PATENT SPECIFICATION

Application Date: March 19, 1929. No. 8828/29.
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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 taking 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 provided 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.,
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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.
In colour cinematography as heretofore proposed the film has been taken with two or more colour components such as, 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 most distasteful 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 cinematograph 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. 312,348.

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 in the ordinary way the object 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 100 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 105 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 bluish green filter 110 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 superimposed, 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
blues in flowers 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 comple-
mentary colours can be produced by mere
contrast and also by retinal fatigue. The
latter fact, 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 extra-
ordinary 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 central disc be
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. 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 black 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 complement 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 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 comple-
mentary filters any desired portion of the
colours of the spectrum can no doubt be
brought out pre-dominantly. The inven-
tion, therefore, is not limited to the use of
any particular pair of colour filters.

In this method of projecting cinemato-
graph films in colours the final result will
depend upon;
(a) The kind of light used for illu-
minating 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
orange-red and blue-green Nos. 22 and 60 or Nos. 24
and 58. 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 correspond-
ingly 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
110 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
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 objec-
tives 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 cinematographic or other suitable means substantially as hereinbefore described.

Dated the 18th day of December, 1929.

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