

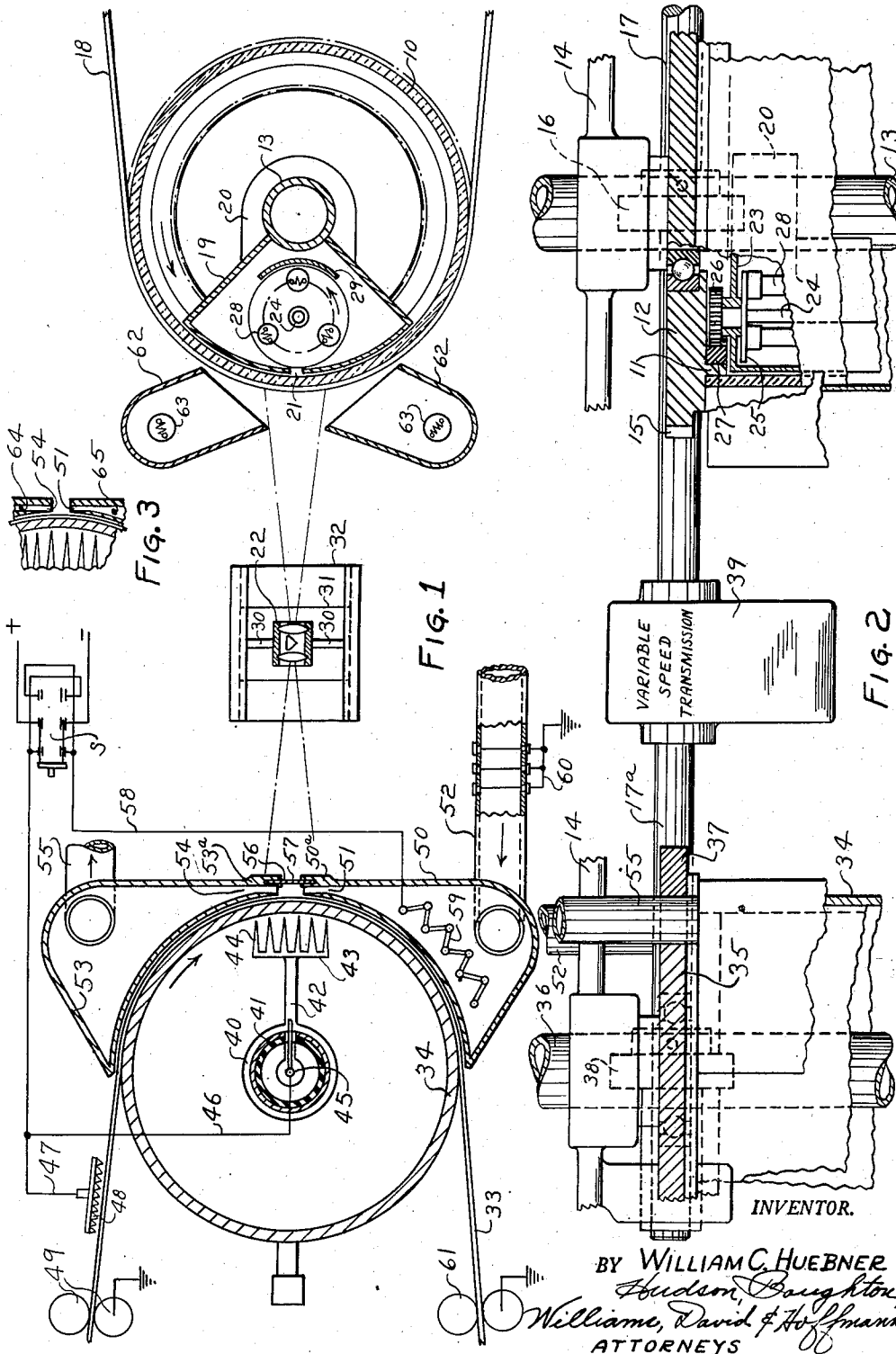
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W. C. HUEBNER

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METHOD AND APPARATUS FOR REPRODUCING IMAGES

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1

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METHOD AND APPARATUS FOR REPRODUCING IMAGES

William C. Huebner, Mamaroneck, N. Y., assignor to The Huebner Company, Dayton, Ohio, a corporation of Ohio

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This invention relates to a process and apparatus for reproducing or printing images such as texts, illustrations, symbols and the like on print receiving material.

An object of the invention is to provide a method and apparatus for printing or reproducing on print receiving material images such as texts, illustrations, symbols and the like wherein the reproduction or printing of the image is accomplished directly from the copy to the print receiving material in final and complete form.

Another object is to provide a method and apparatus as referred to above and wherein the need for the usual or conventional printing plates, inking apparatus, driers and the like is eliminated and consequently the labor and material costs incident to the preparation and use of such plates, apparatus and the like are eliminated.

Another object is to provide a method and apparatus as hereinbefore referred to and wherein the reproduced or printed images on the print receiving material are in final form and do not require drying or further processing or finishing operations.

A still further object is to provide a method and apparatus such as previously referred to and wherein the reproduced or printed image may have any desired size-relationship with respect to the copy image.

A still further object is to provide a method and apparatus as hereinbefore referred to and wherein the reproduced or printed image on the print receiving material is of the same order as the copy image without reversal.

A still further object is to provide a method and apparatus of the character referred to and wherein the print receiving material and the image copy may be substantially spaced apart and the image reproduced or printed on the material without contact between the material and the image copy and without the necessity of inking the image copy or of having means for migrating ink from the image copy to the print receiving material and then subsequently drying the migrated ink on the receiving material.

A still further object is to provide a process and apparatus as hereinbefore referred to and wherein the image copy may be either light reflecting or light transmitting as, for example, opaque copy or transparent copy.

Further and additional objects and advantages not hereinbefore referred to will become apparent hereinafter during the detailed description of an embodiment of the invention which is to follow and which is illustrated in the accompanying drawing, wherein:

Figure 1 is a diagrammatic partial elevation and partial section illustrating an apparatus embodying the invention and capable of carrying out the method.

Fig. 2 is a partial plan view of the apparatus shown in Fig. 1 with certain portions broken away and shown in section, and

Fig. 3 shows a modified construction which may be employed at the printing zone.

The invention contemplates reproducing or printing images on print receiving material by transmitting light rays through the image copy or by reflecting light rays

2

therefrom, with said light rays passing through a lens and projected upon the print receiving material to produce thereon light or radiant areas and dark areas. If the image areas of the image copy are light transmitting or light reflecting then the lighted or radiant areas on the print receiving material will correspond to the image areas of the copy. On the other hand, if the non-image areas of the image copy are light transmitting or light reflecting then the lighted or radiant areas on the print receiving material will correspond to the non-image areas of the copy while the dark or non-radiant areas on the material will correspond to the image areas of the copy. In either case the light rays transmitted through or reflected from the image copy and passing through the lens and projected upon the print receiving material act to dispel negative charges or electrons from the lighted or radiant areas, wherefore said radiant areas have a positive charge or characteristic while the dark areas on the print receiving material will have no charge or a negative charge or characteristic.

It will be assumed first that the image areas of the image copy transmit or reflect the light rays while the non-image areas of the copy do not do so, and hence the lighted or radiant areas on the print receiving material represent the areas which are to receive the reproducing material to reproduce or print the image on the receiving material. Under these circumstances an electrode connected to the positive side of a suitable electrical source will be located behind the print receiving material at the printing zone while said receiving material will also have imparted thereto from the same source a positive precharge.

Suitable precharging electrodes for the reproducing material will be connected to the negative side of the electrical source. Then when the reproducing material is passed across the last mentioned electrodes on its way to the printing zone it will be negatively precharged or ionized.

It is contemplated using reproducing material in cloud-like form such as smoke (combustion from dry or liquid bases, or chemical), mist, vapor, gas or the like. When the negatively precharged or ionized reproducing material reaches the printing zone it will follow the light rays to the print receiving material and be deposited on the positive radiant areas of the receiving material.

The deposition of the reproducing material on the radiant areas of the receiving material reproduces or prints thereon the desired image. If the image copy has the non-image areas light transmitting or light reflecting then the radiant areas on the print receiving material will represent the non-image areas and the reproducing material will be deposited on such non-image areas while the reproduced image will be represented by the non-radiant areas of the print receiving material which receive no deposit.

Certain reproducing materials may be found to function more satisfactorily if positively precharged or ionized than is the case if they are negatively precharged or ionized. In those instances where the reproducing material is positively precharged or ionized then the electrode behind the print receiving material is connected to the negative side of the circuit and the print receiving material is given a negative precharge. Under these circumstances the light rays striking the print receiving material produce the positive radiant areas thereon while the dark or non-radiant areas on the print receiving material have negative characteristics. Consequently the positively precharged or ionized reproducing material when it enters the printing zone will migrate to and be deposited on the dark or non-radiant areas of the print receiving material. If the image areas of the image copy are light transmitting

or reflecting then the non-radiant areas of the print receiving material which receive the deposit will represent the non-image areas. On the other hand, if the non-image areas of the image copy are light transmitting or light reflecting then the non-radiant areas of the print receiving material which receive the deposit will represent the image areas.

Preferably the lens through which the light rays pass will be a reversing lens so that the reproduced image on the print receiving material will be of the same order as the image copy and a non-reversed reproduction thereof.

The image copy and the print receiving material are moved at correlated speeds in the same direction, i. e., both downwardly for example, for the reproduction of the same size images as the copy or different size images relative to the copy. The lens is adjustable intermediate the image copy and the printing zone to vary its focal point to effect image reproduction of the same size or of different sizes with respect to the image copy.

Referring to the drawing, a cylinder 10 constitutes the support for the image copy. The cylinder 10 is shown as formed of light transmitting material such as glass or plastic and it is supported at its opposite ends upon annular flanges 11 formed on the adjacent sides of end plates 12. The end plates 12 are rotatably supported by means of suitable bearings upon a tubular supporting shaft 13 which is fixedly mounted in a suitable supporting frame, a portion of which is indicated at 14.

One of the end plates 12 extends beyond the circumference of the cylinder 10 and has formed on its circumference helical gear teeth 15 which mesh with a helical gear 16 fixed to a rotatable drive shaft 17 extending longitudinally of the frame and later to be referred to. The drive shaft 17 may be driven by any suitable means and its rotation causes rotation of the end plates 12 and cylinder 10 at a desired speed as will later be referred to.

For purposes of illustration an image copy in the form of a transparent belt 18 is shown as passing around the cylinder 10 so as to be moved by the rotation of the cylinder. The transparent belt or image copy 18 may be in the form of a film having the image thereon as texts, illustrations, symbols or the like. The image portions of the belt 18 will be opaque or partially opaque while the non-image portions thereof will be transparent or light transmitting.

A hood or light confining enclosure 19 extending the axial length of the cylinder 10 is mounted in fixed relationship within the cylinder by means of bracket portions 20 supported upon the fixed shaft 13. The hood 19 is of general triangular configuration in cross section with that wall portion of the hood adjacent to the inner circumference of the cylinder 10 being arcuate and concentric to the cylinder. The arcuate wall portion just referred to is provided with a slot 21 extending the longitudinal length of the hood and located in the focal axis of a lens 22, later to be referred to. The hood 19 at its opposite ends has end plates 23 provided with centrally located bearing bosses which rotatably mount a small diameter shaft 24 having fixed thereto adjacent the end plates 23 light supporting disks 25. The shaft 24 outwardly of an end plate 23 of the hood 19 at one of its ends has fixed thereto a pinion 26 which meshes with an internal gear 27 formed on or fixed to the inner side of the annular flange 11 of the said end plate 12.

It will be seen that as the cylinder 10 rotates the shaft 24 will rotate at a substantially increased speed and cause the light supporting disks 25 to rotate with the shaft 24. Elongated tubular lights 28 extend between and are supported by the disks 25, there being three such lights shown as equally spaced circumferentially of the disks. It will be understood that suitable and well known means may be provided for connecting the lights to an electric circuit so that all of said lights will remain illuminated during the rotation of the disks 25 with the lights carried thereby.

An arcuate reflector plate 29 is fixedly supported in the hood 19 and is concentric to the circular path of movement of the lights 28 and is located directly in line with the slot 21 in the hood 19 and extends the longitudinal length of the hood.

The lens 22 may be of any suitable construction although it is contemplated using as a preferable form the reversing lens disclosed in my United States Patent 2,408,855, issued October 8, 1946, and the description contained in said patent of said reversing lens is incorporated herein by reference.

The lens housing is supported by ribs 30 formed on a plate 31 which can be adjusted longitudinally of a base 32, it being noted that the opposite ends of the plate 31 extend into guide channels formed in upwardly extending portions of the base 32. The lens 22 can be adjusted longitudinally of the base 32 from a central position wherein the reproduced image will be of the same size as the image copy to either side of central position for reproducing images larger or smaller than the image copy as the case may be. It will also be understood that the lens may be locked in adjusted position by any suitable means utilized in the art for this purpose.

The print receiving material is indicated at 33 and is shown in the form of a web which extends around a cylinder 34 supported on end plates 35 which may be similar to the end plates 12 that support the transparent cylinder 10. The end plates 35 are rotatably mounted by suitable bearings on a hollow fixed shaft 36 supported by the frame 14. One of the end plates 35 is radially extended beyond the periphery of the cylinder 34 and is provided on its circumference with helical gear teeth 37 meshing with a helical gear 38 fixed to a drive shaft 17a. The drive shafts 17 and 17a are operatively interconnected by any suitable and known variable speed transmission indicated at 39, wherefore the cylinder 34 can be driven at the same speed as the cylinder 10 or at an increased or decreased speed relative thereto.

The cylinder 34 may be formed of metal and properly electrically insulated with respect to the end plates 35 as will be well understood in the art.

The shaft 36 has a collar 40 secured to it with an insulating sleeve 41 interposed between the collar 40 and the shaft 36. The collar 40 supports an arm 42 which extends radially of the interior of the cylinder in a plane that includes the focal axis of the lens 22. The collar 40 may carry a plurality of the arms 42 spaced apart longitudinally of the cylinder or a single arm 42 may be used which is elongated in the longitudinal or axial direction of the cylinder 34. The outer end of the arm 42 carries a plate 43 that extends the axial length of the cylinder 34 and from said plate extend a plurality of blade-like teeth or prongs 44 spaced apart with their free or pointed ends lying closely adjacent to the inner circumference of the cylinder 34.

An electrical conduit 45 extends through the hollow shaft 36 and is electrically insulated therefrom and is electrically connected to the plate 43 and blade-like teeth or prongs 44. The conduit 45 is connected by a wire 46 to one side of an electrical circuit. The blade-like teeth or prongs 44 may be designated as attraction electrode elements which function in a manner later to be described. The said one side of the electrical circuit referred to is also connected by a wire 47 to a suitable electrode 48 located closely adjacent to the outer surface of the web 33 of the print receiving material at a point prior to the web passing through the printing zone and is for the purpose of imparting a precharge to the web of predetermined polarity. The web 33 prior to passing the electrode 48 extends between static eliminators 49 which remove any electrical charge from the web prior to its receiving the said precharge.

The frame 14 supports an enclosed hood 50 for the incoming reproducing material such as the smoke, mist, vapor or the like that is to be deposited on the material

5

or web 33. The hood 50 has its wall that is adjacent to the cylinder 34 arcuately formed substantially concentrically to the cylinder and spaced slightly from the outer circumference of the cylinder. The hood 50 extends the longitudinal length of the cylinder 34 and is provided with a reduced nozzle 51 extending the longitudinal length of the cylinder and having its outlet end terminating at one side of the printing zone as will later become apparent. A conduit 52 is connected to the hood 50 and extends from a source of supply of the reproducing material, such as smoke, mist, vapor or the like, and which material in cloud-like form flows with the necessary pressure through the conduit 52, the hood 50 and out of the nozzle 51 into the printing zone.

An outlet hood 53 similar to the hood 50 is supported by the frame 14 and is provided with an elongated nozzle 54 similar to the nozzle 51 and extending to the other side of the printing zone opposite to the nozzle 51. The exhaust hood 53 is connected to a conduit 55 which preferably is connected to a suction device.

It will be seen that the reproducing material enters the printing zone in cloud-like form from the nozzle 51 and flows thereacross and such of the material as is not deposited on the print receiving material flows through the nozzle 54, hood 53 and outwardly through the conduit 55 from whence it may be recirculated to the inlet conduit 52 if desired.

The hoods 50 and 53 are provided with thickened wall portions 50a and 53a extending toward each other and toward the printing zone and provided with grooves in which may be mounted a perforated or imperforated transparent plate 56. The thickened portions 50a and 53a are extended on the side of the plate 56 remote from the cylinder 34 so as to render the plate opaque, except for the slot 57. If the plate 56 is perforate it may be formed with minute openings spaced closely together. The purpose of the plate 56 is to confine the reproducing material from escaping through the slot 57. However, the plate 56 may be omitted as shown in Fig. 3, since the suction of conduit 54 will act to prevent escape of the material through the slot 57.

The other side or pole of the electric circuit previously referred to includes the wire 58 and said wire extends to electrically interconnected bar electrodes 59 arranged within the hood 50 and electrically insulated therefrom. The electrodes 59 will give a precharge to the reproducing material passing through the hood 50 of opposite polarity to that of the precharge on the web and the charge on the attraction electrodes 44. Any electrical charges which may be present in the reproducing material before it enters the hood 50 are taken off and grounded by the wires 60 extending across the conduit 52, wherefore the reproducing material enters the hood 50 without any electrical charge thereon and in the proper condition to receive the precharge. The electric circuit includes a double throw double pole switch S whereby the polarities of the wires 46 and 58 can be reversed.

It will also be noted that when the print receiving material 33 has passed the printing zone and has left the cylinder 34 any electrical charge thereon is grounded as indicated at 61.

The method embodying the invention will be more specifically explained by describing its practice when using the apparatus hereinbefore explained. It will be assumed that the image copy 18 is in the form of a web containing transparent non-image areas and opaque image areas and that the reproducing material will be deposited on the print receiving material 33 in areas correlated to the non-image areas of the image copy, while the image areas of the image copy will be represented on the receiving material by those areas thereof which receive no deposit of the reproducing material.

It will also be assumed that the reproduction is of the same size as the image copy and hence the lens 22 is located at its mid-position and intermediate the

6

cylinders 10 and 34. The cylinders 10 and 34 being rotated in the direction indicated by the arrows in Fig. 1 and at the same speed cause the webs 18 and 33 to move therewith at the same speed. The lights 28 being illuminated the rays therefrom pass through the slot 21, through the transparent cylinder 10 and through the transparent non-image areas of the image copy. These light rays pass through the reversing lens 22, slot 57, plate 56 and strike the print receiving material to provide thereon lighted or radiant areas corresponding to the non-image areas of the image copy while the non-lighted or non-radiant areas of the receiving material correspond to the image areas of the copy. The radiant areas of the receiving material have positive characteristics while the non-radiant areas thereof have negative characteristics. The reproducing material in cloud-like form, such as smoke, mist, vapor or the like passes through the hood 50 and is negatively precharged by the bar electrodes 59, and when said reproducing material reaches the printing zone it follows the light rays to and is deposited on the positive lighted or radiant areas of the print receiving material, while the dark or non-radiant areas thereof receive no deposit.

In this connection it will be understood that the attraction electrode 44 and the precharging electrode 48 for precharging the print receiving material are connected to the positive side of the circuit. It will be seen that the image copy is reproduced on the print receiving material with the non-image areas of the image copy represented on the receiving material by the deposit of reproducing material, while the image areas of the copy are represented by those areas of the receiving material which have no deposit of reproducing material. Of course if the image areas of the image copy 18 are transparent or light transmitting while the non-image areas thereof are opaque or non-light transmitting then the lighted or radiant areas of the print receiving material which receive the deposit will correspond to the image areas of the image copy while the dark or non-radiant areas of the print receiving material will correspond to the non-image areas of the image copy.

If the particular reproducing material being used functions more satisfactorily if positively precharged or ionized then the switch S is thrown to its other closed position from the position shown in Fig. 1 and the bar electrodes 59 are connected to the positive side of the circuit while the attraction electrode 44 and the precharging electrode 48 are connected to the negative side of the circuit. Under these circumstances the light rays striking the print receiving material produces the positive radiant or lighted areas thereon while the dark or non-radiant areas on the print receiving material have negative characteristics. Consequently the positively precharged or ionized reproducing material when it enters the printing zone will migrate to and be deposited on the dark or non-radiant areas of the print receiving material. Therefore if the image areas of the image copy are light transmitting then the non-radiant areas of the print receiving material which receive the deposit will represent the non-image areas. Conversely, if the non-image areas of the image copy are light transmitting then the non-radiant or dark areas of the print receiving material which receive the deposit will represent the image areas of the image copy.

It will be apparent that successive portions of the image copy continuously passing across the slot 21 will be successively and continuously reproduced on the print receiving material.

It will be recalled that the light supporting disks 25 and the lights 28 carried thereby rotate during the rotation of the cylinder 10 at a substantially increased speed relative to the cylinder and this rotation successively brings the individual lights into position directly in front of the reflector 29. The rapid rotation of the lights 28 varies their relation to the slot 21 and reflector 29 and

this results in the light rays emitted through the slot rapidly varying in intensity and produces the effect of a rapidly pulsating light source, although the general effect to the eye of the pulsating light source is that of substantially constant light.

It has been found that the pulsating intensity cycles of the light rays produces improved migration of the reproducing material with a resulting improvement in the sharpness and accuracy of the reproduction.

Instead of transmitting light through the transparent portions of the image copy it may be desired to reflect light from the image copy in areas representing either the image areas or the non-image areas of the copy depending upon whether the image areas are light reflecting or the non-image areas are light reflecting.

As shown in Fig. 1, a pair of light reflector members 62 are supported by the frame 14 and extend the longitudinal length of the cylinder 10 and are so disposed that the rays from the elongated light tubes 63 mounted in the member 62 are projected upon the surface of the image copy in zones equally disposed on each side of the focal axis of the lens 22. If the image areas of the image copy are light reflecting then the light rays will be reflected from such image areas and pass through the lens 22 but if the non-image areas of the image copy are light reflective while the image areas thereof do not reflect the light then the light rays will be reflected from the non-image areas and pass through the lens. In either event the light rays striking the print receiving material will function in the same way as previously described with respect to the transmitted light rays to cause the deposit of the reproducing material on the receiving material either in areas correlated to the image areas of the copy or in areas correlated to the non-image areas thereof as the case may be. It will be understood that the lights 63 are connected in a suitable electric circuit not shown and in a manner well understood in the art.

Whether transmitted light rays or reflected light rays are employed the reproduction on the receiving material may be of the same size or of a different size than the image copy. Where the reproduction is to be of the same size the lens 22 is adjusted to its mid-position and the image copy and the receiving material are rotated at the same speed. Of course, where the reproduction is smaller than the image copy then the cylinder 34 must rotate slower than the cylinder 10, and conversely, if the reproduced image is to be larger than the image copy then the cylinder 34 should rotate faster than the cylinder 10.

The relative speeds of rotation of the cylinders 10 and 24 can be selected by the variable speed transmission 39 which may take any suitable form whereby the shaft 17 can be connected to shaft 17a to rotate the latter at a slower or faster speed or at an equal speed as the case may be. Of course where the reproduction is of a different size than the image copy then the lens 32 is suitably adjusted one way or the other along its focal axis from its intermediate position.

It will be understood that the image copy instead of being a belt-like web of substantial length could be mounted on the cylinder 10 so as to extend completely or part way around the circumference thereof similar to a printing plate mounted upon a printing cylinder.

It will also be understood that tonal gradations can be reproduced on the receiving material by producing thereon deposits of the reproducing material of variable densities to represent the portions of the image copy that have intermediate light transmitting or light reflecting characteristics relative to these portions of the copy having maximum light reflecting or transmitting characteristics.

As previously stated when the image copy has transparent or light reflecting non-image areas and opaque or non-reflecting image areas and the electrode behind the print receiving material as well as the precharge on the print receiving material are negative, and the precharge

on the reproducing material is positive then the dark or non-radiant areas of the print receiving material corresponding to the image areas of the image copy receive a deposit and a positive reproduction is printed. If the same image copy is employed with the transparent or light reflecting non-image areas and the opaque or non-reflecting image areas and with the electrode behind the print receiving material as well as the precharge on the print receiving material being positive and the precharge on the reproducing material being negative then the lighted or radiant areas of the print receiving material corresponding to the non-image areas of the image copy receive the deposit and a negative reproduction is printed.

Referring to Fig. 3, there are indicated elongated wires 64 and 65 extending the longitudinal length of the cylinder 34 and located, respectively, in the outlet nozzle 54 and inlet nozzle 51. These wires 64 and 65 are connected to the opposite poles of a high frequency alternating electric circuit, the frequency of which may be compared to that used in television wave receiving sets. Inasmuch as high frequency alternating electric circuits of the type just referred to are well known in the art as is also the manner in which they are produced, it is not believed necessary to illustrate such circuit herein and it should suffice to say that the wires 64 and 65 are in such a circuit and that said circuit may take any known and conventional form of high frequency alternating electric circuit, the frequency of which may be compared to that used in television wave receiving sets.

When the wires 64 and 65 are employed the attraction electrode 43 and the precharging electrode 48 and the bar electrode 59 need not be connected in their electrical circuit. Assuming this to be the situation and the wires 64 and 65 to be connected into their high frequency alternating circuit then the reproducing material in cloud-like form passing from the nozzle 51 and through the printing zone will be ionized by the high frequency field between the wires 64 and 65 and will follow the paths of the light rays to the print receiving material and will be deposited on the lighted or radiant areas of such material, which areas may be the image areas of the copy or the non-image areas thereof, depending upon which areas of the image copy are light transmitting or light reflecting. The arrangement just referred to follows the teaching of an observed electrical phenomenon, namely, that when cloud-like reproducing material is injected into light paths and is ionized by a cross current flow of high frequency current within the frequency used in television wave receiving sets, then such reproducing material will be migrated by the light rays to the lighted or radiant areas of a receiving material upon which the light rays strike.

The term "transparent" is used herein and in the claims as connoting the ability to transmit light and includes not only clear transparency but also translucency.

The term "opaque" is used herein and in the claims to signify the ability to reflect light as contrasted to transmitting light.

The term "reproducing material in cloud-like form" is employed herein and in the claims with the significance of the definition of "cloud" in Webster's Unabridged New International Dictionary—Second Edition, namely, a visible assemblage of particles in the air or in a gas; as, a cloud of smoke or of dust or of mist or of vapor.

The term "smoke" is used herein and in the claims to indicate smoke created by combustion from dry or liquid bases or smoke created by chemical action.

Although preferred forms of the invention have been described and illustrated herein it will be understood that the invention may be embodied in other forms coming within the scope and meaning of the appended claims.

Having thus described my invention, I claim:

1. The method of reproducing images directly on print receiving material from image copy and which comprises arranging the print receiving material in spaced relation-

ship to the image copy and with the surface of one side of the print receiving material facing toward the surface of the image copy, projecting light rays correlated to a predetermined portion of the image copy through a lens and upon a restricted printing zone band on the surface of said one side of the print receiving material and which band extends longitudinally substantially the width of the print receiving material but is narrow in its transverse width in comparison to its longitudinal length to produce on said printing zone band radiant surface pattern areas correlated to said predetermined portion of the image copy and to said light rays, ionizing reproducing material in cloud-like form, creating a positive flow of the ionized reproducing material in a restricted and directed predetermined path transversely of said light rays and of said printing zone band throughout substantially the longitudinal length of the latter and spaced from the surface of said one side of the print receiving material but in close proximity thereto to subject the reproducing material to the influence of said radiant pattern areas so it will be diverted by such influence from said flow path and moved to and deposited on the surface of the printing zone band of the print receiving material to form directly thereon the finished reproduced image.

2. The method of reproducing images directly on print receiving material from image copy as defined in claim 1 and wherein an electrical potential differential is created between the ionized reproducing material flowing in said restricted and directed path and an electrode located on the other side of the print receiving material from the said one side thereof to augment the influence of said radiant pattern areas in diverting the ionized reproducing material from said flow path and in moving the same to and depositing it on the surface of the printing zone band of the print receiving material to form directly thereon the finished reproduced image.

3. The method of reproducing images directly on print receiving material from image copy as defined in claim 1 and wherein the projected light rays are reflected from the said predetermined portion of opaque image copy.

4. The method of reproducing images on print receiving material from image copy as defined in claim 1 and wherein the positive flow of the ionized reproducing material in said restricted and directed predetermined path transversely of the light rays and of said printing zone band is created by forcing the reproducing material from a pressure nozzle at one side of the light rays and of the printing zone band and by exhausting the undeposited reproducing material through a suction nozzle located on the opposite side of said light rays and said printing zone band.

5. The method of reproducing images directly on print receiving material from image copy as defined in claim 1 and wherein the projected light rays are transmitted through transparent areas of the image copy located in said predetermined portion of the image copy.

6. The method of reproducing images directly on print receiving material from image copy as defined in claim 5 and wherein the projected light rays are produced and transmitted through the transparent areas of said predetermined portion of the image copy in rapidly pulsating form.

7. The method of reproducing images directly on successive portions of a web of print receiving material from successive portions of a web of image copy and which comprises arranging the web of print receiving material in spaced relationship to the web of image copy and with the surface of one side of the web of print receiving material facing toward the surface of the image copy, moving the print receiving material and the image copy longitudinally in timed relationship to each other, projecting light rays successively correlated to restricted successive portions of the moving image copy through a lens and upon the longitudinally moving print receiving material in successive printing zone bands cor-

related to said successive restricted portions of the moving image copy and each having a length across the web substantially the width of the web of the print receiving material but being narrow transversely in comparison to said length to produce on the surface of said successive printing zone bands radiant pattern areas correlated to the said successive predetermined portions of the image copy and to the light rays correlated to the latter, ionizing reproducing material in cloud-like form, and during the movement of the webs of print receiving material and image copy and the projection of said light rays creating a positive flow of the ionized reproducing material in a constrained directed predetermined path transversely of said light rays and of said successive printing zone bands throughout substantially the length of the latter and spaced from the surface of said one side of the print receiving material but in close proximity thereto to subject the reproducing material to the influence of said radiant pattern areas on said successive printing zone bands so the reproducing material will be diverted by such influence from said flow path and moved to and deposited on the surface of the successive printing zone bands of the print receiving material to form directly thereon the finished reproduced images.

8. The method of reproducing images directly on successive portions of a moving web of print receiving material from successive portions of a moving web of image copy as defined in claim 7 and wherein an electrical potential differential is created between the ionized reproducing material flowing in said restricted and directed path and an electrode located on the other side of the moving web of print receiving material from the said one side thereof to augment the influence of said radiant pattern areas in diverting the ionized reproducing material from said flow path and in moving the same to and depositing it on the surface of the successive printing zone bands of the moving web of print receiving material to form directly thereon the finished reproduced images.

9. The method of reproducing images directly on successive portions of a moving web of print receiving material from successive portions of a moving web of image copy as defined in claim 7 and wherein the projected light rays are reflected from the said successive portions of the moving web of opaque image copy.

10. The method of reproducing images directly on successive portions of a moving web of print receiving material from successive portions of a moving web of image copy as defined in claim 7 and wherein the positive flow of the ionized reproducing material in said constrained and directed predetermined path transversely of the light rays and of said printing zone bands is created by forcing the reproducing material from a pressure nozzle at one side of the light rays and of the printing zone bands and by exhausting the undeposited reproducing material through a suction nozzle located on the opposite side of said light rays and said printing zone bands.

11. The method of reproducing images directly on successive portions of a moving web of print receiving material from successive portions of a moving web of image copy as defined in claim 7 and wherein the projected light rays are transmitted through transparent areas of the image copy located in said successive portions of the moving web of image copy.

12. The method of reproducing images directly on successive portions of a moving web of print receiving material from successive portions of a moving web of image copy as defined in claim 11 and wherein the projected light rays are produced and transmitted through the transparent areas of said successive portions of the moving web of image copy in rapidly pulsating form.

13. The method of reproducing images directly on print receiving material from image copy and which comprises arranging the print receiving material in spaced

11

relationship to the image copy and with the surface of one side of the print receiving material facing toward the surface of the image copy, projecting light rays correlated to a predetermined portion of the image copy through a lens and upon a restricted printing zone band on the surface of said one side of the print receiving material and which band extends longitudinally substantially the width of the print receiving material but is narrow in its transverse width in comparison to its longitudinal length to produce on said printing zone band 10 radiant surface pattern areas correlated to said predetermined portion of the image copy and to said light rays, creating a positive flow of reproducing material in a restricted and directed predetermined path transversely of said light rays and of said printing zone band through- 15 out substantially the longitudinal length of the latter and spaced from the surface of said one side of the print receiving material but in close proximity thereto while simultaneously ionizing the reproducing material by creating a current flow transversely of the light rays and 20 in the direction of the flow path of the reproducing ma-

12

terial and of a high frequency within the range used for television broadcasting to subject the ionized reproducing material to the influence of said radiant pattern areas so it will be diverted by such influence from said flow path and moved to and deposited on the surface of the printing zone band of the print receiving material to form directly thereon the finished reproduced image.

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