July 28, 1925. 1,547,182

C. PULFRICH

DEVICE FOR COMPARING THE LUMINOSITIES PRESENTED TO BOTH EYES OF AN OBSERVER

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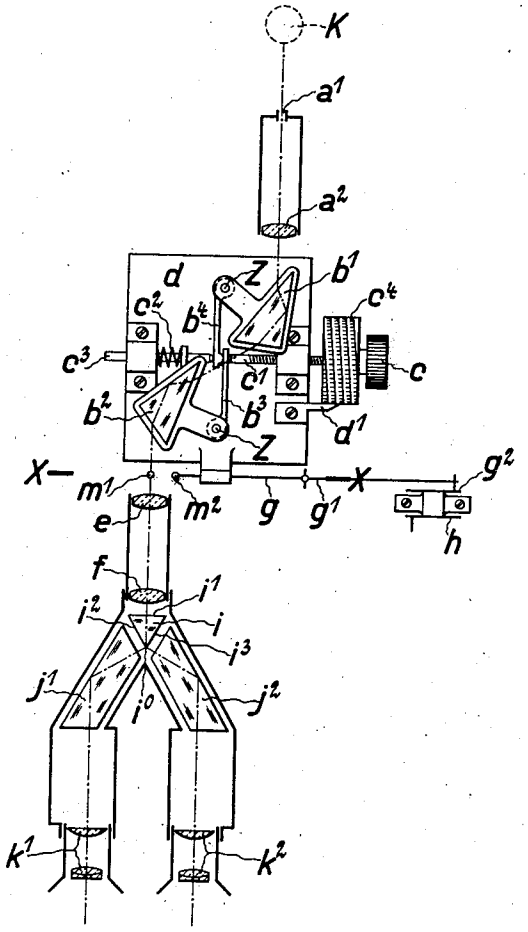


Fig. 1

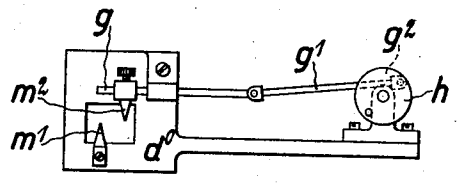


Fig. 2

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DEVICE FOR COMPARING THE LUMINOSITIES PRESENTED TO BOTH EYES OF AN OBSERVER.

Application filed June 19, 1923. Serial No. 646,360.

To all whom it may concern:

Be it known that I, CARL PULFRICH, a citizen of Germany, and residing at Jena, Germany, have invented a new and useful Device for Comparing the Luminosities Presented to Both Eyes of an Observer (for which I have filed an application in Germany on June 22, 1922), of which the following is a specification.

The present invention relates to the known devices for comparing luminosities similar in some respects to the device described in U. S. Patent No. 1,460,732 issued to me on July 3, 1923, which are based upon the following appearance. If an observer, well capable of stereoscopic viewing, moves in a plane, a mark to and fro in a straight line and looks at it with both eyes in such a way that this plane is parallel with the connecting line of the points of rotation of the eyes and stands perpendicularly on the plane determined by the two principal lines of vision, he will only have the impression of this real motion of the mark if the luminosities presented to both his eyes be uniform. In every other case the mark appears to move on a closed path, of which only two points lie in the plane of the real motion of the mark, whilst the other points lie at different distances partly in front, partly behind this plane. The larger is the difference in luminosity and the greater is the speed at which the mark is moved, the larger are the differences in depth noticed. According as the right or the left eye received the greater luminosity, the apparent motion, as seen from above, takes place clockwise or counter-clockwise. For the experiment it is of no importance whether there is presented a bright mark on a dark ground or a dark mark on a bright ground. The appearance remains the same.

The explanation of these appearances is due to the fact that in order to perceive an impression upon the retina of the eye a certain amount of time is required, which is all the larger, the smaller the luminosity presented to the eye, and that, if the luminosities presented to both eyes be different, owing to the motion of the mark the latter is seen by each eye at a different place, the distance of which from the real place of the mark is all the greater, the smaller the luminosity presented to the respective eye.

In order to utilize this appearance these devices are fitted with two mark systems which are capable of being observed binocularly and movable relatively to each other.

The device according to the present invention contains a prism system intended to divide the spectrum in two parts perpendicularly to the direction of the colour dispersion. In addition, provision is made for an adjusting device adapted to vary the ratio of division of these two parts. Finally there is present a binocular observing instrument, in both halves of which one of the two stereoscopic semi-images of both mark systems is simultaneously visible with the mixture of colours obtained from one of those two parts of the spectrum. It is possible to either use at will two mark systems themselves as in my patent above referred to or stereoscopic semi-images of them as in this application. The novel device may, e. g. be used for dividing the spectrum of a red-hot body into two parts of a uniformly bright mixture of colours, whereby the criterion of the ratio of the luminosities transmitted to both eyes, again forms the kind of the relative motion of the mark systems perceived by the observer.

If the device is to serve for determining the temperature of a red-hot body, it is suitable to construct the indicating device, coupled to the adjusting device for altering the ratio of division of both parts of the spectrum, in such a way that on a scale (to be determined empirically) that temperature is indicated at any one time which corresponds to the ratio of division adjusted.

Figs. 1 and 2 of the annexed drawing illustrate as a constructional example a device for determining the temperature of a red-hot body. Fig. 1 is a horizontal section of the device, Fig. 2 shows in elevation the marks requisite for comparing the luminosity and the device, only diagrammatically shown in Fig. 1, for actuating the one mark.

Luminous rays emanating from a red-hot body k pass through a slit a^1 to an objective a^2 in whose focal plane the slit lies and traverse thereupon two prisms b^1 and b^2 disposed as in a spectral apparatus causing constant deflection. These prisms are rotatable each about an axis Z and so coupled by means of a micrometer device as to al-

ways experience a uniform rotation, but in opposite direction, on the micrometer device being actuated with the aid of a milled head c. The micrometer device contains a screw spindle c^1 rotatably supported on a base plate d which also serves the prisms b^1 and b^2 as a bearing plate. The spindle c^1 presses against an arm b^3 which is rigidly connected to the prism b^2 and supported by an arm b^4 rigidly connected to the prism b^1. A spring c^2 keeps by means of a pin c^3 the arm b^4 in contact with the screw spindle c^1. A pointer d^1 fixed on the base-plate d indicates on a scale c^4, figured according to temperatures and traced upon a drum fitted on the screw spindle c^1, the position at any one time of the prisms b^1 and b^2. Behind the prism b^2 is disposed a collective lens e and behind the same an additional collective lens f. Between the prism b^2 and the collective e are disposed two marks or sighting points m^1 and m^2 (vide Fig. 2). The mark m^1 is fixed on a frame d^0, assumed to be rigidly connected to the base plate d, in such a way that its point lies in the centre of the field of view. The mark m^2 is displaceably disposed parallelly to the screw spindle c^1. For this purpose it is fixed on a spindle g which is displaceably supported on the frame d^0 and capable of experiencing a motion to and fro by a hand wheel h by means of a rod g^1 and a crank disc g^2. The latter may also be actuated by clockwork. In order to divide the spectrum produced by the prisms b^1 and b^2, there is disposed behind the lens f a prism i, whose principal section forms an equilateral triangle, in such a way that the side i^1, facing the lens f, of the prism i is perpendicular to the optical axis of the lens f and that the edge of the prism i^0 opposite this side coincides with the real image produced by the lenses e and f. The prism i brings it about that the image of the spectrum is not produced in the image plane determined by the lenses e and f but, owing to reflection at each of both sides of the prism i^2 and i^3, a partial image each of the spectrum is produced on the other of these two sides, whereby these two partial images are separated by the edge of the prism i^0. Behind the prism i are disposed two prisms j^1 and j^2 and two oculars k^1 and k^2 in such a way that in each of the two ocular-image planes lies a real stereoscopic semi-image of the marks m^1 and m^2 and that the luminous rays participating in the production of each of both partial images of the spectrum are fully transmitted to the appertaining ocular. Hence, to each eye of the observer is presented at the same time a semi-image of the marks with the mixture of colours obtained from one of both semi-images of the spectrum.

When using the device the observer has to continuously actuate the hand wheel h and to watch the motion of the spatial image of the mark. In the case of different luminosities of the mixtures of colours obtained from both semi-images of the spectrum the observer perceives a rotary motion of the mark m^2. With the aid of the milled head c the semi-images of the spectrum must be so adjusted that the rotary motion changes over to a rectilinear one. Hereafter the luminosities of the mixtures of colours are alike and the temperature of the red-hot body k observed may be read off on the scale c^4.

I claim:

1. In a device for comparing the luminosities presented to both eyes of an observer, a mark-system, admitting of binocular observation, its component elements being movable relatively to each other in parallel planes, a single prism system adapted to produce a spectrum, another prism system admitting of splitting of the rays into two portions after the spectrum is produced by the said single prism system, perpendicularly to the direction of the colour dispersion, an adjusting device adapted to alter the ratio of division of these two parts, and a binocular observing instrument adapted to render visible in each of both its halves the two images of the mark system simultaneously with the mixture of colours obtained from the appertaining part of the spectrum.

2. In a device for comparing the luminosities presented to both eyes of an observer, a mark-system, admitting of binocular observation, its component elements being movable relatively to each other in parallel planes, an optical system adapted to produce a real image of a spectrum, comprising a prism whose principal section forms an equilateral triangle and which with respect to the image plane of the said optical system is so disposed that its principal section is parallel to the said direction, that furthermore it turns upon the said system a side which is parallel to the image plane of the same and that the edge of the prism, opposite to this side, coincides with the image of the spectrum, an adjusting device adapted to displace the said image of the spectrum perpendicularly to the direction of the colour dispersion, and a binocular observing instrument adapted to render visible in each of both its halves the two images of the mark system simultaneously with the mixture of colours obtained from the appertaining part of the spectrum.

3. In a device for comparing the luminosities presented to both eyes of an observer, a mark-system, admitting of binocular observation, its component elements being movable relatively to each other in parallel planes, a system adapted to produce a spectrum, comprising two refractive prisms rotatable about an axis perpendicular to the

planes of their principal section, a prism system adapted to divide the spectrum produced in two parts perpendicularly to the direction of the colour dispersion, and a binocular observing instrument adapted to render visible in each of both its halves the two images of the mark system simultaneously with the mixture of colours obtained from the appertaining part of the spectrum.

4. In a device for comparing the luminosities presented to both eyes of an observer, a mark-system, admitting of binocular observation, its component elements being movable relatively to each other in parallel planes, two refractive prisms disposed behind each other and rotatable each about an axis perpendicular to the plane of its principal section, means for coupling these refractive prisms so as to rotate in opposite sense, a prism system adapted to divide the spectrum produced by the said refractive prisms in two parts perpendicularly to the direction of the colour dispersion, and a binocular observing instrument adapted to render visible in each of both its halves the two images of the mark system simultaneously with the mixture of colours obtained from the appertaining part of the spectrum.

5. In a device for determining the temperature of hot bodies by comparing the luminosities presented to both eyes of an observer, a mark-system, admitting of binocular observation and being movable relatively to each other in parallel planes, an appliance adapted to produce a spectrum, a prism system admitting of dividing this spectrum in two parts perpendicularly to the direction of the colour dispersion, an adjusting device adapted to alter the ratio of division of these two parts, a binocular observing instrument adapted to render visible in each of both its halves the two images of the mark-system simultaneously with the mixture of colours obtained from the appertaining part of the spectrum, and an indicating device coupled to the said adjusting device and adapted to read off temperatures.

CARL PULFRICH.