

# PATENT SPECIFICATION

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434,434

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## PROVISIONAL SPECIFICATION

### Improvements in or relating to the Production of Copies from Multi-colour Screen Cinematograph Films

I, Dr. GEOFFREY BOND HARRISON, a British Subject, of Ilford Limited, 23, Roden Street, Ilford, Essex, do hereby declare the nature of this invention to be as follows:—

This invention relates to a method for making a number of colour copies either positive or negative, from a single master record in colour associated with a multi-colour screen, either positive or negative.

In commercial cinematography it is usual to make a large number of positive copies of the original or master negative film to be generally released for exhibition at various theatres and the like. Since the number of such copies usually required is exceedingly large and a master copy can only be used satisfactorily to make relatively few, say fifty copies, before mechanical damage due to repeated passage through the printing apparatus renders it useless for preparing further copies, it is usual to prepare a number, say twenty, intermediate copies from the master, which intermediate copies are then used in the preparation of the final published copy, say fifty from each, thus giving a thousand finished copies from a single master record without undue damage thereto.

In the application of this method to the printing of master coloured records on multi-colour screen material, the difficulty arises that if similar screen material is used for the copy materials, a certain amount of lack of definition and degradation of colour will occur at the first stage of copying owing to the difficulty of securing accurate register of the master and copy screens, and at the second stage of printing from the intermediate copy to the final copy, a further lack of definition and degradation of colours will occur from the same cause, thus rendering the final copy very different from the original, and producing undesirable effects.

It is an object of the present invention to provide a method of producing large numbers of copies from a single multi-colour screen cinematograph film in which the lack of definition and degrada-

tion of the colours in the copies caused by one of the printing steps described above is much reduced or eliminated.

The invention consists in the method of producing a large number of coloured copies from a master positive or negative coloured cinematograph film of the multi-colour screen type which comprises the steps of preparing from the master film a plurality of sets of colour separation prints each print of a set corresponding to one of the colours of the screen and each being on unscreened material and from each set preparing a plurality of finished copies by printing the several prints of the set in register on to colour screen copying film using for each print light of colour corresponding to the screen colour to which the print is appropriate.

It will be seen that by the above method the detrimental effect of the colour screen of the first copy in the known method described above is removed since the colour separation prints have no associated colour screen.

In carrying out this method the first colour separation prints are prepared with the aid of narrow cut filters or by means of beams of light each of colour corresponding to one of the colours of the master screen and from which the wave lengths transmitted by the other elements of the multi colour filter have been eliminated by the process described in my pending applications Nos. 10375/33 and 13655/33 (Serial No. 417,860). Owing to the absence of a multi-colour screen on the copy material the colour separation prints will each be an accurate reproduction in monotone of one of the single colour elements of the master film.

One method of carrying the invention into effect will now be described by way of example:

A master positive is prepared on three-colour screen material, preferably by taking a normal screen negative and reversing this negative to give a positive record. An intermediate part colour negative separation record corresponding to each of the colours of the screen is

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Price 4s 6d

- prepared by printing through the master colour screen using for each record a beam of light of colour corresponding to one colour of this screen and from which those wave-lengths transmitted by the remaining two of the three colour elements of the master screen have been eliminated by the method described in co-pending applications Nos. 10375/33 and 13655/33.
- 5 A number of sets of negative part colour separation records are prepared and for each positive the negatives from one set are successively printed in register on a positive copy screen film utilising as before a beam of light for each colour record, from which the colours transmitted by the other colour elements have been eliminated. It is not necessary, in printing the negatives onto the positive, that the elements of the negatives should be in register with the elements of the screen on the copy material.
- 10 During the preparation of the final positive image from original master image, the usual steps must be taken to diffuse the image slightly to compensate in some degree for the lack of exact registration between the original master colour screen and the final copy screen. This diffusion may be effected in any of the known ways and may take place either in the preparation of the part colour negative intermediate records or in the preparation of the final copy from the intermediate part colour records or partially in both stages. It will, of course, be obvious that the same method of diffusing should be used for the preparation of each part colour negative or the printing from each part colour negative
- on to the positive stock. Accurate register of the part colour images printed from the intermediate records on to the final positive is obtained by using film accurately perforated in similar manner to the original for all the copies, which, in association with the very accurate feeding devices of modern cine printing machines which engage with the perforations, is sufficient to ensure accurate registration of the various part colour images with each other. In order to ensure that all the part colour intermediate printing images from each particular image "frame" of the master will be printed on to the same image "frame" of the final positive copy, a registering mark is made on the original master film which may, for example, be in the form of a perforation adapted to co-operate with a member in the printing device to accurately position the film in the printing gate. A similar marking is made on each of the part colour negative films and when the first part colour negative is printed on to the final copy, a mark corresponding to the registering mark borne by it is made on the final copy film and the registering marks on the subsequent part colour images are registered with this mark before printing so that the images will be in accurate register with those already formed on the film.
- Dated this 1st day of March, 1934.
- BOULT, WADE & TENNANT,  
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E.C. 1,  
Chartered Patent Agents.

#### COMPLETE SPECIFICATION

### Improvements in or relating to the Production of Copies from Multi-colour Screen Cinematograph Films

- 75 I, Dr. GEOFFREY BOND HARRISON, a British Subject, of Ilford Limited, 23, Roden Street, Ilford, Essex, 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 a method for making a number of colour copies either positive or negative, from a single master record in colour associated with a multi-colour screen, either positive or negative.
- 85 In commercial cinematography it is usual to make a large number of positive copies of the original or master negative film to be generally released for exhibition at various theatres and the like.
- Since the number of such copies usually required is exceedingly large and a master copy can only be used satisfactorily to make relatively few, say fifty copies, before mechanical damage due to repeated passage through the printing apparatus renders it useless for preparing further copies, it is usual to prepare a number, say twenty, intermediate copies from the master, which intermediate copies are then used in the preparation of the final published copy, say fifty from each, thus giving a thousand finished copies from a single master record without undue damage thereto.
- 95 In the application of this method to the printing of master coloured records on multi-colour screen material the diffi-

culty arises that if similar screen material is used for the copy materials, a certain amount of lack of definition and degradation of colour will occur at the first stage of copying owing to the difficulty of securing accurate register of the master and copy screens, and at the second stage of printing from the intermediate copy to the final copy, a further lack of definition and degradation of colours will occur from the same cause, thus rendering the final copy very different from the original, and producing undesirable effects.

It is an object of the present invention to provide a method of producing large numbers of copies from a single multi-colour screen cinematograph film in which the lack of definition and degradation of the colours in the copies caused by one of the printing steps described above is much reduced or eliminated.

The invention consists in the method of producing a large number of coloured copies from a master positive or negative coloured cinematograph film of the multi-colour screen type which comprises the steps of preparing from the master film a plurality of sets of colour separation prints each print of a set corresponding to one of the colours of the screen and each being on unscreened material and from each set preparing a plurality of finished copies by printing the several prints of the set in register on to multi-colour screen copying film using for each print light of colour corresponding to the screen colour to which the print is appropriate.

It will be seen that by the above method the detrimental effect of the multi-colour screen of the first copy in the known method described above is removed since the colour separation prints have no associated colour screen.

In carrying out this method the first colour separation prints are prepared with the aid of narrow cut filters or by means of beams of light each of colour corresponding to one of the colours of the master screen and from which the wave lengths transmitted by the other elements of the multi-colour filter have been eliminated by a process similar to that described in my Patent Specification No. 417,860. Owing to the absence of a multi-colour screen on the copy material the colour separation prints will each be an accurate reproduction in monotone of one of the single colour elements of the master film.

Some specific methods of carrying the invention into effect will now be described, by way of example, and with reference to the accompanying diagrammatic drawings in which:—

Figure 1 illustrates one method of producing sets of colour separation prints.

Figure 2 illustrates a step in the formation of the mask for use in the method illustrated in Figure 1,

Figure 3 illustrates an alternative method of producing sets of colour separation prints.

Figure 4 illustrates one method of printing the final positive from the separation prints produced by the method illustrated in Figure 1,

Figure 5 shows the registering perforation provided near the end of the base materials of each of the master and positive records and of the intermediate colour separation prints, and

Figure 6 illustrates the engagement of the registering perforations of two films by a registering device.

In each of the following examples a master positive is shown at 1 in Figures 1 and 3. From the master positive a plurality of sets of three intermediate part-colour negative separation prints 2, 3 and 4, each corresponding to one of the colours of the master screen, are prepared by contact printing as shown in Figure 1 using for printing each print a beam of light of colour corresponding to one colour of the master screen and from which light of wave-lengths which would be transmitted by elements of the remaining two of the three colours has been eliminated. The method of producing light of this desired composition is shown in Figure 1. For each print a beam of parallel light G1 and G2 is analysed into a pure spectrum by means of a prism 5 and lens 6. The different colours of the spectrum are brought to real foci at a plane 7 and the colours are directed through the master positive 1 on to the sensitive material for the intermediate negative, by a lens 8. Placed in the plane of the spectrum at 7 is a mask 9 which has opaque portions corresponding in position in the spectrum to the colours which it is desired to eliminate. Thus, in Figure 1A the lower portion of the mask 9 is opaque and serves to eliminate the greens and violets and to pass only those wave-lengths of red which would not be transmitted by the green and violet elements of the master screen. Similarly, in Figure 1B only the central portion of the mask is clear and the top and bottom portions serve to eliminate the green and violet wave-lengths, as indicated. In

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Figure 1C only the bottom portion of the mask is clear and the red and green wave-lengths are eliminated.

In order to secure accurate registration of the images during the final printing step each of the intermediate negatives is accurately perforated and is fed by means of an accurately formed sprocket 10 which also engages with the master positive.

One method of producing the masks described above is to employ the arrangement shown in Figure 2 in which a beam of parallel light G1 and G2 is passed through a filter 11 having a colour transmission similar to that of the elements of one colour of the master positive and the light transmitted by this filter is analysed into a spectrum by means of a prism and lens similar to those employed in the printing step, as described above. A colour-sensitive photographic plate 12 is inserted in the plane of the spectrum and it will be seen that after exposure to this spectrum and development, the mask will bear an opaque band, corresponding in position in the spectrum to light passed by the elements of one colour of the master screen. The process is repeated using a filter 11 corresponding to a different colour of the master screen producing a second mask which may be combined with the first to provide a mask, which when employed in the manner shown in Figure 1, will allow to pass light of wave-lengths corresponding to one of the colours of the master screen, but will not allow to pass light of wave-lengths corresponding to either of the other colours of the screen or wave-lengths which are common to any two colours of the screen. Alternatively, instead of exposing two masks and combining them, a single mask may be produced by successively exposing a plate with different filters 11 in position and then developing the plate.

A number of sets of negative, part-colour separation prints are prepared as described above from each master and for each positive the negatives from one set are successively printed in register on to positive three-colour screen material 13 as shown in Figure 4. The light used for printing each of the negatives is similar to that used for the making of the negative and is obtained in similar manner as shown in Figure 4. To secure registration of the images of the intermediate negatives on the positive copy, the base materials of the negatives and copy are engaged by sprocket wheels in a manner similar to that used for printing the negatives.

It is not necessary in printing the

negatives on to the final positive that the elements of the negatives (which correspond to the screen elements of the master), should be in register with the elements of the screen on the copy material. During the preparation of the final positive from the original master, however, steps should be taken to diffuse the image slightly in order to compensate in some degree for the lack of exact registration between the elements of the original master screen as transferred to the intermediate negatives, and the elements of the final copy screen. This diffusion may be effected in any of the known ways and may take place either during the preparation of the intermediate records or during the preparation of the final copy or partly in both stages. In some cases and when suitable separation between the base materials is arranged sufficient diffusion may be provided by the fact that in the method described above the light of each colour is not parallel at the printing gate.

An alternative way of producing the desired printing light is shown in Figure 3. In this case a sharp cut filter 14 is inserted in the path of a parallel beam of light G1 and G2 used for printing. The filter 14 has a transmission such that only light corresponding to one of the colours of the master screen is allowed to pass, and light which would be transmitted by any of the other screen elements is absorbed. In Figure 3 the printing of only one of the intermediate negatives is shown, but it is to be understood that the same arrangement is employed for each of the intermediate negatives, using appropriate filters. The printing of the final positive from the intermediate negatives is carried out in similar manner using the same or similar filters in each case.

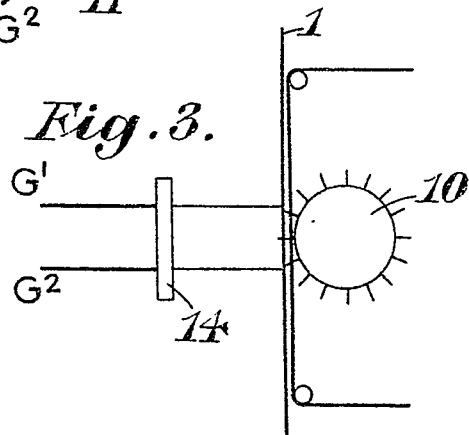
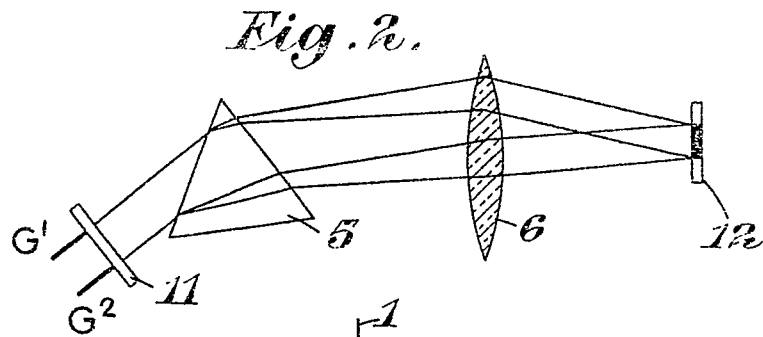
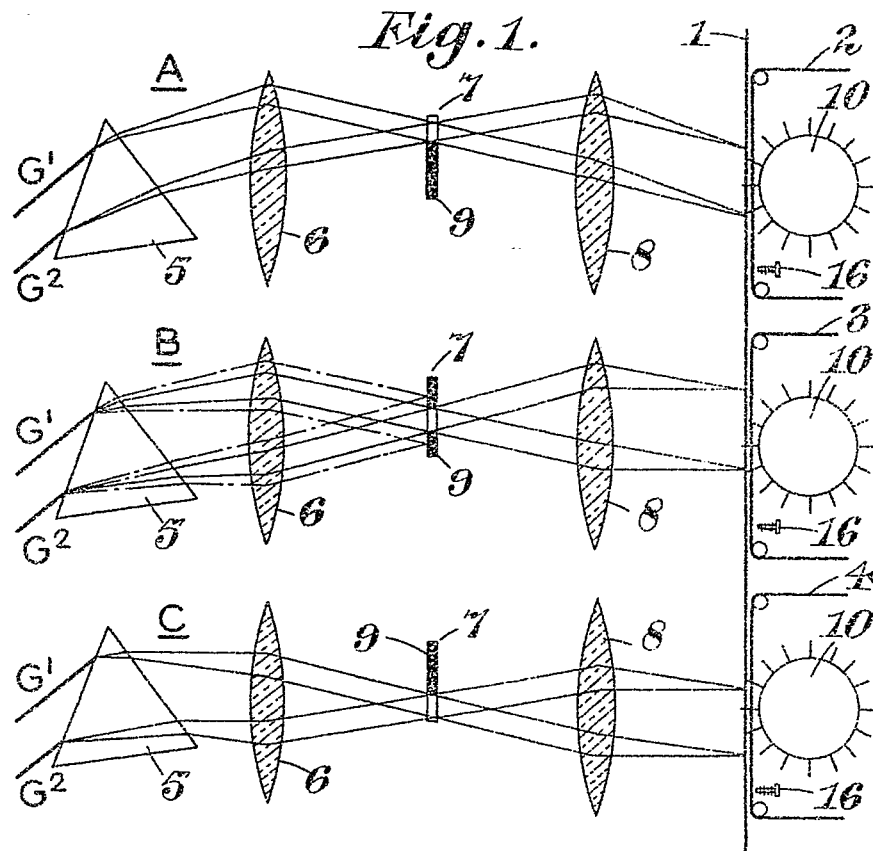
In order to ensure that all the part-colour intermediate negative images from each image frame of the master shall be printed on to the same image frame of the final positive copy, a registering perforation 15 is made near the beginning of the master, as shown in Figure 5, and similar perforations are made in each of the copies. Before commencement of printing either from the master on to an intermediate negative or from an intermediate negative on to a final positive, the registering perforations of each film are engaged by a spring pressed plunger 16 as shown in Figure 6 and the films are engaged by the driving sprocket wheel while their correct relative positions are thus determined. The plunger 16 is released from engagement with the films before feeding is commenced.

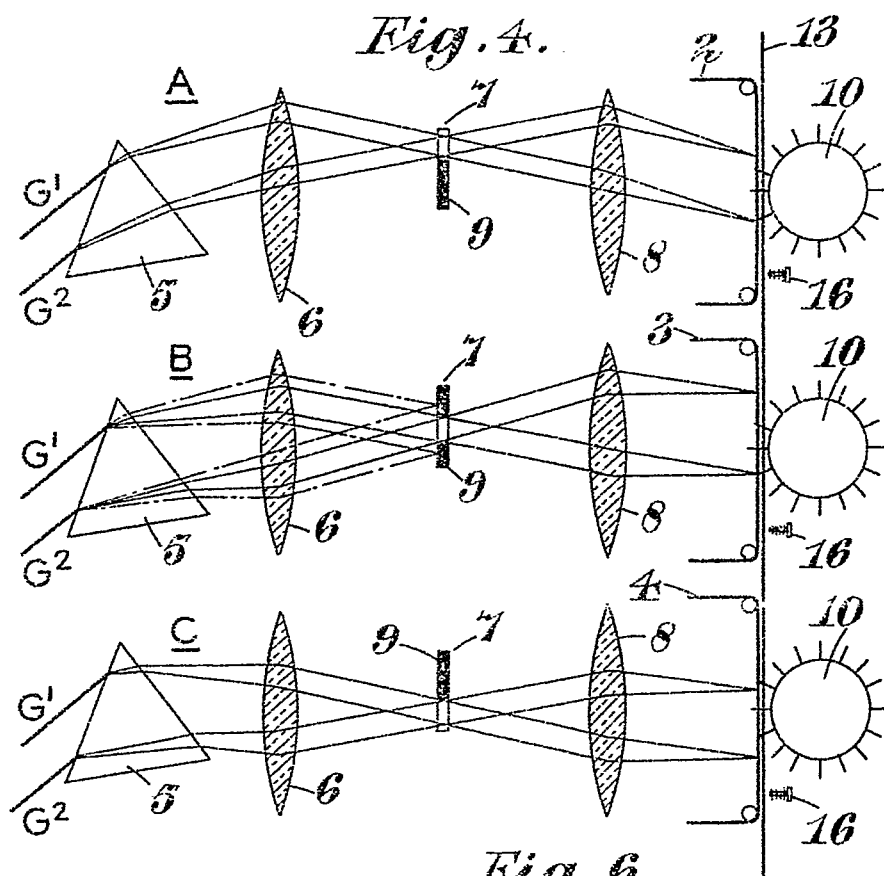
Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The method of producing a large number of coloured copies from a master positive or negative coloured cinematograph film of the multi-colour screen type which comprises the steps of preparing from the master film a plurality of sets of colour separation prints each print of a set corresponding to one of the colours of the screen and each being on unscreened material and from each set preparing a plurality of finished copies by printing the several prints of the set in register on to multi-colour screen copying film using for each print light of colour corresponding to the screen colour to which the print is appropriate.
2. The method of producing coloured copies as claimed in claim 1 wherein the light used for printing each print (whether intermediate or final print) is of colour corresponding to one of the colours of the master screen but contains substantially no light of wave-lengths transmitted by the elements of the screen of different colour.
3. The method of producing coloured copies according to Claim 2 wherein the beam of light used for printing is of colour corresponding to one of the colours of the master screen and light which would be transmitted by the elements of the screen of different colour is eliminated from the beam, by means of sharp-cut filters in the path of the light.
4. The method of producing coloured copies, as claimed in Claim 2, wherein the light used for printing each print is of colour corresponding to one of the colours of the master screen and light of wave-lengths which would be transmitted by elements of the screen of different colour is eliminated from the printing light by analysing the beam into a spectrum and cutting out from the spectrum light which would be transmitted by screen elements of different colour, by means of a mask interposed in the spectrum.
5. The method of producing coloured copies as claimed in any one of the preceding claims wherein during one or both printing steps the image is diffused slightly in order to compensate in some degree for the lack of exact registration between the elements of the original master screen as transferred to the intermediate negatives, and the elements of the final copy screen.
6. The method of producing coloured copies as claimed in any one of the preceding claims wherein at the beginning of each printing step the appropriate films are engaged by registering devices arranged to co-operate with apertures on the films to secure registration of the image frames.
7. The method of producing coloured copies from a master multi-colour screen cinematograph film substantially as described with reference to Figures 1 and 4 of the accompanying drawings or with reference to Figure 3.
8. A coloured copy on multi-colour screen film when produced from a master multi-colour screen film by the use of intermediate negatives substantially as described.

Dated this 22nd day of February, 1935.  
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111 & 112, Hatton Garden,  
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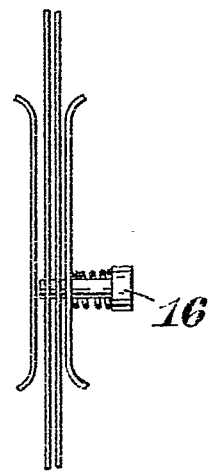
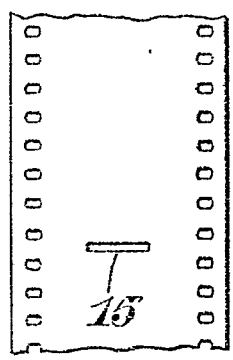
[This Drawing is a reproduction of the Original on a reduced scale.]





*Fig. 6.*

*Fig. 5.*



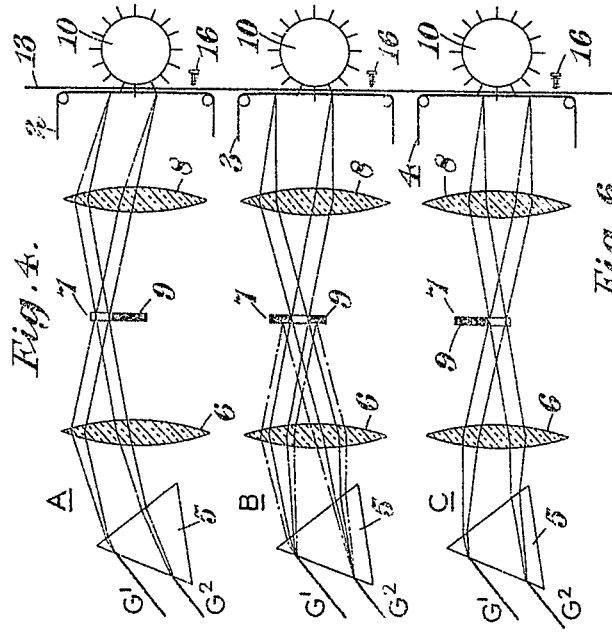
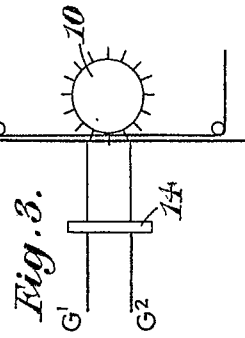
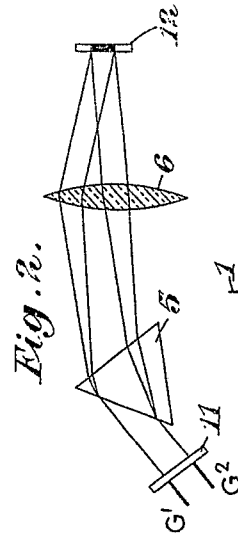
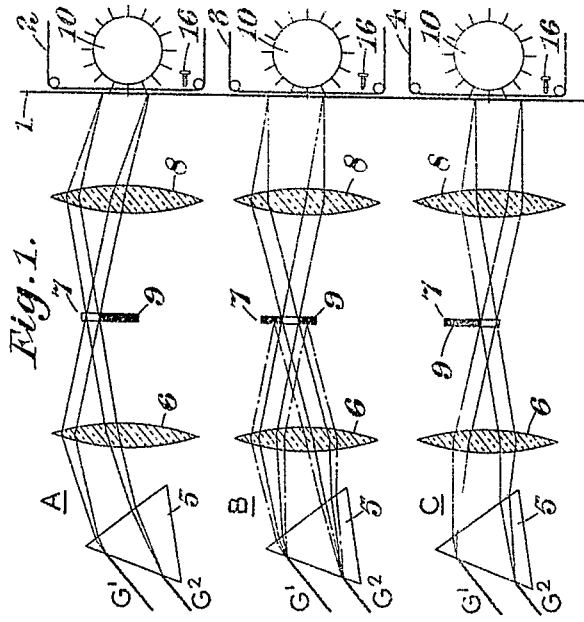


Fig. 6.

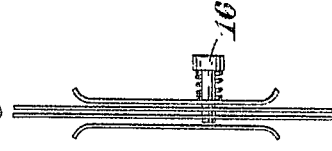
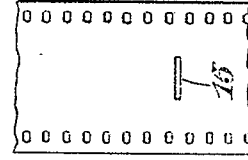


Fig. 5.



[This Drawing is a reproduction of the Original on a reduced scale.]