PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Process and Device for Printing Multi-colour Partial Pictures on Lenticular Films.

We, I. G. FARBENINDUSTRIE AKTIENGESELLSCHAFT, a Joint Stock Company organised according to the laws of Germany, of Frankfurt a/Main, Germany, 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:—

It has been proposed to print by contact partial colour sensation records on a photographic film having no lenticular elements from a lenticular film, which, as is known, comprises within the frame of each picture all partial colour sensations necessary for the composition of the final multi-colour picture (see, for inssance, Specification No. 353,121). Processes are also known which allow of printing optically on a lenticular film multi-colour partial pictures, produced on an ordinary film having no lenticular elements. In carrying out the processes above referred to, only one zone of the usual multi-colour filter, corresponding with the different partial colours, is left uncovered in each particular case during the printing operation. When applying optical printing methods in multi-colour photography, the partial pictures which correspond with one another must be made to register exactly; for this purpose the device for feeding the film has to work with a maximum of precision. There is therefore wanted also a method of printing onto a lenticular film by contact.

The object of this invention is a process for printing by contact on a lenticular film partial colour sensation records produced on ordinary film having no lenticular elements and contained in one or several film bands, for instance a green constituent of the picture, a blue constituent and a red constituent. This process consists in placing the corresponding partial colour records (that is to say, the partial colour records which together form a group containing all the colour sensations required for producing a single picture in colours), one after the other on the side of the lenticular film bearing the lenticular elements, in exactly the same position and illuminating the pictures from this side, the direction of incidence of the light being altered so that it is different in the case of each one of a group of corresponding partial colour records, and care being taken that the partial colour records of each group are projected on the same picture area of the lenticular film.

It is therefore necessary to provide the printing apparatus with catches which engage the perforations of the film to be printed and those of the lenticular film, so that it becomes possible to register each one of a group of corresponding partial pictures of the film to be printed one after the other on one and the same area of the lenticular film. In printing cinematographic picture bands, the perforation for this purpose is already available. If single pictures taken in an ordinary photographic apparatus are to be printed on a printing material having lenticular embossings, the partial colour sensations and the printing material have to be provided with cuts or perforations which correspond exactly with one another and must be made to register during the printing operation. If required the perforations may be replaced in known manner by indentations.

The source of light for the printing operation is of determined breadth and may consist of a glow lamp, an illuminated strip of frosted glass or an illuminated slot in a diaphragm. The breadth of the lamp, strip or slot depends on the form of the lenticular embossing of the printing material and on the kind of objective which serves for the projection of the printed picture, and corresponds to the breadth of one area of the multi-colour filter, or the virtual image thereof, which is to be used in the projecting operation.

If the refracting elements of the printing material consist, as usual, of parallel cylindrical lenses, the dimensions of the several sources of light of the illuminating system in the direction parallel to the cylindrical lenses must be kept as small as possible, whereas the dimensions in the direction perpendicular to the lenticular elements (that is, the breadth) is determined as aforesaid. The dimension of the source of light in a direction per-

pendicular to that of the lenticular elements depends on the properties of the objective with which the print to be produced is to be projected. The distances of the optical centres of the several sources of light from one another and from the picture window of the printing device must be as nearly as possible equal to the distances of the optical centres of the colour stripes of the multi-colour filter, or of the virtual image thereof, from one another and from the lenticular film during the projection. An exact observation of these conditions will however, only be possible in some special cases, as the projection objectives in use have varying focal lengths, and as it is important that the print should be applicable, if possible, in all projection apparatus that enter into consideration. For these reasons the said conditions are fulfilled only approximately, by equalising as much as possible the aforesaid distances, while printing and projecting. Experience has shown that also in this case a very satisfactory reproduction or rendering of the colours is obtained. It is advantageous either to choose for the distances indicated mean values, or to take the greatest of the values in question for the distance of the multi-colour filter, or its virtual image, from the film and the smallest value for the distances between the optical centres of the stripes of the projection filter, or of its virtual image, and determine the size of the illuminating device accordingly. Mean values are chosen if the focal lengths and apertures of the projection objectives of the different apparatus which enter into consideration for the purpose of reproduction do not differ largely from each other, for instance, by not more than 20 per cent. If there are greater differences in the focal lengths and apertures of the projection objectives intended to be used for purposes of reproduction the second of the two methods indicated is followed. If films printed in this manner are to be projected by means of projection apparatus of different sizes, it may be necessary, in order to fulfil the conditions underlying the printing operation as to the distance and the breadth of the filter or its virtual image, to adjust suitably the optical means in the projection apparatus, in a manner analogous to that shown in Fig. 8 of the accompanying drawings for adjusting the optical means in the copying machine.

For the distance of the virtual filter image during the projection, if desired, there can be adopted the value ∞. If it is not possible to arrange the several sources of light of the illuminating device within a sufficiently narrow space, there can be intercalated between the film and the illuminating device lenses which project the virtual images of the sources of light at the required distances.

The dimension of the several sources of light in the direction perpendicularly to the lenticular elements is chosen so that the source of light corresponding with one partial colour has at the most only the dimension of the corresponding partial colour of the multi-colour filter to be employed during the projection, or of its virtual image. It is, however, advantageous that the sources of light be smaller in dimensions, for instance punctiform, and that they be placed in the optical centres of the areas in question. It is advisable to arrange the sources of light in a movable manner so that the whole system can rapidly and simply be adapted to any alteration of the conditions.

It is also possible for the illuminating device to consist of only a single source of light which is movable in such a manner that it takes successively the position of each of the sources of light of the illuminating device above described.

The intensity of the illumination is controlled in a manner known in itself, by inserting resistances in the lighting current, intercalating medium which absorb light (grey filters, wire nets, or the like) in the path of the beams or masking the luminous planes of the several sources of light.

According to the process of the invention negatives as well as positives can be printed onto a lenticular film. In order to obtain a print which is not laterally inverted, it is necessary that the negative should be placed on the printing material with its back next the lenticular elements thereof, and that the positive is placed on the printing material with its layer side next the lenticular elements. If it is desired that also in printing a negative the layer side thereof should be placed on the embossed side of the printing materials, in which case a laterally inverted picture would result, it is necessary either, during the photographing of the negative, to expose the light-sensitive layer through the support or to insert one of the known systems for inverting pictures, or, during the projection, to use a system for inverting pictures or to view the projected picture from behind the projection screen.

If the lenticular elements of the printing material are chosen so that the picture elements, projected by the different lenticular elements in the sensitive layer, are not directly contiguous but are separated from one another by empty spaces, it

is necessary, in order to prevent the colours from whitening, additionally to illuminate each picture area either prior to or during or after printing the partial colour pictures of a group, by means of several luminous stripes running parallel to the direction of the lenticular embossing. By this additional illumination the unexposed parts lying between the single pictures of the lenticular film are blackened. The distance and the breadth of the luminous stripes are chosen in such a manner that only those parts of the emulsion layer are struck by the light which are situated outside the picture field of the partial colour pictures.

It has proved to be particularly advantageous first to produce from the partial colour records to be printed, intermediate positives on a film having no lenticular elements, to print these positives on the lenticular film with their layer side next the lenticular embossing, and to develop the latent picture, produced on the lenticular film, to a positive according to the known reversal method. This arrangement is more favourable for the sharpness of the print, since the layer side is turned towards the lenticular embossing and the additional illumination above referred to by means of the source of light consisting of several stripes is no longer necessary, as all unexposed parts which may be present between the single pictures, have already been blackened by the reversal method.

It is advisable to produce the intermediate positives on a film having a very flat gradation and to dye the emulsion layer of the lenticular film with a yellow or other non-actinic filter dyestuff, (that is, a dyestuff which has no sensitising effect on the silver halide emulsion) in order to maintain the resolving power as high as possible.

The invention is illustrated with reference to the accompanying drawings in which:

Fig. 1 illustrates diagrammatically an arrangement as used in projecting a lenticular film,

Fig. 2 represents a multi-colour filter used in projecting a lenticular film, showing at the same time a slit used for the exposure in the printing operation,

Fig. 3 shows diagrammatically the printing of the red sensation,

Fig. 4 shows diagrammatically the printing of the green sensation,

Fig. 5 shows diagrammatically the exposure of the unexposed parts between the partial pictures which lie behind the lenticular elements,

Fig. 6 illustrates diagrammatically an illuminating device,

Fig. 7 shows diagrammatically another form of an illuminating device,

Fig. 8 represents diagrammatically an arrangement used if the available length of the copying machine is smaller than the distance of the virtual image of the multi-colour filter from the lenticular film.

Referring to Fig. 1, A is the lenticular film, B the objective and C the multi-colour filter used when projecting the lenticular film. When viewing the filter C from the lenticular film A through the objective B, the filter itself cannot be seen, but its virtual image is seen at D. The multi-colour filter may consist of three parallel stripes, a red stripe, a green stripe and a blue stripe; the virtual image D of the multi-colour filter will be the basis for the further explanations, since as will be seen from the description, this virtual image indicates the place at which the source of light should be placed in the printing process.

Fig. 2 represents the multi-colour filter used in projecting the lenticular film bearing the print and consisting of three parallel stripes. E is the slit of the diaphragm R shown in Fig. 3. In order to obtain a sharp print this slit is made as small as possible.

Fig. 3 illustrates diagrammatically the first step in the printing operation. The positive film F bearing a positive made from a negative to be copied is advantageously placed with the side bearing the image in contact with the lenticular film A. The reproduction of the positive film bearing, in the present case, the red colour sensation of the picture is effected by a distinct arrangement and by a distinct size of the diaphragm R provided with a slit, and placed at a distance from the film A equal to that of the virtual image of the multi-colour filter to be used in projecting the lenticular film. The distance AD therefore corresponds to the distance AD in Fig. 1. Owing to the lenticular elements of the lenticular film the opening E (see Fig. 2) of the diaphragm R is copied at the places *r*, the luminosity in copying being determined by the brightness of the partial colour positive F. The printing light is supplied by means of a source whose form is suited to that of the slit, preferably by an elongated line filament lamp, which is best of the opal type.

Fig. 4 represents diagrammatically the printing of the green partial picture. For this step, the diaphragm must be inserted at G, corresponding with the green area of the virtual image D of the multi-colour filter. The single points of the picture are copied on the lenticular film A at *g*.

In a completely analogous manner the blue colour sensation may be printed upon the lenticular film.

Fig. 5 represents diagrammatically the process of exposing the spaces which may remain unexposed in the printing operations. HI is the breadth of the virtual image D (cf. Fig. 1) of the multi-colour filter or more correctly, the breadth of the diaphragm placed at HI through which the exposure is made in the printing operation. On examination of the real pictures registered on the emulsion layer of the lenticular film A, it may be found that spaces W remain on which no light has fallen. After development, these spaces are transparent and may cause a whitening of the colours in reproduction. In order to avoid this drawback, adjacent to each side of the virtual image D of the multi-colour filter there is provided a slit X for illumination which is made so broad in the direction perpendicular to the lenticular elements that the real images of the slits projected on the layer of the lenticular film touch each other as shown in Fig. 5, or slightly overlap. This method is, however, only used for lenticular films which are not developed according to the reversal process.

Fig. 6 shows diagrammatically a source of light which may replace the diaphragm R (cf. Fig. 3) provided with a slit. The source of light is an incandescent lamp having a wire spiral K L M N equal in length to the virtual image D (cf. Fig. 1) of the multi-colour filter. The points L and M correspond to the lines separating the three colour stripes of the multi-colour filter. The electric connections in the lamp are such that each of the three parts KL, LM and MN of the wire spiral can be switched on or off at will and that only that part of the wire is illuminated which is required for copying the actual partial colour negative.

Fig. 7 illustrates diagrammatically another mode of illumination. The source of light is an incandescent lamp provided with a single wire spiral having a length OP equal to the breadth of one area of the virtual image D (cf. Fig. 1) of the multi-colour filter. The lamp can be displaced laterally so that it illuminates the desired section, the sections corresponding to the parts KL, LM and MN of Fig. 5. The lamp is fixed in the different positions for illuminating each section by a lever Q having a ratchet Y which engages projecting bosses S_1, S_2 and S_3 mounted on a fixed base.

Fig. 8 represents diagrammatically an arrangement used if the available length of the copying machine is smaller than the distance of the virtual image D of the multi-colour filter from the lenticular film. In this case, the source of light is placed at the place of the copying machine marked TU and a virtual image of the source of light is formed at T_1U_1 by the lens V so that the distance A—T_1U_1 is equal to the distance A—D in Fig. 1. In this manner, the film is exposed in the same manner as if the source of light itself were at T_1U_1.

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 process of printing on a lenticular film by contact partial colour sensation records taken on ordinary film, wherein the partial colour records, which correspond with one another and are contained in one or several film bands, are placed one after the other, in exactly the same position controlled by perforations or indentations, on the back of the lenticular film, and are illuminated from behind, the direction of incidence of the light being different in the case of each of the corresponding partial records of a group, and the corresponding partial records of each group being projected on the same picture area of the lenticular film.

2. A process according to Claim 1, herein any unexposed parts of the lenticular film between the partial picture elements which lie behind the different lenticular elements are subjected, in a manner known in itself, to an additional illumination.

3. A process according to Claim 1, wherein when the partial colour sensation records to be printed are negatives, there are first produced from them intermediate positives on a film having no lenticular elements, the intermediate positives are printed on the lenticular film with their layer side facing the embossed side of the latter and the latent pictures thus produced are developed to positives in a manner known in itself.

4. A process according to Claim 3, which consists in producing the intermediate positives on an emulsion having a flat gradation, and dyeing the emulsion of the lenticular film with a non-actinic filter dyestuff which has no sensitising action on the silver halide emulsion.

5. An apparatus for the process referred to in any of the preceding claims, comprising a number of sources of light, which number is equal to the number of the areas of the multi-colour filter to be used in the projection of the lenticular film, the sources of light being individually controllable and adapted to the breadth of the

multi-colour filter, or the virtual image thereof, to be used in projecting the lenticular film, the distances of the optical centres of the sources of light from one another and from the lenticular film being equal to the distances which the optical centres of the multi-colour filter, or of its virtual image, to be used for projecting the film will have from one another and from the film respectively during the projection, substantially as described.

6. A modification of the apparatus according to Claim 5 adapted for printing films which are to be projected by means of objectives of varying focal lengths, wherein the distances of the optical centres of the sources of light from one another and from the lenticular film represent mean values of the different distances which the optical centres of the areas of the various multi-colour filters, or of their virtual images, to be used for projecting the film will have from one another and from the film respectively during the projection, substantially as described.

7. A modification of the apparatus according to Claim 5, adapted for printing films which are to be projected by means of objectives of varying focal lengths, wherein the distances of the optical centres of the sources of light from the lenticular film during printing correspond to the greatest distance which the optical centres of the areas of the various multi-colour filters, or of their virtual images, to be used for projecting the film will have from the film during projection, and the distances of the optical centres of the sources of light from one another correspond to the smallest distance which the optical centres of the areas of the various multi-colour filters, or of their virtual images, will have from one another during projection, substantially as described.

8. Apparatus according to any of Claims 5—7, wherein the illuminating device consists of a single source of light and is adapted to be successively brought to different places of a plane that is parallel to the film plane.

9. Apparatus according to any of Claims 5—8, wherein there are interposed between the film and the source of light an optical element or elements, such as a convex lens, so as to adapt the system to the size and position of the projection filter.

Dated this 10th day of December, 1931.

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W.C. 2,
Agents for the Applicants.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1933.

Fig. 1

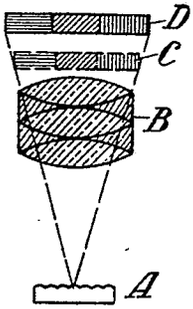


Fig. 2

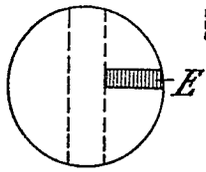


Fig. 3

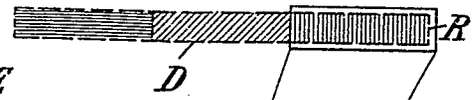
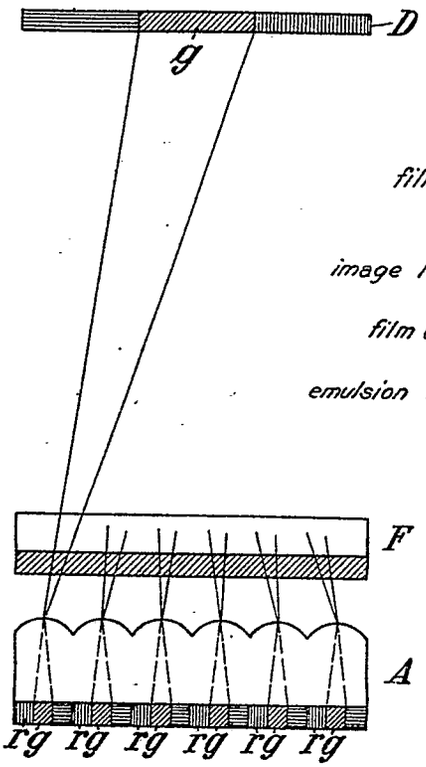
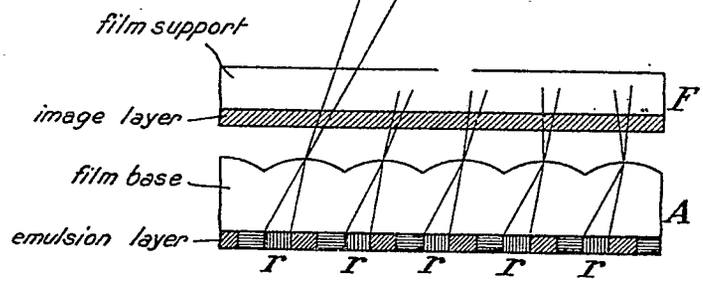


Fig. 4





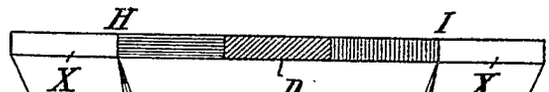
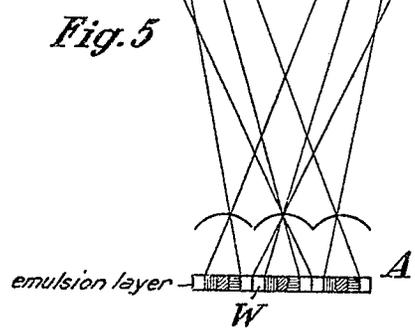


Fig. 5



R

F

A

Fig. 6

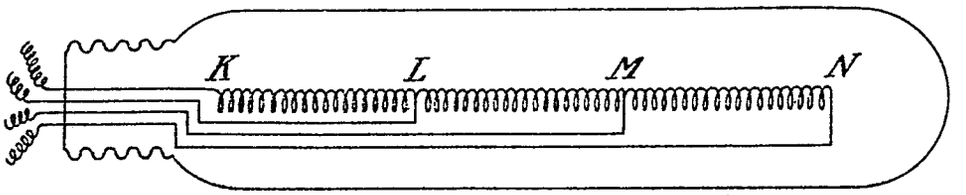


Fig. 7

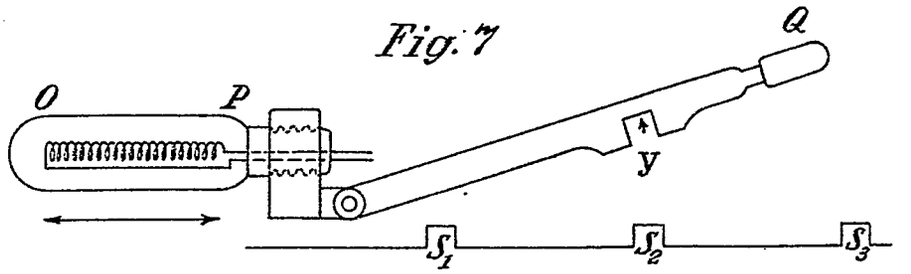
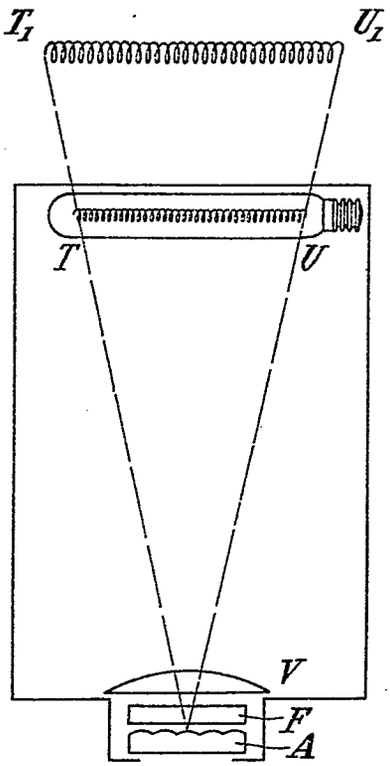


Fig. 8



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

Fig. 1

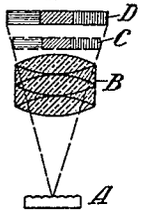


Fig. 2

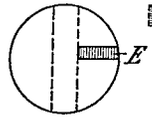
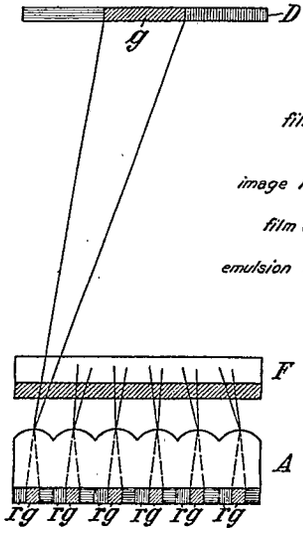
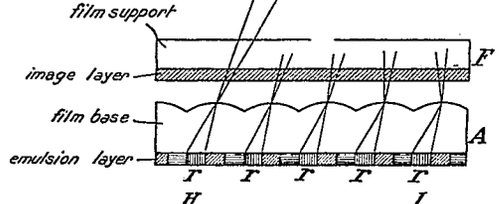


Fig. 3

Fig. 4





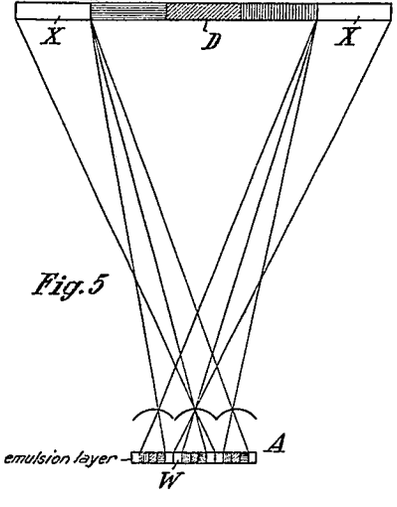


Fig. 5

Fig. 6

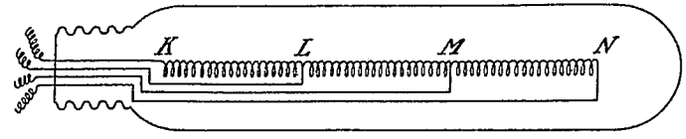


Fig. 7

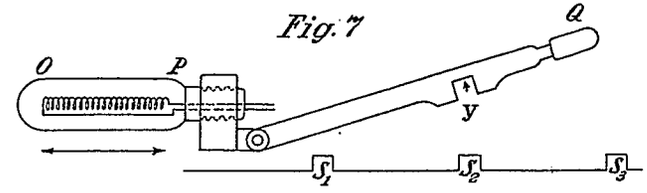
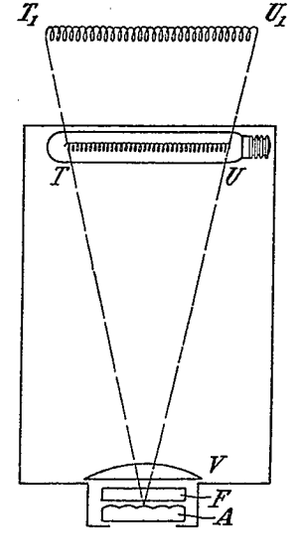


Fig. 8



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