350-173

Search Room

Feb. 24, 1942. R. E. WARD, JR 2,274,110

APPARATUS FOR TREATING POLARIZED LIGHT

Filed March 29, 1940 2 Sheets-Sheet 1

Fig 1

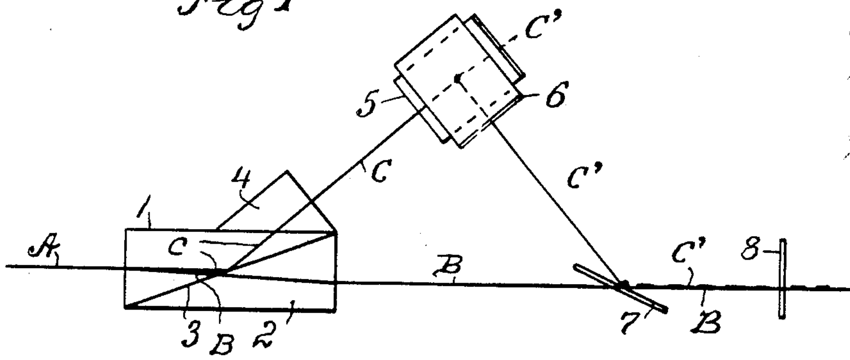


Fig 2

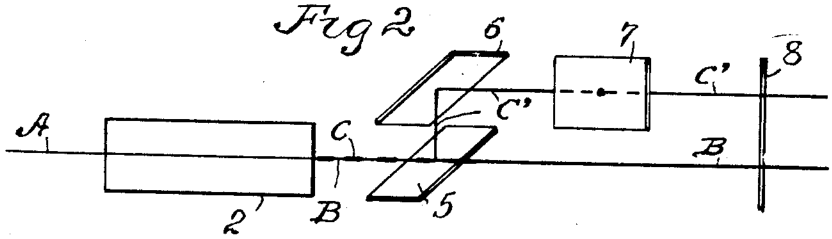


Fig 3

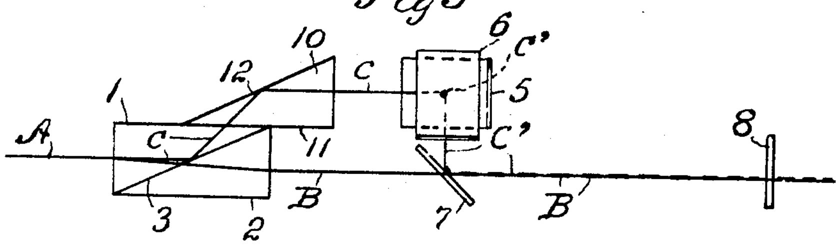
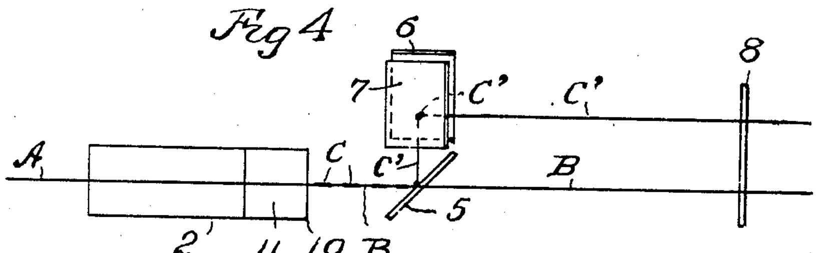


Fig 4



INVENTOR.
Robert E. Ward Jr.
BY Warren D. House

His ATTORNEY.

Search Room

Feb. 24, 1942. R. E. WARD, JR 2,274,110

APPARATUS FOR TREATING POLARIZED LIGHT

Filed March 29, 1940 2 Sheets-Sheet 2

Fig 5

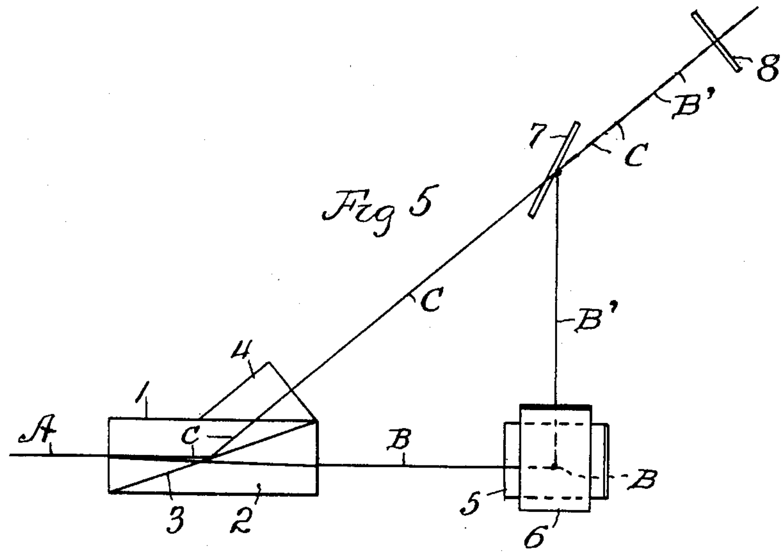


Fig 6

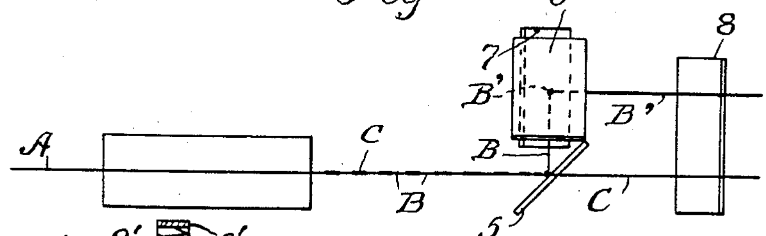


Fig 10

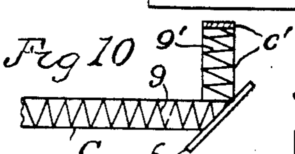


Fig 7

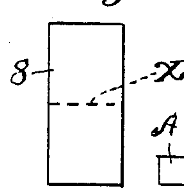


Fig 8

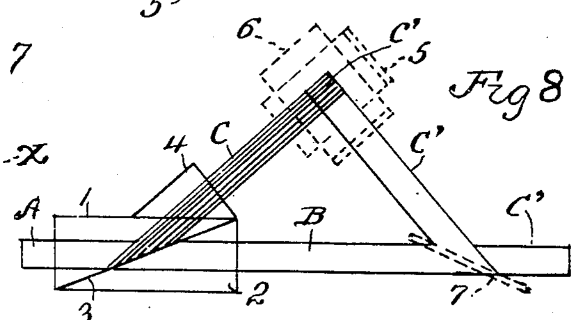
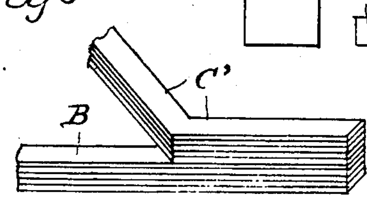


Fig 9



INVENTOR.
Robert E. Ward Jr.
BY
Warren D. House
His ATTORNEY.

Search Room

Patented Feb. 24, 1942 2,274,110

UNITED STATES PATENT OFFICE

2,274,110

APPARATUS FOR TREATING POLARIZED LIGHT

Robert E. Ward, Jr., Kansas City, Mo.

Application March 29, 1940, Serial No. 326,651

1 Claim. (Cl. 88—65)

My invention relates to improvements in apparatus for treating polarized light. The light thus treated may be utilized for many purposes for which polarized light is used, such as determining stresses in materials, flywheels, bridge sections, machine parts, etc.

One of the objects of my invention is the provision of a novel apparatus for treating polarized light which will make it adaptable for use with a minimum of loss of the light, and over a maximum area, at one time, of an object that is being subjected to examination.

A further object of my invention is the provision of a novel apparatus by which a light beam is polarized into two component beams having respectively planes of polarization at right angles to each other, one of the component beams being converted to the same plane of polarity as the other component beam, the two beams then having like polarity being directed into two courses parallel with each other and substantially adjoining, the two beams covering separate areas and being adaptable for use simultaneously in the examination of an object, or for such other purpose as may be desired and are adaptable for use.

A further object of my invention is the provision of a novel apparatus for carrying into effect my invention, which apparatus is simple, easily and cheaply constructed, which is easily operated, and which is efficient in its operation.

The novel features of my invention are hereinafter fully described and claimed.

In the accompanying drawings which illustrate different forms of my improved apparatus:

Fig. 1 is a plan view, partly diagrammatic, of one form of my improved apparatus in which the reflected component ray is passed directly through the auxiliary prism and then converted to the same polarity as the transmitted beam.

Fig. 2 is a side elevation, partly diagrammatic, of what is shown in Fig. 1.

Fig. 3 is a plan view, partly diagrammatic, of another form of my improved apparatus in which the reflected beam passes into the auxiliary prism from which it is reflected out by one side thereof.

Fig. 4 is a side elevation, partly diagrammatic, of what is shown in Fig. 3.

Fig. 5 is a plan view, partly diagrammatic, of another form of my improved apparatus in which the transmitted component beam is reflected to the plane of polarization of the reflected component beam.

Fig. 6 is a side elevation, partly diagrammatic, of what is shown in Fig. 5.

Fig. 7 is an elevation of a screen upon which the two beams of like polarity are finally projected, and which also represents the cross sectional areas of the two beams of like polarity as they are when traveling in parallel courses.

Fig. 8 is a view similar to Fig. 1, showing the incident beam, the reflected and the transmitted beam, as being a bundle of beams.

Fig. 9 is a perspective view showing the bundle of converted reflected component beams where they are finally reflected into a course parallel with and adjoining that of the component transmitted bundle of beams.

Fig. 10 is a diagrammatic representation of the reflected component beam as it is being converted to the same polarity as the transmitted component beam.

Similar characters of reference designate similar parts in the different views.

In the form of my invention shown in Figs. 1 and 2, there is provided a light polarizing means comprising a double prism, consisting of two lengthwise reversely disposed prisms **1** and **2**, and reflecting and refracting oblique layer **3** attached to and between the diagonal sides of the prisms **1** and **2**.

The prisms **1** and **2** are of suitable material, as glass, and the layer **3** may be Icelandic spar or other suitable material.

The prism **1** is the receiving prism, and the prism **2** the emergent one for the extraordinary beam.

The incident light beam A enters at the end of the prism **1** and is divided therein into two component beams B and C having planes of polarization at right angles to each other. The beam B, the extraordinary beam, is transmitted through the prism **2** and then travels in the same plane as the incident beam A. In Figs. 1 and 2, this plane is assumed, for convenience, to be a horizontal plane.

The ordinary beam C is reflected by the layer **3** against the side of the prism **1** faced by the layer **3**. Attached at its diagonal side to the side of the prism **1** against which the beam C is reflected is an auxiliary prism **4** having three sides parallel with the beam C, which is reflected through the prism **4** in the same horizontal plane as the beam B but in a different direction.

It is assumed that the vibrations of the beam B are horizontal, and that the vibrations of the beam C, as it issues from the prism **4** are vertical. Means are provided for converting the beam C to the same plane of polarization as the beam B. As shown in Figs. 1 and 2, such means comprises a mirror **5** disposed facing the prism **4** at a forty-five degree angle to and in the path of the beam C. The beam C is reflected vertically at right angles by the mirror **5** and is thus converted to a beam C′ of the same polarity as the beam B.

Above the mirror **5** is a mirror **6** disposed at a forty-five degree angle to the horizontal, in the path of the converted beam C′, and so as to direct the latter horizontally at right angles to the vertical part of the beam C′ and to the beam C, and in a direction to intersect a vertical plane in the line of travel of the beam B.

At the intersection of the converted beam C′ with the vertical plane of the line of travel of the beam B, is disposed edge up a vertical mirror **7**, and set at an angle such that it will reflect the converted beam C′ into a course over and parallel with that of the beam B. The mirrors **6** and **7** are at a height such that the course into which the mirror **7** directs the converted beam C′ will substantially adjoin that of the beam B, where one course overlies the other. A screen **8**, shown in elevation in Fig. 7, and edgewise in Figs. 1 and 2 disposed at right angles to and intercepting the beams C′ and B where their courses are parallel and one overlying the other, would receive on its upper half the beam C′ and on its lower half the beam B.

The two beams C′ and B, now of like polarity, could be used continuously at the same time, as a single beam, for obtaining observations of materials, or for such other functions for which they are adapted. The area of material to be examined at one time would be double that examinable by one of the beams, and the strength of the light would be substantially the same over the double area as that over the area examinable by one of the beams.

In Fig. 10, the reflected beam C is represented as a ribbon disposed edge up, the zigzag lines **9** thereon representing the vertical vibrations of the beam. The beam C is reflected by the mirror **5** at right angles upwardly, thus converting the beam C into the beam C′ having horizontal vibrations represented by the zigzag line **9′** and of the same plane of polarization as the beam B. The beam C′ is reflected by the mirror **6**, not shown in Fig. 10, horizontally at right angles to the vertical portion of the beam C′ and at right angles to the beam C.

In Fig. 8, the same structure and arrangement is shown, as that shown in Figs. 1 and 2, excepting that the single beams A, B and C and C′, are represented as bundles of beams respectively.

In Fig. 9 are shown in perspective the ribbon like beams B and C′ where their courses become parallel.

In the form of my invention shown in Figs. 3 and 4, there is substituted for the prism **4**, shown in Fig. 1, a prism **10** with its long right angled side **11** abutting against the side of the prism **1** which is opposite the layer **3**. The diagonal side **12** of the prism **10** is disposed parallel with the layer **3** and in the path of the reflected beam C, which is directed by reflection from the diagonal side **12** to the mirror **5** which reflects it at right angles upwardly to the mirror **6**, thus converting it to the beam C′, which is of the same plane of polarization as the transmitted beam B. The mirror **6** reflects the beam C′ to intersect the vertical plane of the line of travel of the beam B, where, as in the form shown in Figs. 1 and 2, the mirror **7** reflects the beam C′ into a course above and parallel with and substantially adjoining that of the beam B. In other respects the construction and mode of operation are the same as that of the form shown in Figs. 1 and 2.

In the form shown in Figs. 3 and 4, the incident beam A enters the prism **1** where it is polarized, the beam B traveling the same as in the form shown in Figs. 1 and 2. The ordinary beam C is reflected by the layer **3** into the prism **10** where it is reflected by the diagonal side of the prism **10** parallel with the beam B after the latter emerges from the prism **2**. The beam C then consecutively is reflected by the mirrors **5**, **6**, and **7** into the course over and parallel with the course of the beam B, its reflection by the mirror **5** converting it into the beam C′ of like polarity with the beam B.

The reflection of the beam C by the prism **10** into parallelism with the beam B requiring a slight change of position of the mirrors **5**, **6** and **7** with relation to the prisms **1** and **2**, from their positions shown in Figs. 1 and 2, but their mode of operation is the same as was described with relation to the form shown in Figs. 1 and 2.

In the form shown in Figs. 5 and 6, the elements employed are the same as those of the form shown in Figs. 1 and 2.

The prisms **1**, **2** and **4** and the layer **3** are arranged as in the form shown in Fig. 1. The mirror **5** is disposed in the path of the transmitted beam B at a forty-five degree angle and reflects the beam B vertically against the mirror **6**, which reflects the beam B at right angles to the vertical portion of the beam and at right angles to that portion between the prism **2** and the mirror **5**. The mirror **6** directs the converted beam B′ by reflection to intersect the vertical line of travel of the beam C, thus converting the beam B to the beam B′ which is of the same polarity as the beam C. At the place of such intersection, is disposed the mirror **7**, which is disposed at angle such that the beam B′ is directed by reflection into a course parallel with and substantially adjoining the course of the beam C.

A screen **8** perpendicular to and in the path of the beams B′ and C would have projected thereon the beam B′, and on its lower half the beam C both beams having like polarity and adapted for use at the same time and continuously as a single beam, whereby this form of my invention would have the same advantages and effect the same functions as has been described with reference to the other two forms of my invention, shown respectively in Figs. 1 and 2 and Figs. 3 and 4.

In Figs. 1 to 6, where two parallel beams are disposed one above the other, the under beam is represented by a dotted line. In Fig. 7, the transverse dotted line, designated by X across the middle of the screen **8** represents the line of division between the cross sectional areas of the two beams of like polarity, as they travel in the same plane next to each other between the mirror **7** and the screen **8**, as in Figs. 2, 4 and 6.

It will be noted that the mirror **5** in Fig. 1 has its bottom edge parallel with the discharge end of the prism **4**, and in Fig. 5 it is parallel with the discharge end of the prism **2**. It will be noted also that the lower edge of the mirror **5** in both Figs. 2 and 6 is parallel with the lower edge of the mirror **6**.

As the angle of incidence of the component beam, that is converted, to both mirrors is 45

Search Room

degrees, said beam will be reflected by each mirror at an angle of 90 degrees.

Other modifications of my invention, within the scope of the appended claim, may be made without departing from the spirit of my invention.

What I claim is:

In an apparatus of the kind described, in combination, light polarizing means comprising a receiving prism and an emergent prism having respectively two diagonal sides next to each other and two oppositely disposed ends, and a layer of polarizing material between said diagonal sides, said polarizing means providing for the incident ray passing through said end of said receiving prism and against said diagonal side thereof where the ordinary component beam is reflected against one side of the receiving prism, and the extraordinary component beam being transmitted through the emergent prism, a third prism, having one side against said one side of said receiving prism, in the path of and transmitting said reflected beam in a plane common to both transmitted beams, means for intercepting and reflecting one of said transmitted component beams at an angle to said common plane, means for intercepting and reflecting said one angularly reflected beam along a second plane, parallel with and adjacent to said common plane, and into intersection with a third plane which is perpendicular to said two planes and in which third plane is the course of travel of said other transmitted component beam, and means for intercepting and reflecting at said intersection said one beam to a course of travel in said second and third planes in the same direction as and parallel with that of said other transmitted component beam.

ROBERT E. WARD, JUNIOR.