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PROVISIONAL SPECIFICATION.

Improvements in and relating to Kinematography in Natural Colours.

I, WILLIAM NORMAN LASCEILLES DAVIDSON, Esquire, Captain (Honorary Captain in His Majesty's Regular Army) late 4th Battalion "The King's" (Liverpool Regiment) of "Harewood" Southview Road Southwick, Brighton do hereby declare the nature of this invention to be as follows:—

5 This invention relates to a practical method by which the known animated pictures can be taken and projected approximately in the colours of nature instead of in monochrome as practised at the present moment. It is based upon the now well known principles of three colour photography, and I make use of persistence of vision in a somewhat similar way to my former Letters
10 Patent No. 23863 of 1899, to cause the necessary superimposition of positive colour records when projected on the screen.

The improvements are in and relating to my late Letters Patent No. 23,863 of 1899; No. 13,468 of 1902, and my existing Letters Patent No. 3729 of 1903, William Friese-Greene's Letters Patent No. 9465 of 1905, and George Albert
15 Smith's Letters Patent No. 26,671 of 1906.

I will now describe my improvements and procedure:—

1. The originality of my present method for producing and exhibiting animated or moving pictures in colours is the use of properly adjusted colour
20 screens which travel with, or at the same, or at about the same speed as the film (or such like) of a bioscope or such like kinematograph camera or projecting machine, for both producing the negative colour records, and projection of the resulting positive colour records on the screen. The respective colours on the colour screen may alternate throughout the entire series of pictures taken or projected on the screen in two colours, such as red and green, or, I
25 may cause the colours on the colour screen to alternate in any different order, such, for instance, as two (or more) reds to one (or more) blue (green or yellow) throughout the entire length of the above described multi-coloured colour screen and kinematograph or projecting machine sensitive or insensitive film or the like.

30 It will be seen by the above that I do not limit myself to any special manner of causing the colours to travel with, or at the same, or at about the same speed as the sensitive or insensitive film in a bioscope (or such like kinematograph camera) or projector, as the conception of colour screens travelling with, or at the same, or at about the same rate as the sensitive or insensitive
35 film (or the like) for producing and exhibiting animated or moving pictures in colours is the important point in my invention, combined with the repetition and alternation of colours as described. I do not limit myself to only using two colours, such as red and green, nor the order in which the different colours alternate. I also do not limit myself to only using films and the like, as I may
40 at times use glass or the like.

I may also at times employ a yellow-stationary screen with and in addition to the described multi-coloured colour screen.

As an alternative, I may cause the sensitive or colour sensitive surface or

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its support to be so suitably coloured (as described, for instance, as in 1.) that the sensitive surface or its support (or both) in itself acts as a multi-coloured colour screen, the colours washing out (if necessary) during the period of development, fixing, *etc.*

Likewise the film or such like on which the positive colour records are printed 5 may also be suitably coloured as previously described in 1., to act in itself as a multi-coloured colour screen, and, preferably, so manufactured or prepared, that the colours will not wash out or disappear, but act permanently as colour screens for projection.

In the above cases a multi-coloured colour screen as described in 1. is not 10 required either for producing or exhibiting the animated pictures in colours, as the colour screens contained in or on the sensitive or colour sensitive surface or its support, or picture, or its support, would act as colour screens, and produce and exhibit the pictures in colours by persistence of vision.

I will now describe my procedure, for instance:—

2. A series of negatives are taken at equi-distance on a colour sensitive (preferably panchromatic) surface in quick succession of a coloured scene with a bioscope or such like kinematograph camera in the usual way, except that instead of employing a revolving shutter fitted with, say, red and blue (or green) colour screens as described in George Albert Smith's Letters Patent 20 No. 26671 of 1906, I employ, say, a length (preferably an endless band) of film or such like, and cause it to travel in any suitable manner with, or at the same, or at about the same speed as the sensitive, colour sensitive, or insensitive film in the kinematograph camera or projector, the above (preferably) endless band of film being so coloured or dyed that the respective colours thereon are as 25 described in 1., and are respectively the size of each of the series of pictures exposed or projected through the colour screens throughout the film.

A negative is thus obtained in which, say, the reds and yellows are recorded in the one picture, and, say, the blue-greens and yellows are recorded in the second, alternately or otherwise throughout the length of the kinematograph 30 film or the like.

3. A series of positive colour records (preferably of a neutral grey-black tint) are made from the above negative colour records, and projected on the screen through any commercial projecting machine with the same or somewhat similar coloured multi-coloured colour screen, as described, for instance, in 1., so that 35 the pictures are projected alternately (or otherwise) through their respective and appropriate colours through the multi-coloured colour screen (as previously described) travelling with or at the same or at about the same rate as the pictures.

It will be seen by the foregoing that I can obtain one picture to every complete revolution of the exposing or projection shutter in alternate or any other 40 order of re-occurring colours, which, in other words, means that when I take or project my colour records through their appropriate colours as already described, at, say, sixteen revolutions of the shutter per second, the pictures will also be taken and exhibited on the screen at the same rate of sixteen 45 pictures a second, and not at the unbalanced rate of 32 pictures a second with the shutter only working at 16 revolutions a second as the case would be if the gearing of the exposing or exhibiting shutter is altered as in George Albert Smith's Letters Patent No. 26,671 of 1906.

I am thus able to both take and project pictures in colours at about the 50 same speed as ordinary black and white animated pictures, and I am also more able to accentuate persistence of vision in relation to colours.

In Letters Patent No. 9465 of 1905 William Friese-Greene recognised the necessity at times of accentuating colours (Letters Patent No. 9465 of 1905, 55 lines 5—10, page 3), but he invariably produces and projects a pair of colour records side by side through a prism, in combination with stationary colour screens, and he does not therefore rely on persistence of vision to superimpose

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the animated colour pictures on the screen; whereas, I dispense with prisms, mirrors and such like (as described in my late Letters Patent No. 13,468 of 1902 and my existing Letters Patent No. 3729 of 1903, and William Friese-Greene's Letters Patent No. 9465 of 1905), and thereby obtain far sharper and clearer animated pictures in colours by persistence of vision superimposition, combined with (at times) accentuation of colours as already described.

5 I may sometimes exhibit the animated colour pictures as transparencies in any suitable machine, or I may even print (by any suitable means) the series of animated pictures on paper, or the like, the paper being so folded (similar to a book) that each page will contain a picture in a colour or colours, and on causing the pages to fly open as quickly as possible, the pictures would be seen animated and in colours.

The two above ways of showing animated pictures is known in monochrome but not in natural colours, which I consider novel.

15 As an alternative, I may at times print the negative colour records on, say, a bichromatic sensitive surface in a similar way to the well known three colour processes, mechanically or otherwise, the resulting series of positive colour records being so dyed or coloured (mechanically or otherwise) in their appropriate and respective colours that the series of moving pictures will appear (by persistence of vision superimposition) in colours when projected on the screen (or such like) without the use of colour screens as previously described.

Dated this 7th day of January 1908.

W. N. LASCELLES DAVIDSON, CAPTAIN.

COMPLETE SPECIFICATION.

25 **Improvements in and relating to Kinematography in Natural Colours.**

I, WILLIAM NORMAN LASCELLES DAVIDSON, Esquire, Captain (Honorary Captain in His Majesty's Regular Army) late 4th Battalion "The King's" (Liverpool Regiment) formerly of "Harewood" Southview Road, but now of "Ranmore" Cross Roads, both in Southwick, Brighton, in the County of Sussex, 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, that is to say:—

This invention relates to a practical method by which the known animated pictures can be taken and projected approximately in the colours of nature instead of in monochrome as practised at the present moment.

35 It is based upon the now well known principles of three colour photography, and I make use of persistence of vision in a somewhat similar way to that referred to in the Specification of my former Letters Patent No. 23863 of 1899 for both taking the original negative colour records and causing the necessary superimposition of the resulting positive colour records when projected on the screen but according to my present invention I preferably employ films for the negative colour records, and the positive colour records but for the multi-coloured screen preferably an endless band of film.

45 The improvements relate more particularly to the inventions described in the Specifications of my late Letters Patent No. 23863 of 1899, No. 13468 of 1902 and my existing Letters Patent No. 3729 of 1903, William Friese-Greene's Letters Patent No. 9465 of 1905 and George Albert Smith's Letters Patent No. 26671 of 1906.

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I will now describe my improvements and procedure wherein I employ any convenient number of colours or shades of colour.

The essential feature of my present invention for producing and exhibiting animated or moving pictures in natural colours consists in the use of properly adjusted colour screens which travel with or at the same, or at about the same speed as the film of a bioscope or such like kinematograph camera or projecting machine, for both producing the negative colour records and projection of the resulting positive colour records on the screen. 5

The respective colours on the colour screen may alternate throughout the entire series of pictures taken, or projected on the screen, in two colours, such as red and bluey-green, or I may arrange the colours on the colour screen in any different order, such, for instance as two or more reds to one or more blue, green, or yellow, throughout the entire length of the above described multi-coloured colour screen, or sensitive or insensitive film. 10

I may at times employ a yellow stationary screen with, and in addition to, the described travelling multi-coloured colour screen to balance the respective colours in relation to each other and also to cut down the ultra violet rays. 15

Instead of employing a separate multi-coloured colour screen, I may cause the sensitive or colour sensitive surface or its support to be so suitably coloured that the sensitive surface or its support (or both) in itself acts as a multi-coloured colour screen the colours washing out when producing negative colour records during the subsequent operations of developing, fixing and the like. 20

Likewise the film on which the positive colour records are printed may also be suitably coloured to act in itself as a multi-coloured colour screen, the colours screening the appropriate colour record positives, and so manufactured or prepared, that the colours will not wash out or disappear but act permanently as colour screens for projection. 25

In the above cases a separate multi-coloured colour screen is not required either for producing or exhibiting the animated pictures in colours, as the colour screens contained in or on the sensitive or colour sensitive surface or its support, or picture, or its support, would act as colour screens, and produce and exhibit the pictures in approximately natural colours. 30

I will now describe my procedure by way of example.

A series of negatives are taken at equi-distance on a colour sensitive (preferably panchromatic) surface in quick succession of a coloured scene with a bioscope or such like kinematograph camera in the usual way except that instead of employing a revolving shutter fitted with say red and bluey-green colour screens as described in George Albert Smiths Letters Patent No. 26671 of 1906, I employ a length but preferably an endless band of multi-coloured film, and cause it to travel in any suitable manner with, or at about the same speed as the colour sensitive film, the above (preferably endless) band of film being so coloured or dyed that the respective colours thereon are the size of each of the series of pictures exposed through the colour screens throughout the film or the like. 35 40

A series of negatives is thus obtained in which say, the reds and yellows are recorded in one picture or negative, and, say, the blue greens and yellows are recorded in the second, alternately or otherwise, according to arrangement throughout the length of the kinematograph film. 45

A series of positive colour records (preferably of a neutral grey black tint) are made from the above negative colour records, in the manner hereinafter described or in the usual manner and projected on the screen through any commercial projecting machine with a similarly coloured multi-coloured colour screen, so that the pictures are projected in quick succession in the desired order through their respective and appropriate colours on the screen. 50

It will be seen by the foregoing that I can obtain one picture to every complete revolution of the exposing or projecting shutter in alternate or other order of reoccurring colours which, in other words, means that when I take or 55

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project my colour records through their appropriate colours as already described at, say, sixteen revolutions of the shutter per second, the pictures will also be taken, or exhibited on the screen, at the same rate of sixteen pictures a second, and not at the unbalanced rate of thirty two pictures a second with the shutter

5 only working at sixteen revolutions a second as the case would be if the gearing of the exposing or exhibiting shutter were altered as in George Albert Smith's Letters Patent No. 26671 of 1906.

I am thus able to both take and project pictures in colours at about the same speed as ordinary black and white animated pictures, and I am also

10 better able to accentuate persistence of vision in relation to colours with one half the length of film that George Albert Smith would require to last exactly the same period of time when producing the negative colour records or projecting the positive colour records on the screen.

In the Specification of Letters Patent No. 9465 of 1905 William Friese-

15 Greene recognised the necessity at times of accentuating colours but he invariably produced and projected a pair of colour records side by side through a prism, in combination with stationary colour screens, whereas I dispense with prisms, mirrors and such like and thereby obtain far sharper and clearer animated pictures approximately in natural colours.

20 I will now proceed to give some further particulars which will be of assistance in carrying my invention into effect.

I have found in actual practise that a duration of $\frac{1}{32}$ part of a second on the screen for each picture of the positive colour records is sufficient to impress the retina of the eye with the proper gradation and shades of colour, also the

25 proper superimposition of colours to produce the effect of the original scene approximately in natural colours; this I accomplish simply by causing my multi-coloured colour screens to travel with, at, or at about the same speed as the sensitive or colour sensitive or insensitive surface or pictures, so that with a shutter proper of a kinematograph camera or projector in which one revolution

30 of the shutter proper makes a change of one picture, I have simply to cause the shutter proper to revolve at about sixteen revolutions a second in combination with my multi-coloured colour screens to cause the pictures to be produced or projected on the screen so that each colour screened picture impinges the sensitive or colour sensitive or insensitive surface or screen at about

35 $\frac{1}{32}$ part of a second each.

The sensitive surface on which the negative colour records are produced must as heretofore pointed out be panchromatic, that is to say, the sensitive surface must be as much as possible sensitive to the primary colours of the solar spectrum and particularly to the red rays of the spectrum.

40 I have found that rapid sensitive surfaces in commercial use serve very well when specially colour sensitised.

Any known colour sensitizers can be employed, but I prefer the use of the new isocyanines, the formula and strength of which are known.

The colours in the multi-coloured colour screen must be accurately adjusted

45 according to whichever colour sensitizer is used and according to the colour sensitiveness of the sensitive surface.

The simplest way to make the multi-coloured colour screen is to fix out say, a length of perforated kinematograph film in hypo, thoroughly wash it and then sensitize it in a bichromate bath in which has been previously added, say, a

50 blue or bluey-green dye stuff of suitable strength to give the intensity of colour required when finished.

The right strength of the dye varies according to the colour sensitiveness of the surface to be impressed or exposed or positive colour records projected, therefore no hard and fast rule can be given and the depth of colour must be

55 determined by the individual worker.

When the above bichromatised film is dry, it is placed in a kinematograph camera or such like (preferably without any lens affixed to same), in the usual

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manner the camera is pointed toward the sun or other bright light and the handle rotated, and by shielding the film from the light by hand or otherwise at every other revolution of the shutter, every other space on the film will be say, blue (if a blue dye has been used) and every other space will be clear on the bichromatised surface being thoroughly soaked and the free dye unacted 5 upon by light being washed out.

An alternative method is to employ say, a silver sensitized film and to shield, say, every other change of film, develop to suitable density and fix and tone the opaque portions to the required blue with an iron toner, then dye; the red or following colour will not usually affect the parts of the film already toned 10 blue but will only be absorbed where the blue toner has not acted upon the clear gelatine parts.

The correct tints of the exhibiting screens are controlled by monochromatic colour values and density of the positive colour records and the intensity of light in use. 15

The same surface holding the, say blue dye in suspension with clear spaces between is then immersed in a red or orange red dye until the clear spaces have absorbed sufficient of the red colour to balance the blues according to the adjustment required in relation to the colour sensitiveness of the surface about to be employed. 20

I shall have now a length of kinematograph film, on which are most accurately impressed the required colours, and which forms my multi-coloured colour screen.

In like manner the multi-coloured colour screen can be prepared for projection. 25

The multi-coloured colour screen can also be made or coloured by hand instead of by photographic or mechanical means, and the colour records can be prepared by the aid of the multi-coloured colour screen in the manner herein-before described.

In all cases the ends of the multi-coloured colour screen are preferably joined 30 to form an endless band of any suitable length; this endless band is made or caused to engage with the sprockets or other suitable parts of a kinematograph camera or projector, so that each colour (or series of colours) is accurately adjusted in the "gate" to superimpose the corresponding future negative colour records in taking the pictures, or the positive colour records for projection on 35 the screen.

Under some extraordinary conditions of producing animated or moving pictures in natural colours such for instance as sunset, I may at times require to accentuate the "reds" in which case I would employ a multi-coloured colour screen in which there are say, two reds in succession to one blue (or blue 40 green) at any required intervals throughout the endless band.

In like manner I may make and employ multi-coloured colour screens in which a series of two colours, such as red and blue or blue-green blend into three colours, as red, yellow or green and blue and back again into two or more colours or an accentuation of colours as described above. 45

The multi-coloured colour screen for projection must be coloured to suitable tints in the same order and reoccurrence of colours as the one the negative colour record was exposed with, and the positive colour records must be projected on the screen through their respective and appropriate colour or colours 50 as will be readily understood.

The original multi-coloured colour screen used for taking the series of negative colour records may be employed for projecting the resulting positive colour records in natural colours on the screen if suitable.

In all cases the sensitive or colour sensitive or insensitive surface or pictures move with, at, or about the same speed as the multi-coloured colour screens 55 as previously described.

Having described the production and reproduction of animated pictures in

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natural colours by means of separate multi-coloured colour screens, I will now proceed to describe the manner by which multi-coloured colour screens are caused to form part of the original animated negative colour records as well as the animated positive colour records.

5 When producing negative colour records, I prefer that the multi-coloured colour screens (when incorporated in the same) should entirely wash out, leaving no colour screens on the series of negative when finished and ready for printing.

10 This makes the operation of printing the series of positive colour records from the series of negative colour records a simple operation, not having any colour screens to contend with, therefore I prefer the support ultimately to carry the sensitive or colour sensitive surface to be made as hereinbefore described or multi-coloured colour screens of suitable colours to balance the colour sensitive-ness of the colour sensitive surface at the time in use may be temporarily impressed with colours capable of being washed out or otherwise destroyed and attached to the back or front of the colour sensitive surface by any known photo-mechanical means or by hand, the original object to be reproduced in natural colours being exposed in quick succession through the above multi-coloured colour screens, incorporated on the colour sensitive surface back, or on its support, or sensitive surface.

20 In a similar way I cause suitable tints of colours to be incorporated, preferably permanently on the support ultimately to carry the positive sensitive surface, or I may cause (by any known and suitable mechanical or photo-mechanical means, or by hand) colours of suitable tints to balance the monochromatic colour values of the series of animated positive pictures to be impressed or attached to either the support, back, or surface or front of the series of animated positive colour records, each individual positive colour record being so screened and prepared that the same order and re-occurrence and alternation of colours as the original negative colour records is duplicated on the series of positive colour records.

30 The colour screened colour record positives are passed through any commercial projecting machine (without any alteration) in the identical way, of showing ordinary monochrome animated pictures, and the colour screened records will be projected and seen on the screen in approximate natural colours by persistence of vision.

35 In the above cases the positive colour records travel with the multi-coloured colour screen as one.

In either case whether a separate multi-coloured colour screen be employed for either (or both) taking the negative colour records or projection of positive colour records, or whether the multi-coloured colour screen forms part of the negative colour records or positive colour records for projection, the various colours required and contained in or on same may be coloured in mass the size of each picture, or the colours may be in lines, dots, circles or any suitable pattern according to individual requirements.

45 The stationary yellow screen I place anywhere in the direct path of the rays of light entering the lens, and I employ the screen to cut down the ultra violet rays when required and also as a means of balancing colours.

I do not limit myself to any special manner of causing the colours to travel at the desired speed as the conception of colour screens travelling with, or at the same, or at about the same rate as the sensitive or insensitive film for producing and exhibiting animated or moving pictures in colours is the important point in my invention, combined with the repetition and alternation of colours as described.

50 Nor do I limit myself to using only two colours, such as red and a bluey-green, nor the order in which the different colours occur.

55 When the multi-coloured colour screens travel at different speeds to that of the sensitive or colour sensitive or insensitive surface or series of negative or

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positive colour records they must be arranged so as to synchronise therewith at the moment of projection or exposure.

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:—

1. The use in kinematograph apparatus of separate accurately adjusted multi-coloured colour screens travelling at the same speed as the sensitive or colour sensitive or insensitive surface or series of negative or positive colour records or at about the same speed but so as to synchronise therewith at the moment of projection or exposure substantially as set forth.

2. The use in kinematograph apparatus of multi-coloured colour screens, the various colours of which are incorporated with the sensitive or colour sensitive or insensitive surface or series of negative or positive colour records substantially as set forth.

3. The use in kinematograph apparatus of a series of positive colour records of the character referred to in Claim 2 multi-coloured in any desired order of re-occurring colours so as to act as colour screens in themselves substantially as set forth.

4. In kinematograph apparatus the manufacture of a multi-coloured colour screen consisting in fixing out a length of perforated film in hypo, then washing it, then sensitizing it in a bichromate bath to which has been added a blue or other suitable dye, then drying the film and placing it in a kinematograph camera or other suitable instrument, then pointing the camera toward a sufficiently bright light and rotating the handle of the camera and shielding the film from the light at alternate or other revolutions of the camera shutter, then washing the bichromate surface to wash out the blue dye unacted upon by light, then immersing the film in red or orange red or other dye until the clear spaces have absorbed sufficient of the red or other colour to balance the blue as set forth.

5. In kinematograph apparatus, the manufacture of a multi-coloured colour screen consisting in exposing to light in a camera or the like a silver sensitized film, shielding, say, every other change of film, developing to a suitable density, fixing and toning the opaque portions to the required blue with an iron or like toner immersing the film in a dye solution of red or other suitable colour and then drying the film substantially as set forth.

6. The use in kinematograph apparatus of the multi-coloured colour screen and records substantially as set forth.

7. The improved method of taking and projecting animated photographs in approximate natural colours substantially as set forth.

Dated this 10th day of August 1908.

WHITE & WOODINGTON,
Chartered Patent Agents,
Birkbeck Bk. Chrs. Holborn, London.