

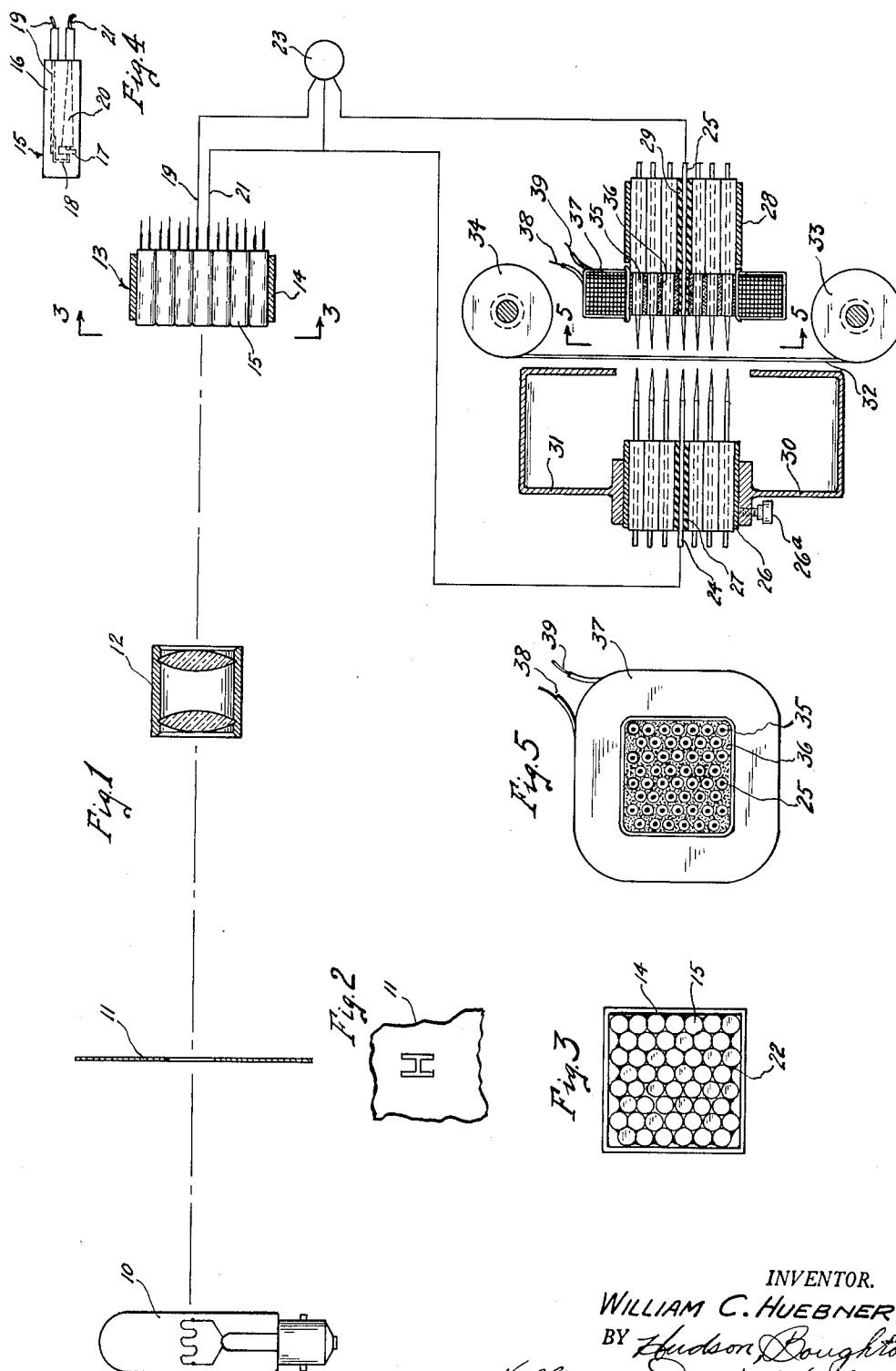
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APPARATUS FOR REPRODUCING IMAGES

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APPARATUS FOR REPRODUCING IMAGES

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This invention relates to a novel and useful apparatus for reproducing or printing images on paper or other suitable receiving material.

More particularly the invention relates to a novel and useful apparatus for reproducing or printing successively and directly and instantly on paper or other suitable receiving materials single complete images, such as letters, numerals, symbols, signs, characters, pictures and the like.

The present invention resides in the provision of an efficient and effective form of apparatus for carrying out the process disclosed in my copending application Serial No. 249,753, filed October 4, 1951, and the apparatus disclosed herein is a modification and improvement of the apparatus disclosed in said copending application. The principal object of the present invention is to provide an apparatus for carrying out the process disclosed in my said copending application Serial No. 249,753, and which apparatus is more compact, and is simplified as compared to the apparatus disclosed in said copending application Serial No. 249,753, and also the apparatus of the present invention is so constructed that the electrostatic fields of force for reproducing the image on the paper or other material are concentrated and reproduce the image in a more clearly defined and effective manner.

In my prior Patent 2,180,417, issued November 21, 1939, I disclose and claim, as pointed out in my said copending application Serial No. 249,753, an apparatus for photographically composing type characters and wherein single characters or images are selected by means of a keyboard and are composed photographically in lines on a light-sensitive film or member with said film or member after photographic development, being used to produce a printing plane or cylinder to be used subsequently in a printing couple.

Similarly to my said application Serial No. 249,753, another object of the present invention is to provide an apparatus for directly and instantly reproducing or printing on paper or other suitable receiving materials single complete images, such as letters, characters, symbols, pictures and the like which do not employ a great number of moving mechanical parts subject to wear, misalignment, etc., which produce inaccuracies, but utilize light rays and electrical devices responsive to such rays and acting to directly and instantly reproduce and print on the paper or suitable receiving materials the complete images desired.

It will be understood that another object of the present invention is to provide a compact and simplified apparatus for accomplishing the objects specified in my said copending application Serial No. 249,753.

An important object is to provide an apparatus whereby the reproducing material is caused to penetrate or become molecularly fused or integrated with the receiving material to a greater extent than is the case when using the apparatus shown in my said copending application Serial No. 249,753, and whereby the re-

produced image is sharply defined due to the concentrated and shielded electrostatic fields of force.

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

Fig. 1 is a schematic view illustrating the passing of the light rays through the transparent image and the projection thereof upon the target containing the light responsive devices, and also illustrating the electrical circuit from the light responsive devices to the discharge and attraction elements between which are the electrostatic fields of force and through which fields the paper or other receiving material passes.

Fig. 2 is a fragmentary elevational view of the image carrying member of Fig. 1.

Fig. 3 is an elevational view of the target shown in Fig. 1 and is taken from line 3—3 of Fig. 1 looking in the direction of the arrows.

Fig. 4 is a detached elevational detail view of one of the light responsive devices carried by the target, and

Fig. 5 is an elevational view of the attraction elements shown in Fig. 1 and is taken from line 5—5 looking in the direction of the arrows.

The apparatus disclosed herein is utilized for reproducing or printing directly and instantly on paper or other suitable receiving material various desired single complete images, such as letters, characters, symbols, pictures, codes signs and the like by passing light rays simultaneously through the entire image copy to be reproduced and projecting the same upon the surface area of a target. The target is of substantial size so as to extend over a substantial area and in this instance the target is illustrated as of polygonal configuration. The target includes a frame within which are mounted a plurality of light responsive electrical devices which are closely grouped together but which are dispersed over the entire area of the target. These devices have their ends onto which the light rays are projected arranged in this instance substantially in a plane. The light rays passing through the image and projected upon the target energizes simultaneously those devices upon which the rays strike and consequently the thus energized devices will be located in an area defined by the configuration of the image to be reproduced. Each of the devices in the target frame is connected by a separate electric circuit to a discharge and attraction element having their ends spaced apart to provide an air gap. The discharge and attraction elements correspond in number to the light responsive devices and are respectively mounted in frames similar to the target frame and in similar position therein to their respective light responsive device. The energization of the light responsive devices upon which the light rays passing through the image are projected simultaneously causes energization of the electrical circuits connected to such devices and creates electrostatic fields of force between the discharge and attraction elements of such circuits and hence the electrostatic fields of force thus created will be located in an area defined by the configuration of the image to be reproduced. Clouds of reproducing material such as mists of fine particles, smoke, atomized liquids and the like are passed through the atmospheric gap between the elements and the reproducing material is acted upon by the electrostatic fields of force and is migrated onto the paper or other receiving material located in the gap to reproduce instantly and completely thereon the desired image.

The term "single image" as used herein is intended to cover not only a single letter, symbol or the like but also to cover a single image in the form of a whole sheet of

printed matter or in the form of a large picture, it being understood that in such cases the size of the target and the number of discharge and attraction elements necessarily would have to be increased to cover a sufficiently large area that would include the size of the image.

The light source, the image carrying member, the shutters and the reflectors for the light rays may be the same as illustrated and described in my said copending application and consequently have not been illustrated herein except insofar as they are schematically shown in the diagrammatic illustration of Fig. 1. With this understanding the light source indicated at 10 and the image carrying member shown at 11 in Fig. 1 will be understood as corresponding to the light source and image carrying member shown in the apparatus covered by said application Serial No. 249,753. It will also be understood that the image carrying member 11 is provided with a transparent image to be reproduced and that the rays from the light source 10 pass through the transparent image and are reflected by the reflector rings of the apparatus and then pass through the lens 12 and are projected thereby upon the target 13.

As pointed out in said copending application Serial No. 249,753, the target 13 preferably is adjustably mounted so as to be moved toward and away from the lens 12 to vary the focal distance and thus vary the size of the light ray image projected upon the target.

The target 13 is shown for illustration purposes as including a rectangular frame 14 in which are mounted a plurality of light responsive devices 15. The side of the target upon which the light rays are projected is of substantial area and the target frame mounts within it a multiplicity of closely grouped light sensitive electron emitting devices which completely fill the frame and have their light receiving ends located in this instance substantially in a planular surface area defined by the target frame 14. The devices 15 preferably are "Germanium Photodiodes" commercially available and a product of Sylvania Electric Products Inc. The "Germanium Photodiodes" are employed because of their extremely small size and also because of their ability in response to light to emit a flow of electrons producing maximum electrical power output. The "Germanium Photodiodes" are only .080 inch in diameter and approximately $\frac{3}{16}$ of an inch in length and consequently an extremely large number can be mounted in a relatively small area and in compact proximity to each other. It will be understood that the individual devices 15 are greatly exaggerated as to size in the drawing.

The "Germanium Photodiode" each comprises a small glass tube 16 closed at the end that is exposed to light rays. Within the glass tube 16 adjacent the closed end thereof is a small slab 17 of polished germanium and a sharply pointed tungsten whisker 18 bears against the slab 17. The whisker 18 is electrically connected to a wire 19 that leads from the glass tube. The slab 17 is also supported on and electrically connected to an element 20 which in turn is electrically connected to a wire 21. It will be understood that each light responsive device 15 is connected to a pair of wires 19 and 21 and that the target 13 includes a large number of such devices which, due to their extremely small size, can be accommodated within the area of the frame 14 and arranged in staggered rows as clearly shown in Fig. 3.

The devices 15 are retained in the frame 14 by the nested relationship between adjacent devices and by filling the crevices of the outside rows with cement as indicated at 22 in Fig. 3. By using the cement just referred to the devices 15 can be assembled and secured together into units composed of a large number of devices and these interfitting units can be mounted in the frame 14, it being understood that since each device 15 is housed within a glass tube 16 the devices are electrically insulated from each other. It will also be understood that the closed end of the tubes 16 are at that side of the target

on which the light rays will be projected, so that said rays will act on the germanium slab 17 while the wires 19 and 21 will project from the opposite side of the target. The total area of the target is such that the projected image thereon will be of large size and then reduced in size when reproduced on the receiving material.

It will further be understood that each device 15 has a pair of wires 19 and 21 connected therewith and extending therefrom and that there will be as many electrical circuits as there are devices. Each of these circuits includes an amplifying device 23 which preferably will be the commercially known "Transistor" manufactured and sold by The Bell Telephone Laboratories. The "Transistor" lends itself admirably to the use referred to because of its small size, i. e., half the size of a pea and because of its great amplifying ability, namely, it can amplify an electrical current at least one hundred thousand times.

The wire 21 of each circuit extends to and is connected with a discharge element 24 which is in the form of a small needle-like wire. The wire 19 of each circuit extends to the "Transistor" from which it extends to and is electrically connected with an attraction element 25 which is also in the form of a small needle-like wire and which is arranged directly opposite and in alignment with the discharge element of the same circuit with the points of the elements spaced apart a predetermined distance to provide an atmospheric gap therebetween. As in my said copending application Serial No. 249,753, it may be desirable in certain instances to provide an independent source of high potential electricity for the elements 24 and 25 and have the circuits amplified by the "Transistors" actuate relays to control the independent high potential circuits to the elements.

The discharge elements 24 are mounted in this instance in a rectangular holder 26 and said discharge elements are arranged similarly to the light responsive devices 15 of the target and can likewise be assembled in units and are insulated from each other by insulating sleeves 27. The attraction elements 25 are similarly arranged in a holder 28 and likewise are insulated from each other by insulating sleeves 29. The elements 24 and 25 are smaller in diameter than the devices 15 and a substantially greater number of the elements can be grouped in a given area than can the devices 15.

The points of the discharge elements 24 are located intermediate openings formed in the adjacent inner ends of an input pressure conduit 30 and an exhaust or vacuum conduit 31 identical with the corresponding conduits illustrated and described in my said copending application Serial No. 249,753.

It will be understood that clouds of reproducing material such as smoke, mist or atomized liquid particles are forced under pressure through the conduit 30 and across the air gap between the points of the discharge and attraction elements to be acted on by the lines of force of the electrostatic fields of force between said elements and deposited on the receiving material 32 located in the atmospheric gap between the discharge and attraction elements, in the same way as the deposits are made in the apparatus disclosed in my said copending application Serial No. 249,753.

The receiving material 32 is unwound from a reel 33 and wound upon a reel 34. Any excess reproducing material which is not deposited on the material 32 by the lines of force is exhausted through the suction conduit 31.

It will be understood that the light rays passing through the complete transparent image of the image carrying member 11 are projected simultaneously onto the target 13 and will illuminate simultaneously certain of the light responsive devices 15 and which illuminated devices are located in an area corresponding to the configuration of the complete image to be reproduced. Consequently these certain devices will energize simultaneously their respective circuits which are amplified by the amplifiers

5

23 and produce electrostatic fields of force between the discharge elements 24 and the attraction elements 25 also located in an area corresponding to the configuration of the complete image to be reproduced on the material 32, all as clearly explained in my said copending application Serial No. 249,753.

In the present construction the attraction elements are in the form of needle-like wires similar to the discharge elements and with an attraction element correlated to each discharge element and lying in axial alignment therewith as distinguished from the single plate-like attraction element described in my said copending application Serial No. 249,753.

The arrangement in the present application is felt to have the advantage that the separate attraction elements cooperating with their respective discharge elements produce electrostatic fields of force which are compacted and which do not tend to disperse or broaden out as is probably the case with the common plate-like attraction element as the lines of force pass from the discharge element to the attraction element. Consequently the image reproduced on the receiving material 32 by the present construction is more accurate and sharply defined and consists of a multiplicity of minute dots of the deposited reproducing material and which are somewhat similar to the dots of a half tone reproduced image. The reproducing material deposited on the receiving material by the apparatus herein disclosed appears to be more strongly molecularly fused, integrated with or penetrated into the receiving material than is the case with the apparatus disclosed in my copending application Serial No. 249,753 and this result is believed due to the use of attraction elements for each discharge element rather than a common attraction element and also because of the use of a magnetic shield for the electrostatic fields of force herein-after described.

The holder 26 is adjustable in its support toward and away from the receiving material to vary the gap between the discharge and attraction elements. The holder 26 can be clamped in adjusted position by the setscrew 26a. Adjustment of the discharge elements away from the material softens the reproduced image and conversely, adjustment toward the material sharpens the image. The magnetic action later to be referred to also sharpens the reproduced image while omission of the magnetic action softens the image.

In order to provide in some instances for the concentration of the electrostatic fields of force within the area defined by the frames 26 and 28 which mount the discharge and attraction elements the following arrangement is employed. The attraction elements 25 intermediate their pointed ends and the ends of the insulating sleeves 29 are provided with insulating sleeves 35 of reduced diameter as compared to the sleeves 29.

The interstices between the smaller insulating sleeves 35 are filled with iron filings 36 mixed with a suitable plaster or other composition and these filings form a magnetic core in and around the attraction elements 25. A ring-shaped coil of wire 37 extends around the group of attraction elements and the magnetic core formed by the iron filings 36 and the ring 37 is connected to a suitable source of electric energy by wires 38 and 39.

It will be understood that when the ring 37 is electrically energized said ring and the core formed by the filings 36 constitute an electromagnet, with the magnetic lines of force of said magnet extending parallel to the electrostatic lines of force and encompassing the latter and thus providing a shielding action operating to confine and draw the electrostatic lines of force in a straight path between the points of the discharge and attraction elements.

It will be understood that the apparatus described in this application functions to reproduce instantly on the receiving material the single complete images in substantially the same manner as does the apparatus described in my said copending application Serial No. 249,753 and

6

that successive images may be reproduced on the receiving material in a line by successively moving the image member 11 to cause the light rays to pass through different successive images and by moving the receiving material 32 in correlation therewith.

It will also be understood that the size of the target 13 can be varied to provide a larger area on which to project the light rays and that the area of the grouped discharge and attraction elements can be similarly varied. In this way a single complete image can be reproduced instantly of any desired size and also a single complete image which may constitute a whole sheet of printer matter or a large picture.

Although a preferred structural arrangement has been illustrated and described, it will be understood that such arrangement may be varied or modified within the scope of the appended claims.

Having thus described my invention, I claim:

1. An apparatus for reproducing complete images directly and instantly on receiving material which comprises a plurality of closely grouped needle-like discharge elements mounted in a predetermined compact arrangement within a predetermined area, a plurality of similarly closely grouped needle-like attraction elements spaced from the discharge ends of said discharge elements with an atmospheric gap therebetween and with each attraction element correlated to a discharge element and in alignment therewith, an independent electrical circuit connected to each cooperating pair of discharge and attraction elements, means for energizing said circuits selectively to produce electrostatic fields of force between predetermined discharge elements and their correlated attraction elements and including a target having an area correlated to the area within which the elements are grouped and provided with light sensitive electron emitting devices corresponding in number to said circuits and in arrangement to said discharge and attraction elements and dispersed throughout the target area but closely grouped relative to each other, means for positioning receiving material in said atmospheric gap, means for passing clouds of reproducing material through said gap intermediate said receiving material and said discharge elements, and means for projecting simultaneously onto said target area light rays in the configuration of the complete image to be reproduced to illuminate simultaneously certain of said light responsive devices to energize simultaneously certain of said circuits and cause the electrostatic fields of force between the pairs of discharge and attraction elements in said certain circuits instantly to deposit the reproducing material on the receiving material in the configuration of the entire and complete image.

2. An apparatus for reproducing images as defined in claim 1 and wherein said means for energizing said circuits includes an amplifier in each of said circuits.

3. An apparatus for reproducing images as defined in claim 1 and wherein said light sensitive electron emitting devices are of tubular form and are grouped together to form a unit which may be interfitted with similar units, the devices adjacent the periphery of the unit being structurally interconnected by an adhering integrating composition whereby several units can be interfitted to produce a larger area target, and a support mounting the grouped light sensitive electron emitting devices.

4. An apparatus for reproducing images as defined in claim 1 and wherein said discharge elements are grouped together to form a unit which may be interfitted with similar units, the discharge elements adjacent the periphery of the unit being structurally interconnected by an adhering integrating composition whereby several units can be interfitted to produce an increased area of discharge elements, and a support mounting said grouped elements.

5. An apparatus for reproducing images as defined in claim 1 and wherein said discharge elements are mounted

in a holder and said holder is mounted in a supporting frame for adjusting movement longitudinally of the elements, and means for locking the holder in adjusted position relative to said supporting frame.

6. An apparatus for reproducing images as defined in claim 1 and wherein said attraction elements are grouped together to form a unit which may be interfitted with similar units, the attraction elements adjacent the periphery of the unit being structurally interconnected by an adhering integrating composition whereby several units can be interfitted to produce an increased area of attraction elements, and a support for the grouped attraction elements.

7. In an apparatus for reproducing images as defined in claim 1 and wherein said attraction elements extend through a magnetic core located adjacent to the attraction ends of said elements while a wire coil ring surrounds said core and is adapted to be connected to a source of electrical energy, wherefore when said coil is electrically energized it constitutes with said core an electromagnet the lines of force of which extend parallel to and shield the electrostatic lines of force.

8. An apparatus for reproducing images as defined in claim 7 and wherein said magnetic core is formed of iron filings filling the interstices between the attraction elements.

References Cited in the file of this patent

UNITED STATES PATENTS

853,755	Belin	May 14, 1907
1,072,152	Ocampo	Sept. 2, 1913
1,817,098	Ranger et al.	Aug. 4, 1931
1,941,001	Hansell	Dec. 26, 1933
2,473,729	Salz	June 21, 1949
2,547,706	Heubner	Apr. 3, 1951
2,556,550	Murray	June 12, 1951
2,583,546	Carlson	Jan. 29, 1952
2,584,695	Good	Feb. 5, 1952

FOREIGN PATENTS

241,636	Great Britain	Oct. 26, 1925
606,130	Great Britain	Aug. 6, 1948
606,133	Great Britain	Aug. 6, 1948