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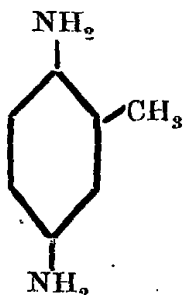
Date of Application, 27th June, 1912—Accepted, 27th June, 1913

COMPLETE SPECIFICATION.

Improvements in or relating to the Production of Photographs in Natural Colors.

I, RUDOLF FISCHER, of Beymestrasse 20, Steglitz, near Berlin, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

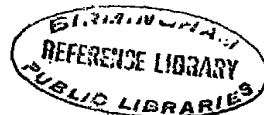
- 5 My invention relates to the production of photographs in natural colors. Various methods have been proposed to utilize the oxidising properties of various bodies in connection with the production of coloured photographs. For instance leuco-bodies of organic compounds have been employed in conjunction with one or more nitrogen and oxygen groups which can be readily
10 eliminated, for the production of sensitive layers or coloured photographic images, while coloured prints have been obtained by exposing a chromium di-oxide layer under a negative and developing the image so formed by means of a solution of an alkaline bi-sulphite and an organic compound which is oxidisable into a colouring matter by the chromium di-oxide.
- 15 It is well known that by developing exposed films of halogen-silver in suitable solutions, monochrome pictures can be directly obtained, the exposed halogen-silver oxidising the substance in the solutions to an insoluble or comparatively insoluble coloring-matter which is precipitated on the reduced silver.
- 20 A familiar example of such colour development is found in the case where an alkaline pyrogallol developer is employed without any preservative such as sodium sulphite. Amongst other substances which act in a similar manner may be mentioned indoxyl, thioindoxyl, hydrochinone and alpha-naphthol, para-
midophenol and xylenol ($C_6H_3(CH_3)_2OH$), paramidophenol and alpha-naphthol, dimethyl paraphenylenediamine and alpha naphthol, dimethyl paraphenylenediamine and phenol, also toluenylenediamine,
- 25



diamidodiphenylamine ($NH_2.C_6H_4.NH.C_6H_4.NH_2$.) and other diphenylamine derivatives, and generally those bodies which while acting as developers also produce a more or less insoluble coloured oxidation product. Hereinafter this
30 mode of development will be termed "color development", and the substances causing the same "color formers".

According to my invention I utilise this stronger oxidation capacity of exposed halogen-silver as compared with that of unexposed halogen-silver for

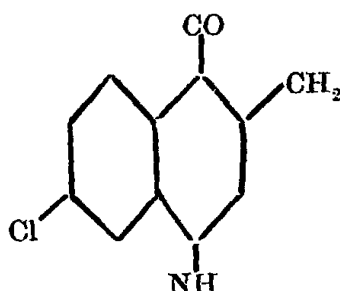
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producing colored photographs. I can do this in various ways, and both additive as well as subtractive colored pictures can be produced equally well.

I. For example, if a color screen is to be made as an additive colored picture, I expose a halogen-silver layer sensitive to light under a screen, say a line screen, one-third of whose surface is permeable to light, whilst two-thirds thereof are covered. I then develop the layer in a solution producing a blue coloring-matter for example, indoxyl, and an alkali, such as described in *Der Photographischen Korrespondenz* 1907 pages 55 and 115. I then expose it under a second screen, or the original screen, so that a further one-third of the surface is exposed, and then develop it in a solution, for example, thioindoxyl, producing a red coloring-matter. I then expose the whole surface without the screen negative, the remaining or previously unexposed halogen-silver being acted upon and this is colored green when developed in a solution, for example chlorindoxyl



producing a green coloring-matter. During the second and third exposures the silver below the particles of coloring matter protects the unchanged halogen-silver below it from further exposure and development. Moreover, this protection can be afforded by the coloring-matter already formed, by using during the subsequent exposures a light which is absorbed by the existing coloring-matter. The three-color picture or screen thus formed can be used as a three-color screen after removing the silver under the particles of coloring-matter with, for example, Farmer's reducing agent, and after removing the unchanged halogen-silver by means of a fixing agent.

II. For subtractive pictures I employ, as usual, three-part-negatives, each of which corresponds to one of the primary colors. From these negatives three part-positives are produced on halogen-silver layers, then developed as above described with the corresponding color-formers, and finally placed one above the other.

The part-positives can also be obtained directly from complementary-colored negatives produced by means of multi-color screens such as described above, by making positive part-extracts from the negatives either using filters and copying on a panchromatic halogen-silver layer, or without filters and copying on selectively-sensitised halogen-silver layers. These positives are developed, colored and superposed one on another as described above.

The last described method of reproduction on three selectively-sensitised halogen-silver emulsions can be carried out in one operation in the following manner:—Three emulsions are made, one being sensitive only to blue light, another only to green light, and a third only to red light. In these emulsions are incorporated the substances necessary for the formation of each color, *i.e.* the substances termed "color formers" the latter being so selected, for example, that that color is formed at any time which is complementary to the corresponding selective color-sensitization of the halogen-silver. Now when these three emulsions are poured out in three layers one on another, there is formed, for instance under the action of blue light, a yellow color, and at the places acted on by red and green light the corresponding complementary colors. When the colors are correctly chosen those places which white light strikes become nearly

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black, whilst at those whereon no light strikes for instance under the covered or dense parts of the negative, no coloration is formed at all, and consequently after fixing white results. By copying a screen negative on such a layer the correct colors and correct black and white values are obtained.

5 Instead of pouring the three above emulsions, in three layers one on another, before pouring them I may treat them in a suitable manner, for instance by tanning, so that they can be mixed without the three compounds (halogen-silver and color-formers) uniting to form one homogenous layer or film. This
10 treatment has heretofore been proposed for a theoretically developed process of color photography. (Photographische Korrespondenz of 1907 pages 55 and 115.)

The halogen-silver which is unchanged during the copying operation and the silver formed simultaneously with the coloring-matter are removed by fixing and reducing agents.

15 When practising the process with three layers I may use a yellow coloring-matter mixed with a binder as an intermediate layer for the purpose of reducing the sensitiveness to blue in the halogen-silver layers sensitive to green and red.

It is, moreover, preferable not to pour the three emulsions directly one on another, but to interpose a colorless layer in order to prevent diffusion of the
20 color-producing substances.

An example of one method of carrying the invention into effect is as follows:—

25 With a complementary-colored screen-negative an exposure is made through a blue-filter on a transferable panchromatic layer of halogen-silver emulsion. The exposed picture is developed with pyrogallol, fixed and the silver removed say by Farmer's reducer. The developer is made up as follows: Pyrogallol 1 gr. soda carbonate 5 water 100 c.m.; such a developer will give, as is well known in the case of a pyrogallol developer used without a "preservative" such
30 as sodium sulphite, a yellow part-picture which is now removed and transferred to a suitable backing or support. An exposure is then made through a green filter on a similar layer and a purple-red picture developed in the following developer:

0.5 grammes of thioindoxyl carboxylic acid, 5c. cms. of acetone, 5 grammes of potash, and 100 c., cms. of water.

35 After fixing and removing the silver, this red picture is transferred on to the yellow one. Finally, by using a red filter an exposure is made on a panchromatic layer and this is developed in the following developer; 0.5 grammes of indoxyl carboxylic acid, 5 c. cms. of acetone, 2 grammes of potash, 100 c. cms. of water. After the removal of the silver and halogen-silver this blue picture
40 is transferred on to the two former pictures.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

45 1. For the production of color photographs producing the various primary colors by color development of the exposed halogen-silver by means of such substances as are oxidised by exposed halogen-silver to form colored substances which are soluble with difficulty.

2. For carrying into practice the process set forth in Claim 1, producing the
50 three primary colors in lines one beside the other by successively exposing a halogen-silver emulsion layer under a line-screen, which is shifted to the extent of one line at each exposure, and developing each line so exposed with a color former to give the desired colour, substantially as described.

3. A mode of carrying into practice the process set forth in Claim 1, characterised by the part-pictures requisite for a subtractive process being made in
55 the manner specified in Claim 1.

4. For the production of coloured photographs according to Claim 1,

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making three selective, color-sensitive, halogen-silver emulsions with the corresponding color-formers and then superimposing the three layers one on another substantially as described.

5. A modification of the procedure set forth in Claim 4, consisting in first tanning each of the emulsions and then mixing them to form one layer or emulsion. 5

6. In the process set forth in Claim 4, mixing a yellow coloring-matter with a binder and using same as an intermediate layer in front of the halogen-silver layers sensitive to green and red, for the purpose of reducing the sensitiveness to blue. 10

7. In the process set forth in Claim 4, forming or applying colorless intermediate layers between the three sensitive layers, in order to prevent the diffusion of the color formers.

8. The production of colored photographs substantially as described.

Dated this 27th day of June, 1912. 15

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