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(54) Colour printing

(57) In the production of colour prints by the additive process, the lines of the three successive primary colour exposures being determined by a single exposure of trial paper through a grey wedge and laterally spaced primary colour filters to diffused light from the original (to produce a trial print comprising gradually darkening yellow, magenta and cyan scales), the trial print is compared with reference standards which are at least 50% darker than the faintest colour shades recognisable by the eye and having a density value of at least 0.2D, preferably 0.5–0.8. A rotary disc 1 bearing focusing aperture 2, diffuser 3, blue filter 4, green filter 5 and red filter 6, is attached to bellows frame 8 with a clearance from enlarger lens 15 of 1–2mm. Trial paper 22 having a time scale 23 is exposed below grey wedge 21 and primary colour filters 18, 19 and 20.

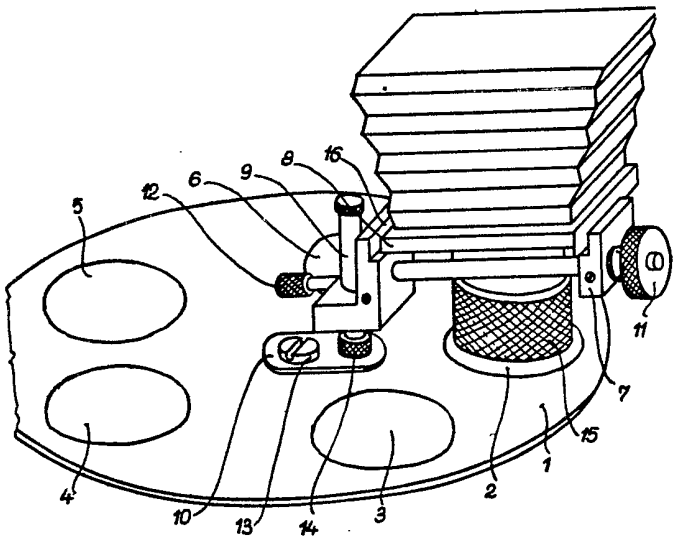


Fig. 1

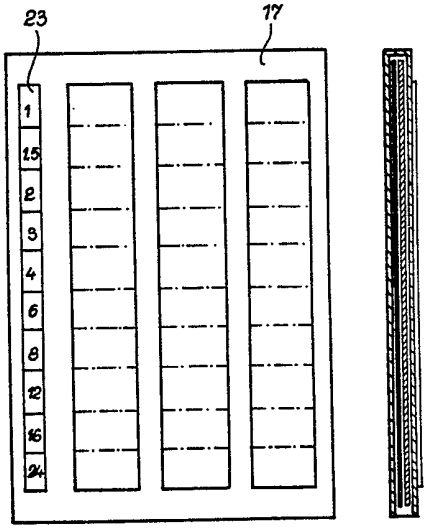
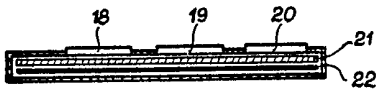


Fig. 3



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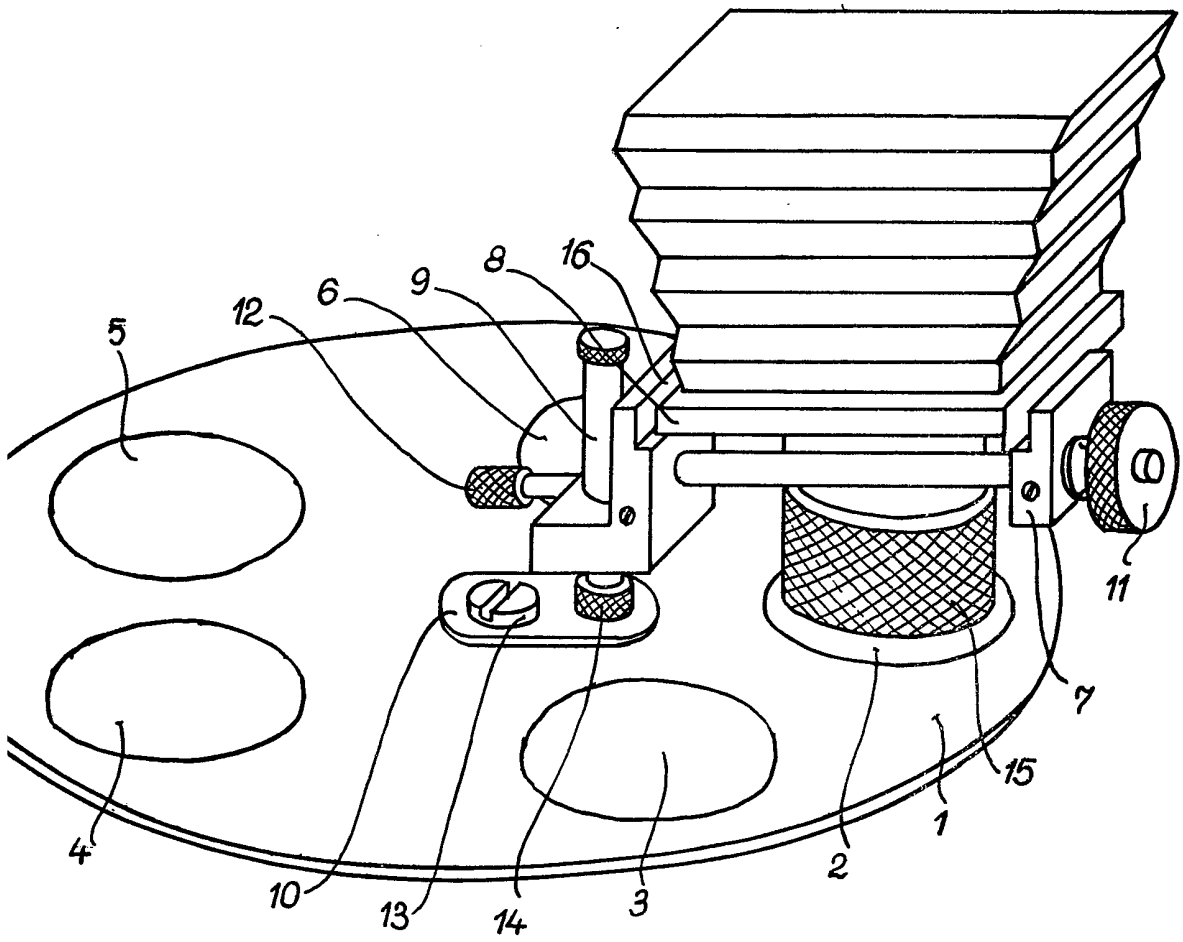
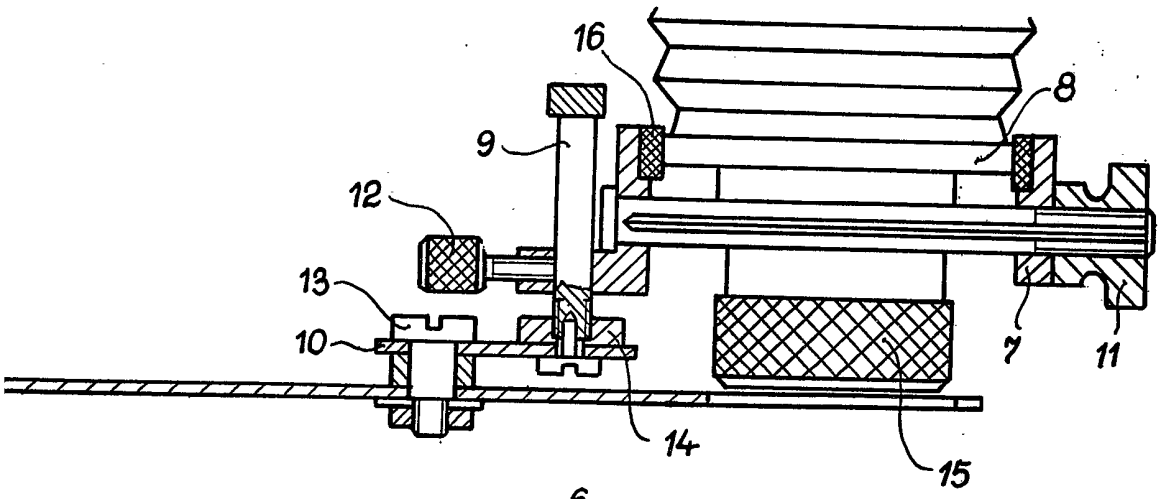


Fig. 1



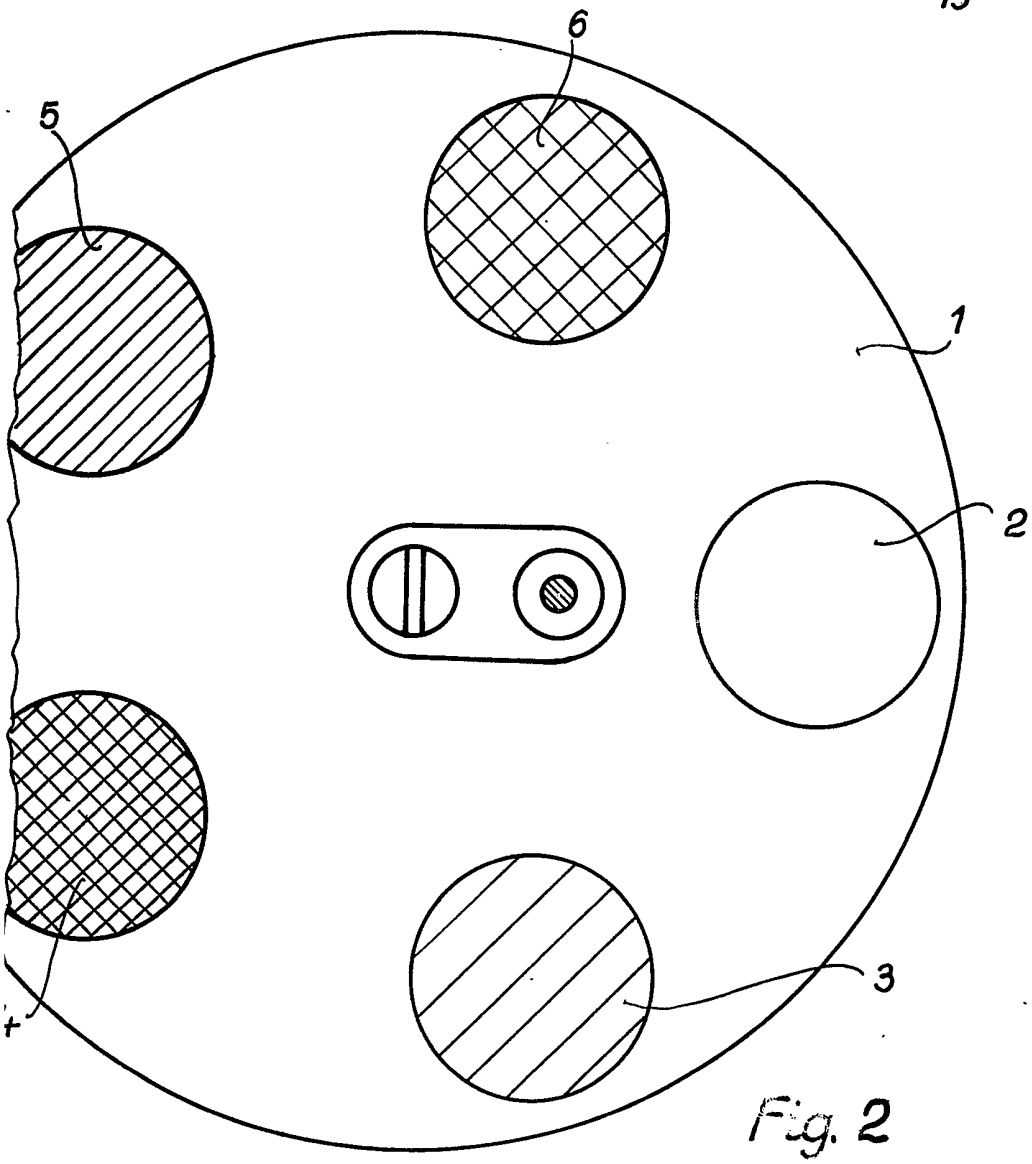
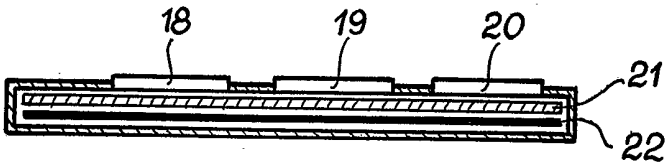


Fig. 2



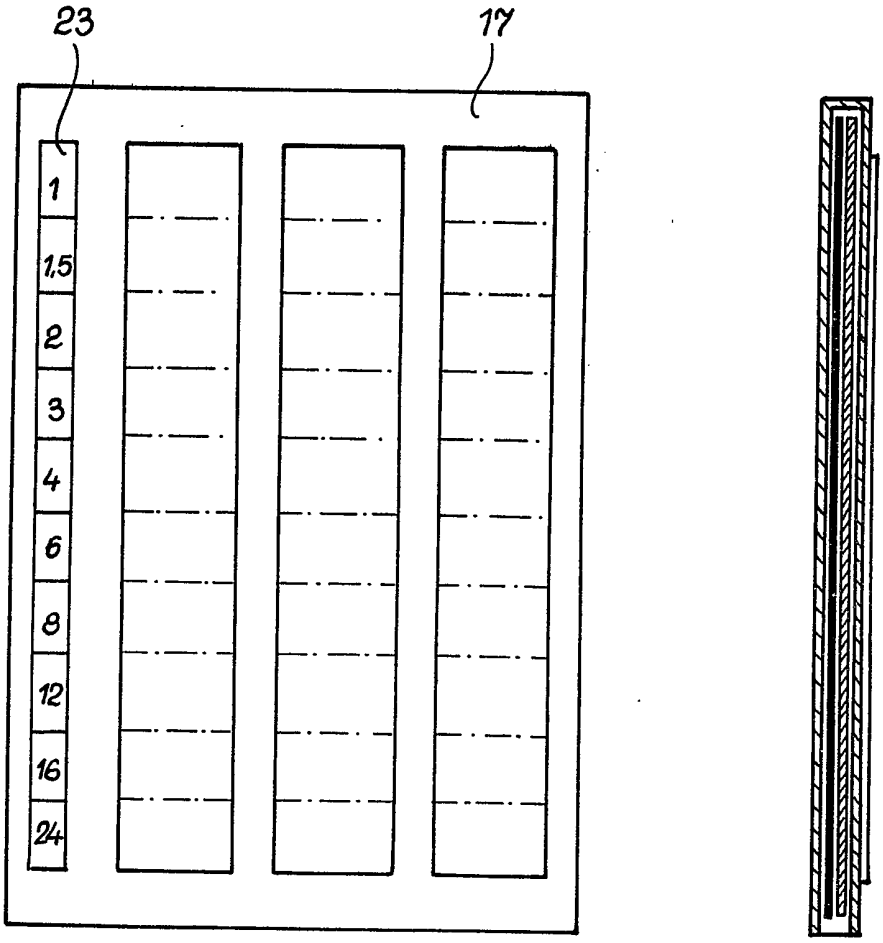


Fig. 3

SPECIFICATION

Process and equipment for enlargement of colour-balanced prints in additive system

The invention relates to a process and equipment for enlargement of colour-balanced colour prints in additive system, in course of the correction filtering the colour filters having been arranged in the path of the beam of light of the objective of the enlarger are placed beneath the lens, where they are alternately actuated, at the same time the time of exposure needed for obtaining the colour-balanced picture are determined by means of a trial picture. The colour control and integrating equipment, i.e. outfit for the realization of the process is also forming the object of the invention, which contains additive colour filters and an integrating plate and beholds them under the objective.

The colour-analyser mask forming a part of the process and also forming an object of the invention, contains additive colour filters and a grey wedge.

By using the process and the equipment according to the invention traditional enlargers may be rendered suitable for producing colour-balanced enlargements, simultaneously determination of the proper time of exposure becomes possible.

According to prior arts the equipments being suitable for coloured enlargements are based mostly on the substractive process all over the world. Complete enlargers being suitable for coloured enlargements based on the additive method have been produced in some countries (so e.g. USA, GFR, Italy, etc.), however, these are so expensive that the purchase thereof for the majority of the amateurs becomes simply impossible, at least it is far uneconomical. The high pricess result first of all from the fact that electronical means and dichroic colour filters are built-in in an increasing extent. The same stands for the enlargers based on the substractive system and the colour analysers, which can be separately purchased.

For the majority of the amateurs the only possibility having been offered by the market is to complete their traditional black-and-white enlargers by colour filtering means needed for the coloured enlargement. However, in course of coloured development the most difficult task is to learn the so-called colour filtering, representing an essential condition for obtaining colour-balanced pictures, requiring—according to our experiences—extensive theoretical knowledge and a long practice, these requirements, however, are surpassing the possibilities of an average amateur or hobby-photographer.

The complementary instruments, the colour-analyser and the expensive electronic enlargers have worked well in professional developing works, but could not offer help for the amateurs for home-work; the prerequisite for the reliable operation of said equipment lies in the maintenance of the technological processes on a controlled, continuous and stable level, however, this requirement cannot be met in the domestic laboratories of the amateurs, being the bathroom in the majority of cases. Simultaneously changing of the factors is leading to colour-shift and there is not a single electronical device, which could evaluate these phenomena in advance.

After having recognized the difficulties, already in the fifties some experiments were performed for extablishing a process based on the additive system, by using either the so-called colour wedge which could be produced by crossing three (blue, green and red) colour filters and photographical grey wedge or by using colour filters with gradually darkening colour density of itself. The essence of this method is, that the colours of the negative picture are integrated to grey by the aid of a diffuser and projected to the photograhical paper, while the times of exposure being suitable for adjusting the colour balance had to be determined by recognizing the faintest grade of the colour steps of the paper picture. This theory has been adapted and developed, in so far as graphical markings were used to promote the perception of the "faintest" colour being utmost subjective in regard to judgement. Such a method is described in the British patent specification No. 1 341 288 (Exposure Calculator and Filter Device for Darkroom Color Photography).

Experiments are also known, which aimed—taking the proposals of the contemporary technical literature as a basis—to fasten the additive colour filters to the lens of the enlarger. Thus method has been adapted by the cited British patent but the solution was applied by other apparatuses too. As an example should be mentioned the additive filter-set "Tricolor" of SIMMARD.

However, the solutions mentioned involved serious defects and errors. The most decisive error was represented by the basic principle itself, which was maintained as a common characterisic of all the methods having been used up to now, inspite of the different versions, namely the recognition of the faintest shades of colours. Any of the developed photographic materials is showing the characteristic feature in so far that the density of the negative is proportional to the quantity of the incident light but within certain limits, in the straight section of the so-called density curve. In the initial slowly ascending part of the curve, just where the limit darkening of the negative becomes visible, density follows the change of the light intensity far slower, than later, in the straight section of the curve. This regular phenomenon is accompanied by the practical consequence, that the beginning of

the limit-blackening being recognized by the eye, i.e. the faintest shade is hardly changing in dependence of the considerable increase of the exposition, although such differences in exposition are already disturbing the colour-balance. Furtheron, said method could be applied only in that case, if the effective shades of colour of the yellow, magenta and cyan colour grades of the photographic paper are in an accurate mutual distance within the colour cycle and the same quantities, i.e. in this case the same limit values result the grey colour. However, in practice this is impossible. Sometimes the factories producing photographic materials are using colouring agents with quite a different character and considerably differing wavelengths. As a consequence, said method has proved erroneous and inaccurate from several points of view and this is the reason, that the colour wedge—being perfect in itself, as means—has been almost forgotten.

The second main disadvantage lays in that the additive colour filter device was fastened to the lens of the enlarger. This solution can be considered as unsuccesful from several points of view. First of all, because the lenses are sunk in several enlargers and do not protrude from the lower supporting frame, accordingly attachment becomes impossible. Secondly, in the majority of cases said solution prevents the possibility of regulation of the diaphragm, since the clamped device is blocking its path. Thirdly, the lens is rather delicate, and it is unadvisable to burden it with a foreign load and to subject it to the clamping force needed for stable fixing of a separate device.

The aim of the invention is to eliminate the errors of the evaluating processes based on the recognition of the faintest colour shade, starting from the judgement of the limit-darkening. The proper judgement should not depend on the subjective colour perceptional ability of the individual, at the same time a colour sample, a coloured reference standard should stay at disposal, taking the peculiar features of the photographic materials into consideration and yielding a basis for accurate calculation. Furtheron, the solution should offer simple and cheap equipment for realizing of the process.

By means of the light of the negative having been integrated by the diffuser, a trial picture is illuminated through the colour-analyser mask produced by the combination of the additive colour filters and the grey wedge with an time exposure having been experimentally determined and prescribed in advance, in dependence of the applied translucent materials.

Hereafter, the gradually darkening fields of the yellow, magenta and cyan wedges appearing on the trial picture are compared to the coloured reference standard, the density of which amounts to min. 0.2 D, accordingly, the darkening of the negative is at least by 50% higher, than the faintest shade which can be able recognized by eye.

By means of comparison the exposure times belonging to the colour-balanced picture are determined.

In accordance with the invention, the coloured reference standards are expediently prepared by developing the photographic paper having the same or similar character, as the product to be used in course of enlarging or by colouring other materials by some kind of dyestuff. In course of the preparation the colour density of the coloured reference standards is expediently set to the value within the range between 0.5 and 0.8D. Taking into consideration, that darkening of the negative is falling into the straight section of the density curve, the human eye may well follow the changes of the density being proportional to the intensity of the illumination, accordingly, adjustment of the colour balance will be more accurate, than in the previous cases.

The realization of the new process is enabled by a simple and reliable technical solution, by means of which the additive colour filters may be fastened to the enlarger without touching the lens of it, thus eliminating the drawbacks of the previous solutions. This colour control and integrating structure fitting containing the additive colour filters and the integrating plate (i.e. the diffuser)—otherwise "adapter"—is fixed in sense of the invention to the lower part of the bellow of the lens or to the lamphouse or to the console of the enlarger and it is provided with adjusting and fixing elements for the adjustment in horizontal and vertical direction, respectively.

With a preferrred embodiment of the colour control and integrating device the colour filtering and integrating means having been arranged in the path of the beam of light are placed in an aperture holding the filter and forming a common casing.

With a preferred embodiment of said filter holder the colour filter and integrating means having been arranged in the path of light are arranged in five openings of the common mounting.

With a further embodiment of the colour control and integrating device the colour filter and the integrating means having been arranged in the path of the beam of light are placed in the openings of separated mounting.

In accordance with the invention the colour-analyser mask containing the additive filters and the grey wedge is provided with a time scale having been calibrated in compliance with the coloured reference standards. Expediently, the time scale displays directly the times of exposure, however, codes and code system substituting the time scale may be also used.

The invention will now be further described by way of Examples with reference to the accompanying drawings, in which

Figure 1 and *Figure 2* show one of the embodiment of the equipment according to the invention,

Figure 3 is one of the embodiment of the colour-analyser mask, according to the invention.

One of the possible embodiments of the colour filter and integrating means, alias adapter, are shown in Figs. 1 and 2. With this embodiment on the disc-shaped filter support 1 the vacant adjusting aperture 2, the integrating plate (i.e. the diffuser), the blue colour filter 4, the green colour filter 5 and the red colour filter 6—arranged in the further apertures in the order of sequence of application—are to be seen. As a diffuser 3 frosted glass or a thin colourless transparent diffuse synthetic plate should be used. The filter support 1 is fixed by means of the clamping jaws 7 and the clamping screw 11—by inserting the inserts 16 made of rubber or a synthetic material—to the lower supporting frame 8 of the bellow of the lens of the enlarger, i.e. on the edge of the frame. Adjustment of the filter support is performed by displacing it in a vertical direction on the guide rod 9, while fixation is taking place by means of the screw 12. Adjustment in the horizontal direction is performed by means of the excentric arm being fixed by means of the screw 14. In such a manner, the symmetrically arranged apertures 2 to 6 may be adjusted exactly in the axis of the lens 15 and directly under its lower plane with a clearance distance of 1–2 mm; by rotating the disc-shaped filter support 1 around the pin 13 alternating actuation becomes possible.

As a filter support any other solid e.g. a flat slide to be displaced in a mounting may be used instead of the disc. A version is also possible, with which the diffuser and the colour filters are arranged in partly or entirely separated mounting and can be bent individually below the lens, similarly to the red adjusting filter of the black-and-white enlargers.

The embodiment of the clamping jaw having been illustrated here may be substituted by any other similar suitable clamps. The means serving for the horizontal and vertical adjustment can also be differently formed, e.g. by using hinges. Expediently there is a ratchet mechanism arranged on the disc-shaped filter support enabling the accurate adjustment of the apparatus under the objective. It seem to be expedient to indicate the position of the different colour filters on the rim of the disc by means of markings or incisions to be felt by touch in order to facilitate identification in the darkroom.

In case, if for any reason the construction of the enlarger did not make possible to fasten the device onto the lower supporting frame of the below of the lens, the clamping jaw is to be fixed on any other suitable part of the enlarger, but never onto the lens itself. Such places are e.g. the upper part of the below or any other point of the laphouse or the console of the enlarger. In case of necessity suitable complementary elements, extensions may be connected to the adapter. The second structural unit is represented by the colour-analyser mask, which is serving for the adjustment of the colour balance in course of the process according to the invention.

A possible embodiment of the colour-analyser mask is to be seen in Fig. 3. With this embodiment the casing 17 of the colour-analyser mask is formed by a flat box having been provided with apertures on the side, reminding of the film casket of the old-type cameras. In the longitudinal apertures the blue 18, green 19 and red colour filters 20 are arranged, being of the same quality, as the additive colour filters having been arranged in the filter support 1. Directly underneath, the photographical grey wedge 21 (film)—illustrated in the figue in a sectional view—is arranged; the graduation lying perpendicularly to the openings is indicated by the perpendicular dash line. The grey wedge consists advantageously of 10 to 15 grades, darkening evenly and gradually e.g. by the value of + 0.10 or + 0.15 D.

The coloured photographical paper 22 is to be slipped into the mask in that way that the side with the emulsion should be upwards. The time scale 23 can be made in several forms, in Fig. 3 a possible version thereof is to be seen; the numerical values of the scale are accurately correlated with the density grades of the grey wedge. With simpler embodiments the numerical values of the time scale are written onto the colour-analyser mask itself, but a version is also possible, where the digits are appearing on the developed trial picture beside the coloured grades. In this case the time sclae on the transparent film material is incorporated into the colour-analyser mask. The digits can be substituted by other signs, so e.g. letters, in this case there is a special code for the calculation of the times of exposure.

The colour-analyser mask can be made in a more simple manner, e.g. so, that the elements to be incorporated are enclosed by two sheets of glass being fixed by an outer rim. Such a colour-analyser is simply placed over the photographical paper. Whatever form is chosen for the colour-analyser mask and for the time scale, the essential feature lies in that the numerical values should be calibrated in compliance with the coloured reference standard.

Calibration is realized in such a manner, that in course of production the time of exposure is determined experimentally, being adapted fundamentally to the density of the

translucent material having been applied, by means of which the light (integrated by the diffuser) of a negative of average colour distribution and grade of darkening, with a mediocre diaphragm aperture of the lens, e.g. f:8, when inciding onto the trial paper is giving a result, which meets the double requirment after development. The first requirement lies in that the time of exposure with additive filtering, during which a colour-balanced print can be enlarged without performing a separate test, should lie in the middle-range of the time scale. The second requirement lies in, that on the developed trial paper field of averagely dark density should appear beside said digits. The lowest limit value of the desired density equals to 0.2 D, that means, that grade of darkening is by 50% higher, than the palest colour shade being visible to the eye on the colour print. According to practical measurements the density thereof lies in general at the value of apprx. 0.05 D, when the densitometer is set to zero corresponding to the basic white colour of the paper. It seems to be, however, expedient, to establish the grade of darkening in a value of 0.5 to 0.8 D, as already mentioned, being the most advantageous in respect to visual comparison.

The time of exposure value having been determined by said experiment is to be indicated in the manual of the apparatus for the accurate adjustment of the colour balance. The errors and inaccuracy of the previously used processes based on the use of the coloured wedge have been increased namely by the fact, that the time of exposure determining fundamentally the density of the trial picture was not prescribed at all, and if, so only in an aproximative manner.

The coloured reference standards (not illustrated here) are forming an important part of the invention. The density thereof results from the tests mentioned before, accordingly, their value is accurately fixed. The coloured reference standards are made in a most advantageous manner from the photographical paper having been already developed, but any other material coloured with a dystuff may be used for this purpose. In order to be able to reach maximal accuracy, it is possible to put different reference standards into commercial circulation for the photographical papers of different colour character. However, the use himself can make the reference standard by simply cutting the proper square from the coloured trial wedge having been made of a different type of photographic paper. In order to facilitate comparison, the coloured reference standards are expediently made in a size corresponding to the fields (squares) of the coloured wedge and they are to be fixed on a neutral white or grey base.

The application of the process and equipment according to the invention will be described by the way of an example:

First of all the colour control and integrating device is to be installed onto the enlarger according to the prescriptions. Hereafter, by exposition through the vacant adjusting aperture, the sharpness of the negative lying on the base-board of the enlarger frame is to be adjusted in the desired size. The essence of the selection of the negative lies in the average colour distribution of the properly exposed outdoor photo.

In course of the following step the aperture of the objective is set to the prescribed value and the photographical paper of the proper size is to be placed—in the darkroom—into the colour-analyser mask; the photographical paper set in place of the picture to be enlarged, respectively, in the middle thereof, is to be exposed via the diffuser with the time of exposure according to prescriptions (e.g. 80 seconds).

Thereafter the photographical paper taken out from the mask is to be developed in accordance with the prescriptions of the manufacturer in the usual manner. Out of the yellow, magenta and cyan colour grades one has to select the fields, the grade of density of which is corresponding to the coloured reference standards on the base of comparison. The time of exposure belonging to said grades are to be read or identified from the time scale. By rotating further the filter supporting disc an other photographical paper is to be exposed by using said times of exposure, through the additive filters, three times in regular succession. The time scale values corresponding to the yellow-magenta-cyan coloured reference standards inducate the expositions with the blue-green-red filtering.

The colour print having been developed as a result of the process previously described, as well as the enlargements made from the other squares of the negative of same average density and colour temperature, will be in compliance with reality both in respect to general density and colours.

The application of the equipment according to the invention, which can be produeced at low costs, is mostly advantageous not only for amateurs, but also for professional photographers with smaller studios. The possibility of corrrection filtering is practically infinite in contrast to the processes performed with the substractive colour filters of finite intensity respectively, grading. The well known advantage of the additive method lies in the nicer and clearer colours to be obtained. The colour wedge is functioning with a high accuracy in course of the process and it is reliable even under the average circumstances of amateurs. The colour filter may be installed onto already existing enlargers, one may use the apparatus one is accustomed to. At the same time the lower price is accompanied by a better quality and higher rentability. By using the solution

according to the invention, without special preliminary training and routine excellent coloured enlargements can be made independent of the subjective colour perceptional ability being quite different at the single individuals, enabling the performance of coloured enlarging in the circle of photoamateurs, to be performed successfully under domestic circumstances.

CLAIMS

1. A process for enlargement of colour-balanced colour prints by using the additive method, in which the colour filters disposed in the path of the beam of light from the objective lens of the enlarger are placed below the lens in course of correction filtering, where they are alternately acutated and the times of exposure required for obtaining colour-balanced prints are determined by means of a trial print in such a manner that the latter is exposed by the integrated light of the negative via the additive colour filters and a grey wedge and thereafter developed and evaluated, and wherein the trial print is exposed with the time of exposure determined in the course of previous tests, and after developing it the field of the yellow, magenta and blue-green (cyan) wedges with a graduated darkening appearing theron are compared to coloured reference standards (etalons) which are at least by 50% darker than the faintest colour shades recognizable by the eye, and which are of a density value of minimum 0.2 D, and the times of exposure associated with the colour-balanced picture are determined by comparison.

2. Process according to claim 1, wherein the coloured reference standards are made by developing colour print expediently of the same or similar character as the product to be used in course of enlarging, or by colouring materials by using a dyestuff.

3. Process as claimed in claim 2, wherein in course of processing the density of the coloured reference standards is set to an average value, expediently within the range between 0.5 and 0.8 D.

4. Colour control and integrating adapter for performing the process according to claim 1, containing in its apertures additive colour filters and an integrating plate and keeping them under the lens, wherein the adapter is fastened to the lower part of the bellows or other displaceable structure of the objective lens, or the frame thereof or to the lamphousing of the console (bracket) of the enlarger and is provided with adjusting and fixing means for the displacement in a horizontal and vertical direction, respectively.

5. Adapter as claimed in claim 4, wherein the colour filter and integrating means placed in the path of the beam of light are arranged in the opening(s) of a filter support forming a common casing.

6. Adapter as claimed in claim 5, wherein the filter support is provided with five apertures, of which three receive the colour filters, the fourth the inegrating plate and the fifth is left vacant.

7. Adapter as claimed in claim 6, wherein the colour filter and the integrating means of the filter support disposed in the path of the beam of light are arranged in the mutually separated apertures in mountings.

8. Colour-analyser mask for performing the process as claimed in any of claims 1 to 3, containing additive colour filters and a grey wedge, wherein it contains a time scale calibrated in compliance with the coloured reference standards (etalons).

9. Time scale for the colour-analyser mask as claimed in claim 8, wherein the times of exposure are indicated directly on the time scale.

10. Time scale for the colour-analyser mask as claimed in claim 8, wherein the numerical exposure values on the time scale are substituted by an associated special code or code system.

11. A process as claimed in claim 1 substantially as herein described with reference to and as shown in the accompanying drawings.

12. Apparatus as claimed in claim 4 or claim 8 or claim 9 substantially as herein described with reference to and as shown in the accompanying drawings.

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