

No. 686,897.

Patented Nov. 19, 1901.

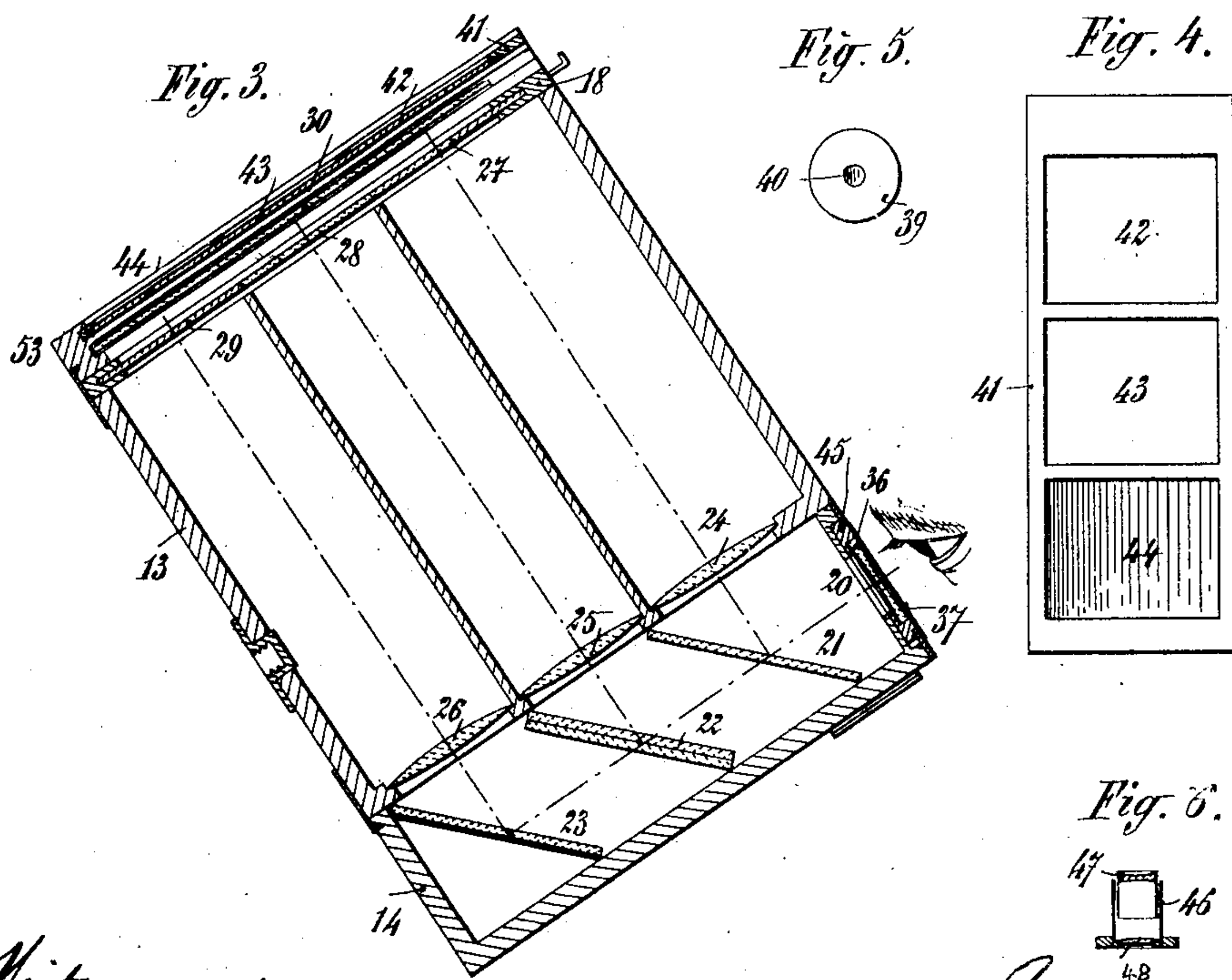
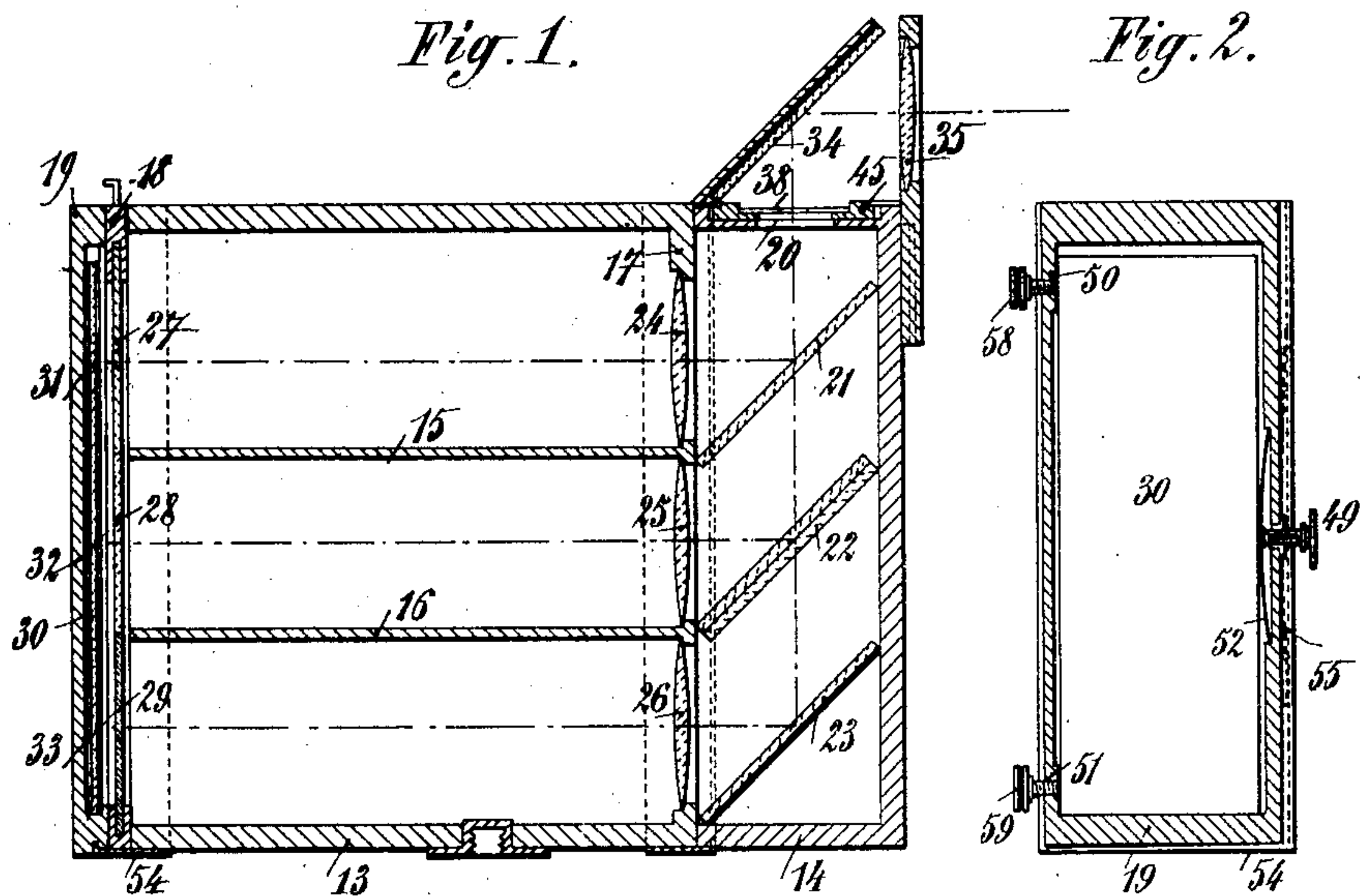
L. D. DU HAURON.

APPARATUS FOR TAKING AND EXHIBITING PHOTOGRAPHS IN NATURAL COLORS.

(Application filed Aug. 19, 1899.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses  
H. H. Boulter  
Montup

Inventor  
Louis Lucas du Hauron  
By Wm. E. Boulter  
Attorney

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2 Sheets—Sheet 2.

Fig. 7.

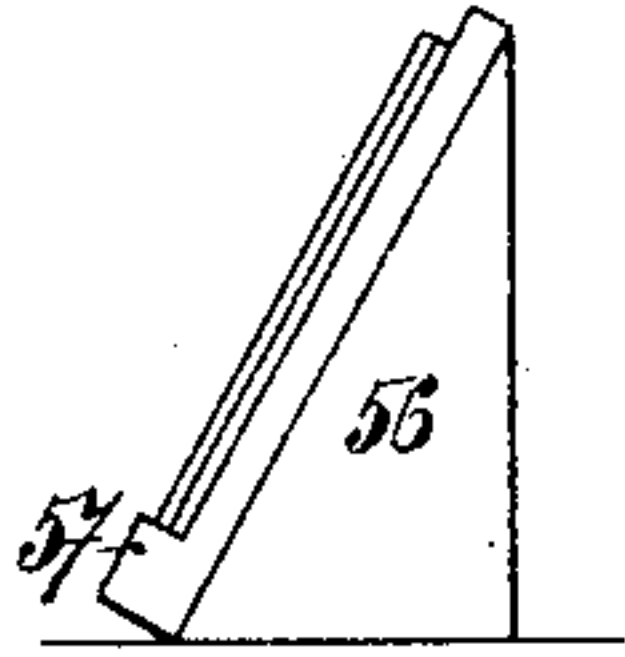


Fig. 8.

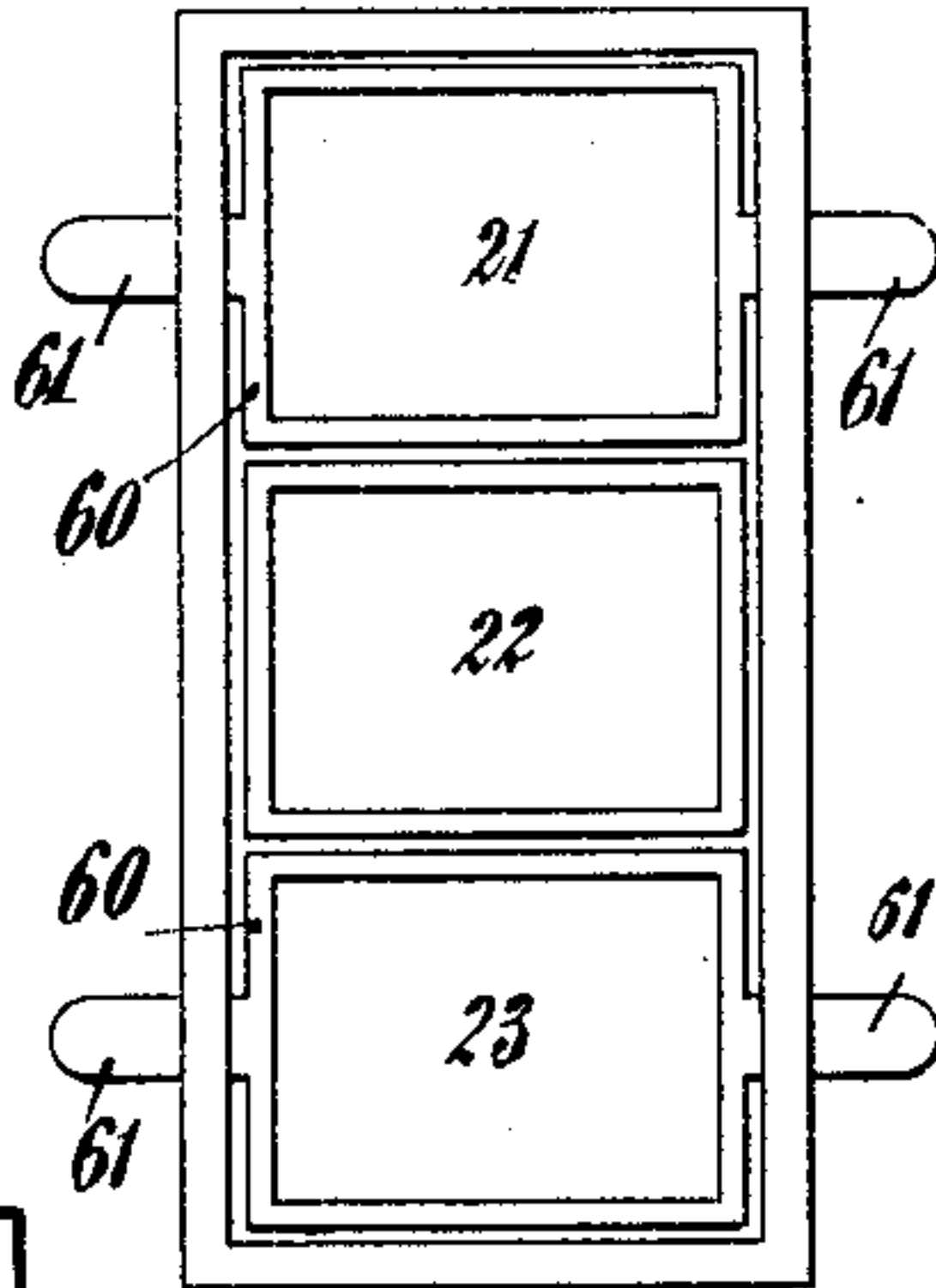


Fig. 9.

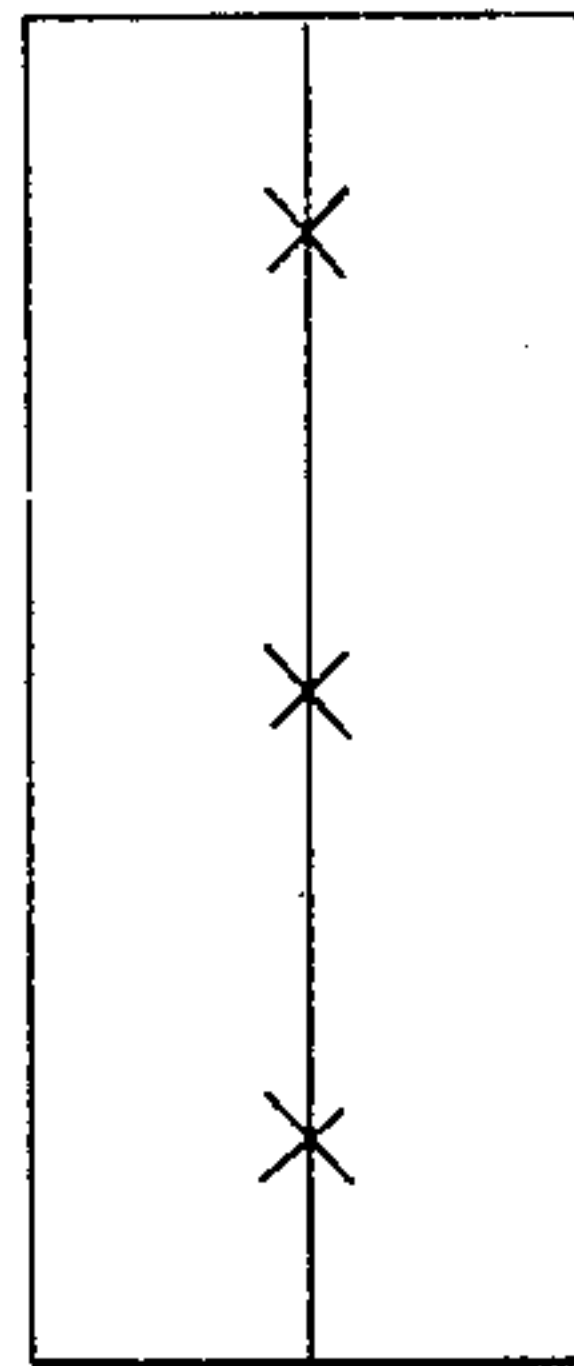


Fig. 10.

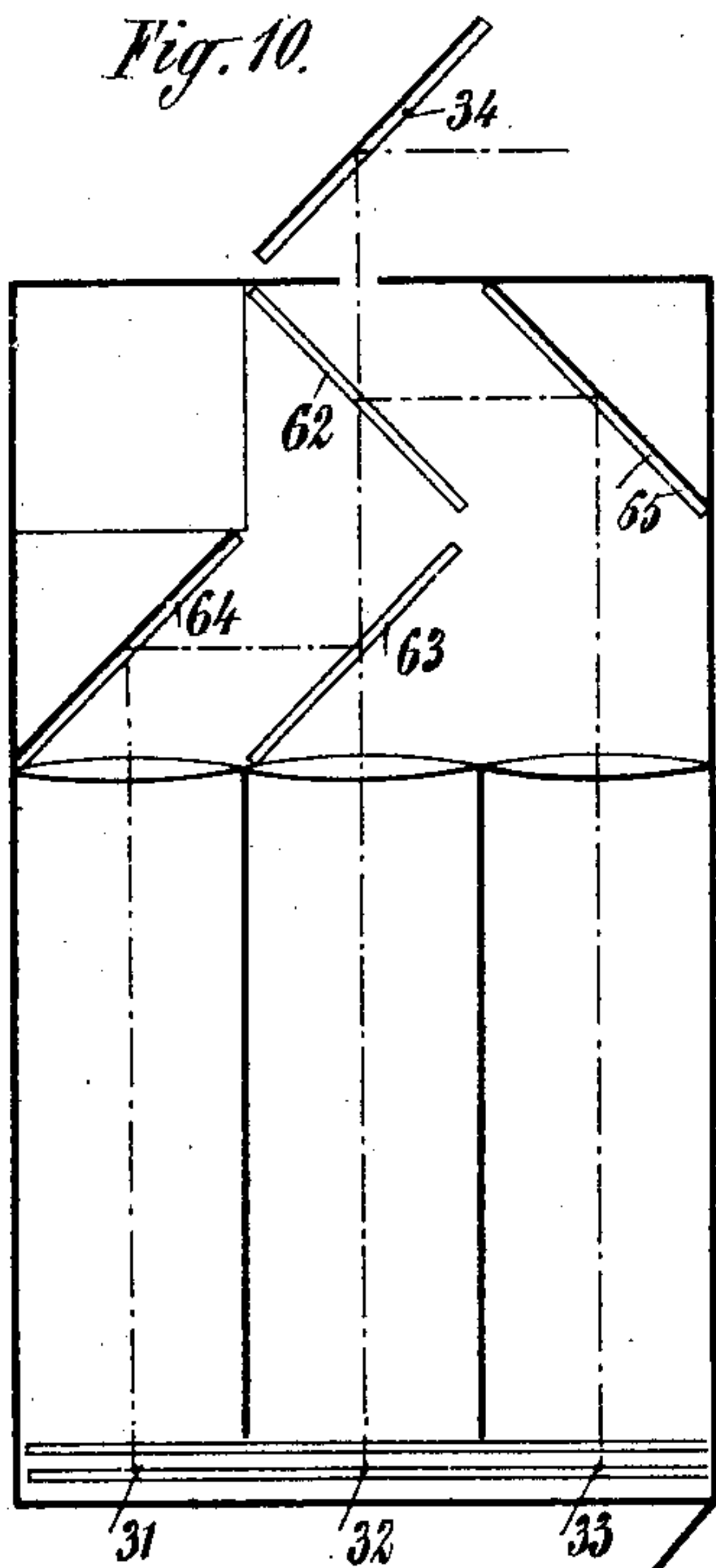


Fig. 11.

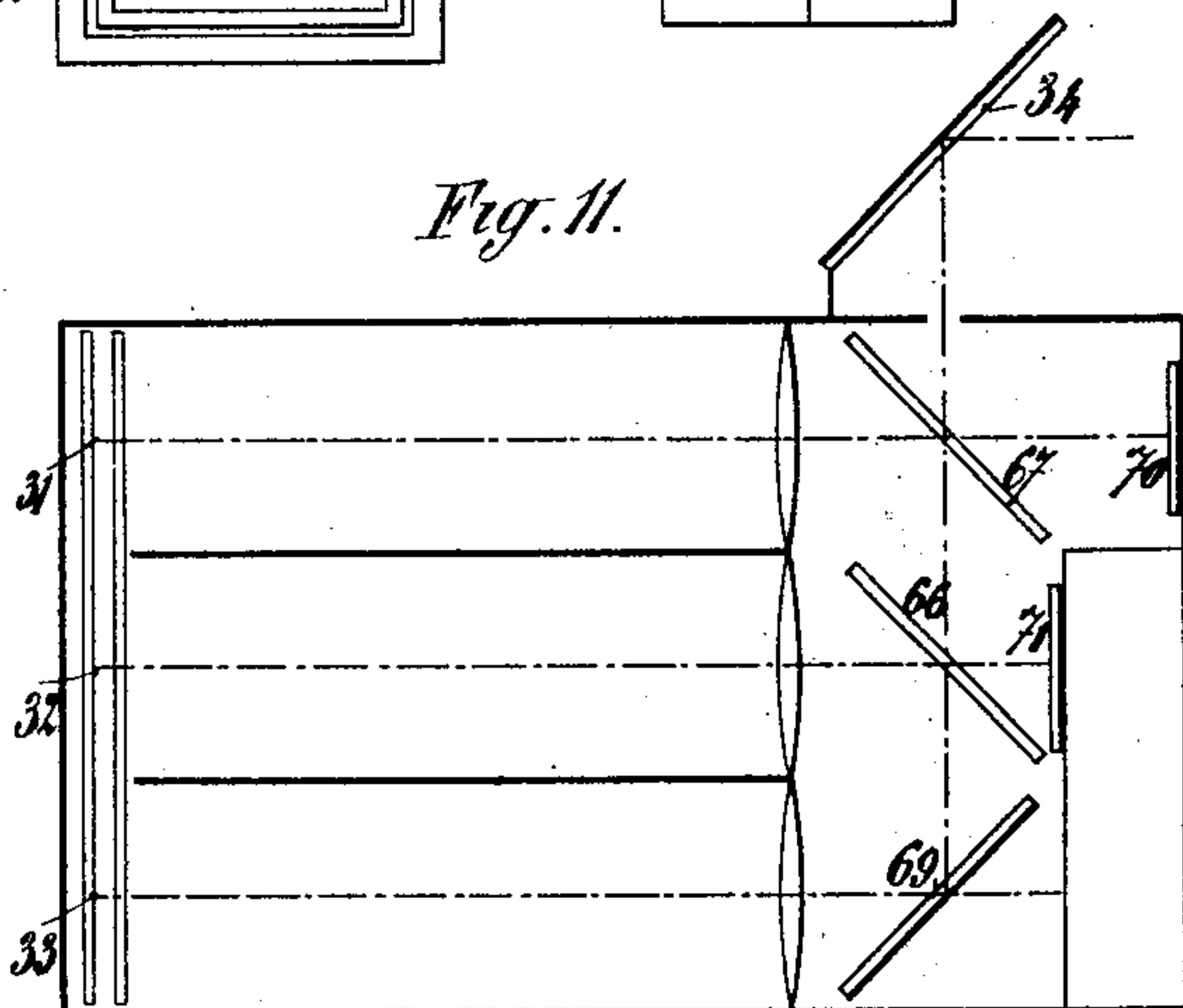
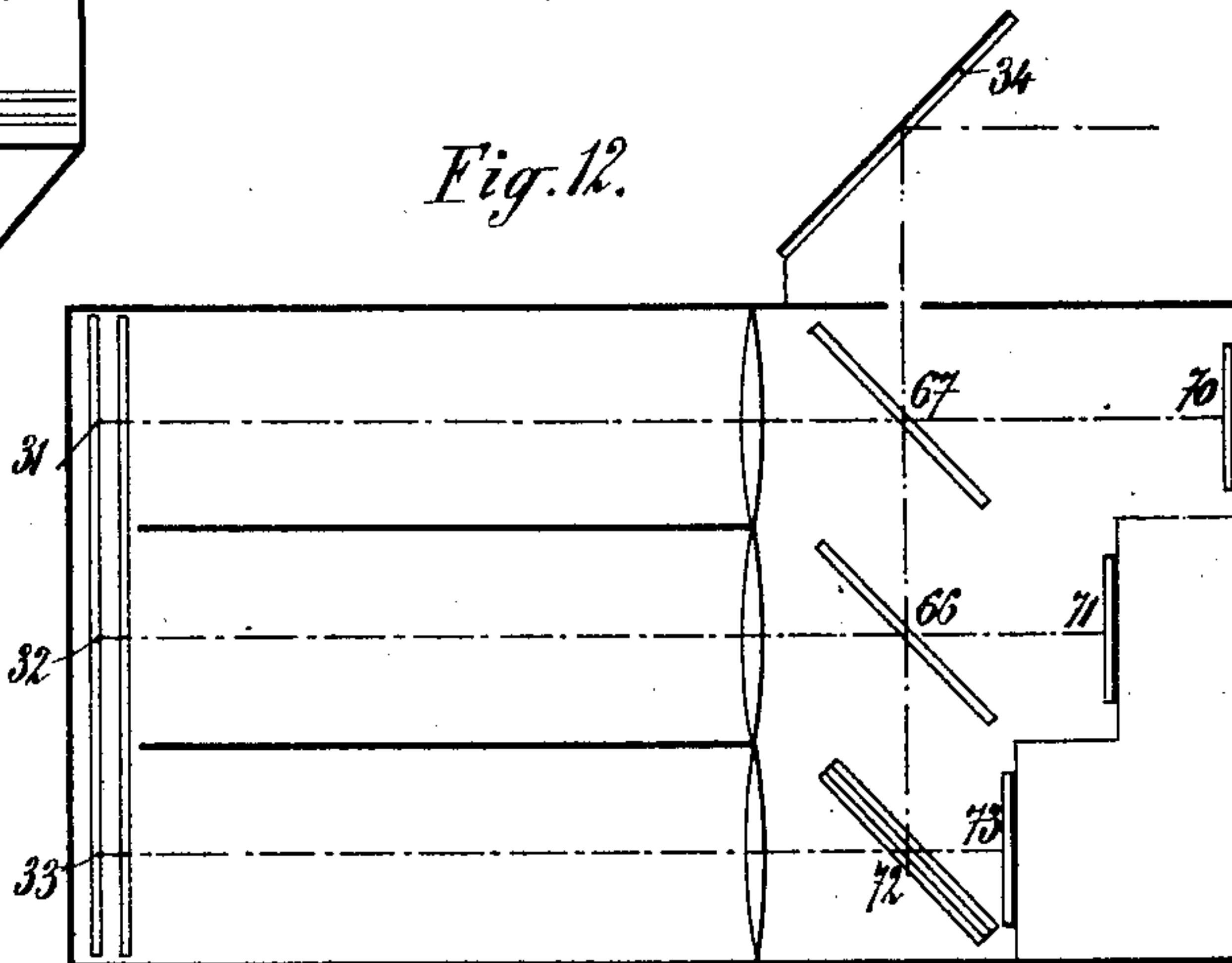


Fig. 12.



Witnesses

J. H. Boulton

*[Signature]*

Inventor:

Louis Ducos du Hauron  
By *[Signature]* Attorney



# UNITED STATES PATENT OFFICE.

LOUIS DUCOS DU HAURON, OF ST. MAURICE, NEAR PARIS, FRANCE.

APPARATUS FOR TAKING AND EXHIBITING PHOTOGRAPHS IN NATURAL COLORS.

SPECIFICATION forming part of Letters Patent No. 686,897, dated November 19, 1901.

Application filed August 19, 1899. Serial No. 727,811. (No model.)

*To all whom it may concern:*

Be it known that I, LOUIS DUCOS DU HAURON, a citizen of the Republic of France, residing at St. Maurice, near Paris, France, have  
5 invented certain new and useful Apparatus for Taking and Exhibiting Photographs in Natural Colors, (for which application has been made in Great Britain under No. 15,753, dated August 1, 1899; in France, dated May  
10 16, 1899, and in Belgium, dated August 2, 1899,) of which the following is a specification.

This invention relates to an apparatus by the aid of which the operation of the light taking place and manifesting itself in the  
15 dark upon the photographic plate when the ordinary operative method is employed will automatically produce a view of the object in its original colors in the said apparatus without a fresh operation being necessitated.

20 Two principles serve as a basis for the construction of the device, which will now be described: first, that of reversing the direction in which the luminous rays travel, and, second, that by virtue of which an object reflected  
25 by the two opposite faces of a non-plated (or unsilvered) glass plate ceases to present double outlines if between the glass plate and the object a convergent lens is interposed in the principal focus of which the object is placed,  
30 and this irrespective of what may be the focal length, the effect of the lens being to place the object optically at infinity. Inversely the same lens has the property of forming in its principal focus a non-doubled image of a  
35 distant object reflected by the non-plated (or unsilvered) glass plate.

In the accompanying drawings, Figure 1 represents the apparatus in the position it occupies at the moment of exposure. Fig. 2 is  
40 a cross-section showing a method of securing the sensitized plate. Fig. 3 represents the same apparatus in the position preferably imparted to it when on looking into the apparatus one observes the polychromatic result.  
45 Figs. 4, 5, and 6 represent detail parts completing the different functions of the apparatus represented in Figs. 1, 2, and 3. Figs. 7, 8, and 9 are views serving to complete the explanations given in the following description concerning the different means for marking  
50 or registering, the object being to render all apparatus interchangeable. Figs. 10, 11,

and 12 are diagrammatic views showing modifications of the device represented in Figs. 1, 2, and 3.

55 The apparatus consists of a box or casing composed of two parts 13 and 14. The former, 13, is divided by partitions 15 and 16, forming three spaces, into which the luminous rays enter, respectively, through convergent lenses 60 24, 25, and 26, of one and the same focal length and arranged rigidly upon the vertical wall 17, separating the two parts 13 and 14 of the apparatus. These lenses may be simply ordinary non-achromatic lenses, and 65 they may be of circular or rectangular form, as desired. The second part 14 comprises an opening 20 for the admission of luminous rays for taking the photograph or negative or for the admission of the visual rays when 70 one observes the positive triple photograph. Below this opening 20 are arranged, at an angle of forty-five degrees, three glass plates 21, 22, and 23, two of which—namely, 21 and 22—are non-plated, (or unsilvered,) while the third, 75 23, is silvered.

At the end of the part 13 of the apparatus and facing the partition 17 a frame 18 is placed, in which are arranged a blue-violet screen 27, corresponding to the unsilvered 80 glass plate 21, a green screen 28, corresponding to the other unsilvered glass plate 22, and a red-orange screen 29, corresponding to the silvered glass plate 23. Behind this frame 18 a sensitized panachromatic or orthochromatic plate is placed, which is arranged in a frame or holder 19 at the principal focus of the lenses and on which plate are received the impressions of the images 31, 32, and 33, respectively passing through the screens 27, 90 28, and 29.

Above the opening 20 a removable support 45 is placed, on which is mounted, at an angle of forty-five degrees, a mirror 34, serving to reflect the images to be photographed. This 95 mirror 34, which is only provided on the apparatus for the purpose of taking the photograph, can be replaced by a prism with total reflection. Upon the front of the apparatus a convergent lens 35, of comparatively great 100 focal length, is placed, which serves as a "magnifier" or focusing-lens. The same is thus used only at the moment of taking the photograph and only in case where the object to



be reproduced lies very near, its object being then to transport it optically to infinity. A lens 36, Fig. 3, very slightly concave and serving as the eyepiece, is applied when the triple image is to be observed, and has for its object to render the view of the latter very clear. It is preferably covered with a diaphragm 37, the small opening of which occupies exactly the optical center of the apparatus. The dotted lines indicate in the two figures the direction in which the luminous rays travel. The rays reflected by the mirror 34, Fig. 1, traverse the diaphragm 38 in the opening 20 and then are divided into three bundles. The first is reflected by the unsilvered glass plate 21, traverses the lens 24, then the blue-violet screen 27, and forms the image 31. The second is reflected by the second unsilvered glass plate 22, traverses the lens 25, then the green screen 28, and forms the image 32. The third, which is the strongest, is reflected by the silvered glass plate 23, traverses the lens 26, then the red-orange screen 29, and forms the image 33. The red-orange light, being the least actinically active of the three lights transmitted by the different screens, necessitates the use of a silvered glass plate, which, reflecting almost the whole of the rays it receives, reduces the exposure required for the third image to that of the second. In order to control the action of the blue-violet light, which would require an exposure of much less duration for the first image than for the two others, upon the opening 20 (only for the time of exposure) is placed a green transparent screen 39, Fig. 5, which freely transmits only the green and red rays, but the center of which is pierced with a narrow opening 40, transmitting, as far as the blue-violet light is concerned, only sufficient light to form the corresponding image during the same time of exposure as the two other parts of the apparatus. Under these conditions the equilibrium between the three images would not be perfect in the case of panchromate plates being used. The image formed by the green light would appear with a slight delay, a very simple remedy for which consists in covering the unsilvered glass plate 22 with a second unsilvered glass plate, which is represented in Figs. 1 and 3, in perfect contact therewith. The two glass plates are connected together, say, by means of strips of paper pasted over their edges. Great care must be taken not to cement the two glass plates together over their active surfaces; otherwise the two supplementary reflections which are required would be destroyed. When the triple negative or chronogram is obtained, a positive is made by contact upon opal glass or upon polished glass, using, preferably, a special plate for positives, and this triple positive is placed in a frame 53, arranged on the apparatus in the same position that the frame 19, carrying the negative plate, occupied during the exposure, care being taken that each of the three positives occupies the position

which the negatives furnishing the same formerly occupied and that the color-screens are on their part maintained in their respective places, only the gelatin layer or film must be placed upward and not below as during exposure of the negative.

Upon the bottom of the apparatus, Fig. 3, a frame is applied, formed of a plate 41, Fig. 4, in which three openings 42 43 44, corresponding to the three positive images, are provided. In one of them—namely, 44—a transparent membrane screen or film of a somewhat dark gray is placed, the object of which is to moderate the brilliancy of the third image illuminated by the red-orange screen and reflected by the silvered glass plate 23. The frame or support 45, carrying the eyepiece 36 of slight divergency, is then put in place. This last frame 45 should be black or of a dark color and should extend sufficiently in width in order that the eye which does not look into the apparatus may remain open without affecting the clear vision of the other eye. The instrument being appropriately inclined toward the light, as shown in Fig. 3, if the eye is applied against the opening of the diaphragm 37 one observes in the direction of the mirrors an amplified polychromatic image, being the synthetical result from the combination or fusion of the three black positives, one illuminated by red-orange light, the second by green, and the other by blue violet. This image appears identical—not only as regards color, but as regards perspective and the erection of the lines—to the photographed object, as if the latter were presented to the eye placed in the center of the diaphragm. The image is entirely free from aberration, from refrangibility, and from distortion notwithstanding the use of non-achromatic lenses and the arrangement of the latter at large and unequal distances from the diaphragm. This general correction is due to the fact that the rays in returning from the three images to the eye through the combination of lenses and reflectors follow exactly the same path which they had traversed originally. If it is desired to increase the field or angle of view, which is naturally and strictly limited according to the construction of the apparatus, all that is necessary is to arrange over the opening 20, Figs. 1 and 2, a small tube 46, Fig. 6, provided at each end with a lens, the one in front, 47, being divergent and the one at the back, 48, convergent, the focus of the former being shorter than that of the second. The whole combination thereof constitutes an inverted Galileo lens and possesses two properties—first, that of collecting and concentrating in the field occupied by each of the three images upon the plate a larger portion of the horizon, and, second, that inversely to the former of exhibiting during the observation of the triple image in the apparatus this same portion under the real angle of magnification. This small supplementary objective permits of dispensing with the fo-



cusing-lens as well as the lens of slight divergence which serves as the eyepiece. All that is necessary is to adjust the two constituent lenses to a slight extent relatively to each other until the correct focus is obtained. On this objective the different diaphragms as well as the yellow perforated circular screen are adjusted.

According to the law of reversion of the direction of luminous rays the symmetrical and mathematically-correct arrangement of the three internal mirrors and of the three lenses is by no means necessary for the separate appearance of the three images constituting the polychrome picture in the apparatus which has furnished the same. The exactness in the separation and the adjustment of the reflectors and also the exactness in the separation and the arrangement on one and the same straight line of the three lenses need not be troubled about, and the same remark applies to the symmetrical arrangement of the three obtained images, as has been stated—that is to say, an arrangement in which the distance from one another upon one and the same straight line is equal. Only three conditions have to be observed: First, the relative positions and the adjustment of the three reflectors must during the examination of the triple image be absolutely the same as during the exposure; second, the relative positions of the three lenses must be absolutely the same during the examination of the triple image as during the exposure, and, third, the perfectly straight or more or less broken line which passes through one and the same point of the three representations or prints upon the plate carrying the same must during the examination of the colored representation have the same lateral adjustment relatively to the perfectly straight or more or less broken line which passes through the axes or the centers of the three lenses as during the exposure. In order to fulfil the two first conditions, it is sufficient to give a complete fixity to each of the two systems of parts constituting the apparatus—namely, the three reflectors on the one hand and the three lenses on the other hand. In order to fulfil the third condition, it is necessary to maintain during the whole series of operations a perfect locking of the negative plate and of the positive plate, of each one individually as well as of both together, at the moment when one of them receives an impression below the other, and this locking or registering should be effected constantly only upon one and the same side—namely, one of the two long sides which simultaneously limit the three images. The locking or registration of the negative plate at the moment of exposure is effected by the aid of a screw 49, Fig. 2, which by acting upon its edge causes it to bear only with the two ends of its opposite edge upon two projections or shoulders 50 and 51, provided on the recessed part of the holder in which it is introduced. In this manner it

can assume only one position, even if its section should be irregular. It matters not that the two small outer ends of the recessed parts leave free play to the plate, which need only be locked or wedged in the other direction. In order to prevent actual contact of the end of the screw 49 with the edge of the plate, a steel plate 52 is arranged in the recess, this plate being riveted thereto at its ends and covered with a strip of felt, leather, fabric, or thin bristol-board.

If the apparatus, constructed with a view to permit of a less primitive or restricted use, is fitted with frames in numbers in proportion to the number of objects desired to be taken in a single excursion, each of these frames must be adapted to be wedged or registered exactly in the apparatus. For this purpose a guide 54, in which all the frames are to be introduced, is appreciably larger than the frames themselves. The latter being introduced into this guide meet laterally a spring 55, riveted only at one of its ends. This spring acting only by its elasticity forces each frame to adjust itself flush with the opposite edge of the guide.

The locking of the positive plate during the period of its impression below the negative plate is effected by means of a block 56. (Represented in Fig. 7.) The two plates bear with their own weight at their lower edges against two shoulders, one of which is represented at 57. It is indispensable during this operation to choose for the lower edge of the negative plate the one which has been locked or wedged up originally against the shoulders of the frame of the chromographic chamber. The positive plate is thus printed with accuracy without recourse being had to a pressure-frame, provided that the light only emanates from a fixed luminous point not too near the plate—such, for instance, as a magnesium flame or a gas-burner or the like.

It is evident from the preceding that the triple device obtained under these conditions, being subsequently placed in the apparatus and locked or wedged up by the same edge as in the operation just described, will present itself under conditions of registration identical to those of the triple phototype which had furnished the same. The gelatin layer will be forcibly turned up as though it was applied during the exposure of the negative against the gelatin layer of the latter, which layer was turned down. The said layer will only be raised to an extent equal to the thickness of the plate, the simple or compound eyepiece which serves for observing the triple image amply remedying the slight loss of distinctness due to this small increase in the distance of the lenses.

In order to correct the defects of the points of junction or registration which may accidentally occur during observation, the shoulders 50 51 of the frame 53 are provided with screws 58 59, having milled heads, and the operation of which permits of very conven-



iently restoring the coincidence of the lines of the three chromographic images.

On using an apparatus such as that described in combination or not with its interchangeable frames a result is obtained which in itself is very important—namely, that of permanently registering the view for this single apparatus of all synthetical images which it has furnished. It is, however, optional, as will presently be seen, to render all the apparatus interchangeable or, what amounts to the same thing, to render all the triple images or chromograms interchangeable from one apparatus to the other. Thus by making use of any apparatus one will obtain the corresponding view of a chromoscopic object obtained with another similar one. The combination of the apparatus with a very simple device will permit, by the aid of a previous and likewise very simple operation, to thus transform these apparatus, which are of one and the same shape, into interchangeable instruments.

Two of the three interior lenses—for instance, the two outer ones 21 and 23—instead of being fixed are susceptible of a very slight displacement in all directions, but only in their plane, which is likewise that of the frame 60, serving for mounting each one of them. This frame itself is rendered slightly movable in the same plane. For this purpose each of the two frames 60 has provided at its two ends small projections 61, serving as handles, Fig. 8, which pass through the walls of the chamber through suitable openings. These handles thus project outside the chamber, one to the right and the other to the left relatively to the observer who looks through the eyepiece. On the other hand, one will have temporarily locked or wedged up in the apparatus and in the place of a chromogram a glass plate or opal glass, on which is drawn a regular triple geometrical figure, which is a very fine photographic reduction, Fig. 9. This figure serves as a standard type for all similar apparatus as regards shape. Reduced to more simple expression, it consists of three points provided upon one and the same straight line, dividing the plate in its center and parallel to the fixed edge of the plate. These three points, determined each by the crossing of two very fine lines, are spaced to an extent equal to that chosen for the spacing of the centers of the lenses. If under these conditions the eye is applied against the opening of the eyepiece, a bundle will be observed composed of six lines intersecting each other in pairs. They are colored if the colored screens have been retained in their recesses or rabbets and uncolored if the latter have been removed. It would be a very accidental occurrence, whatever care may have been taken in the construction of the apparatus, if the three crossing intersections registered with accuracy. By causing one or both of the two movable lenses one after the other to slide by the aid of their handles the three in-

tercrossings or markings can be combined optically, the third lens, which corresponds to the fixed median lens, remaining stationary. Whenever one position has been found, the position is fixed definitively by the aid of screws entering the parts projecting from the chamber. The ends of the extensions being hinge-jointed may be subsequently folded down. The optical registration may also be effected by operating not the lenses, but the reflectors. The inclination of the latter may be slightly modified by pasting upon the two frames or parts inclined to an angle of forty-five degrees supporting them thin pieces of paper of varying thicknesses. The adjustment of the mirrors would be rendered very simple by causing them to rest upon three points, two of which would be situated at the ends of one and the same edge and the third in the middle of the opposite edge; but the adjustment would require more time than in the case where the first method is employed.

The apparatus such as described gives in spite of the primitive and elementary nature of its constituent parts very satisfactory results. It will nevertheless not be superfluous, if greater expense be not objected to, to apply certain advantages and refinements thereto, which are obtained by the use of achromatic lenses or even by the combination of two lenses properly adjusted, (double objectives.) One will thus obtain apparatus acting slightly more rapidly, permitting especially of operating with a larger opening of the diaphragm and of obtaining images which will not only be correct and registered when virtually examined in the apparatus, but will be susceptible of being pigmentarily taken by contact.

The system of the reflectors may receive the following modifications: In Fig. 10, 62 and 63 are two unsilvered glass plates. 64 and 65 are two silvered glass plates. The central image 32, formed directly (without reflection) through the two transparent reflectors 62 and 63, is in this case the most luminous, and it is in front of this one that the red-orange screen has to be arranged. The two other images are each formed, as shown, after two successive reflections, the first of which, effected by a transparent reflector, greatly reduces the amount of luminous rays, as in the preceding apparatus, these images being then transmitted to the sensitized plate by the silvered reflectors. The triple image is to be observed by turning the bottom of the apparatus slightly up toward the sky or light unless a large outer reflector 66 be employed. In Fig. 11, 67 and 68 are two unsilvered glass plates, 69 being the silvered glass reflector. The image produced by the orange light must be formed at 33. 70 and 71 are two supplementary silvered glass plates arranged normally to the reflected rays 67 and 70 and 68 71, which they normally reflect in order to form the images 31 and 32. The paths traversed by the three bundles are here strictly equal, which results in certain advantages



from an optical point of view; but the construction is more complicated, and the third proof or impression—namely, that of red-orange light—when examined upon the plate outside the apparatus is inverted thereon, the objects appearing turned upside down, this being, however, a slight disadvantage, seeing that the law of reversion causes them to be seen in the true direction as in the two other proofs or impressions when once the plate has been placed in the apparatus. Moreover, the plates must be locked or wedged up at two corresponding sides forming an angle and no longer at a single side; otherwise the red orange would not appear at the same height as the other two. In Fig. 12 the third image 33—namely, that of the red-orange light—is no longer reversed upon the plate relatively to the two others, as was the case in Fig. 11, for its image is now, like the two others 31 and 32, the result of two reflections, the first one from an unsilvered glass plate 72 and the second from a silvered glass plate 73. On the other hand, it is much less luminous, a defect which will be partly remedied by superposing without cementing them, not two unsilvered glass plates, as has been stated before with regard to the green image, but several unsilvered glass plates.

It goes without saying that the different constructions indicated in this specification are capable of being doubled with a view to produce stereoscopic effects. It is likewise evident that the synthetical immaterial images, such as seen in the apparatus, may be thrown through the apparatus itself upon a screen. It is of course necessary that in order to obtain this result an intense light should be concentrated upon the constituent images. For this purpose one single focus may be employed either by dividing the bundle of luminous rays into three by the aid of a combination of reflecting-mirrors analogous to those above described or by having recourse to a lantern of a special shape, the light of which will be lengthened in the direction of the plate to the three images, and of which the condenser and the reflector instead of being spherical will be cylindrical.

With regard to the supporting-frame (represented in Fig. 4) it may be useful to mention that the most varied artistic effects can be obtained, if so desired, by an assortment of frames of this kind, the three openings of which will be furnished with unequally-transparent screens. It will be, moreover, interesting, either for studying the subject or by way of recreation, to effect transpositions of colors by the aid of a set of frames furnished with screens of the various colors, these frames being applied after removing the colored interior screens.

I claim—

1. Apparatus for photographing and exhibiting photographic views in natural colors comprising a chamber divided into three compartments, a plate-holder and color-screens

at one end, a series of lenses arranged at their focal distance from said plate-holder, a series of reflectors beyond the said lenses arranged at an angle of forty-five degrees relatively to the vertical plane of said lenses, the said chamber being provided with an opening centrally above said reflectors, substantially as described.

2. Apparatus for photographing and exhibiting photographic views in natural colors comprising a chamber divided into three compartments, a plate-holder and color-screens at one end, a series of lenses arranged at their focal distance from said plate-holder, a series of reflectors beyond the said lenses arranged at an angle of forty-five degrees relatively to the vertical plane of said lenses, said chamber having an opening centrally above said reflectors, and a displaceable reflector arranged at an angle of forty-five degrees above said opening in the chamber.

3. Apparatus for photographing and exhibiting photographic views in natural colors comprising a chamber divided into three compartments, a plate-holder and color-screens at one end, a series of lenses arranged at their focal distance from said plate-holder, a series of reflectors beyond the said lenses arranged at an angle of forty-five degrees relatively to the vertical plane of said lenses, said chamber having an opening centrally above said reflectors, a displaceable reflector arranged at an angle of forty-five degrees above said opening, and a lens 35 arranged in front of said reflector.

4. Apparatus for the production and exhibition of photographic views in natural colors comprising a chamber divided into three compartments a plate-holder and color-screens at one end a series of silvered and unsilvered reflectors at the other end of the partitioned chamber three intermediate lenses and a diaphragm 20, and a removable reflector 34 substantially as described.

5. Apparatus for the production and exhibition of photographs in natural colors comprising a chamber divided into three compartments a plate-holder and color-screens at one end a series of silvered and unsilvered reflectors at the other end of the partitioned chamber three intermediate lenses a diaphragm 20, a reflector 34, and a lens 35, substantially as described.

6. In an apparatus of the character described, a series of reflectors arranged at an angle of forty-five degrees relatively to the vertical plane of the lenses, one of said reflectors comprising a plurality of superposed but uncemented glasses, substantially as described.

In testimony whereof I have hereto set my hand in the presence of two subscribing witnesses.

LOUIS DUCOS DU HAURON.

Witnesses:

LOUIS SULLIGER,

EDWARD P. MACLEAN.