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Schick

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[54] **HEADLIGHT TESTER**

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[52] **U.S. Cl.** **356/121**
[51] **Int. Cl.** **G01j 1/00**
[58] **Field of Search** .... 356/121; 250/219 WD, 250/219 DR

[56] **References Cited**

UNITED STATES PATENTS

2,643,117	6/1953	Frisbie et al.	350/219 WD
3,532,432	10/1970	Mansour	356/121
2,714,327	8/1955	Squyer et al.	356/121
3,077,139	2/1963	Todd et al.	356/121

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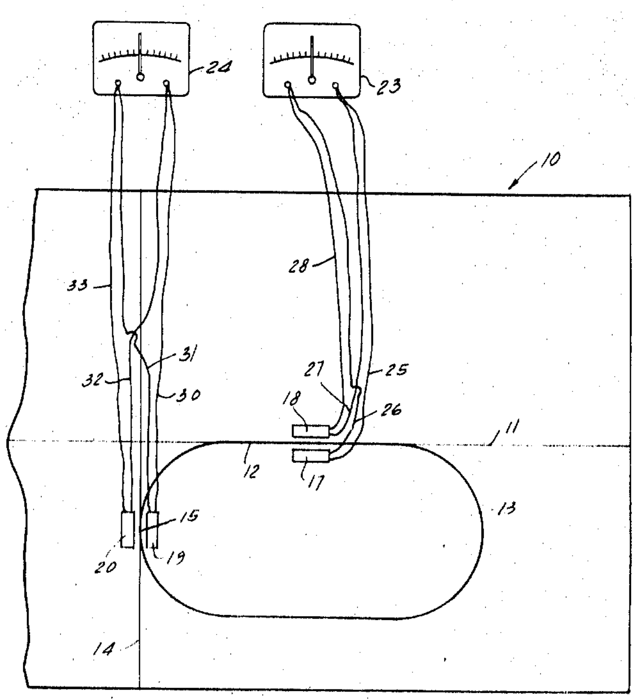
[57] **ABSTRACT**

A device for use in determining the location of an edge of a pattern of a light source while either testing the alignment or aiming the low beam of a light source such as a No. 2 headlight, characterized by a pair of vertically spaced photoelectric devices which are located on a support such as a screen or board with one device above and one device below a predetermined desired position for the upper edge of the high intensity zone of a pattern of the light source and a second pair of photoelectric devices disposed on a separate support or the same board or screen on opposite sides of a predetermined desired position for the left edge of the high intensity zone of the pattern. Each pair of photoelectric devices is connected to a meter means such as a milliammeter which is capable of indicating a difference in the output of the two photoelectric devices of each pair. By relatively moving the pattern and the pairs of photoelectric devices either by aiming the headlight or by moving the support for the pairs of photoelectric devices to produce the greatest indication on the milliammeter, the edge, either the upper edge or the left edge of the high intensity zone, is aimed to coincide with the predetermined desired position.

4 Claims, 4 Drawing Figures



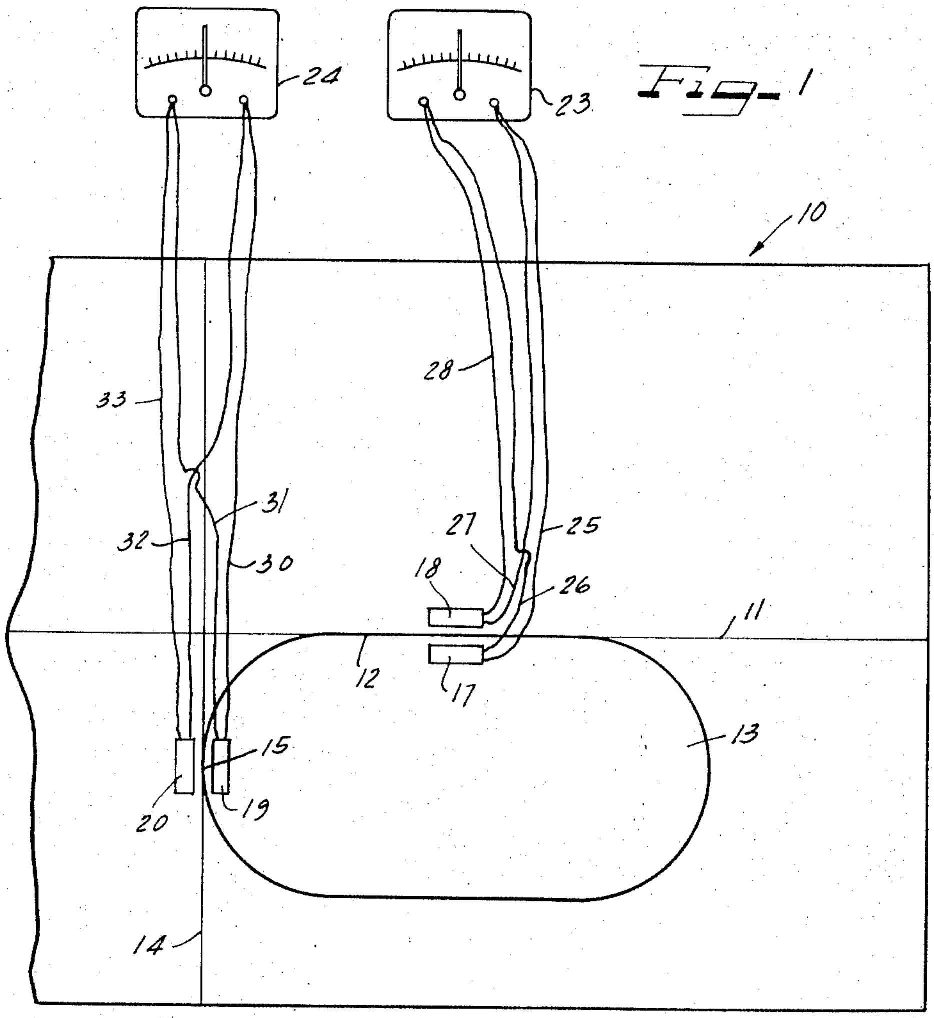


Fig. 1

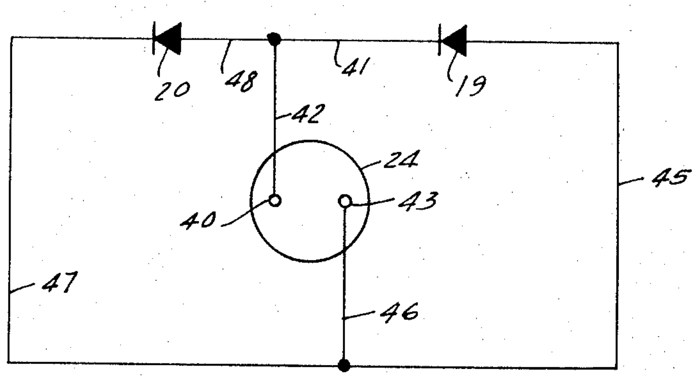


Fig. 2

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Fig. 3

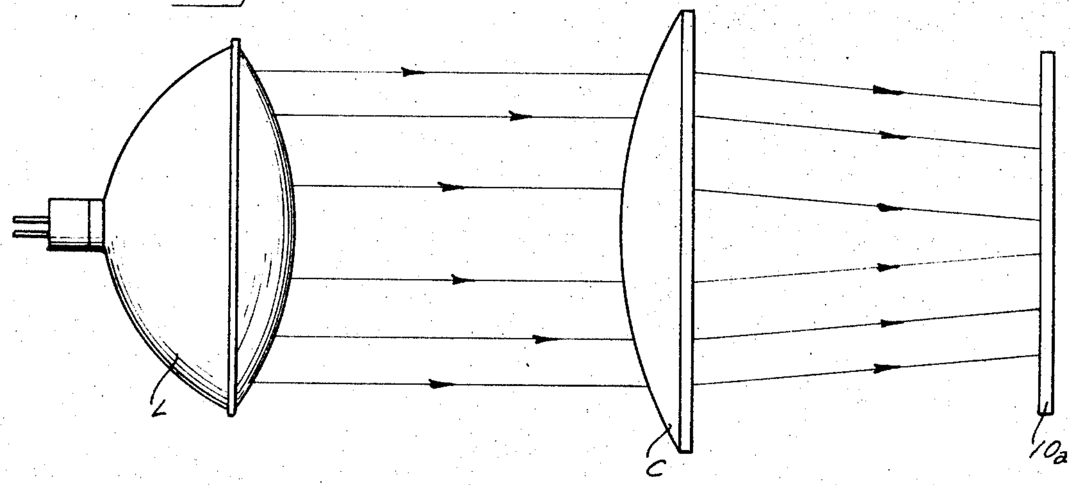
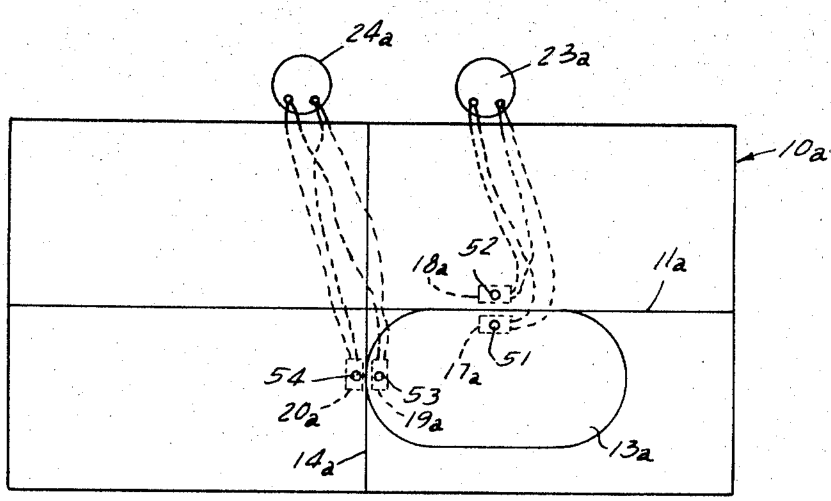


Fig. 4



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HEADLIGHT TESTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to an aiming or testing device and particularly to the photoelectric means used therewith.

2. Prior Art

Proper alignment of a headlight or headlights on an automobile is required by various local, State and Federal requirements and correct alignment is concerned with the upper horizontal and left vertical edges of the high intensity zone of the headlight beam pattern. One lighting inspection code requires alignment of the low beam light pattern such as that of a number 2 type headlight so the upper horizontal edge of the high intensity zone of the headlight is at the height of the horizontal centerline of the headlight when the pattern is projected on a screen at a distance of 25 feet. The code also requires that the left edge of the high intensity zone of the pattern be displaced approximately 2 inches to the right of the vertical centerline of the headlight to minimize glare to oncoming drivers during nighttime driving conditions.

Many types of devices and methods for properly aiming headlights and testing headlight alignment have been proposed. One method utilizes mechanical devices mounted on the built in aiming pads around the edge of the face of the headlight lens to position the plane of the aiming pads in correct relationship with the horizontal and vertical axes of the headlamp. However, due to manufacturing tolerances such as irregular beam patterns and variations in alignment of the plane of the aiming pads with the beam pattern edges, considerable variations in beam aim can result.

A second method for either aiming headlights or testing headlight alignment utilizes a screen having reference marks or lines and the operator visually locates the edges of the high intensity zone of the light beam with respect to the predetermined reference lines. However, such a method requires a darkened work area and is subject to operator errors due to judgment variations between operators as to the position of the edge of the high intensity zone.

A third method utilizes a device having photoelectric sensitive cells arranged in a pattern to indicate the center of the high intensity zone of the lamp. In such a device, the aiming of the center of the high intensity zone is believed to properly aim the left-hand vertical edge and the upper horizontal edge. However, due to variations in the size and shape of the zone, such devices do not necessarily provide consistent aiming of the left-hand vertical edge and the upper horizontal edge. This method can use an apparatus which is positioned adjacent to the headlight and examples of the type of apparatus are illustrated in U.S. Pat. No. 2,291,114, U.S. Pat. No. 2,308,095 and U.S. Pat. No. 2,714,327. This method has also been used with an aiming screen such as disclosed in U.S. Pat. No. 3,077,139.

A fourth method for aligning the left-hand vertical edge and the upper horizontal edge of high intensity zone of a headlight beam utilizes a projection board and an arrangement of photoelectric cells such as disclosed in U.S. Pat. Nos. 3,386,333 and 3,467,473. In both of these patents three cells are aligned on a vertical line and three cells are placed on a horizontal line in a particular arrangement with regard to the desired reference lines for both the upper horizontal edge and the left-hand edge of the high intensity zone. In the device disclosed in U.S. Pat. No. 3,386,333, the output of each of the three cells is connected to a computer amplifier which obtains a factor or quantity by dividing the output of the cell disposed furthest in the high intensity zone by the difference of the intermediate cell minus the output of the cell disposed on the reference line. When the edge is properly aimed, the quantity or factor has a minimum value. In the device disclosed in U.S. Pat. No. 3,467,473, the outputs of the three cells are placed in a computer amplifier which takes the second differential of the output to give an indication which has its maximum value when the edge is properly aimed. Both of these systems are expensive to produce due to the electronic equipment necessary to utilize the outputs of the photo cells in the required mathematical formulas.

SUMMARY OF THE INVENTION

The present invention comprises an arrangement of photoelectric cells for determining the location of an edge of a beam pattern from a light source and is utilized while either testing the alignment of a light source such as a headlight or aiming an edge of a beam pattern from the light source. The photoelectric cells are arranged on a support means such as a screen or board as a spaced pair with a desired reference line or desired position for the edge extending therebetween and a pair of photoelectric cells is connected to a meter means, such as a milliammeter, which is connected in a manner to determine the difference in the output of the two photoelectric cells which difference is at a maximum when the edge of the high intensity zone coincides with the predetermined reference line or desired position.

Accordingly, it is an object of the present invention to provide a lamp testing and aiming device capable of determining the location of an edge of the high intensity zone of a headlight and aiming it at the proper position.

Another object of the present invention is to provide a device for headlight aiming and testing which determines the location of the edges of a headlight high intensity zone regardless of variations in the structure of the headlight.

A still further object of the present invention is a device for locating the edges of a high intensity zone of a headlight regardless of the operator's skill.

Yet another object of the present invention is to provide a device for locating the edges of the high intensity zone of a light source which device is relatively inexpensive to manufacture.

Other objects, features and advantages of the invention will be readily apparent from the following description of a preferred embodiment thereof although variations and modifications may be effected without departing from the spirit and scope of the novel concept of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the aiming board of the present invention;

FIG. 2 is a circuit diagram for the present invention;

FIG. 3, is a diagrammatic view showing the invention as used with a condensing lens and a smaller board or screen; and

FIG. 4 is a plan view of the board or screen of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The principles of the present invention are particularly useful in a headlight aiming and testing system for an automotive vehicle headlight which includes an aiming board or screen generally indicated at **10** in FIG. **1.** The board **10** has a horizontal line **11** which is a predetermined reference line for an upper horizontal edge **12** of the high intensity zone **13** of the light beam pattern. A second reference line **14** is a vertical line placed on the board at the predetermined position for the left vertical edge **15** of the high intensity zone **13.**

One method of using this system would be to have photoelectric cells supported by the board **10** in which the headlight of the vehicle is located 25 feet in front of the board **10** with the horizontal centerline of the headlight coinciding with the horizontal reference line **11** and with its vertical centerline located at a predetermined distance to the left of the reference line **14.** As mentioned above, in one recommended procedure for testing or aiming, the vertical centerline of the headlight should be 2 inches to the left of the reference line **14.** According to this recommended procedure, a tolerance of plus or minus 2 inches is allowed on the location of the upper horizontal edge **12** with respect to the reference line **11** and a tolerance of 2 inches to the left and 4 inches to the right is allowable in the position of the edge **15** with respect to the reference line **14.**

To determine the position of the horizontal upper edge **12** and the left-hand edge **15** of the high intensity zone **13,** four light-sensitive means such as photoelectric cells or devices **17–20** are utilized. The light sensitive means are of a type that convert light energy into electromotive force or to state it in another manner create electrical energy when exposed to light which amount of energy is proportional to the intensity of light being projected on the cell.

The photoelectric devices **17** and **18** are arranged as a pair and are vertically spaced from each other on a line extending substantially transversely to the horizontal reference line **11.** As illustrated, the device **17** is disposed below the line **11** and the device **18** is positioned above the line **11.** The devices **19** and **20** are arranged on a horizontally extending line which is transverse to the reference line **14** which extends therebetween. As illustrated, the reference lines **11** and **14** which pass between the pairs of photoelectric devices are at a predetermined distance from each of the photoelectric devices of their respective pairs.

To measure the output of each of the two pairs of photoelectric devices, a meter means such as a milliammeter **23** or **24** is provided. The meter **23** is electrically connected to the photoelectric device **17** by leads **25** and **26** and is connected to the photoelectric device **18** by leads **27** and **28.** The meter **24** is connected to the photoelectric device **19** by leads **30** and **31** and to the photoelectric device **20** by leads **32** and **33.** As illustrated, each of the meters **23** and **24** has an indicating needle and preferably is a center null type meter.

As best illustrated in FIG. **2,** a circuit diagram showing the electrical connection for the photoelectric devices **19** and **20** to the meter **24** is illustrated. The photoelectric device **19** has its negative terminal connected to terminal **40** of the milliammeter **24** by lines **41** and **42** and has a positive terminal connected to the terminal **43** of the meter **24** by lines **45** and **46.** The photoelectric device **20** has its negative terminal connected to the terminal **43** of the meter **24** by lines **46** and **47** and terminal **40** of the meter **24** is connected by lines **42** and **48** to the positive terminal of the device **20.** Thus, if both photoelectric devices **19** and **20** are creating an electromotive force, the current flow from the device **19** through the milliammeter **24** is opposite to the current flow of the photoelectric device **20.**

With the photoelectric devices **19** and **20** arranged with respect to the reference line **14,** the device **19** is located in the area of the high intensity zone **13** of the light beam and therefore is producing electromotive force. On the other hand, the photoelectric device **20** is outside of the zone **13** and is thus producing either none or a very small amount of electrical current. When the edge **15** of the zone **13** is moved to the left, the amount of light projecting on the device **20** increases so that its current output increases. Furthermore, the projecting of light on the device **20** causes a reduction in the internal resistance of the device **20** which allows a portion of the current produced in the device **19** to flow through the device **20** and reduce the amount of current flowing through the meter **24.** Since the milliammeter **24** is indicating the relative difference between the two currents which are flowing in opposite directions through the meter, its reading will be changed as the output of electromotive force from the device **20** increases. If the edge **15** of the zone **13** is moved to the right of the line **14,** the amount of light being projected on the device **19** decreases causing a decrease in its electromotive force which causes a lowering of the current flow therefrom.

To locate the edge **15** with respect to the line **14,** the operator moves the light beam horizontally to the left and then to the right and determines the maximum reading on the meter **24.** At the maximum reading, the edge **15** will be aimed to coincide with the reference line **14.** If the edge is moved to the left, the output from the device **20** is increased and causes a drop in the reading of the meter. If the edge **15** is moved to the right, the intensity of the light projected on the device **29** decreases causing a decrease in the output to cause a reduction in the meter reading or indication.

The electrical circuitry for the devices **17** and **18** and the meter **23** is exactly the same as the previously described circuitry. Thus, the edge **12** is aimed at the desired line **11** when the reading of the meter **23** is at a maximum. If the edge **12** is moved upward from the desired position, the photoelectric device **18** will increase its output which passes through the meter **23** in a direction opposite to the output of the device **17** and will reduce the reading of the meter. If the edge **12** is moved below the line **11,** the output of the device **17** decreases resulting in a decrease indication from the meter **23.** Thus, to properly aim the edge **12** at the line **11,** the operator of the system moves the high intensity zone **13** vertically up and down and determines the maximum meter reading and then resets the adjustment screws on the headlight to obtain that predetermined maximum reading.

In another method of practicing the invention, the screen **10** is replaced by a small aiming board or screen **10*a*** which is used in conjunction with a condensing lens C which reduces the size of the light pattern from a light source L (FIG. 3). The screen **10*a*** is a support means for photoelectric devices **17***a* – **20***a* (FIG. 4) which devices are arranged on the screen **10***a* in a manner similar to the arrangement of the photoelectric devices **17**–**20** in FIG. **1** with devices **17***a* and **18***a* on opposite sides of position or reference line **11**a and connected to meter means **23***a* and the devices **19***a* and **20***a* on opposite sides of a reference or position line **14***a* and connected to meter means **24***a*. The photoelectric devices may be mounted on the front surface of the screen or behind the screen and exposed to the light beam through suitable apertures **51**–**54** therein (FIG. 4). Instead of using apertures, the screen may be translucent so that light passing therethrough impinges on the photoelectric devices.

Since the condensing lens C reduces the size of the pattern **13***a*, the screen **10***a* is positioned relatively close to the light source L which may be a headlight or other light source such as a fog light or spot light. The distance between the screen **10***a* and light source L is determined by the characteristic of the condensing lens C and is adjusted to have the effect of the 25 feet as previously explained.

In this form of the apparatus, the screen **10***a* is positioned in a zero position with respect to the light source by support structure not illustrated, so that a properly aimed headlight will have its left vertical edge coincide with line **14***a* and upper horizontal edge coincide with the line **11***a*. To test the alignment of the headlight, the screen **10***a* is moved to the right and left and then up and down by appropriate means in the support structure to obtain the maximum readings on meter **24***a* and **23***a*, respectively, which readings determine when the left vertical edge and upper horizontal edge of the high intensity zone of the headlight being tested coincide with the predetermined position. lines **14***a* and **11***a* respectively. By measuring the amount and direction of the movement of the screen **10***a* from the zero position in both the vertical and horizontal direction on an appropriate scale which is calibrated to show the corresponding distance of movement at 25 feet and which scale is provided on the support structure, the amount of error in the alignment of the light source from a proper alignment can be determined. If an error exists, the screen **10***a* is returned to the zero position and the headlight adjusted to properly aim the left vertical edge and the upper horizontal edge at the position lines **14***a* and **11***a* respectively. Thus the screen or board **10***a* can be used in a device for either testing the alignment of a light source alone or testing and correctly aiming the light source to be in the proper alignment.

In the above-described embodiment, the board or screen **10***a* acts as a support means for the two pairs of photoelectric devices **17***a*–**20***a* which support means is movable in a support structure. Instead of using a screen or board **10***a* as a support means, each pair of photoelectric devices can be mounted on a separate support means such as a bracket with the desired position or reference line disposed between the devices of each pair. Each of the brakets is movably mounted in the support structure by means such as calibrated knobs with one bracket being movable along a horizontal line and the other bracket being movable along a vertical line. The means for moving the brackets have an appropriate scale which is calibrated to show the corresponding distance of movement at 25 feet and which scales provide the amounts of error of the alignment of both the horizontal edge and vertical edge of a light source from a proper aligned position. Thus, the arrangement of the brackets with their pairs of photoelectric devices can be used either for testing the alignment of a light source alone or for testing and correcting a light source to be in a proper alignment as described hereinabove.

As mentioned hereinabove, an advantage of the present system over those of the prior art is its simplicity and inexpensive manufacturing costs. Another advantage is that although the pairs of photoelectric devices such as **17** and **18** should be of similar characteristics, manufacturing variations therein will not effect the results during either testing or aiming of a headlight. Therefore, there is no necessity for calibrating the photoelectric devices of each pair with respect to each other. Thus the frequently required calibration of some prior art systems is not required by the photoelectric system of the present invention.

Although minor modifications and variations may be suggested by those versed in the art, it should be understood that I wish to embody within the scope warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. In a system for determining a location of an edge of a high intensity zone of a light pattern of a light source such as a headlight of an automobile, the improvement comprising:

a pair of light sensitive means for sensing the intensity of the light projected thereon;

means for supporting said pair of light sensitive means in a spaced apart relationship on a line extending transversely to the edge of the high intensity zone with a predetermined position located therebetween so that when the edge of the high intensity zone coincides with the position, one of said pair is outside of the high intensity zone and the other of said pair is in said high intensity zone;

meter means;

means connecting said pair of light sensitive means with one another and with said meter means in a manner for indicating the difference in the intensity of the light sensed by each of said pair of light sensitive means so that the maximum indication of difference occurs when the edge of high intensity zone coincides with said position;

each of said light sensitive means comprising a photoelectric device having a negative terminal and a positive terminal;

the negative terminal of one of said devices being connected to the positive terminal of the other of said devices;

said connected negative and positive terminals being connected to one terminal of said meter device; and

the remaining terminals of said devices being connected to another terminal of said meter device;

whereby electromotive force current from the device which will be normally located in said intensity zone when the edge thereof is on said predetermined position is opposite to the current flow of the device which is normally outside of said intensity zone when said edge is on said position.

2. A headlight aiming device for use in a system to determine the location of an edge of a light source such as an edge of a high intensity zone of a light pattern of a headlight of an automotive vehicle, comprising:

a pair of light sensitive means for sensing the intensity of light projected thereon by converting light energy into electromotive forces;

means for supporting the pair of light sensitive means;

meter means for measuring the electromotive forces generated by the pair of light sensitive means;

said pair of light sensitive means being disposed on said supporting means on a line extending transversely to the edge of said light high intensity zone and having a predetermined position located therebetween;

said pair of light sensitive means being coupled to each other and said meter means being connected to each of said pair of light sensitive means in a manner to register the difference of the electromotive forces produced thereby so that relative movement of the supporting means and the edge of the high intensity zone to coincide with the predetermined position creates a maximum indication on the meter means;

each of said light sensitive means comprising a photoelectric device having a negative terminal and a positive terminal;

the negative terminal of one of said devices being connected to the positive terminal of the other of said devices;

said connected negative and positive terminals being connected to one terminal of said meter means; and

the remaining terminals of said devices being connected to another terminal of said meter means;

whereby electromotive force current from the device which will be normally located in said intensity zone when the edge thereof is on said predetermined position is opposite to the current flow of the device which is normally outside of said intensity zone when said edge is on said position.

3. In a system for determining the location of both a horizontal and a vertical edge of a high intensity zone of a light pattern of a light source such as a headlight of an automobile, comprising:

a pair of light sensitive means for sensing the intensity of the light projected thereon;

means for supporting said pair of light sensitive means in a spaced apart relationship on a line extending transversely to the edge of the high intensity zone with a predetermined position located therebetween so that when the edge of the high intensity zone coincides with the position one of said pair is outside of the high intensity zone and the other of said pair is in said high intensity zone;

meter means;

means connecting said pair of light sensitive means with one another and with said meter means in a manner for indicating the difference in the intensity of the light sensed by each of said pair of light sensitive means so that the maximum indication of difference occurs when the edge of high intensity zone coincides with said position;

second means for determining the location of a second edge with respect to a second predetermined position;

said second means comprising a pair of light sensitive means for sensing the intensity of the light projected thereon;

means for supporting said second pair of light sensitive means in a spaced apart relationship on a line extending substantially transversely to the second edge of the pattern with said second predetermined position located between the second pair of light sensitive means;

second meter means;

means connecting said second pair of light sensitive means with one another and with said second meter means in a manner indicating the difference in the intensity sensed by each of the second pair of light sensitive means so that the maximum indication of difference by said second meter means occurs when the second edge coincides with the second position;

the light sensitive means of both pairs converting light energy into electromotive force and wherein the indication of each of the meter means is a difference of the magnitude of the electromotive force created by the pair of light sensitive means connected thereto;

said light sensitive means of each pair comprising a photoelectric device having a respective negative terminal and a respective positive terminal;

the negative terminal of one of said devices in each pair being electrically connected with the positive terminal of its pairmate and to one terminal of the meter means associated with that respective pair;

the remaining terminals of each respective pair of photoelectric devices being connected to another terminal of the associated meter means, each of said meter means being a center null type meter; and

the arrangement being such that one of the devices of each pair is normally located within said high intensity light zone pattern when said edges are in substantial coincidence with said predetermined positions and the remaining device of each pair is outside of said zone.

4. A headlight aiming device for use in a system to determine the location of an edge of a light source such as an edge of a high intensity zone of a light pattern of a headlight of an automotive vehicle, comprising:

a pair of light sensitive means for sensing the intensity of light projected thereon by converting light energy into electromotive forces;

means for supporting the pair of light sensitive means;

meter means for measuring the electromotive forces generated by the pair of light sensitive means;

said pair of light sensitive means being disposed on said supporting means on a line extending transversely to the edge of said light high intensity zone and having a predetermined position located therebetween;

said pair of light sensitive means being coupled to each other and said meter means being connected to each of said pair of light sensitive means in a manner to register the difference of the electromotive forces produced thereby so that relative movement of the supporting means and the edge of the high intensity zone to coincide with the predetermined position creates a maximum indication on the meter means;

a second pair of light sensitive means for sensing the intensity of light projected thereon by converting light energy to electromotive forces;

a second means for supporting the second pair of light sensitive means;

a second meter associated with the second pair of light sensitive means;

said second pair of light sensitive means being mounted on the second supporting means on a line extending transversely to the first pair and being spaced apart with a second predetermined position located therebetween;

said second pair of light sensitive means being coupled to each other and said second meter means being connected to each of the light sensitive means of the second pair in a manner to indicate the difference in the electromotive forces generated therein so that the relative movement of the high intensity zone and the supporting means to have an edge coinciding with each of said first-mentioned position and a second position creates a maximum indication on each of said meter means;

the light sensitive means of both pairs converting

light energy into electromotive force and the indication of each of the meter means is a difference of the magnitude of the electromotive force created by the pair of light sensitive means connected thereto;

said light sensitive means of each pair comprising a photoelectric device having a respective negative terminal and a respective positive terminal;

the negative terminal of one of said devices in each pair being electrically connected with the positive terminal of its pairmate and to one terminal of the meter means associated with that respective pair; and

the remaining terminals of each respective pair of photoelectric devices being connected to another terminal of said meter means, each of said meter means being a center null type meter; and

the arrangement being such that one of the devices of each pair is normally located within said high intensity light zone pattern when said edges are in substantial coincidence with said predetermined positions and the remaining device of each pair is outside of said zone.

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