

June 21, 1949.

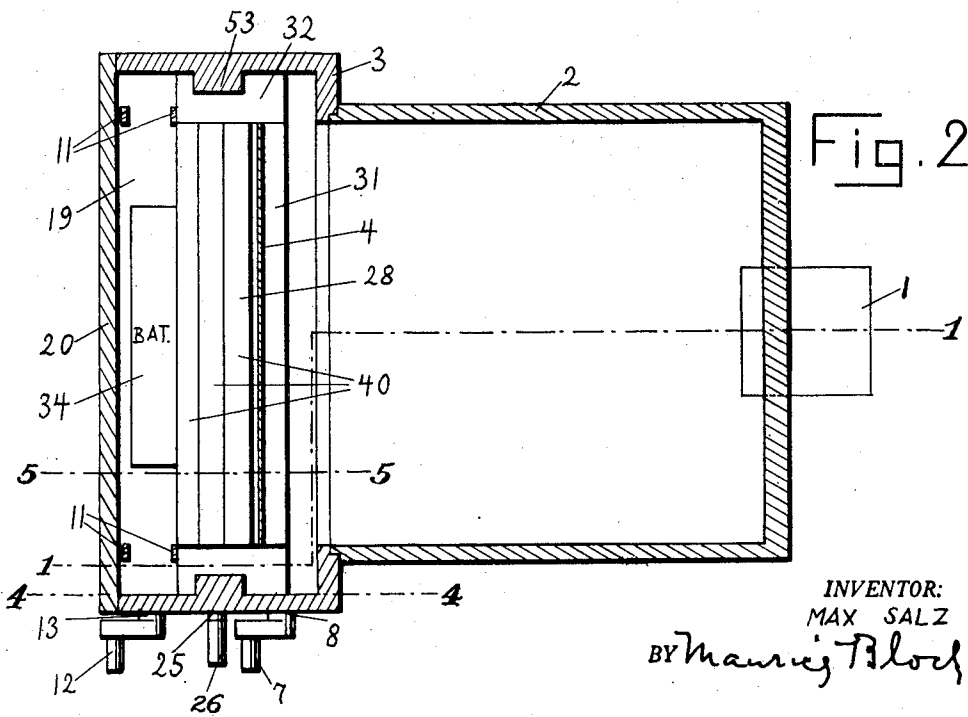
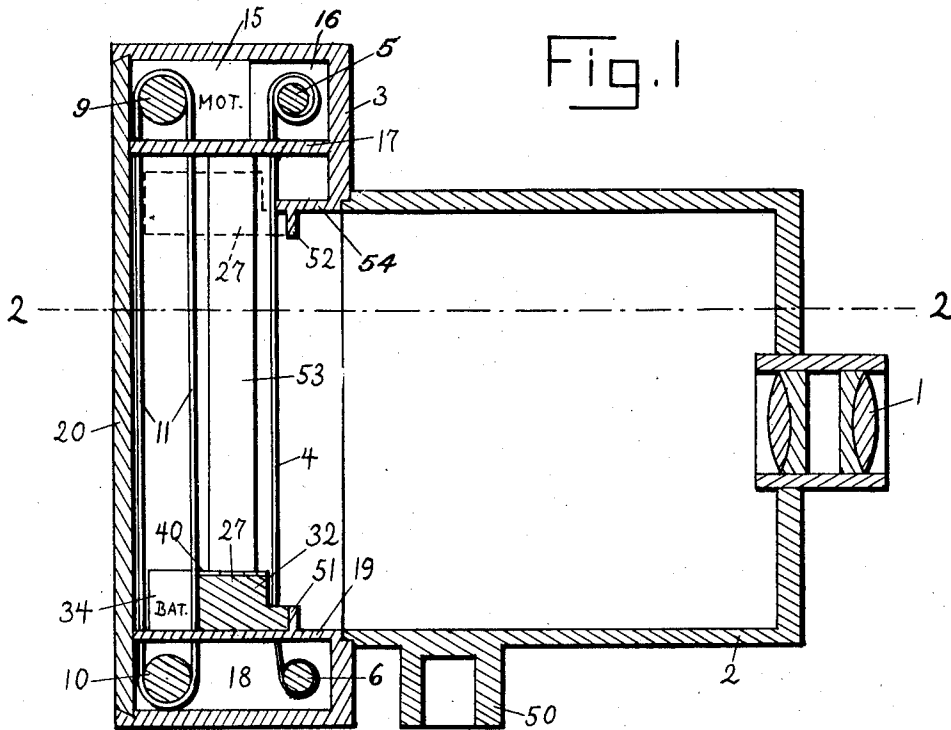
M. SALZ

2,473,729

COLOR FACSIMILE APPARATUS

Filed July 31, 1945

2 Sheets-Sheet 1



INVENTOR:
MAX SALZ

BY *Maurice T. Block*

ATTORNEY

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2 Sheets-Sheet 2

Fig. 6

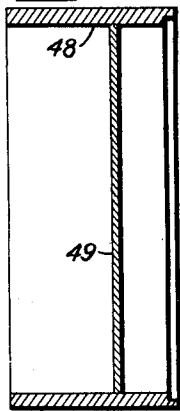


Fig. 7

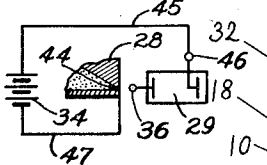


Fig. 4

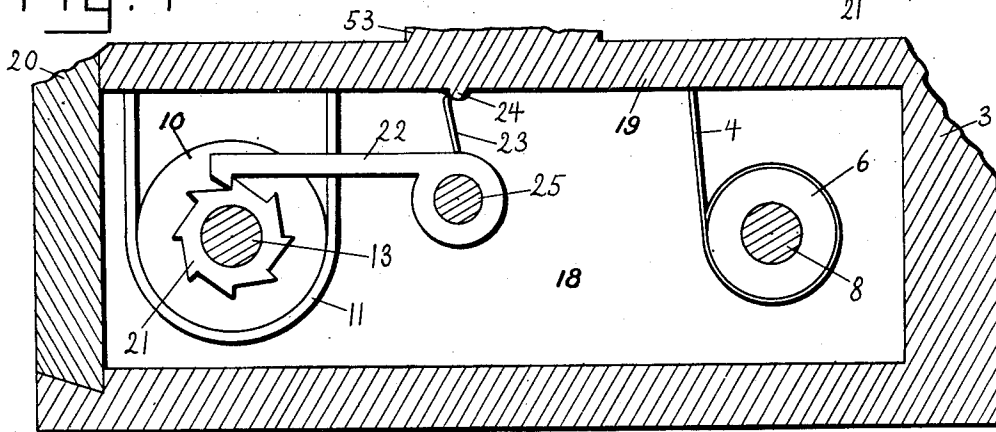


Fig. 3

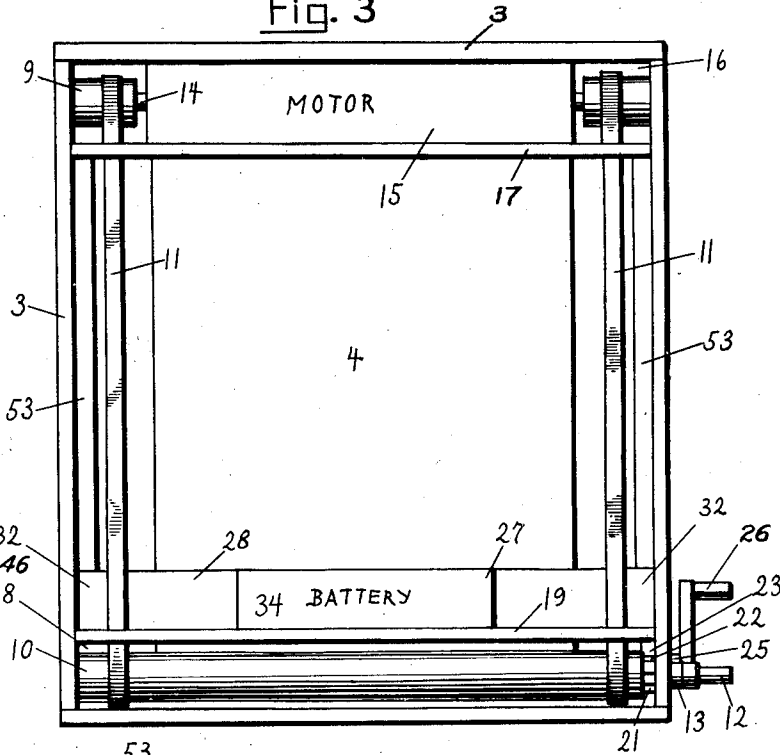
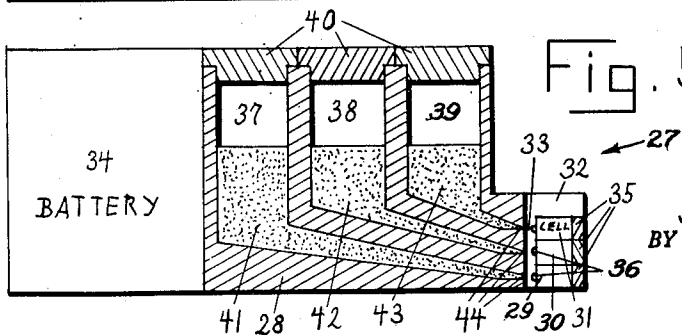


Fig. 5



INVENTOR.
MAX SALZ

BY *Max Salz*

ATTORNEY

UNITED STATES PATENT OFFICE

2,473,729

COLOR FACSIMILE APPARATUS

Max Salz, New York, N. Y.

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6 Claims. (Cl. 178—5.2)

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My invention relates to the production of photographic pictures and, more particularly, to that part of this production in which a picture projected by the lens of a camera is used for the production of a permanent picture or facsimile of the projected picture on a sheet, plate or any other suitable picture carrier.

In conventional photography, the rays or light spots of the projected picture control chemical processes in a chemically prepared layer of picture carrier. Objects of my invention are to dispense with such a chemical control and with corresponding chemical preparation of such a layer, and to use an electric control instead.

Other objects are to produce the permanent picture or facsimile by sprinkling a surface of the picture carrier with minute particles of a finely dispersible substance having a color different from the color of this surface, to distribute these particles or to vary their density corresponding to the projected picture, to control this sprinkling, this distribution or this density electrically, and to derive this electric control from photo-electric effects of the light spots of the projected picture.

Further objects are to produce a picture or facsimile on a carrier by coloring particles, to produce a permanent picture or facsimile which is immediately visible after the picture is taken without any subsequent development, and to make it possible to inspect and to supervise the picture or facsimile during the process of taking the picture.

Still other objects are to provide for different colors of the picture, or facsimile to produce a picture or facsimile showing colors corresponding to the natural colors of the projected picture, and to produce all colors of the permanent picture or facsimile by one exposure.

Still further objects are to obtain the objects stated before by simple and reliable means, by means which are easily operated and which can be used in connection with a camera or projector of conventional structure, and to provide for use of an ordinary camera optionally or alternately for the particular objects of the invention or for the objects of conventional photography.

Still other objects and advantages will appear from the following description of an exemplifying embodiment of my invention, from the appended claims, and from the accompanying drawings in which:

Fig. 1 shows a cross-section of a camera provided with a device according to my invention, said cross-section being taken along the broken

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line 1—1 and seen from the lower side in Fig. 2.

Fig. 2 shows a cross-section taken along the line 2—2 and seen from the upper side in Fig. 1.

Fig. 3 shows a back view of the same camera, seen from the left side in Fig. 1, the removable back wall being taken off.

Fig. 4 shows a cross-section of a part of the inventive device shown in Figs. 1, 2 and 3, this cross-section being taken along the line 4—4 and seen from the lower side in Fig. 2.

Fig. 5 shows a cross-section of a movable part of the inventive device, this cross-section being taken along the line 5—5 and seen from the lower side in Fig. 2.

Fig. 6 shows a cross-section of a part which may be exchanged with a part shown in Figs. 1, 2 and 3 and may be used additionally for the objects of my invention, this cross-section being positioned corresponding to Fig. 1.

Fig. 7 shows a schematic diagram of a circuit which may be used in the inventive device.

Figs. 4 and 5 are represented on a considerably larger scale than Figs. 1, 2, 3 and 6.

Referring to the drawings, numeral 1 indicates an objective or lens system adapted to project pictures. The objective 1 may have any suitable structure, may be provided with adjusting and closing devices in any known manner, and may be connected in any suitable manner with a camera housing 2 which has an open back side.

When the picture is being taken, the back side of the housing 2 is closed by a casing 3 affixed, preferably detachably, to the housing 2 and having a front opening coinciding with the back opening of the housing 2. A picture carrier 4 is positioned in the casing 3 and across its front opening. Preferably, this carrier is formed by a sheet of paper or of any other suitable material which may be flexible, may extend from an upper roller 5 rotatably supported by the casing 3 to a similar lower roller 6 and may have a length providing for a plurality of pictures. Each time when a picture has been taken, one of the rollers 5 and 6, for example the roller 6, is turned by means of a handle or crank 7 positioned outside of the casing 3 and connected to the roller 6 by a shaft 8 passing through a bore of this casing. Thereby, a fresh part of the carrier is unwound from the roller 5 and brought into position for taking another picture, and the part carrying the taken picture is wound around the roller 6.

Two other rollers 9 and 10 are also rotatably supported in the casing 3, are connected to each other by chains or belts 11 and can be rotated by means of a handle or crank 12 positioned out-

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side the casing 3 and connected to one of the rollers, for example to the lower roller 10, by a shaft 13. One of these rollers, for example the upper roller 9, is affixed to a shaft 14 which can be rotated in one direction, for example in that direction that is anti-clockwise in Fig. 1, by suitable motoric means, for example by a clock work or spring motor 15 of common and well known structure which comprises a stationary part affixed to the casing 3. The roller 9 may comprise two parts positioned symmetrically with respect to the motor 15 and connected by the shaft 14 which may pass through the casing of this motor and forms a rotary part thereof.

The rollers 5 and 9 and the motor 15 may be confined in a chamber 16 partitioned off the space of the casing 3 by a wall 17 provided with openings for the passage of the carrier sheet 4 and the chains 11. The rollers 6 and 10 may be confined in a similar chamber 18 partitioned off by a wall 19 provided with similar openings. The back wall of the casing 3 may be formed by a removable cover 20 which may have dove-tailed upper and lower edges slidably engaging dove-tailed slots of the casing 3. A wall 54 may extend from the front opening of the casing 3 about as far as to the sheet 4.

When, by means of the crank 12, the roller 10 is turned in that direction which is clockwise in Figs. 1 and 4, this rotation is transmitted by the chains 11 to the roller 9 and the shaft 14 whereby the spring motor 15 is wound up. A toothed wheel 21 affixed to the roller 10 or its shaft 13 and engaged by a detent 22 prevents reverse movement of the rollers 10 and 9 and unwinding of the motor 15 as long as the detent 22 is in the shown position. The detent 22 is secured in this position by a flat spring 23 affixed to the detent 22 and engaging a projection 24 of the casing 3 or its partitioning wall 19. The detent 22 is affixed to a shaft 25 passing turnably through a bore of the casing 3. The outer end of the shaft 25 is affixed to a handle 26.

By turning the handle 26, the detent 22 can be turned in clockwise direction in Fig. 4 into a position where the spring 23 contacts the projection 24 from the other side and where the detent 22 is disengaged from the toothed wheel 21. Thereby, the motor 15 is released for operation, and this motor drives the chains 11 so that they go up at the front side which is on the right side of the rollers 9 and 10 in Fig. 1.

A movable member or car 27 is affixed to the chains 11 and is in the shown position near the partitioning wall 19 when the motor 15 has been wound up completely. When the chains 11 are driven by the motor 15, they raise the car 27 gradually until the car comes to rest near the wall 54 or is stopped by this wall in the position shown in dotted lines in Fig. 1. When the motor is wound up again in the manner described before, the car 27 returns to the lower position shown in full lines.

Details of the car 27 are best to be seen from Fig. 5. The car comprises a container 28 positioned near the back side of the sheet 4 and a number of photo-electric cells 29, 30 and 31 positioned near the front side of this sheet. The container 28 and the cells 29, 30, 31 are connected by lateral parts 32 passing at both small sides of the sheet 4 whereby the car 27 has a narrow slot 33 left for the passage of the sheet 4. A battery or electric current source 34 may be affixed to the back side of the container 28. The lateral parts 32 may have grooves slidably en-

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gaging vertical rails or ledges 53 formed by projections of the walls of the casing 3.

Preferably, the photo-electric cells are arranged in rows perpendicular to the moving direction of the car 27. Each row may be exposed only to a selected species of light through a colored layer 35 of glass or any other suitable transparent material applied to the front of the cells. For example, the cells 29 of the lowermost row may receive the yellow part of the projected rays, the median row 30 the blue part, and the uppermost row 31 the red part. Preferably, the cells of each row are placed close beside each other, and a great number of cells of minute size are used, this size being shown considerably exaggerated in the drawings for the sake of clearer representation. One of the electrodes of each cell is connected to a pole 36 positioned so near the carrier 4 that the voltage resulting from the radiation received by the cell influences the adjacent spot of the carrier.

Preferably the container 28 has several separated inner chambers, for example three chambers 37, 38 and 39, which are closed by covers 40 and are filled with a finely dispersible substance having a color different from the color of the back surface of the carrier 4, and being adapted to color this surface more or less according to the density of particles deposited on this surface. For example, the substance 41 contained in the chamber 37 is yellow, the substance 42 in the chamber 38 blue, and the substance 43 in the chamber 39 red. In certain cases, the substance may be white or black or of any other color different from the color of the surface of the carrier.

The container 28 has a number of outlets or fine openings 44, each belonging to one of the chambers 37, 38 and 39 and positioned in close vicinity of the back surface of the sheet 4 and, preferably, at the lowest point of the respective chamber. The outlets are adapted to release particles of the coloring substance in the direction toward the carrier 4 and are juxtaposed to the poles 36. Preferably, the pole 36 of a cell receiving light of a certain color is in juxtaposition to an outlet 44 releasing particles of the same color.

The dispersible substances 41, 42 and 43 may be liquids or powders or mixtures of both. Preferably, these substances are dry powders consisting of very small particles. The width of the outlets 44 is very small whereby the particles are frictionally retained in the container when they are not elicited or extracted. But the outlets 44 are sufficiently wide to release particles when they are attracted by an electric charge or voltage created on the neighboring spot of the sheet 4 by the influence of the charge or voltage of the corresponding pole 36.

The released particles strike the adjacent surface of the carrier 4 and stick to the struck spot, coloring the same and, thus, producing a picture. In order to make the particles stick better, this surface may be covered by an adhesive, for example, by a dry adhesive of that kind which is used for letter envelopes or gummed tape. After the picture has been taken, the position of the particles or the picture formed by them may be secured still more permanently, if necessary, in any suitable and known manner, for example, by covering the picture with a transparent layer of shellac.

Any type of photo-electric cells or devices creating a voltage corresponding to the intensity of

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received light may be used. Minute cells of this kind are well known, for example, from their use in iconoscopes and similar scanning devices for television. Some of known photo-electric cells require a voltage source for operation. If such cells are used, the voltage may be supplied by the battery 34.

As diagrammatically shown in Fig. 7, this battery may be connected by a wire 45 to a pole 46 connected to one of the electrodes of a photo-electric cell, for example, of a cell 29, and by a wire 47 to the corresponding outlet 44 whereby a voltage exists between the particle contacting this outlet and the corresponding pole 36 or the corresponding spot of the sheet 4, respectively, as soon and as long as light received by the cell 29 causes a flight of electrons from one electrode of the cell to the other or a reduction of the resistance of the cell. This voltage causes the particle to leave the outlet and to hit the sheet 4, thereby conveying its electric charge and making free a corresponding charge on the other side of the sheet 4 for transfer to the pole 36. This process may be regarded as a temporary closing of the circuit.

Whatever type of photo-electric cells are used, the quantity of particles released from the outlet 44 corresponds to the duration and intensity of radiation received by the cell. If necessary, the voltage created by the cell may be amplified in common and well known manner.

Before a picture is taken, the camera 2 is so positioned and the objective 1 so adjusted that the object of the picture is projected and focussed on that plane which the photo-electric cells pass when the car 27 moves. The correct position and adjustment can be checked by removing the cover 20 and inspecting the projected picture if the sheet 4 is sufficiently transparent to make this picture visible from the back side of the sheet. Or, the correctness of the projection may be checked after the casing 3 has been temporarily replaced by a frame 48 adapted to be affixed to the housing 2.

The frame 48 has open front and back sides and contains a transparent pane 49 of that kind which is usually used for checking the adjustment of photographic cameras. When the frame 48 is affixed to the housing 2, the pane 49 has a position accurately corresponding to the position of that plane which the photo-electric cells or their light responsible parts pass when the car 27 moves.

The housing 2 may be supported in the adjusted position by any suitable means. For example, the housing 2 may have a foot 50 adapted to be affixed to the top of a stand or support of usual structure. After the adjustment, the frame 48 is replaced by the casing 3.

Preferably, all sides of the cells 29, 30 and 31, except the front side covered by the transparent layers 35, are opaque whereby light can enter the cells from the front side only. In the lowermost and uppermost position of the car 27, the cells may be completely shut off from light rays by ledges 51 and 52 extending from the walls 19 and 21 respectively and covering, in these positions, the front of the cells.

The described device operates as follows:

The taking of the picture starts when the motor 15 which has been wound up in the manner described at any previous time is released by turning the handle 26 of the detent 22. In contradistinction from conventional chemical photography, the taking of the picture does not start when

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the lens system 1 is opened. The lens system may remain open and the sheet 4 may be exposed to the projected rays permanently or from some time before to some time after the process of taking the picture.

The motor drives the car 27 sliding up along the guiding ledges 53 whereby the poles 36 pass over the front side and the outlets 44 over the back side of the sheet 4 until all spots of the exposed part of this sheet have been passed by a cell of each row or kind. Whenever a cell receives projected light, the voltage created thereby in the cell causes the release of one or more coloring particles to the back surface of the sheet. The final result is that this surface is sprinkled with particles and carries a picture consisting of three overlapping pictures of the three cardinal colors and thereby showing a mixture of colors corresponding to the colors of the projected picture.

If the projected picture is sufficiently bright, the motor and the car may move rapidly. If such rapid movement does not produce a sufficiently colored picture, the movement may be adjusted in any suitable and well known manner to a slower pace, or the process of taking the picture may be repeated as often as required. Removal of the back wall 20 allows inspection of the produced picture in order to determine whether the coloring is satisfactory.

If the picture carrier 4 has a black surface or a surface of darker color than the substances 41, 42 and 43, light or bright spots of the produced picture correspond to similar spots of the projected picture, and the produced picture is positive. If, however, the carrier 4 is white or of lighter color than the coloring substances, a negative picture is obtained. Such negative picture can be used to produce a positive picture, for example, by photographing the negative picture again in the same manner and by the same device.

The same device can be used, whenever desired, for conventional chemical photography, simply by inserting a photographic film instead of the carrier 4. In this case, the car 27 and the mechanism driving the same is not used. If the sheet 4 has a photographic or chemically light-reacting layer, chemically and electrically produced or controlled pictures overlapping and completing each other may be taken at the same time.

I desire it understood that my invention is not confined to the particular embodiment shown and described, the same being merely illustrative, and that the invention may be carried out in other ways without departing from the spirit of my invention as it is obvious that the particular embodiment shown and described is only one of the many that may be employed to carry out my invention.

Having described the nature of my invention, what I claim and desire to protect by Letters Patent is:

1. In a device for producing permanent facsimiles of projected pictures, a picture carrier having a color receiving surface, a container having a narrow outlet positioned close to said surface, a finely dispersible substance confined in said container, extending close to said outlet and consisting of coloring particles adapted to be moved through said outlet, a photo-electric cell having a pole with a voltage depending on the intensity of light received by said cell, said pole being positioned so near to said outlet that said voltage influences those of said particles which

are nearest to said outlet whereby said voltage exerts a moving force on said latter particles, and means to move said container and said cell parallel to said surface with said outlet and said pole remaining in the same position relatively to each other, and an optical system projecting an image on a plane in which said cell moves.

2. In a device for producing permanent facsimiles of projected pictures, a sheet-shaped picture carrier, a container having a narrow outlet positioned close to one side of said carrier, a finely dispersible substance confined in said container, extending close to said outlet and consisting of coloring particles adapted to be moved through said outlet, a photo-electric cell having a pole with a voltage depending on the intensity of light received by said cell, said pole being positioned at the other side of said carrier and juxtapositioned to said outlet, the distances between said pole, said carrier and said outlet being so small that said voltage influences those of said particles which are nearest to said outlet whereby said voltage exerts an attraction on said latter particles, and means to move said container and said cell parallel to the sides of said carrier with said outlet and said pole remaining juxtapositioned, and an optical system projecting an image on a plane in which said cell moves.

3. In a device for producing permanent facsimiles of projected pictures, a picture carrier having a color receiving surface, a container having narrow outlets arranged in a row close to and across said surface, a finely dispersible substance confined in said container, extending close to said outlets and consisting of coloring particles adapted to be moved through said outlets, a row of photo-electric cells, each having a pole with a voltage depending on the intensity of light received by the respective cell, each of said poles being positioned so near to one of said outlets that the voltage of the pole influences those of said particles which are nearest to said latter outlet whereby said voltage exerts a moving force on said latter particles, and means to move said container and said cells in a direction parallel to said surface and crossing the direction of said row of outlets with said outlets and said poles remaining in the same positions relatively to each other, and an optical system projecting an image on the plane in which said cells move.

4. In a device for producing permanent facsimiles of projected pictures, a sheet-shaped picture carrier, a carriage having a slot passed by said carrier, a container carried by said carriage and having narrow outlets arranged in a row close to and across one side of said carrier, a finely dispersible substance confined in said container, extending close to said outlets and consisting of coloring particles adapted to be moved through said outlets, a row of photo-electric cells, each having a pole with a voltage depending on the intensity of light received by the respective cell, said cells being carried by said carriage and being positioned at the other side of said carrier, each of said poles being positioned close to said other carrier side and juxtapositioned to one of said outlets, the distances between each pole, said carrier and the juxtapositioned outlet being so small that the voltage of said pole influences those of said particles which are nearest to said latter outlet whereby said voltage exerts an attraction on said latter particles, and means to move said carriage with said cells in a direction parallel to the sides of said carrier and crossing the direc-

tion of said row of outlets, and an optical system projecting an image on the plane in which said cells move.

5. In a device for producing permanent facsimiles of projected pictures, a sheet-shaped picture carrier, a container having a plurality of chambers with narrow outlets positioned close to one side of said carrier, finely dispersible substances confined in said chambers, extending close to said outlets and consisting of coloring particles adapted to be moved through said outlets, the particles contained in one of said chambers coloring differently from the particles contained in another chamber, a plurality of photo-electric cells comprising different kinds of cells, each kind responding to light of another color, each cell having a pole with a voltage depending on the intensity of light activating the cell, each of said poles being positioned at the other side of said carrier and juxtapositioned to one of said outlets, the distances between each pole, said carrier and the juxtapositioned outlet being so small that the voltage of the pole influences those of said particles which are nearest to said latter outlet whereby said voltage exerts an attraction on said latter particles, and means to move said container and said cells parallel to the sides of said carrier with said outlets and said poles remaining juxtapositioned, and an optical system projecting an image on the plane in which said cells move.

6. In a device for producing permanent facsimiles of projected pictures, a sheet-shaped picture carrier, a carriage having a slot passed by said carrier, a container carried by said carriage and having a plurality of chambers each having outlets arranged in a row close to and across one side of said carrier, finely dispersible substances confined in said chambers, extending close to said outlets and consisting of coloring particles adapted to be moved through said outlets, the particles contained in one of said chambers coloring differently from the particles contained in another chamber, a plurality of photo-electric cells carried by said carriage and comprising rows of different cells, each row responding to light of another color, each cell having a pole with a voltage depending on the intensity of light activating the cell, said poles being positioned at the other side of said carrier and juxtapositioned to said outlets, the distances between each pole, said carrier and the juxtapositioned outlet being so small that the voltage of the pole influences those particles which are nearest to said latter outlet whereby said voltage exerts an attraction on said latter particles, and means to move said carriage with said cells in a direction parallel to the sides of said carrier and crossing the direction of said rows of outlets, and an optical system projecting an image on the plane in which said cells move.

MAX SALZ.

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