[Second Edition.]

PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Process for Producing Three-colour Photographs and Kinematographic Films on a Film with Layers on both Sides.

I, BELA GASPAR, Doctor of Medicine, of 38, Innsbrucker Strasse, Berlin-Schoneberg, Germany, a subject of the King of Roumania, 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 :—

In my Patent No. 408,991, there is described and claimed a process for the production of kinematograph films and photographs in two or more colours, in which process a plurality of differently diffusely coloured and sensitised layers are formed on each other and in which the lower part layer or layers is or are sensitised in respect of rays which are allowed to pass not only through the part layer or layers above the same but also through the part layer itself, the dyestuffs colouring the layers being, after appropriate copying destroyed at the image or non-image portions.

It has now been found that the production of diapositives, and particularly of kinematographic pictures, has certain advantages over the process described in my said patent, if, for the purpose of producing three-colour pictures, two superimposed coloured layers are arranged on one side of the film and the third coloured layer is formed on the other side of the support instead of the three superimposed coloured layers being arranged on one side of the support. In the case of kinematographic films and diapositives, these advantages lie in the fact that the so-called "non-curling layer" may be omitted and its place taken by the light-sensitive layer. Moreover, the subsequent correction of the colours is very simple and the light-sensitive layers can be developed out in a shorter time. In addition, the copying is simpler owing to the fact that, according to the invention, it is not necessary with most of the layers to work with a coloured light of a strictly definite colour or spectral region.

It is already known to form two coloured layers on one side of a layer-carrier and a coloured layer on the other side, but the individual layers in these arrangements are sensitised for light rays which are complementary to the specific colour of the layer. In the case of these arrangements, it is known to be impossible to obtain well exposed pictures unless extremely long times of exposure are employed. However, in the case of most of the intensive colourations that are necessary for diapositives, even these long exposure periods are useless.

It has further been proposed in Specification No. 375,338, in a process of preparing subtractive multi-colour pictures, to print single colour sensations of the original successively on to a positive film bearing several superposed light sensitive layers of different sensitiveness to colours, the printing light in the different printing operations being adapted only to the sensitiveness of the individual printing layer on which the individual olour sensation is to be recorded without regard to the colour of the light filter used during exposure of the peculiar colour sensation. The one particular method claimed for carrying out this process in the said patent comprises printing red, blue and green colour sensations on to a film provided with three emulsion layers, of which two layers are arranged on the one side and the third layer on the other side of the support, and of which the first layer is dyed bluish-green and sensitised to blue, the second layer, arranged between the first layer and the support, is dyed yellow and sensitised to green, and the third layer is dyed purple and sensitised to red, the red sensation being printed with blue light on to the layer dyed bluish-green, the blue sensation being printed with green light on to the layer dyed yellow and the green sensation being printed with red light on to the layer dyed purple. I make no claim herein to such process, nor to such coloured and sensitised films when used in such process.

The process for producing multi-colour kinematograph films and photographs according to the present invention is a development of the process claimed in my prior Patent No. 408,991 and is characterised in that the three-colour selection pictures are simultaneously copied

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optically or in contact from one side or both sides on to a film comprising three diffusely coloured silver halide layers disposed two layers on one side and one layer on the other side of the support, the individual layers being sensitised for those rays which are let through by the particular overlying layers and by the dyestuff that colours the layer itself, and the dyestuffs in the layers being subsequently destroyed at the image or non-image portions.

The process according to the present invention is, therefore, distinguished from the first-mentioned prior proposals by reason of the particular sensitisations of the layers and from the second-mentioned prior proposal by reason of the fact that the colour selection pictures are copied simultaneously.

The advantages of the process according to the present invention will be clear from the following example which, at the same time, represents a typical but non-limitative embodiment according to the present invention.

One side of the support is coated with yellow-coloured and purple-coloured emulsions in such a manner that the layer of purple-coloured emulsion lies on the top of the layer of yellow-coloured emulsion. The other side of the support is coated with a bluish-green emulsion. As is known, the principal colour in a three-colour picture is the bluish-green partial picture, but the nature of the purple partial picture is also very important. The yellow partial picture of the three-colour picture on the contrary is in the background and neither the sharpness nor the correct modulation of this partial picture plays a part in the nature of the total coloured picture. Consequently, it is all the more important in the first place to be able to copy the two principal colours in the three-colour picture sharply and in addition to be able, subsequently to influence the intensity of the pictures by subsequent chemical treatment, for example, by reduction. For this purpose it is very advantageous for the layers which are coloured with the colours of the important partial colours to lie on the outside, as described in the case of the above arrangement.

On the other hand, it is often also advantageous, for the purpose of avoiding parallactic errors, to have the two principal colours on one side of the support and to arrange the yellow colour on the other side of the support.

For producing pictures upon the material described above, one may proceed as described in Patent No. 408,991 by copying from one side only. It is, however, a characteristic feature of the present invention that the colour selection pictures are copied simultaneously on to the material and not successively. As copy matter, either black-and-white colour selection negatives or any desired coloured copy matter may be employed. In this case the sensitisation of the layers will be effected in the manner stated in my patent No. 408,991. For example, the purple layer is sensitised for blue rays, the yellow layer is sensitised for orange-red rays and the bluish-green layer is sensitised for infra-red rays. Further advantages resulting from the arrangement of the three layers on the two sides of the support according to the present invention may be obtained if the sensitisation and colouring are effected in such a manner that the middle layer, which contains the third colour, also acts as an isolating layer or protective filter, as hereinafter more fully described, since the partial negatives may then be copied from both sides of the film.

As the two outer layers are coloured in colours, such as purple and blue, which have an absorption gap in the blue region of the spectrum, a special sensitisation of these layers to particular spectral zones is not essential. The yellow layer is sensitised for infra-red rays with kryptocyanine for example.

Copying is now very simple; the partial pictures corresponding to the two outer layers are simultaneously copied on the two outer layers with white light from which the infra-red rays have been filtered out by a suitable filter which contains, for example, naphthol green or filter bluish-green or by inserting in the path of the rays a vessel which contains a copper sulphate or nickel salt solution.

The yellow partial negative or partial positive is also simultaneously copied into its corresponding layer using, however, infra-red rays.

The yellow layer may also be made sensitive only to red; in this case the two outer partial pictures are simultaneously copied with a blue filter. In addition, the front purple layer may also be sensitised for red, in which case this layer will be sensitised for the red rays as well as being sensitised for or sensitive to the blue rays. If the outer layer be sensitised to red, the middle layer must be sensitised to infra-red in order that both layers may not be affected by the same light. From this it results that, in contradistinction to the process of Patent No. 408,991, one is not so strictly bound in the sensitising of the layers and one has a greater amount of freedom in increasing the sensitivity, this being especially important in

the case of the copying of the positive film where it is possible to work with a shorter exposure and consequently more rapidly.

Consequently, the essence of the invention lies in the fact that, by suitable sensitisation, the layers are rendered suitable for the simultaneous copying of the selection pictures, i.e., according to the invention the possibility is provided of copying the selection pictures simultaneously from one side, optically or in contact, or, as is very advantageous for the sharpness of the picture, of copying the same simultaneously from both sides either optically or in contact. In the latter case, the colouration of the middle layer will, as described in the above example, be so chosen that this layer isolates the two outer layers from one another as far as the copying light is concerned or, in other words, acts as a protecting layer by absorbing the copying rays that penetrate to it from the front and the back (e.g., the yellow colour prevents the blue rays passing from one side to the other). Alternatively, the sensitising of the layers may be so chosen that, for those rays which pass through from one side to the other, the opposite layer is insensitive.

It is possible to obtain both exposures as well as copies by means of the process according to the present invention.

After the exposure of the material, the dyestuff images are formed in any desired manner, preferably by means of the selective destruction of the dyestuffs at the image or non-image portions in accordance with my prior Patents Nos. 397,159, 395,718, 397,188 and 397,192.

For carrying out the process according to the invention the arrangements given in the following table may be employed.

	Specific colour of the layer.			Sensitising of the layer.		
	I One side of the film	II	III Other side of the film	I	II	III
Ex. 1.	yellow	purple	bluish-green	green or red	red or infra-red	green or blue uns[1]
Ex. 2.	purple	yellow	bluish-green	blue uns[1] or red	,,	,,
Ex. 3.	bluish-green	yellow	purple	blue uns[1] or green	green or infra-red	blue uns[1] or red
Ex. 4.	yellow	bluish-green	purple	green or red	infra-red or green	,, o.f.b.c.[2]
Ex. 5.	purple	bluish-green	yellow	blue or red	infra-red	green or red o.f.b.c.[2]
Ex. 6.	bluish-green	purple	yellow	blue or green o.f.b.c.[2]	infra-red	,,

[1] uns. = unsensitised.

[2] o.f.b.c. = or for both colours.

Colour of the copying light for use with films coloured and sensitised as indicated in the above table.

	Layer I	Layer III	Layer II
Ex. 1.	Green		red
	White-infra[1])		infra-red
Ex. 2.	Blue		red
	White-infra[1])		infra-red
Ex. 3.	Blue		green
	White-infra[1])		infra-red
Ex. 4.	White-infra[1])		infra-red
	red		green
	bluish-green		infra-red
Ex. 5.	White-infra[1])		infra-red
	blue	green	infra-red
	red		,,
Ex. 6.	White-infra[1])		infra-red
	blue	red	infra-red
	green	green	,,

[1]) White-infra = white minus infra-red—i.e., the infra-red light has been filtered out.

Copying is effected, as regards the examples in the preceding table, on each side of the material and the copying of the middle layer is preferably effected from the same side as that on which the two layers are situated.

In each part layer there is copied that particular part-image which corresponds with the colour of the layer; thus in the yellow coloured layer there will be copied the positive or negative of the blue selection picture, in the purple layer the positive or negative of the green selection picture and in the blue-green layer the positive or negative red selection picture of the exposure.

The one double layer may also be exposed by means of selectively absorbing composite two-colour copy matters (which are coloured in colours that are complementary to the sensitivity of the individual part layers) in the manner described in Specification No. 408,991 for a one-sided light-sensitive material consisting of a plurality of superposed part layers.

Furthermore, for the purpose of avoiding the adjustment of the colour and intensity of the sources of light each time, one may variegate, i.e., diffusely colour, the black-and-white negative or diapositive (according to whether a process for the production of pictures is employed which leads to positive pictures or reverse pictures) in the gelatine. In this manner the various corrections of the time of exposure for a definite copy material or a different colour effect of the copy can be obtained. For example, black-and-white partial pictures (copy matter) of the purple and blue partial pictures are coloured so as to absorb infra-red by bathing them for a short time in a solution of naphthol green or filter bluish-green, and the black-and-white copy matter of the yellow partial picture is coloured almost black with patent blue and tartrazine.

The subsequent correction of the individual partial colour pictures is greatly facilitated owing to the arrangement of the layers in accordance with the invention by treating only one side of the film with a liquid. This can easily be carried out with known devices. The correction of the colours consists in either reducing a too prominent colour by suitable means—for example with a dilute acid solution of potassium permanganate—or by sodium hydrosulphite solution or titanium chloride solution—or by causing suitable substances, which act as colour-intensifiers, to act on the dye picture. It is, however, also possible to proceed by correcting the whole coloured picture by diffuse colouration in the colour. If, for example, the total colour of the coloured image is too red, the colour may be improved by subsequently bathing in a weak blue or green dyestuff solution.

In the middle layer, which acts as an isolating layer, only the dyestuff that is used in the production of the picture is as a rule employed as a protecting or isolating filter dyestuff. However, any desired additional filter dyestuff may be incorporated in the middle layer as well as in the outer layers in the manner already described in specification No. 408,091, and this additional filter dyestuff can afterwards be washed out or destroyed so as not to take part in the picture production itself.

The building up and mode of operation of the layers are illustrated diagram-

matically and by way of example only in the accompanying drawings, in which :—

Figure 1 corresponds with the example set forth in the preceding table under Example 2.

Figure 2 corresponds with the example set forth in the table under Example 1.

Figure 3 corresponds with the example set forth in the table under Example 3.

Figure 4 corresponds with the example set forth in the table under Example 4.

Figure 5 corresponds with the example set forth in the table under Example 5.

Figure 6 corresponds with the example set forth in the table under Example 6.

Referring to the drawings, the Figures illustrate double-sided photographic material in which the support *a* is coated on one side with one coloured light sensitive layer (Layer III) and on the other side with two differently coloured and sensitised light-sensitive layers (Layers II and I).

On to this illustration of the layers there is projected the lines of the spectrum which, in the drawing, begins on the left at the infra-red end and extends through the whole of the visible spectrum.

The vertical lines, which pass through all the layers, show, as indicated, the wavelengths—700, 600 and 500 mμ. D and F denote the similarly designated lines of the spectrum, the former, as is known, denoting the separating line between the red and green regions of the spectrum and the latter denoting the separating line between the green and blue regions of the spectrum.

The obliquely hatched surfaces show the absorption ranges of the dyestuff that colours the layer whilst the vertically hatched portions of the surface are the opacities or absorptions of the layers formed thereon. These vertically hatched absorptions denote that, of the light which reaches the layers in question through the superimposed layer or layers (as denoted by the parallel arrows in Figure 1), a certain portion has been absorbed away by the higher or external coloured layer. Consequently, as diagrammatically indicated, the opacities of the higher layers are, for certain spectral regions, effective also for the lower-lying layers.

The mark X and the positioning of the same relative to the spectrum lines 700, 600 and 500 mμ denotes the portion of the spectrum for which a particular layer is sensitised when only a single zone of sensitisation is involved. Certain layers may, however, be sensitised for alternative regions of the spectrum. Such alternative sensitisations are denoted by the marks × and X, × indicating a first alternative and X a second alternative sensitisation. In some cases, as indicated below, a layer may be sensitised in both regions.

With regard to Figure 1, in the layer I, the absorption curve (obliquely hatched) denotes a purple dyestuff which absorbs between 500 and 600 mμ. In layer II the absorption curve denotes a yellow dyestuff absorbing up to 500 mμ and in layer III a bluish-green dyestuff absorbing between 600 and 700 mμ.

Layer I is sensitised for blue or for red.

Layer II is sensitised for red or for infra-red.

Layer III is sensitised for green or for blue or for both rays.

In Figure 2 layer I contains a yellow dyestuff, layer II a purple dyestuff and layer III a bluish-green dyestuff.

Layer I is sensitised for green or for red.

Layer II is sensitised for red or for infra-red.

Layer III is sensitised for green or for blue or for both rays.

In this arrangement layer III absorbs between 600 and 700 mμ and allows light to pass from 600 mμ downwards. The middle purple layer II absorbs the green light and accordingly prevents exposure of I through the blue part image. In this connection the layer II acts as an isolating layer or protective filter. In the other spectral regions 400 to 500 mμ the yellow colour of the layer I prevents exposure from below. In the range 600 to 700 mμ blue light is unable to pass to the layer I because the layer III itself absorbs this part of the spectrum.

The layers I and II are exposed from the side bearing these layers, layer I with green or red light and layer II with red or infra-red light. The layer III is simultaneously exposed from the opposite side with green or blue light.

In Figure 3 layer I contains a bluish-green dyestuff, layer II a yellow dyestuff and layer III a purple dyestuff.

Layer I is sensitised for blue or for green.

Layer II is sensitised for green or for infra-red.

Layer III is sensitised for red or for blue or for both rays.

In Figure 4 layer I contains a yellow dyestuff, layer II a bluish-green dyestuff and layer III a purple dyestuff.

Layer I is sensitised for green or for red.

Layer II is sensitised for infra-red or for green.

Layer III is sensitised for blue or for red or for both rays.

In Figure 5 layer I contains a purple dyestuff, layer II a bluish-green dyestuff and layer III a yellow dyestuff.

Layer I is sensitised for blue or for red or for both rays.

Layer II is sensitised for infra-red.

Layer III is sensitised for green or for red or for both rays.

In Figure 6 layer I contains a bluish-green dyestuff, layer II a purple dyestuff and layer III a yellow dyestuff.

Layer I is sensitised for blue or for green or for both rays.

Layer II is sensitised for infra-red.

Layer III is sensitised for green or for red or for both rays.

In Figures 5 and 6, dotted absorption curves are drawn in the spectral region between 400 and 500 mμ. These denote an additional filter dyestuff which is capable of being readily washed out or destroyed and which does not serve for building up the picture but for screening off the bottom layer.

In all cases the coloured layers are, according to the present invention, exposed simultaneously and the dyestuffs at the image or non-image portions are subsequently destroyed in any suitable manner, preferably in accordance with the processes according to my prior Patents above referred to.

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. A process for producing multi-colour kinematograph films and photographs according to which three-colour selection pictures are simultaneously copied optically or in contact from one side or both sides on to a film comprising three diffusely coloured silver halide layers disposed two layers on one side and one layer on the other side of the support, the individual layers being sensitised for those rays which are let through by the particular overlying layers and by the dyestuff that colours the layer itself, and the dyestuffs in the layers being subsequently destroyed at the image or non-image portions.

2. A process for producing multi-colour kinematograph films and photographs according to Claim 1, characterised in that the colour selection pictures for the front layer and the back layer or one of these two layers is or are copied with white light (or a composite light of any desired colour) from which the coloured rays to which the middle layer is sensitive have been filtered out, and the selection picture for the middle layer is simultaneously copied with light that is complementary thereto.

3. A process for producing multi-colour kinematograph films and photographs according to Claim 2, characterised in that the colour selection pictures of the front and back layers of the material are copied with white light or light of any desired colour, from which light the infra-red has been filtered out, the selection picture for the middle layer being simultaneously copied with infra-red light.

4. A process for producing multi-colour kinematograph films and photographs according to Claims 2 and 3, characterised in that, in the doubly coated side of the material, both layers are simultaneously exposed under a two-colour copy matter (which contains coloured partial pictures in the colour which is complementary to the sensitivity of the individual part layers).

5. A process for producing multi-colour kinematograph films and photographs according to Claim 1 characterised in that each single colour selection picture (positive or negative) of the copy matter is diffusely coloured with a colour which corresponds with the sensitiveness and the penetration of the part layer of the copying material intended for reproduction, the colour selection pictures being copied simultaneously by optical means.

6. A process for producing multi-colour kinematograph films or photographs according to any of the Claims 1 to 4, characterised in that one side of the completed picture is reduced in a diffusely dyestuff-destroying medium or is retreated in a bath with a colour-intensifying action.

7. Multi-layer coloured photographic material for carrying out the process according to Claim 1, comprising two consecutively formed and differently coloured light-sensitive layers on one side of a support and one coloured light-sensitive layer on the other side, characterised in that the middle layer is so coloured that it acts as a protective filter against the copying light for the two outer layers, the said middle layer being sensitised for a colour for which the front and back layers are non-sensitive.

8. A three-colour photographic material for carrying out the process according to Claim 1 and comprising two consecutively formed and differently coloured light sensitive layers on one side of a support and one coloured light sensitive layer on the other side, characterised in that the middle layer is sensitised for infra-red rays.

9. A three-colour photographic material for carrying out the process according to

Claim 1, characterised in that one side of the support carries on the outside a light-sensitive yellow-coloured layer and, on the inside, a light-sensitive purple-coloured layer, in the case of which layers the outside one is sensitised for green or red rays and the inside one is sensitised for red or infra-red rays, and the other side of the support carries a bluish-green light-sensitive layer which is either unsensitised or is sensitised for green.

10. A three-colour photographic material for carrying out the process according to Claim 1, characterised in that one side of the support carries on the outside a purple-coloured light-sensitive layer and on the inside a yellow-coloured light-sensitive layer, in the case of which layers the outside one is either unsensitised or is sensitised for red rays and the inside one is sensitised for red or for infra-red rays, and the other side of the support carries a bluish-green light-sensitive layer which is either unsensitised or is sensitised for green.

11. A three-colour photographic material for carrying out the process according to Claim 1, characterised in that one side of the support carries on the outside a bluish-green light-sensitive layer and on the inside a yellow-coloured light-sensitive layer, in the case of which layers the outside one is either unsensitised or is sensitised for green rays and the inside one is sensitised either for green or for infra-red rays, and the other side of the support carries a purple-coloured light-sensitive layer which is unsensitised or is sensitised for red rays.

12. A three-colour photographic material for carrying out the process according to Claim 1, characterised in that one side of the support carries on the outside a yellow light-sensitive layer and on the inside a bluish-green light-sensitive layer, in the case of which layers the outside one is sensitised for green or alternatively for red rays and the inside one is sensitised for infra-red rays or alternatively for green rays and the other side of the support carries a purple-coloured light-sensitive layer which is unsensitised or is sensitised for red rays.

13. A three-colour photographic material for carrying out the process according to Claim 1, characterised in that one side of the support carries on the outside a purple light-sensitive layer and on the inside a bluish-green light-sensitive layer, in the case of which layers the outside one is either unsensitised or is sensitised for red rays and the inside one is sensitised for infra-red rays, and the other side of the support carries a yellow-coloured light-sensitive layer which is sensitised for green or for red rays or for rays of both of these colours.

14. A three-colour photographic material for carrying out the process according to Claim 1, characterised in that one side of the support carries on the outside a bluish-green light-sensitive layer and on the inside a purple light-sensitive layer, in the case of which layers the outside one is unsensitised or is sensitised for green rays and the inside one is sensitised for infra-red rays, and the other side of the support carries a yellow-coloured light-sensitive layer which is sensitised for green or for red rays or for rays of both of these colours.

15. A three-colour photographic material for carrying out the process according to Claim 1, and comprising two consecutively formed and differently coloured light-sensitive layers on one side of a support and one coloured light-sensitive layer on the other side, characterised in that one of the outside layers is sensitised for infra-red rays.

16. The improved process for the production of multi-colour kinematograph films and photographs, substantially as hereinbefore described.

Dated this 14th day of November, 1932.

GEE & Co.,
Patent Agents,
Staple House, 51 and 52, Chancery Lane,
London, W.C.2,
Agents for the Applicant.

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2nd Edition

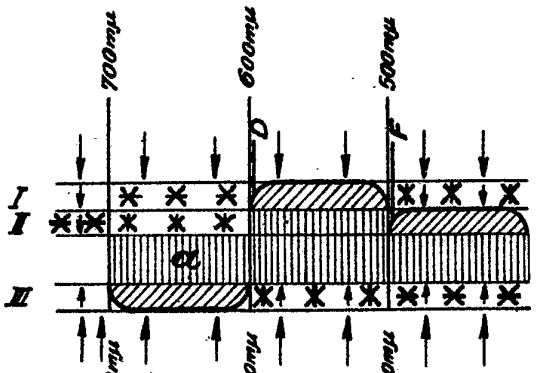

Fig. 1

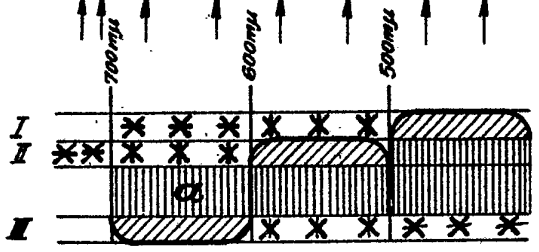

Fig. 2

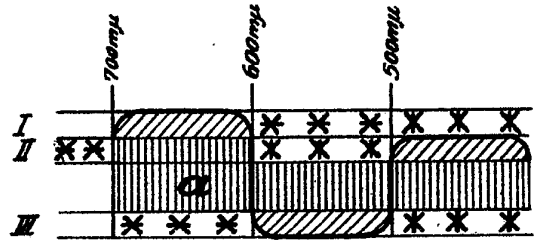

Fig. 3

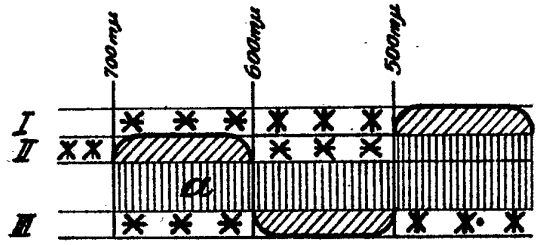

Fig. 4

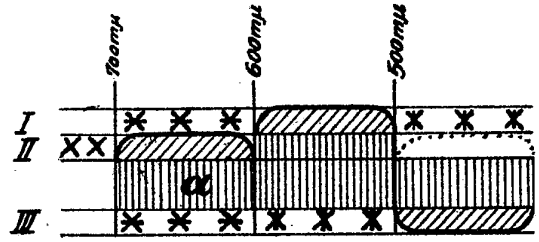

Fig. 5

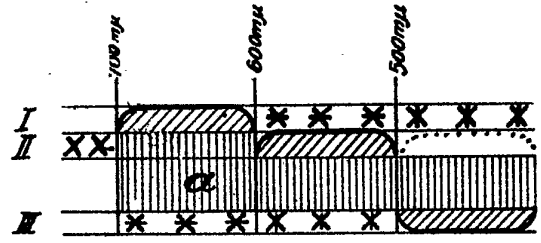

Fig. 6

Malby & Sons, Photo-Lith