron image, intensifies the electron image and converts it to an ultraviolet image, exposes ultraviolet sensitive material to said ultraviolet image to form a latent image, and develops said latent image to provide an accurate direct positive copy.

It is still another object of this invention to provide such a new and improved reproduction method, system and apparatus, as above, wherein the ultraviolet image has spectral energy characteristics matched to the spectral absorption of the ultraviolet sensitive material, and does not require protection against ordinary visible light, X-rays, nuclear radiation, and the like.

It is a further object of this invention to provide such a new and improved reproduction method, system and technique, as above, wherein the ultraviolet sensitive material exposed to the ultraviolet image is developed and permanently fixed by the application of heat, ammonia, alkaline coupler, or the like, and is adaptable to dry, liquid or vapor techniques, as desired.

In accordance with the features of an alternative embodiment of this invention, the image intensifying and converting means may take the form of a pair of spaced-apart, transparent electrodes having a source of high frequency potential connected thereto to establish a potential field therebetween. Sandwiched between the spaced-apart electrodes is a thin film of a photoconductive material and a layer of an ultraviolet electroluminescent phosphor. Advantageously, these components comprising the image intensifying and converting means are assembled in close contact with each other so as to form an integral, compact assembly. When a visible light image impinges on the photoconductive material through one of the transparent electrodes, the impedance of the photoconductive film changes in accordance with the character-

istics of the visible light image. This change in impedance, in turn, causes changes to occur in the electrical field across the phosphor layer to produce an ultraviolet image at the other transparent electrode. Ultraviolet sensitive material, sensitive in the same spectral range as the image, is positioned adjacent to said other transparent electrode and is exposed to the ultraviolet image to form a latent image which may be developed as described above in accordance with knwon techniques.

Therefore, it is another object of this invention to provide new and improved facsimile reproduction apparatus which comprises an assembly of a pair of spaced-apart electrodes having a photoconductive film and an ultraviolet phosphor layer sandwiched therebetween.

It is a further object of this invention to provide new and improved image reproduction apparatus, as above, wherein a high frequency potential source is connected between said electrodes to establish a potential field such that the impedance changes in the photoconductive film in accordance with the impingement of a visible light image thereon causes changes in the potential field to occur across the phosphor layer to produce an ultraviolet image for exposing an ultraviolet sensitive substrate.

It is a still further object of this invention to provide a new and improved reproduction method, system and apparatus as above, which is characterized by its speed and flexibility of operation, and its adaptability of use with various types of translucent, transparent, and opaque objects to be copied.

The novel features which are characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following description taken in conjunction with the accompanying drawing in which:

FIGURE 1 illustrates in block diagram form the method of operation and the construction of an image reproducing system embodying the principles of the present invention;

FIGURE 2 illustrates one illustrative embodiment of the invention which utilizes a high vacuum image intensifying and converting tube as one element of the system; and

FIGURE 3 illustrates an alternative embodiment of the invention which utilizes a compact, unitary assembly of transparent electrodes, photoconductive film, and ultraviolet electroluminescent phosphor layer in a high frequency potential field to provide intensification and conversion of the visible light image to an ultraviolet image.

Referring now to the drawing, and more particularly to FIGURE 1 thereof, there is shown an object **10** which is the original from which the reproduction is to be made. In accordance with one of the highly advantageous features of this invention, the original object **10** may be transparent, translucent, or opaque, and if the object **10** takes the form of a document, the document may be printed on one or both sides without adversely affecting the operation of the invention. For purposes of illustration, the object **10** will be described as a document bearing the printed matter **12** on the upper surface thereof, although those skilled in the art will readily appreciate as this description proceeds, that the invention is not limited to use with a printed document but in fact, can be used to produce facsimile copies of any object from which a visible light image can be obtained and that the object may be a moving web in a scanning system as well as a stationary object.

The visible light image of the printed matter **12** may be obtained through the use of any suitable visible light source such as natural light, a tungsten source, etc. In the illustrative embodiment of FIGURE 1, the light source **14** is shown as positioned above the printed matter **12** to form a reflected visible light image thereof, although it will be appreciated that if the objects **10** is formed of transparent or translucent material, the light source **14** may be positioned below the object **10** for light transmission therethrough to form the visible light image to be reproduced.

The reflected visible light image from the printed matter **12** on the object **10** is transmitted through a suitable optical system **16** to the input of image intensifying and converting means **18**. It will be appreciated by those skilled in the art that the optical system **16** may comprise suitable prisms, mirrors, and optical lenses, as desired, for transmitting the visible light image to the image intensifying and converting means **18**. It also will be understood that, under ordinary circumstances, the visible light image will be of relatively low intensity when it impinges the image intensifying and converting means **18**.

In accordance with a feature of this invention, this relatively low intensity visible light image is intensified at the image intensifying and converting means **18**, as by converting the visible light image to a photoelectron image through the use of a photocathode having a photoemissive surface and by subjecting the photoelectrons generated at the photocathode to a relatively high potential for accelerating the photoelectrons. The accelerated photoelectrons comprising the intensified photoelectron image impinge upon an ultraviolet emitting phosphor for converting the photoelectron image to a corresponding relatively high intensity ultraviolet image. It will be appreciated that the intensity of the ultraviolet light image thus generated will be dependent upon the intensity of the visible light image transmitted to the image intensifying and converting means **18** and upon the degree of intensification of the photoelectron image within the image intensifying and converting means **18**.

The ultraviolet image at the output of the image intensifying and converting means **18** then is caused to expose ultraviolet sensitive material, which in one use of the invention, may take the form of an ultraviolet sensitive diazo paper **20** to form a latent image of the printed matter to be copied.

In accordance with known techniques for developing latent images upon diazo paper, the diazo paper **20** then may be suitably developed to form a facsimile reproduction of the original graphic or other subject matter. As explained in greater detail hereinbelow, the latent image on the diazo paper may be developed by applying heat, ammonia, or liquid alkaline coupler, thereto, and the invention is not limited in its use to either heat development, ammonia development, or other types of development, either in a wet or dry form. Ultraviolet sensitive diazo materials suitable for use in the invention are available commercially, such as the ammonia vapor developable materials, and so-called moist developable materials, both of which give dye images; heat developable materials of the type which forms a bubble image such as the Kalvar materials sold by the Kalvar Corporation of New Orleans, Lousiana, bichromated colloids which gives a relief image after exposure and washing with water, Dycril plastic which gives a relief image after exposure and washing with dilute alkali, and direct positive ordinary blueprint papers. Thus, it is clear that the use of the invention is not limited to any specific types of ultraviolet sensitive materials and that the exemplary materals discussed herein merely are illustrative of such ultraviolet sensitive materials.

A specific illustrative embodiment of the invention is illustrated in FIGURE 2 of the drawing. As there shown, the object to be copied **10** is illuminated by the visible light source **14** to provide an incident, reflected, visible light image. This relatively feeble visible light image is transmitted by means of the optical system comprising the prism **24** and the lens **26** to an image intensifying and converting means **18** where it is focused upon the photocathode **28**. The photocathode **28** serves to generate photoelectrons forming the photoelectron image corresponding to the visible light image which impinges upon the photocathode. Various photoemissive materials suitable for use as the photocathode **28** are known to those,

skilled in the art, and for example, the photocathode **28** advantageously may comprise oxidized cesium antimony or its equivalent. It is advantageous of course, to utilize a photocathode having a spectral response matched to the source of illumination.

As shown in the illustrative embodiment of FIGURE 2, the image intensifying and converting means **18** may take the form of a magnetically focused high vacuum tube having the photocathode **28** at one end thereof and a photoanode or phosphor screen **30** spaced therefrom at the other end of the vacuum tube **18**. Advantageously, a source of high potential **32**, for example the source of D.C. potential in the order of 25,000 volts, is connected between the photocathode **28** and the photoanode **30** so as to create a high potential field in the vacuum tube for accelerating the photoelectrons emitted by the photocathode **28**.

In this illustrative embodiment, the image intensifying and converting tube **18** advantageously may comprise a plurality of radial lens members G1, G2, G3, G4, G5, G6, G7 and G8 successively positioned within the envelope of tube **18**, which lens members may take the form of stainless steel cylindrical shells for accelerating the photoelectron image from the photocathode **28** to provide the desired degree of intensification. This acceleration is effected by a voltage divider comprising a plurality of resistances **33** connected across the terminals of the high potential source **32**, the junctions of each pair of resistances being connected respectively to individual ones of said radial lens members, as shown in FIGURE 2.

The accelerated photoelectrons are focused on the photoanode phosphor screen **30**, either by suitable electrostatic focusing means or by electromagnetic means, such as the electromagnet **35** shown adjacent the image intensifying tube **18** in FIGURE 2. Those skilled in the art will appreciate that the function of the electromagnet **35** in this embodiment of the invention is to provide sharper focus of the photoelectron image by spinning the electrons as they pass through the radial lens members within the tube **18**. These electrons end up at the exact point of focus on the photoanode **30** corresponding to the point of light impingement on the photocathode **28**.

In accordance with a feature of this invention, the photoanode phosphor screen **30** is comprised of an ultraviolet cathodoluminescent phosphor material. One such material, which is known in the art as P–16 phosphor, comprises calcium magnesium silicate which has been cerium activated. Thus, it will be appreciated, that the impingement of the intensified photoelectron image on the phosphor screen **30** converts the electron image to an ultraviolet image which in the illustrative example emits energy in the spectral range of approximately 3300 to 4500 Angstroms which matches closely the ultraviolet absorption of commercially available diazo papers. It will further be appreciated that the intensity of the ultraviolet light image at the phosphor screen **30** will be dependent upon the intensity of the visible light image transmitted to the image intensifying and converting means **18**, upon the power supplied, and upon the efficiency of the photocathode and photoanode.

Also, as shown in the FIGURE 2 embodiment, the high vacuum image intensifying and converting tube **18** includes an aluminum backing **34** on the photocathode side of the phosphor screen **30**. The purpose of the aluminum backing **34** is to prevent light feedback from the phosphor screen **30** so that all the ultraviolet image is transmitted through the output lens system of the tube **18**. This ultraviolet image is transmitted through a suitable lens system **36** or a fiber optic system on the photoanode face (not shown) to impinge upon and expose the ultraviolet sensitive surface **38** of a record sheet positioned on the backing plate **40** or placed directly adjacent to the fiber optic tube face (not shown). In accordance with a feature of this invention, the energy absorption characteristics of the ultraviolet sensitive surface **38** is matched to the spectral energy output of the phosphor. The closer the match between this absorption characteristic and the phosphor, the more effective the system. Therefore, in this embodiment the ultraviolet sensitive surface has a spectral sensitivity in the range of approximately 3300 to 4500 Angstroms so that a latent image of the object to be copied is formed on the ultraviolet sensitive material when it is exposed to the ultraviolet image.

Advantageously, the ultraviolet sensitive material may take the form of a diazo paper in which the latent image may be developed by the application of heat, ammonia, or other means, in accordance with well-known practices. Thus, if the ultraviolet sensitive material is in the form of Kalvar paper, the latent image may be developed by transporting the ultraviolet sensitive sheet **38** through the heated rollers **42**, or in the alternative, the ultraviolet sensitive sheet **38** may be exposed to other heat sources such as infra-red lamps. Where other types of ultraviolet sensitive papers are used, the latent image may be developed by similar heat sources, by ammonia vapor or by other means in accordance with known techniques.

If in the use of the invention, the efficiences of the photoanode phosphors are so low as to require relatively high degrees of energy absorption by the copy to obtain full exposure, the temperature of the photoanode phosphor may rise to an undesirable point. In this event, it is contemplated that the photoanode phosphor surface may be cooled, as by the fan **44**, or alternatively cooled by any suitable means. In addition, a conductive coating can be applied to the photocathode surface **28** to reduce resistivity and to increase the acceleration of the photoelectrons generated by the photocathode. Still further, it is within the principles of this invention that the photoelectron acceleration may be improved by the use of high intensity pulsing accelerating voltages.

In one embodiment of the invention, the image intensifying and converting means **18** took the form of a high vacuum light image intensifying tube manufactured by the Westinghouse Electric Corporation and similar to type WX–4480 which was magnetically focused and supplied with a 5–10 photocathode and a P–16 phosphor. Manifestly, this particular type of light image intensifier tube is merely one type of image intensifying and converting means suitable for use in the invention disclosed herein, and the use of the invention is not limited to such a particular type of light image intensifier tube.

FIGURE 3 illustrates an alternative embodiment of the invention which utilizes a different type of image intensifying and converting means. As there shown, the object **10** to be copied is illuminated by means of the light source **14** to provide a visible light image, as discussed hereinabove. This visible light image is transmitted and focused by means of the optical system comprising the prism **24** and lens **26** so as to impinge upon the photocathode of the image intensifying and converting assembly **18**. In this particular embodiment, the image intensifying and converting means **18** advantageously comprises a unitary assembly formed of a pair of spaced-apart transparent electrodes **46** and **48**, which may be formed of glass covered with a transparent tin oxide layer **50**. The metallic layer **50** of each transparent electrode is connected to a terminal of a high frequency A.C. source **52** which, when the switch **54** is closed, provides an alternating potential field between the spaced-apart electrodes. Sandwiched between the spaced-apart electrodes, is a thin film **56** of the photoconductive material, which may be cadium sulphide. Adjacent the photoconductive film **56**, there may be a layer of opaque dielectric material to prevent light feedback (not shown) and a layer of ultraviolet electroluminescent material **58**, which for example, may take the form of an activated zinc sulphide or the like. As shown in FIGURE 3, the spaced-apart transparent electrodes, the photoconductive film, and the ultraviolet phosphor layer are assembled in a compact unitary assembly which in actual practice, can be a relatively thin and

lightweight arrangement. A sheet of ultraviolet sensitive material **38** is positioned adjacent the electrode **48**, for exposure by the ultraviolet image in the manner described hereinbelow.

Thus, in the operation of the invention, the incident or reflected visible light image impinging upon the photoconductive film **56** causes its impedance to be changed in accordance with the characteristics of the visible light image. This change in impedance causes charges to occur in the electrical field across the phosphor layer **58** to produce an ultraviolet light image at the transparent electrode **48** adjacent the ultraviolet sensitive material **38**. It will be appreciated that the degree of amplification of the image in this embodiment is a function of the applied voltage from the source **52**, the intensity of the input visible light image from the optical light system and the efficiencies of the photoconductor and the phosphor.

Thus, there is described and illustrated hereinabove a new and improved method, system and apparatus for facsimile reproduction of subject matter. This invention has the advantage of speed, low cost, accurate reproduction from any object, whether transparent, translucent or opaque, and of the use of ultraviolet sensitive materials which can be developed by heat, ammonia, or other means and which materials are relatively unaffected by visible light, X-rays, nuclear radiation and the like.

While there has ben shown and described a specific embodiment of the present invention, it will, of course, be understood that various modifications and alternative constructions may be made without departing from the true spirit and scope of the invention. Therefore, it is intended by the appended claims to cover all such modifications and alternative constructions as fall within their true spirit and scope.

What is claimed as the invention is:

1. The improvement of apparatus for making facsimile reprodctions of an object to be copied comprising the combination of optical means for transmitting a visible light image of the object to be copied, electronic image intensifying and converting apparatus including a photocathode having a photoemissive surface for receiving said transmitted visible light image and for generating photoelectrons forming a corresponding electron image, a phosphor screen photoanode spaced from said photocathode, a source of high potential connected between said photocathode and photoanode for accelerating said photoelectrons to intensify said photoelectron image, said phosphor screen photoanode being effective to convert said photoelectron image to an ultraviolet image when the intensified photoelectron image impinges thereon, ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet image and operatively associated with said electronic image intensifying and converting apparatus for receiving said ultraviolet image to form a latent image of said object to be copied and means for developing said latent image to provide a visible reproduction of said object.

2. The improvement of aparatus for making facsimile reproductions of an object to be copied comprising the combination of optical means for transmitting a visible light image of the object to be copied, electronic image intensifying and converting apparatus including a photocathode having a photoemissive surface for receiving said transmitted visible light image and for generating photoelectrons forming a corresponding electron image, a phosphor screen photoanode spaced from said photocathode, a source of high potential connected between said photocathode and photoanode for accelerating said photoelectrons to intensify said photoelectron image, said phosphor screen photoanode being effective to convert said photoelectron image to an ultraviolet image when the intensified photoelectron image impinges thereon, utraviolet sensitive material having a spectral sensitivity in the spectral range of ultraviolet image and operatively associated with said electronic image intensifying and converting apparatus for receiving said ultraviolet image to form a latent image of said object to be copied and a source of heat adapted to apply heat to said ultraviolet sensitive material for developing said latent image to provide a visible reproduction of said object.

3. The improvement of apparatus for making facsimile reproductions of an object to be copied comprising the combination of optical means for transmitting a visible light image of the object to be copied, electronic image intensifying and converting apparatus including a photocathode having a photoemissive surface for receiving said transmitted visible light image and for generating photoelectrons forming a corresponding electron image, a phosphor screen photoanode spaced from said photocathode, a source of high potential connected between said photocathode and photoanode for accelerating said photoelectrons to intensify said photoelectron image, said phosphor screen photoanode being effective to convert said photoelectron image to an ultraviolet image when the intensified photoelectron image impinges thereon, a sheet of ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet image and operatively associated with said electronic image intensifying and converting apparatus for being exposed to said ultraviolet image to form a latent image of said object to be copied, a source of heat for applying heat to said sheet to develop said latent image to provide a visible reproduction of said object, and sheet transport means for moving said exposed sheet into heat receiving relationship with said source of heat.

4. The improvement in accordance with claim **3** wherein said sheet transport means comprises heated friction rollers.

5. The improvement of apparatus for making facsimile reproductions of an object to be copied comprising the combination of optical means for transmitting a visible light image of the object to be copied, electronic image intensifying and converting apparatus for receiving said transmitted visible light image and for generating photoelectrons forming a corresponding electron image, a source of high potential connected to said apparatus for accelerating said photoelectrons to intensify said photoelectron image, said apparatus comprising a phosphor screen effective to convert said photoelectron image to an ultraviolet image when the intensified photoelectron image impinges thereon, ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet image and operatively associated with said electronic image intensifying and converting apparatus for being exposed to said ultraviolet image to form a latent image of said object to be copied, and means for developing said latent image to provide a visible reproduction of said object.

6. The improvement in accordance with claim **5** wherein said last-named means comprises a source of heat adapted to develop said latent image by applying heat to said exposed material.

7. The improvement in accordance with claim **5** wherein said last-named means comprises a source of ammonia adapted to develop said latent image by applying ammonia to said exposed material.

8. The improvement of apparatus for making facsimile reproductions of an object to be copied comprising the combination of electronic image intensifying and converting apparatus for receiving the visible light image and for generating photoelectrons forming a corresponding electron image, a source of potential connected to said apparatus for accelerating said photoelectrons to intensify said photoelectron image, said apparatus comprising means effective to convert said intensified photoelectron image to an ultraviolet image, ultraviolet sensitive material having a special sensitivity in the spectral range of said ultraviolet image and operatively associated with said electronic image intensifying and converting

apparatus for receiving said ultraviolet image to form a latent image of said object to be copied and means for developing said latent image to provide a visible reproduction of said object.

9. The improved method of making facsimile reproductions of an object comprising the steps of forming a visible light image of an object to be copied, transmitting said visible light image through a suitable optical system to an electronic intensifying and converting apparatus capable of converting said visible light image to a corresponding electron image and intensifying said electron image, causing the intensified electron image to impinge upon a suitably coated surface to convert said electron image to a corresponding ultraviolet light image, and having an intensity dependent upon the intensity of the visible light image transmitted to said apparatus and upon the degree of intensification of said electron image within said apparatus, causing the ultraviolet light image from said apparatus to impinge upon ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet light image to form a latent image of the object to be copied, and developing said latent image on the ultraviolet sensitive material to form a visible copy of said object.

10. The improved method of making facsimile reproductions of an object comprising the steps of forming a visible light image of an object to be copied, transmitting said visible light image through a suitable optical system to an electronic intensifying and converting apparatus capable of converting said visible light image to a corresponding electron image and intensifying said electron image, causing the intensified electron image to impinge upon a suitably coated surface to convert said electron image to a corresponding ultraviolet light image, and having an intensity dependent upon the intensity of the visible light image transmitted to said apparatus and upon the degree of intensification of said electron image within said apparatus, causing the ultraviolet light image from said apparatus to impinge upon ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet light image to form a latent image of the object to be copied, and applying heat to said ultraviolet sensitive material to develop said latent image and form a visible copy of said object on said material.

11. The improved method of making facsimile reproductions of an object comprising the steps of forming a visible light image of an object to be copied, transmitting said visible light image through a suitable optical system to an electronic intensifying and converting apparatus capable of converting said visible light image to a corresponding electron image and intensifying said electron image, causing the intensified electron image to impinge uopn a suitably coated surface to convert said electron image to a corresponding ultraviolet light image, and having an intensity dependent upon the intensity of the visible light image transmitted to said apparatus and upon the degree of intensification of said electron image within said apparatus, causing the ultraviolet light image from said apparatus to impinge upon ultraviolet sensitive diazo material having a spectral sensitivity in the spectral range of said ultraviolet light image to form a latent image of the object to be copied, and applying ammonia to said ultraviolet sensitive diazo material to develop said latent image and form a visible copy of said object on said diazo material.

12. The improved method of facsimile reproductions of an object comprising the steps of forming a visible light image of an object to be copied, converting said visible light image to a corresponding electron image and intensifying said electron image, converting the intensified electron image to a corresponding ultraviolet light image, causing the ultraviolet light image to impinge upon ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet light image to form a latent image of the object to be copied, and developing said latent image on the ultraviolet sensitive material to form a visible copy of said object.

13. The improved method of making facsimile reproductions of an object comprising the steps of forming a visible light image of an object to be copied, converting said visible light image to a corresponding electron image and intensifying said electron mage, converting the intensified electron image to a corresponding ultraviolet light image, causing the ultraviolet light image to impinge upon ultraviolet sensitive diazo material having a spectral sensitivity in the spectral range of said ultraviolet light image to form a latent image of the ojbect to be copied, and applying heat to said ultraviolet sensitive diazo material to develop said latent image and form a visible copy of said object of said diazo material.

14. The improved method of reproducing a visible light image of an object comprising the steps of forming a visible light image of an object to be copied, converting said visible light image to a corresponding electron image and intensifying said electron image, converting the intensified electron image to a corresponding ultraviolet light image, causing the ultraviolet light image to impinge upon ultraviolet sensitive diazo material having a spectral sensitivity in the spectral range of said ultraviolet light to form a latent image of the object to be copied, and applying ammonia to said ultraviolet sensitive diazo material to develop said latent image and form a visible copy of said object on said diazo material.

15. The improved method of reproducing a visible light image of an object comprising the steps of forming a visible light image of an object to be copied, transmitting said visible light image through a suitable optical system to an electronic intensifying and converting apparatus, of the type having a thin film of photoconductive material and a layer of ultraviolet electroluminescent phosphor sandwiched between a pair of transparent electrodes, causing the visible light image to impinge on said thin film of photoconductive material to change its impedance and thereby change the electrical field occurring across the phosphor layer in accordance with said visible light image for generating corersponding ultraviolet light image, causing the ultraviolet light image from said phosphor layer to impinge upon ultraviolet sensitive material positioned adjacent one transparent electrode and having a spectral sensitivity in the spectral range of said ultraviolet light image to form a latent image of the object to be copied, and developing said latent image on the ultraviolet sensitive material to form a visible copy of said object.

16. The improvement of apparatus for making facsimile reproductions of an object to be copied comprising the combination of optical means for transmitting a visible light image of the object to be copied, electronic image intensifying and converting apparatus including a pair of spaced-apart transparent electrodes having sandwiched therebetween a thin film of photoconductive material and an ultraviolet electroluminescent phosphor layer, a source of high potential connected between said pair of spaced-apart transparent electrodes, said optical means causing said visible light image to impinge on said thin film of photoconductive material to change its impedance in a manner corresponding to said visible light image and thereby cause changes to occur in the electrical field across said phosphor layer to provide an ultraviolet image, ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet image positioned adjacent one transparent electrode of said electronic image, intensifying and converting apparatus for receiving the ultraviolet image to form a latent image of said object to be copied and means for developing said latent image to provide a visible reproduction of said object.

17. The improvement of apparatus for making facsimile reproductions of an object to be copied comprising

the combination of electronic image intensifying and converting apparatus including a pair of spaced-apart transparent electrodes having a photoconductive film and an ultraviolet electroluminescent phosphor layer positioned therebetween, a source of high potential connected to said transparent electrodes, optical means for causing a visible light image of the object to be copied to impinge on one of said transparent electrodes to change the impedance of said photoconductive film and for causing charges to occur across said phosphor layer in a manner corresponding to said visible light image, the occurrence of charges across said phosphor layer being effective to generate an ultraviolet image, ultraviolet sensitive material having a spectral sensitivity in the spectral range of said ultraviolet image positioned adjacent the other transparent electrode of said electronic image intensifying and converting apparatus for receiving said ultraviolet image to

form a latent image of said object to be copied and means for developing said latent image to provide a visible reproduction of said object.

18. The improvement in accordance with claim **17** wherein said photoconductive film is comprised of cadmium sulphide and said phosphor layer is comprised of zinc sulphide.

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