Nov. 14, 1967 M. C. BERGER 3,352,200

APPARATUS FOR PROVIDING MULTI-COLOURED COMPOSITIONS

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Fig. 1

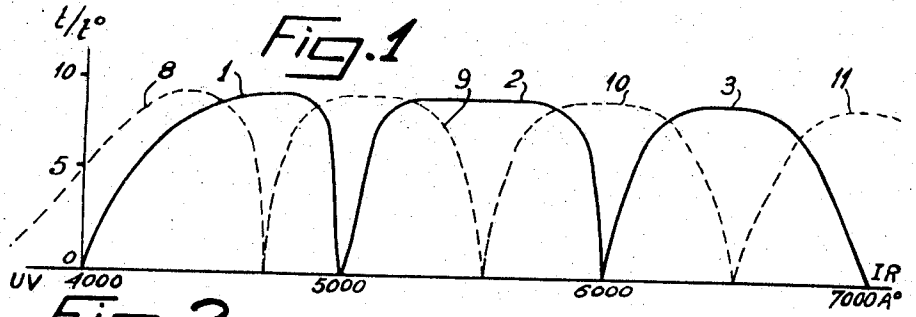


Fig. 2

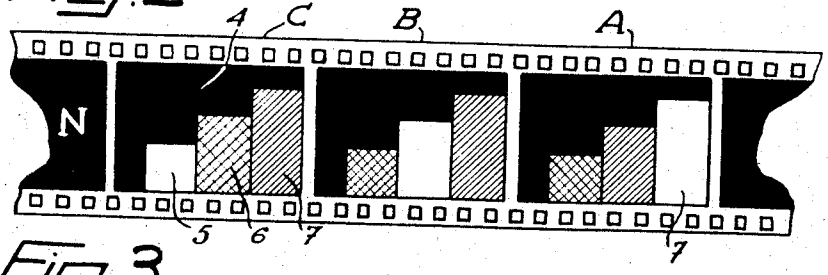


Fig. 3

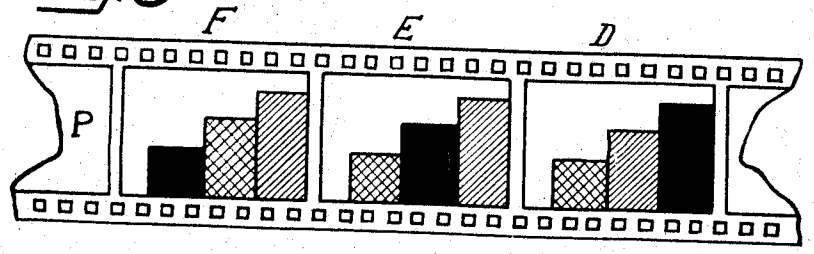
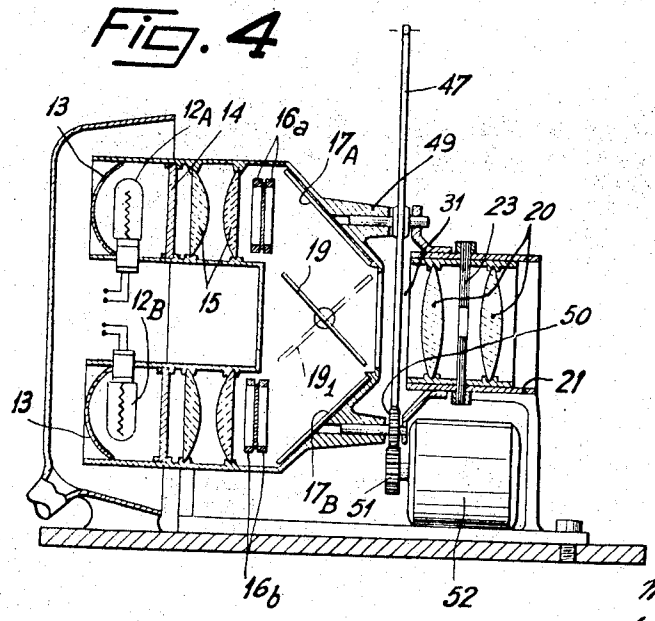


Fig. 4



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APPARATUS FOR PROVIDING MULTI-COLOURED COMPOSITIONS

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Fig. 6

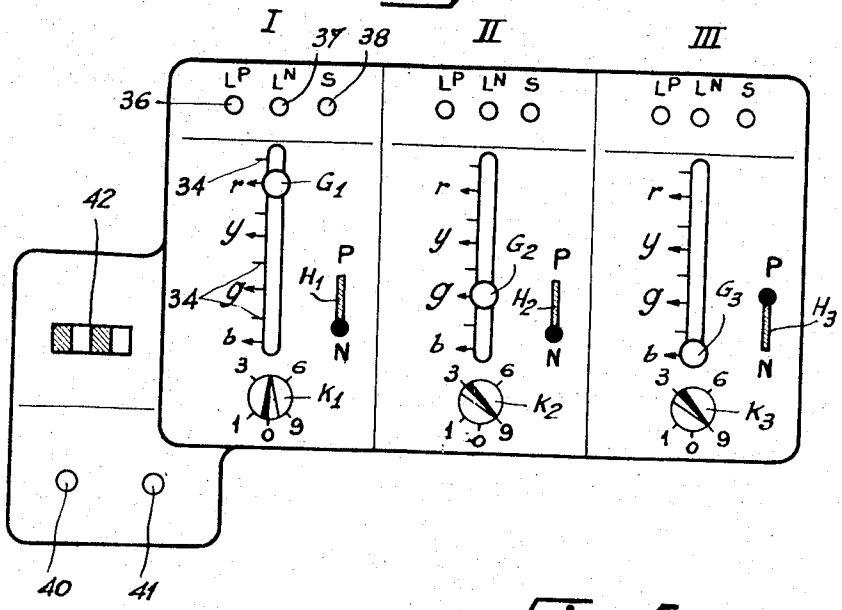


Fig. 5

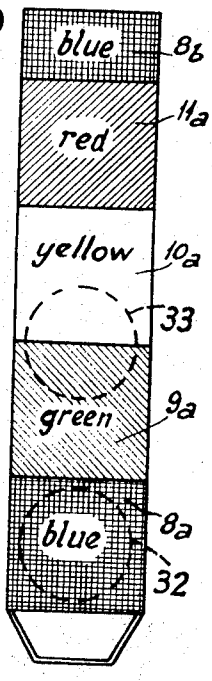
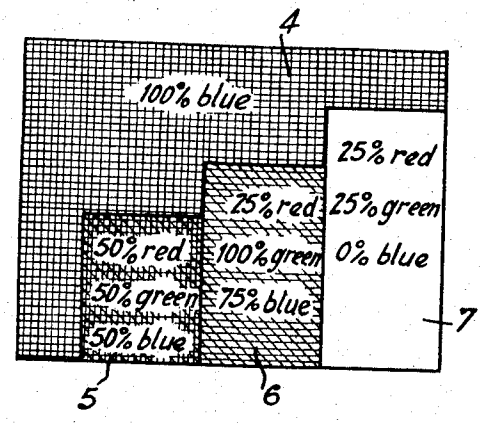


Fig. 7



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APPARATUS FOR PROVIDING MULTI-COLOURED COMPOSITIONS

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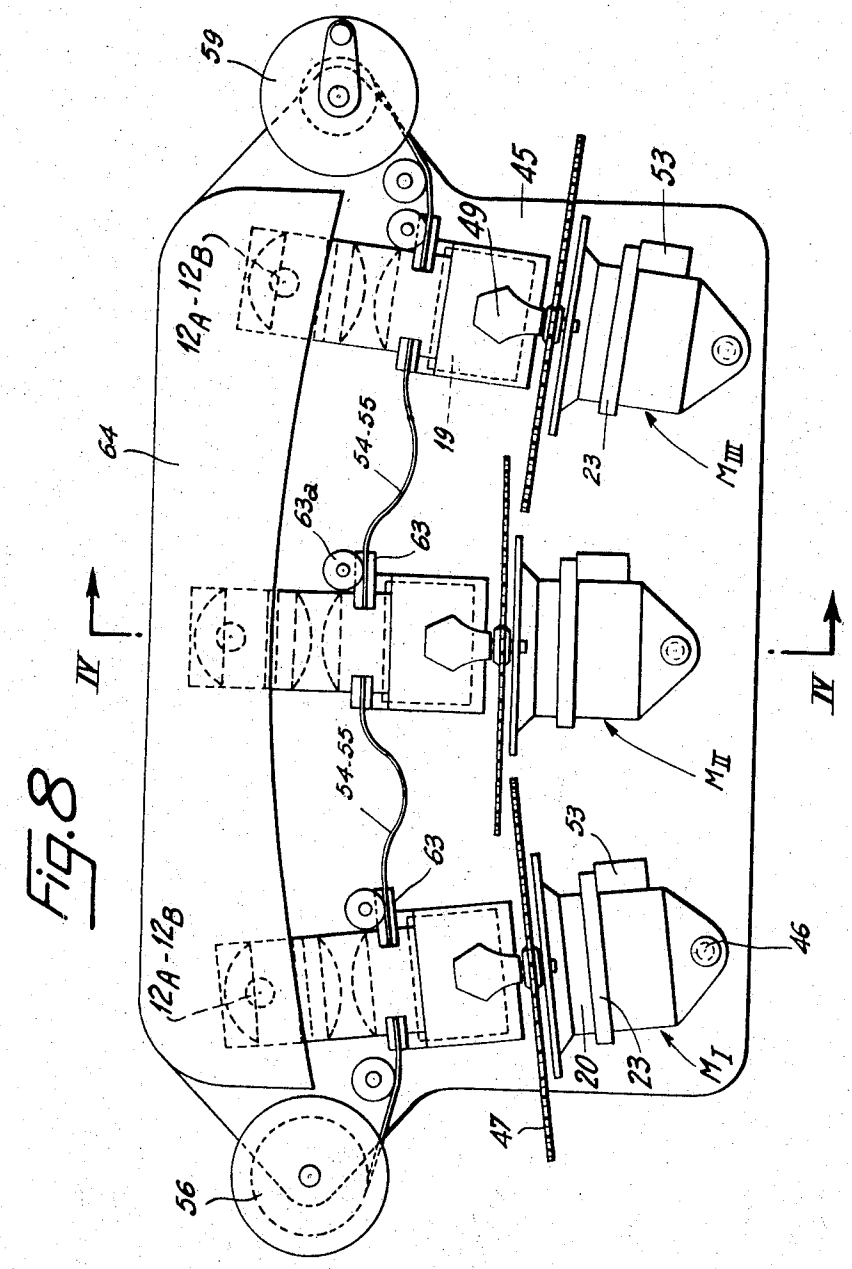

Fig. 8

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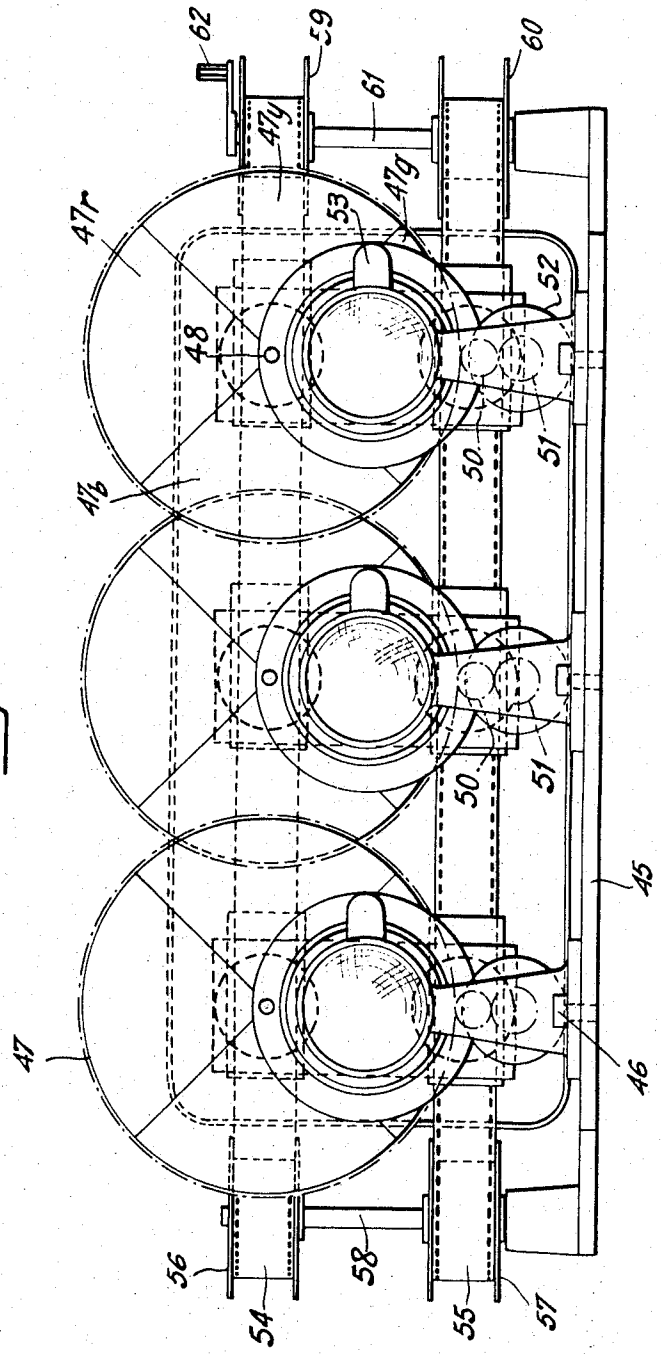

Fig. 9

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Fig. 10

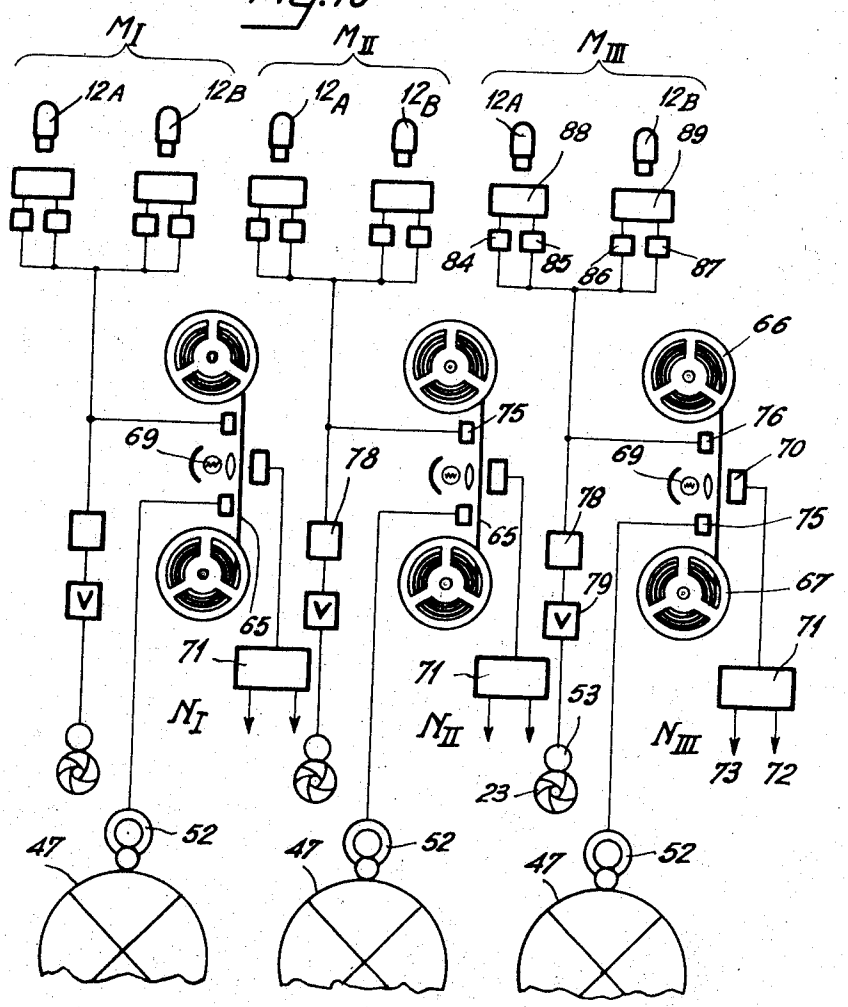

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Fig. 11a

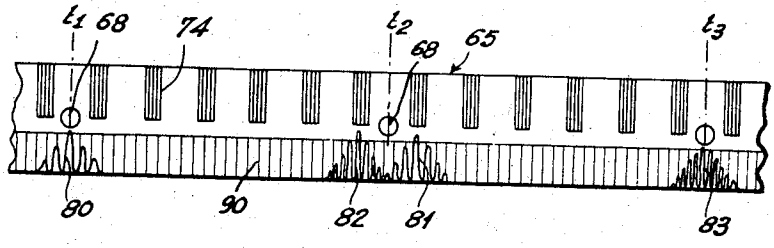


Fig. 11b

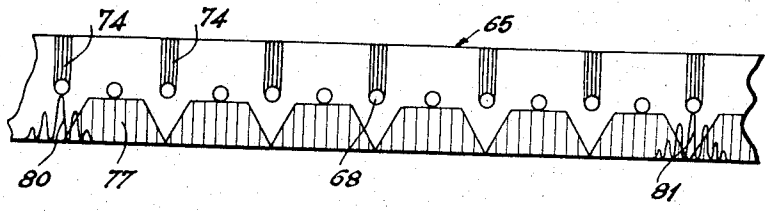
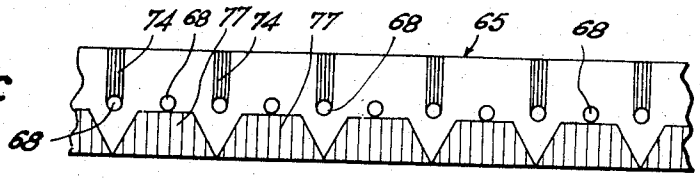


Fig. 11c



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United States Patent Office 3,352,200 Patented Nov. 14, 1967

3,352,200

APPARATUS FOR PROVIDING MULTI-COLOURED COMPOSITIONS

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Claims priority, application France, Nov. 13, 1963, 953,595
10 Claims. (Cl. 88—24)

This invention concerns an apparatus for providing multi-coloured compositions. Although not so restricted the invention is particularly useful in, for instance, the wallpaper industry and printed fabric industry. In these industries the same design is made in a number of colour harmonies, and so the same printing equipment can be used to provide a number of differently coloured articles which gives the purchasers some selection.

In the conventional procedure, a designer works out a design in a satisfactory harmony, then has to visualise other harmonies in shades such that the same pattern or design can be used with different colour ranges. This is a very difficult job for it is physically impossible to provide mock-ups of every possible colour combination, while just to think of every possible combination is beyond the power of imagination.

This invention has as its subject matter an apparatus for enabling more of the colouring possibilities for any given pattern or design to be explored. More generally, the invention helps to provide a very large number of derived harmonies from a basic harmony considered as satisfactory in the statistical distribution of the colours used.

According to one aspect of the present invention, a method of providing a multi-coloured composition comprises providing a plurality of transparent black and white images of the composition such that corresponding areas on the transparencies differ in shade, and projecting each image through a selected colour projection filter onto a surface, the images being projected simultaneously whereby the differently coloured projected images are superimposed to form a multicoloured composition on said surface.

It will be seen that, since the various corresponding zones of the images have different transparencies, each zone of the complete composition projected on the surface or screen and resulting from the addition of the differently coloured elementary images has a different colour from the adjacent zones, since the proportions of superimposed colours vary from one zone to another.

In a preferred method each transparent black and white image is prepared by photographing the subject of the composition through a selected colour analyser filter. Preferably, the same are interference filters which cover substantially the entire visible spectrum without overlapping, thus giving a complete trichromatic or quadrichromatic analysis of the colour spectrum. It will be appreciated that all the colours of the original compositions are represented as grey shades on at least one of the black and white images produced.

In the preferred method, the images are then projected on to a screen through arbitrary projection filters which cover the whole visible spectrum without overlapping, the number of projection filters being greater than the number of analysing filters used in making said images. Thus the basic composition may be analysed by 3 filters (trichromatic analysis), but the coloured images are projected through any three or four filters giving a complete four-colour composition. Consequently, depending upon whichever filter is missing, the images projected onto the screen have a dominant colour which helps to harmonise the shades of the various zones.

In another advantageous embodiment of the invention, negative as well as positive images are prepared and are superimposed one upon another on the screen, to form the multi-coloured composition. Of course, it is useless to simultaneously project the positive image and negative image of the same colour, since all that would happen would be that the screen would be uniformly illuminated in this colour.

Using the set of black and white negative images, this set having the same harmony affinities with the original composition, enables the number of possible colour harmonies obtainable from the same filters i.e. from the same fundamental colours—to be multiplied. Also, irises can be used to vary the amount of light passing through each transparent image, to provide a further modification of the colour harmony of the projected images by changing the proportions of fundamental colours in the colour mix.

A single basic original coloured composition can provide a very large number of derived coloured images from which the most aesthetically satisfying can be selected. To this end, the image on the screen can be photographed conventionally on colour film, or else the basic composition of each image whose synthesis provides the required coloured image can be recorded.

According to another aspect of the present invention, there is provided projection apparatus for providing a multi-colored composition comprising a plurality of projectors each having a light source, a support for at least one transparent black and white image, and a filter holder in which a selected filter may be held, the arrangement being such that the projectors may simultaneously project differently coloured images onto a common surface such that the images are superimposed and form a multi-coloured composition. Preferably each projector comprises two light sources, two supports for corresponding positive and negative images, a common projection lens associated with a variable iris, a change-filter device, and optical changeover means enabling either positive or negative images to be projected.

The invention is illustrated, merely by way of example in the accompanying drawings, in which:

FIGURE 1 is a graph showing the pass bands of coloured analyser filters used in the method and an apparatus according to the invention,

FIGURES 2 and 3 show the three negative images and the three positive images, respectively, which have been photographed through coloured analyser filters having the bands shown in FIGURE 1 and which will be projected through projection filters,

FIGURE 4 is a sectioned view of an apparatus for projecting a corresponding positive or negative image through a coloured filter,

FIGURE 5 shows by way of example a filter for use in a manually controlled apparatus of the kind shown in FIGURE 4,

FIGURE 6 shows the control panel for the manual apparatus of FIGURE 4,

FIGURE 7 shows an example of a coloured composition which can be produced with the images shown in FIGURES 2 and 3.

FIGURE 8 is a plan view of a complete automatic projection apparatus,

FIGURE 9 is a front elevation of the apparatus shown in FIGURE 8,

FIGURE 10 is a diagrammatic view of an electronic control system for the apparatus shown in FIGURES 8 and 9, and

FIGURES 11*a*, 11*b* and 11*c* each show a section of one of a number of magnetic tapes controlling one of the basic projection units of the apparatus of FIGURES 8 to 10.

Selected images of a coloured subject can be made through coloured filters. Also, once black and white images of a subject have been prepared through each of the filters, a multi-coloured composition of the original subject can, by additive synthesis of the colours, be provided in the natural colours of the original by means of filters similar to those used to take the images. Thus referring to FIGURE 1, a trichromatic selection can be made by means of three analyser filters having pass bands **1, 2, 3**. Filters of this kind can be embodied by interference methods and can, for instance, sub-divide the entire visible range of the spectrum of light, extending from 4,000 to 7,000 A., into three non-overlapping adjacent bands including every colour. The filter **1** is blue, the filter **2** green and the filter **3** red. Three transparent images A, B, C of a subject are taken consecutively through these three analyser filters. In the example shown, the subject is very simple—three rectangles, one blue-green **5**, one violet **6** and one yellow **7**, on a white background **4**. On all the negatives shown in FIGURE 2 the part corresponding to the white background **4** is very dark, and each rectangle appears on the black and white negative as a grey whose shade depends upon the percentage of the colour passed by each filter. The corresponding positives shown in FIGURE 3 are prepared from the negatives shown in FIGURE 2, so that three transparencies D, E, F are obtained with grey densities which are the converse of the grey densities of the negatives. When the three positives D, E, F are projected simultaneously through the filters **1, 2, 3** respectively (acting as projection filters), the natural colours of the subject are restored provided, of course, that the pass bands of the projection filters are exactly the same as for the taking filters, that the colour temperature of the projection lamps is correct and that the three projected images are correctly superimposed on a single screen.

However, in accordance with the present invention, the six "master images" A to F (or possibly more masters if more than three colours are used for the selection) are used to obtain coloured harmonies other than the original by the systematic use of filters different from the analyser filters. The basic harmony, although "transposed" by different filters into a different tone range, retains affinities with the colour harmony used for the "master images." To this end, advantageously, four projection filters are used which have pass bands **8** to **11** in FIGURE 1, namely a blue filter, a green filter, a yellow filter and a red filter. As can be seen in FIGURE 5, the four projection filters **8***a*, **9***a*, **10***a* **11***a* are disposed consecutively in a strip, and a half-filter **8***b* of the same colour as the filter **8***a* follows the filter **11***a* for reasons which will be given hereinafter. The images obtained by projection from one or more of the master images A to F with any filters can be superimposed one upon another except that the negative master and corresponding positive master should not be filtered through the same coloured filter to be superimposed one upon another on the same screen.

A basic projector of the kind shown in FIGURE 4 can be used to deal with three simultaneously projected images. The apparatus comprises two projection lamps **12A, 12B** each associated with a reflector **13** and with a heat shield **14**. Associated with each light source is a condenser **15** which causes the light to pass in substantially parallel rays through frames **16***a*, **16***b* containing the negative image and positive image respectively. Mirrors **17A, 17B** reflect the light to a rotatable mirror **19** which can be either in the solid-line position or in the chain dotted line position 19_1. When in the solid-line position the mirror **19** reflects the light from the lamp **12A** through a lens **20**, and when in the chain dotted line position the mirror **19** reflects the light from the lamp **12B** to the lens **20**. The same is mounted in a holder **21** which can be adjusted axially for focusing and has an internal variable-iris diaphragm **23**.

Assuming that the filter strip **30** shown in FIGURE 5 is adapted to slide vertically in the light-path of the projector, for example in the space **31** in the apparatus shown in FIGURE 4 (said strip being substituted in place of the hereinafter described disc **47** shown in said space in FIGURE 4), it can be moved in steps corresponding to half the height of the filters **8***a*, **9***a*, **10***a*. With this arrangement the entire light beam as denoted by a circle **32** can pass through a filter of a particular colour, or else, as indicated by a circle **33**, half the light beam can travel through one of two adjacent filters, and the other half can travel through the other such filter, to provide by additive synthesis a colour somewhere between the colours of the two adjacent filters. The filter strip can be moved as required by a linkage (not shown) and a handle or knob or the like G_1, G_2, G_3, on a control panel of the apparatus, shown in FIGURE 6.

A complete hand-operated projection apparatus comprises three units I, II, III each substantially of the kind shown in FIGURE 4. Each unit I, II, III (FIG. 6) is adapted to project a positive-negative pair of images A to D, B to E, C to F (FIGURES 2 and 3). Each unit comprises, in addition to the aforesaid knob or handle which can be moved to notches **34** to select the filter colour and the intermediate colours, a handle or knob or the like H_1, H_2, H_3 which selects the positive or negative master by rotating the corresponding mirror **19**, and a knob K_1, K_2, K_3 controlling the opening of the corresponding iris **23**. Each unit also comprises switches **36, 37** for the corresponding lamps **12A, 12B** and a switch **38** controlling lamp ventilation.

It will be assumed that the positives and negatives shown in FIGURES 2 and 3 are in the apparatus. With the control panel in the position shown in FIGURE 6, the negative C is projected in red by the unit I through a half-open iris, the negative B is projected in green by the unit II with a fully open iris, and the positive D is projected in blue in unit III with a fully open iris. The colouring composition of the projected image is therefore completely different from the original subject, and the constituent proportions of the colours are shown in FIGURE 7. The originally white background **4** is now blue since it consists entirely of 100% blue. The original blue-green zone **5** is now grey since its make-up is approximately 50% red, 50% green and 50% blue. The originally violet area **6** is now blue-green since its make-up is now approximately 25% red, 100% green and 75% blue. The originally yellow area **7** remains almost yellow but of a darker shade, since its make-up is now approximately 25% red and 25% green, with no blue. Clearly, therefore, this composition looks completely different from the "master" composition except for the area **7** whose colour is in the same range.

If required, by an appropriate arrangement of filters and diaphragms one coloured zone can be made to merge with another by the same apparent colour being produced for both zones. This action changes the superficial ratios in the composition as well as the colours.

When a composition is considered satisfactorily harmonious, it is recorded. To this end, the apparatus comprises operating buttons **40, 41** of two photographic cameras. The button **40** operates a conventional colour camera to record the image which then appears on the projected screen, and the second camera photographs the control panel shown in FIGURE 6—i.e. the elements of the coloured composition, so that the same can be restored subsequently if required. A numbering device **42** can also display at this time the number of the group of positives and negatives being projected.

If required, the possible number of fundamental compositions can be numbered and obtained automatically, and to do this the apparatus of FIGURES 8 to 10 may be used. The six monochromatic master images A to F each provide a colour possibility, and if, as already stated, combinations formed by a negative and the corresponding positive are omitted, they can provide twelve

different binary combinations—AB, AC, AF, AE, BD, BC, BE, CD, CE, DE, DF, EF. They can also provide eight different ternary combinations—ABC, ABF, AEC, AEF, BDF, BDC, CED, DEF. Each of the six monochromatic master images can have all the possible filter colours—four if whole filters are used, or eight if the filters are also used in halves. For each binary composition the numbers of possibilities are, of course, the square of the previous numbers—i.e., 16 or 64 respectively, and for the ternary compositions the numbers of possibilities are the cubes of the basic possibilities—i.e., 64 and 512.

In the first case (four colours) we have:

6×4 monochromatic images	24
12×16 binary coloured images	192
8×64 ternary coloured images	512
Total	728

In the second case (eight colours) we have:

6×8 monochromatic images	48
12×64 binary coloured images	768
8×512 ternary coloured images	4096
Total	4912

Each binary or ternary composition is actually infinitely variable since the shade of each of the constituent colours of any composition can be varied by means of the corresponding iris.

The apparatus shown in FIGURES 8 to 11*a*, 11*b*, 11*c* can provide these combinations automatically and comprises three basic units M_I, M_{II}, M_{III} of the kind shown sectioned in FIGURE 4. The units are mounted on a common base **45** to which each is pivotally connected by a pivot **46** to ensure that the projected images converge satisfactorily on the projection screen. The complete filter associated with each unit, instead of taking the form of a straight strip of basic filters as in FIGURE 5, is in the form of a disc **47** comprising four segments **47***r*, **47***y*, **47***g* and **47***b* formed by transparent elements of each of the four basic colours. The disc **47** pivots on a pivot pin **48** disposed in a support **49** (see also FIGURE 4). The disc **47** has a toothed periphery and is driven via an intermediate gear **50** by a gear **51** mounted on the shaft of a "step-by-step" motor **52** (i.e., the motor performs one complete revolution for each electric pulse received). Depending upon whether each master image is required to pass through four or eight colours, the pitch diameter of the gear **51** is 25% or 12.5% of the pitch diameter of the toothed rim of the disc **47** and has 25% or 12.5% of the tooth number thereof. Each iris is associated in known manner with a galvanometer device **53** which is known per se and which automatically adjusts the iris aperture in dependence upon the strength of the current flowing through the device **53**.

The master images A, B, C are mounted on a strip of cinefilm **54** and the master images F, E, D are mounted on a strip **55** of cinefilm, the strips **54**, **55** being disposed on reels **56**, **57** respectively mounted on a common spindle **58**. Two take-up reels **59**, **60** respectively for two film strips of the same length are rigidly secured to a common spindle **61** and operated by a crank handle **62**. The images A, B, C and D, E, F are not consecutive on the films, intervals being left between them in order that the convergency of the units M_I to M_{III} may be adjusted. Gates **63** of each unit have a knurled wheel **63***a* enabling every image to be centred exactly notwithstanding differences in the distances between the units. The lamps **12A**, **12B** of the units are all mounted in a common ventilating unit **64**.

FIGURES 10 and 11 show how the automatic control system for the apparatus just described is arranged. A magnetic tape recorder connected to read-out devices is associated with each of a number of units N_I to N_{III}. Tapes **65** of each of the last-mentioned three units are

borne by a pair of reels **66**, **67**. Advantageously, the tapes are endless, for continuous unwinding, and the speed of the various reels is synchronised. (In an alternative embodiment (not shown) the recordings corresponding to the three units can be made on a single magnetic tape having six tracks.)

As can be seen in FIGURES 11*a*, 11*b* and 11*c*, each tape **65** has two tracks and a central zone formed with apertures **68** which are "read" by a photo-electric system comprising a light source **69** and a cell **70**, so that a pulse-like electric signal is delivered as each aperture passes by. The pulses are supplied to toggles **71**, so that each output **72**, **73** thereof is energised alternately. The outputs **72**, **73** are taken to two solenoids (not shown) adapted to pivot the pivoting mirror **19** (FIGURE 4) of each system from the solid-line position **19** to the chain dotted line position 19_1.

Pulses **74** are recorded at a readily detectable audio frequency on the top half of the tape **65**. The pulses **74** are sensed by reading devices **75** and the detected electric signals are supplied to the single-revolution motors **52** which provide the stepwise drive of the discs **47**.

The bottom half of the strips controls the irises and lamps and is read by a magnetic head **76**. Signals of a constant frequency, for instance, 1 kc./s. are recorded on the bottom half of the strip, the strength of these signals controlling the devices **53**. In FIGURE 11*a* the corresponding signal is continuous and is represented by a strip **90**, whereas in FIGURES 11*b* and 11*c* the signal is represented by a sequence of trapezia **77**. The signal read by each head **76** is taken through a filter **78** and amplifier **79** to each device **53**. Also recorded on the bottom half of the tape are triangular signals **80**–**83** whose frequencies are distinctly different both from one another and also from the frequencies of the signals **77** and **90**. For instance, the signal **80** has a frequency of 500 c./s., the signal **81** has a frequency of 2 kc./s., the signal **82** has a frequency of 4 kc./s. and the signal **83** has a frequency of 8 kc./s. Filters **84** to **87** respectively pass one each of these frequencies. The pair of filters **84**, **85** is associated with one pulsing and interlocking relay **88** and the pair of filters **86**, **87** is associated with a second similar relay **89** respectively controlling the lamps **12A**, **12B** of the corresponding unit. Consequently, when any of the signals **80** to **83** appears, one of the relays **88** or **89** picks up or drops, so that the lamps **12A** or **12B** light up and go out alternately.

FIGURE 11*a* corresponds to the tape part which enables a monochromatic master image to be studied. For instance, the signal **80** lights the lamp **12A** at the time t_1. The mirror **19** is assumed to be in the appropriate position and so a negative master image is projected, changing colour at each of the signals **74** which rotate the disc **47** through one step. Since the strength of the signal **90** stays constant, the opening of the iris **23** stays constant. A sequence of pulses produced by the signals **74** rotates the disc **47** through one revolution. By the end of this time, for instance, all the monochromatic possibilities of an image A have been scanned.

The signal **82** lights the lamp **12B** of the same unit at a time t_2. When the aperture **68** passes by, the position of the mirror **19** reverses and the signal **81** extinguishes the lamp **12A**. For instance, the eight chromatic possibilities of the master image D associated with the master image A (FIGURE 3) are scanned, whereafter the mirror pivots back and the lamp **12B** goes out, at a time t_3. A similar system can be used to scan all the monochromatic possibilities of the other four master images.

For binary and ternary combinations of master images, two changes in the position of the mirror **19** are required. These are caused by the aperture **68** which coincide with two brief consecutive signals **74** providing a change of filter colour. Halfway through the time interval between the two signals **74**, a third aperture **68**

changes the direction of the mirror **19**. The signal **77** controlling an iris **23** has zero value in the same time interval, grows to reach a maximum which it retains for some time, then decays. Consequently, while a filter is in position in any unit, corresponding positive and negative images of the same original composition are projected consecutively, and the intensity of the light grows to a maximum for each of them or starts at a maximum and decays to zero. Signals **80** to **83** for lighting and extinguishing the lamps are associated with the signal **77** to provide binary combinations (FIGURE 11*b*). For ternary combinations (FIGURE 11*c*), the lamps are alight continuously.

The or each magnetic tape can move at a reduced speed, in which case tape length can be reduced and "blanks" can be contrived on two tapes (or two tracks of the same tape) when two of the units are in a fixed position, to simplify synchronisation.

The tape signals are symmetrical and so operation is equally satisfactory for both directions of tape movement. Projection can therefore be stopped and reversed at any time and, if required, "stilled" on a particular colour combination for it to be studied at leisure.

As previously, this coloured combination can be recorded by direct photography or by photography on a panel where markers or, if required, measuring instruments indicate the position of the three projection units at the time when any coloured combination is selected.

Of course the embodiments thereinbefore described can be modified, inter alia by the substitution of equivalent technical means, without for that reason departing from the scope of this invention.

I claim:

1. Projection apparatus for providing a multi-coloured composition comprising a common surface, and a plurality of projectors each projector having two light sources, two supports for corresponding positive and negative transparent black and white images, a selection device for selecting positive or negative images for projection, a filter holder in which a selected filter may be held, a filter changing mechanism, an adjustable iris, an iris size control, a common projection lens system, and means for arranging the projectors to project simultaneously differently coloured images onto said common surface such that the images are superimposed and form a multi-coloured composition.

2. In combination:

projection apparatus for providing a multi-coloured composition comprising a common surface, and a plurality of projectors each projector having a light source, a support for at least one transparent black and white image, and a filter holder in which a selected filter may be held, means being provided for arranging the projectors to simultaneously project differently coloured images onto said common surface such that the images are superimposed and form a multi-coloured composition,

colour photographs apparatus directed at said common surface, and

control means for actuating said colour photography apparatus at preselected times to photograph the multi-coloured image on said common surface.

3. In combination:

projection apparatus for providing a multi-coloured composition comprising a common surface, and a plurality of projectors each projector having two light sources, two supports for corresponding positive and negative transparent black and white images, a selection device for selecting positive or negative images for projection, a filter holder in which a selected filter may be held, a filter changing mechanism, an adjustable iris, an iris size control, a common projection lens system, and means for arranging the projectors to project simultaneously differently coloured images onto said common surface such that the images are superimposed and form a multi-coloured composition,

a panel indicating at any instant the image being projected, the iris setting and the filter being used,

photographic apparatus for photographing the panel, and

control means for actuating the photographic apparatus to photograph said panel.

4. Projection apparatus for providing a multi-coloured composition comprising a common background, a plurality of projectors each projector having two light sources, two supports for corresponding positive and negative transparent black and white images, a selection device for selecting positive or negative images for projection, a filter holder in which a selected filter may be held, a filter changing mechanism, an adjustable iris, an iris size control, a common projection lens system, and means for arranging the projectors to project simultaneously differently coloured images onto said common surface such that the images are superimposed and form a multi-coloured composition, and a magnetic tape control device for each projector, the control devices controlling said projectors to provide all possible combinations of multi-coloured images.

5. Apparatus as claimed in claim **4** wherein the magnetic tape of each control device comprises a number of tracks each controlling in each projector said filter changing mechanism, said iris size control and said selection device.

6. Projection apparatus for providing a multi-coloured composition comprising a common surface, and a plurality of projectors each projector having two light sources, two supports for corresponding positive and negative transparent black and white images, a selection device for selecting positive or negative images for projection, said selection device comprising a mirror rotatably mounted to reflect beams from a positive or negative image onto a common path, and a toggle whose outputs are connected to two electromagnetic devices operative in opposite senses on the mirror, a filter holder in which a selected filter may be held a filter changing mechanism, an adjustable iris, an iris size control, a common projection lens system, and means for arranging the projectors to project simultaneously differently coloured images onto said common surface such that the images are superimposed and form a multi-coloured composition.

7. Projection apparatus for providing a multi-coloured composition comprising a common surface, and a plurality of projectors each projector having two light sources, two supports for corresponding positive and negative transparent black and white images, a selection device for selecting positive or negative images for projection, a rotatable disc divided into differently coloured segments to provide filters, a step-by-step motor for rotating said disc to change said filter effectively, an adjustable iris, an iris size control, a common projection lens system, and means for arranging the projectors to project simultaneously differently coloured images onto said common surface such that the images are superimposed and form a multi-coloured composition.

8. Apparatus as claimed in claim **5** wherein a signal of variable strength is provided on the magnetic tape of each control device to control the iris size through a system whose operating amplitude is proportional to signal strength.

9. Apparatus as claimed in claim **4** wherein the magnetic tape comprises a single track having a number of signals recorded thereon at various frequencies for controlling in each projector the filter changing mechanism, the iris size control and the selection device, a control circuit being provided for each, the control circuits including frequency filters to select the correct signal from the track.

10. Projection apparatus for obtaining a multi-coloured composition, comprising a common surface; a plurality

of projectors each having a light source, an image support, a filter holder, a filter changing mechanism, an adjustable iris, and iris size control means; a plurality of generally similar black and white transparent images, disposable in said supports of the projectors, the different images having different degrees of transparency at corresponding areas; a plurality of different colour filters carried by said filter holder and selectively disposable in the light path of each of the projectors; and projector positioning means for positioning the projectors each to project, upon said common surface, a multi-coloured composition having the transparency characteristics of said images disposed in said supports of such arranged projectors and the colour characteristics of the color filters disposed in said light paths of such arranged projectors.

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