[Second Edition.]

PATENT SPECIFICATION

Application Date: March 19, 1929. No. 8828/29. 329,438

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PROVISIONAL SPECIFICATION.

Improvements in or relating to the Projection of Pictures in Natural Colours.

We, ANTHONY BERNARDI, an Austrian Citizen, and RAYCOL LIMITED, a British Company, both of 22, Surrey Street, London, W.C. 2, do hereby declare the nature of this invention to be as follows:—

This invention relates to improvements in apparatus for projecting pictures in natural colours such as cinematographs, magic lanterns and the like. In colour cinematography as heretofore proposed the film has been taken with two or more colour components such, for example, as red and bluish green. The film after development is projected through filters of the same colours as those employed in the taken process, the two components being projected either successively or simultaneously. The use of filters for screen projection similar to those employed in the taking process leads to a great loss of light and hence a lack of brilliancy in the projected coloured picture. We have discovered, however, that one of these filters may practically be dispensed with. Thus, for example, if a film be taken through ordinary full-blooded filters, say red and green, and is then projected through a red filter only—the picture taken through the green filter being unprovided with a filter—so that we have projected upon the screen a red picture, projected through a red screen and a green picture projected directly without a colour screen at all, then under these circumstances the red light projected upon the screen appears to evoke by contrast the complementary blue-green colour so that the blue-green filter may be dispensed with for screen projection. Practically the same results can be obtained by substituting for the full green filter used in taking a thinner and much weaker filter of the same tint for projection. Of course, the green filter in projection may be retained of a full green colour whilst the red is attenuated. A very large increase in the amount of light falling upon the screen results from the use of the combination of filters as above described and thus one of the greatest difficulties in the successful projection of colour cinematograph pictures is overcome.

It may be pointed out that the use of a full and an attenuated colour filter in the manner set out above makes it possible to obtain a very pure white upon the screen, which has been very difficult if not impossible to obtain by any of the methods heretofore proposed for colour cinematography.

It will be obvious, of course, that our invention can be carried out with other filters than red and green and further its use is not limited to colour cinematography, it having beneficial results when used in any apparatus for projecting pictures in natural colours.

Dated the 18th day of March, 1929.

GEE & Co.,
Patent Agents,
Staple House, 51 and 52, Chancery Lane,
London, W.C. 2, and
71, George Street, Croydon,
Agents for the Applicants.

COMPLETE SPECIFICATION.

Improvements in or relating to the Projection of Pictures in Natural Colours.

We, ANTHONY BERNARDI, Dr. Phil., an Austrian Citizen, and RAYCOL LIMITED, a British Company, both of 22, Surrey Street, London, W.C. 2, 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:—

This invention relates to the exhibition of pictures in colours, for example, by means of cinematographs, magic lanterns and the like.

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In colour cinematography as heretofore proposed the film has been taken with two or more colour components such, for example, as red and bluish green and the film, after development, is projected through colour filters of the same, or substantially the same, colour values as those employed in the taking process, the two colour components either being superimposed on the screen or projected successively on to the screen so that they more or less register, whereby the pictures are exhibited in colour due to the phenomenon known as "persistence of vision". The use of these filters, however, in the projection process leads to a great loss of light and hence not only does the illuminant employed in the projection have to be of considerably greater intensity than in ordinary monochromatic cinematography but there has heretofore always been a certain lack of brilliancy in the projected coloured picture which is thus not at all pleasing to the eye. Furthermore, when the colour component pictures are projected successively on to the screen the eye is fatigued.

It has also been proposed but, as far as we are aware, never carried into practice, to take a film with exposures alternately through a red or other colour filter and without a filter so that alternate pictures are thus a "red" or other component and a plain black and white picture. It was proposed to project these pictures successively and respectively through a red or other colour filter and without a filter on to the screen relying on the phenomenon of persistence of vision. Such a process has, however, many disadvantages and will not successfully produce pictures in substantially natural colours.

We have discovered, however, that if the film be taken through—let us say—orange and blue-green filters so that there is an "orange" component and a "blue-green" component and the film so taken is projected, the "orange" component through an orange filter and the "blue-green" component without a filter so that there is on the screen an orange image of the "orange" component and a black and white image of the "blue-green" component, then under these circumstances the orange light projected upon the screen appears to evoke by contrast and fatigue the complementary blue and green colours and a very pleasing picture is produced in substantially natural colours.

In the photographing operation, an ordinary cinematographic or other camera may be employed, but a dividing prism or other reflecting system carrying the required filters—orange and blue-green, let us say—should be interposed between the lens and the film. Whilst the photograph is being taken, therefore, light from any single point of the object in the field-of-view passes through the lens and is divided by the prism into two approximately equal bundles of rays. One bundle passes through the orange filter before coming to a focus to form a picture on the film, whilst the second bundle similarly passes through a blue-green filter to form the second picture on the film. In the preferred arrangement these two colour component pictures are produced in opposite corners (that is diagonally) of the single picture space of the ordinary film conveniently by the method described in Specification No. 312,248. The negative thus produced is developed in the ordinary way, and the positive is developed and printed also in the ordinary way.

In the second operation, that of projecting on to the screen, an ordinary projector is employed, with the exception that the single picture-projecting lens, in the preferred arrangement, is replaced by a pair of such lenses, one for each of the two pictures occurring in the usual picture space of the ordinary film. The orange component picture photographed, as already described, through an orange filter is projected through a similar filter, so that there is produced upon the screen a photograph of the object taken with orange light only. The second colour component picture is simultaneously projected simply by the second lens without any filter at all, so that in the absence of the orange picture the picture taken through the blue-green filter appears finally on the screen in black-and-white. Instead of using two projecting lenses, one only may be employed working in combination with a prismatic or other reflector to collect the light from the two pictures, and reflect it through the single lens or both lenses may be fitted with reflectors. One filter only is used, as in the arrangements already referred to. The two pictures thus projected are carefully superposed, when the resulting picture is seen, not in orange light only, but in a range of substantially natural colours extending more or less throughout the spectrum.

It must be remembered that the black-and-white picture thrown upon the screen without a filter is one that has been photographed through a blue-green filter. The various shades of grey, therefore, which occur in it, ranging from white to black, represent more or less proportionally the amount of blue-green light given off by the different parts of the object, and utilised for the production of the picture

on the film. This fact is probably responsible for the differentiation of the green-blue colours which ultimately results.

The theory of the method which it is sought to cover by this application is perhaps incomplete. It has been known to physicists for a long time that complementary colours can be produced by mere contrast and also by retinal fatigue. The latter method, for example, has been exploited freely for advertising purposes. Evokement of complementary colours by contrast and to some extent also by fatigue is probably the explanation of the extraordinary range of colours produced by our method, but so far as we are aware it has never been suspected that colours of such intensity as we produce by our method could be obtained in such a way. This evokement can be exhibited simply and convincingly by many experiments. One of the most striking methods of doing this is to take pieces of variously coloured gelatines and punch a small hole in the centre of each one of them. If one of these coloured gelatines, blue say, perforated as described, is placed in the lantern and projected upon the screen in an otherwise dark room an approximately white disc is seen upon the screen with a surround of blue. If now a piece of dull-black cardboard be taken and placed upon the screen so as to receive the white image of the aperture in the gelatine, it will be found that the colour of this disc is now a rich orange yellow of a pronounced metallic type, indistinguishable in fact from a sheet of polished metal. Again, if a red gelatine is employed in this experiment and the bright central disc be received upon a piece of black cardboard the disc now appears of a deep prussian blue. Every colour in fact in which gelatine is procurable when dealt with in this way gives a colour by evokement or contrast which approximates very closely to the complementary of the colour of the gelatine. The great advantage of evoking colour in this way is that it allows of a very substantial increase in the amount of light which falls upon the screen from the source of light in the lantern. This increase is probably of the order of 30%.

With the particular pair of filters assumed, the crucial colours—white and flesh tints—are rendered with great fidelity, but generally speaking the colours at the red end of the spectrum are better reproduced than those at the blue end of the spectrum, but by the use of appropriate pairs of substantially complementary filters any desired portion of the colours of the spectrum can no doubt be brought out pre-dominantly. The invention, therefore, is not limited to the use of any particular pair of colour filters.

In this method of projecting cinematograph films in colours the final result will depend upon:

(a) The kind of light used for illuminating the object—sunlight, arc light, incandescent light etc.

(b) The colours of the object itself.

(c) The light and colour transmitting values of the filters.

(d) The range of the colours to which the film is sensitive.

The filters employed may vary over a considerable range. We have found in practice that Wratten & Wainwrights give excellent results. The particular colours employed can be varied for different objects.

For out-of-door scenes in which foliage and gay coloured flower-gardens predominate we have obtained excellent results with Wratten & Wainwrights orange-red and blue-green Nos. 22 and 60 or Nos. 24 and 59. For taking shots in the studio, in which incandescent tungsten lamps are employed, giving off an excess of red light, the filters have to be correspondingly modified, Nos. 29 and 40 then give good results. In selecting a particular pair of filters for photographing a given object these filters must in the first place be practically complementary to one another, and in the second place one of the colours should preferably be one dominant in the object. For all-round work we have found that an orange-red and blue-green give excellent results, the colours at the red end of the spectrum, foliage, flesh tints, and white being reproduced with great fidelity.

It is well known that all green foliage reflects a considerable portion of red light to the eye and it is this fact no doubt that accounts for the satisfactory colour reproduction of foliage when using the orange-red filter referred to. Another advantage of using orange-red is that it is possible to match it with a pot glass and use this instead of a gelatine filter in the final projection stage.

In the final projection stage the taking red filter may be used or one of a slightly lighter tint.

It may be desirable for some purposes in order to obtain a desired colour balance on the screen to regulate the relative intensities of the light transmitted by the two objectives. This in practice can be done by fitting one or other of the two objectives with an adjustable aperture.

Any optical projection apparatus may be employed in the projection stage but it should preferably satisfy the following conditions, viz., the line joining the centre of the two lenses should be rotat-

able so that it can be brought into parallelism with the lines joining the centres of the two pictures and the separation of the two lenses should be adjustable to bring the two images on the screen into superimposition.

It will be apparent that this invention may be carried out with other filters than red and green, and that further its application is not limited to colour cinematography, it having beneficial results when used in any apparatus for projecting pictures in substantially natural colours.

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

1. A method of exhibiting pictures or the like in substantially natural colours by cinematographic or other suitable means consisting in employing two pictures of the same object or group of objects taken through differently coloured complementary or substantially complementary filters and simultaneously projecting the said two pictures on to a screen in superimposition, one through a like filter to that through which it was taken and the other without the interposition of a filter.

2. A method of exhibiting pictures or the like in substantially natural colours by cinematographic or other suitable means consisting in employing two simultaneously taken pictures of the same object, one through an orange filter and the other through a green or bluish-green filter and simultaneously projecting the said two pictures, after development and printing, on to the screen in superimposition, one through a like filter to that through which it was taken and the other without the interposition of a filter.

3. A method of exhibiting pictures or the like in substantially natural colours by cinematographic or other suitable means consisting in employing two simultaneously taken pictures of the same object, one through an orange filter and the other through a green or bluish-green filter and simultaneously projecting the said two pictures on to the screen in superimposition, the picture taken through the orange filter being projected through an orange filter and the picture taken through the green or bluish-green filter being projected without the interposition of a filter.

4. The improved method of exhibiting pictures or the like in substantially natural colours by a cinematographic or other suitable means substantially as hereinbefore described.

Dated the 18th day of December, 1929.

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