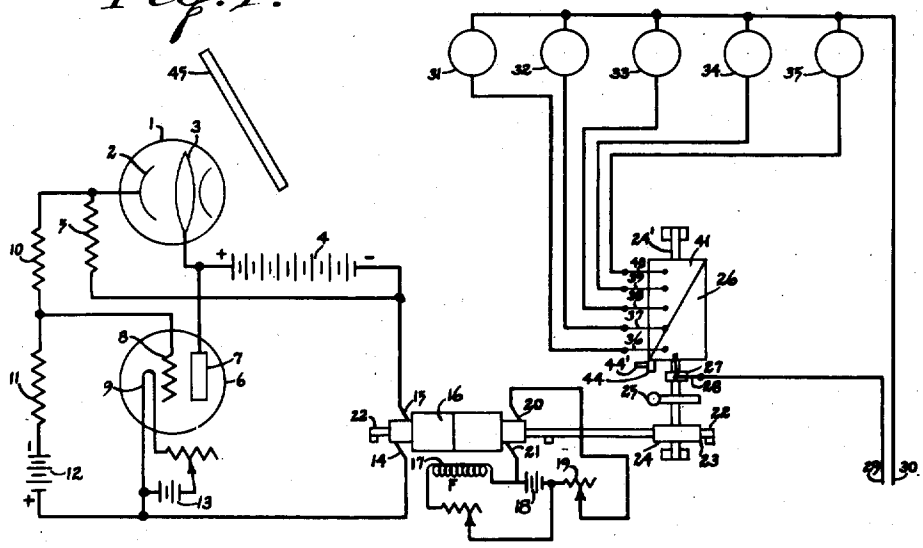
Feb. 18, 1936. G. W. CALVER 2,030,854

CONSTANT INTENSITY ILLUMINATION SYSTEM

Filed March 30, 1933

Fig. 1.



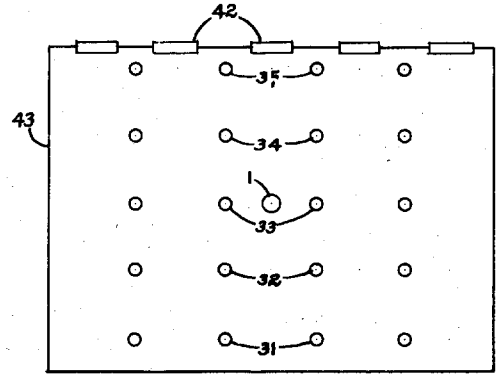


Fig. 2.

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CONSTANT INTENSITY ILLUMINATION SYSTEM

George W. Calver, United States Navy

Application March 30, 1933, Serial No. 663,671

2 Claims. (Cl. 240—9)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to a system of illumination, more particularly to an automatic system wherein the intensity of illumination within a compartment is kept relatively constant regardless of changes in the natural or daylight illumination.

During ordinary daylight conditions it is seldom if ever necessary to supplement the natural light with artificial light in a room where sufficient windows have been provided. However, due to the presence of clouds, rain, snow, smoke, etc., it is often necessary to supplement the natural light with artificial light or to provide illumination that is wholly artificial.

This invention has for one of its principal objects the provision of a method of and an apparatus for automatically maintaining the intensity of illumination within a room or other compartment at a predetermined desired level irrespective of variations in the natural illumination.

Another object of this invention is to provide a system of illumination wherein the intensity to be automatically maintained may be manually selected so that any desired intensity in keeping with the work to be done thereby may be obtained.

With the above and other objects in view, this invention consists in the construction, combination and arrangement of parts as will be described more fully hereinafter.

In the drawing:

Fig. 1 is a diagrammatic view of one embodiment of my invention;

Fig. 2 is a plan view of a room having windows on only one side showing one manner of distributing the artificial lamps according to this invention.

Fig. 1 of the drawing shows a photo-electric cell 1 having cathode 2 and anode 3 connected to a source of potential 4 by means of a high resistance 5. The photo-cathode 2 is connected by means of a resistance 10 to the grid or control element 8 of a thermionic tube 6. The plate or anode 7 of tube 6 is connected to the positive lead of the battery or other source of potential 4. The negative terminal of battery 4 is connected to the brush 15 of the double armature motor 16. The cathode 9 of tube 6 is energized by an appropriate source of potential shown at 13. The grid 8 of the tube is connected through resistance 11 and battery 12 or other source of direct current potential to the cathode 9. The cathode 9 is further connected to brush 14 of double armature motor 16. The field of the double armature motor 16 is shown at 17 and is excited by battery 18 through an appropriate control resistance. The battery 18 is also connected through rheostat 19 to brushes 20 and 21 which cooperate with the commutator on the opposite end of the shaft from the one with which brushes 14 and 15 cooperate. The armature of motor 16 is mounted on the shaft 22 which is suitably supported by bearings. Attached to one end of shaft 22 is a worm 23 which cooperates with a worm gear 24 to drive a shaft 24' which is supported in suitable bearings. Mounted on shaft 24' is a non-conducting cylinder 41 that is partially covered by a conducting portion 26 that extends about the cylinder to form a conducting portion thereon that intercepts a continuously varying angle from one end to the other. The conducting portion 26 of the cylinder is connected to a slip ring 27 and a brush 28 is adapted to contact therewith. The brush 28 is connected by lead 29 to one of the terminals of a suitable source of electric current, while the conductor 30 is connected to the other terminal. Cooperating with the contacting member 26 are a series of brushes 36, 37, 38, 39, and 40 each of which is connected to one terminal of the lamps 31, 32, 33, 34, and 35, respectively. The remaining terminals of the lamps are connected to the conductor 30.

In Fig. 2 the arrangement of the lamps 31 to 35 inclusive is shown. In this figure each of the reference characters 31 to 35 denotes a row of lamps extending across the room parallel to the side of the room having windows. The lamps are arranged so that they are not exactly opposite the windows whereby little of the direct illumination from these lamps will pass out of the room through the windows.

The above described system operates in the following manner: First, it is assumed that the daylight coming through windows 42 is sufficient to provide the desired intensity of illumination throughout the whole room. In this case none of the lamps 31 to 35 inclusive would need to be illuminated. Now assume that it became very cloudy and the intensity of illumination within the room 43 became so low that additional illumination would be desirable. The photo-electric cell 1 would cease to conduct sufficient current to maintain a potential drop across the resistance 5 to keep the grid 8 at a sufficient positive potential to allow a sufficient amount of plate or anode current to flow through the circuit including the anode 7, battery 4, brush 15, and the cooperating armature winding of double armature motor 16 back to the brush 14 and thence to the cathode to overcome the field created by the other armature winding connected to brushes 20 and

21. The motor armature 16 would then turn in a direction such as to rotate the cylinder 41 until sufficient of the contacts 36, 37, etc. are in contact with the conducting segment 26 to complete the circuit of a sufficient number of the lamps 31, 32, etc. to bring the illumination intensity to the desired value. Assuming next that the cloud passes on and the illumination intensity from the sky and sun furnishes sufficient light within the room 43 that the lamps are no longer necessary. The increased illumination would render the photo-electric cell 1 conducting to such a degree that a considerable potential drop would exist across the extremities of the resistance 5. This potential drop across the resistances would raise the potential of the photo-cathode 2, thereby decreasing the negative potential normally on the grid 8 of the tube 6 due to battery 12 and result in a large plate current flow in the plate circuit of the tube 6. This plate current flowing through the armature winding connected to brushes 14 and 15 of the double armature motor 16 would tend to magnetize the armature in a direction so as to oppose the magnetizing effect of the winding connected to brushes 20 and 21. When the current flowing through the armature winding connected to brushes 14 and 15 becomes sufficiently great, it will overcome the effect of the other winding and cause the armature of the motor to rotate in the opposite direction to the direction of rotation when the winding connected to brushes 20 and 21 only is energized. The worm gear 24 would then cause cylinder 41 to be rotated in the opposite direction, cutting out the lamps 31, 32, 33, 34, and 35 in the inverse order in which they were illuminated until such an intensity of light is again obtained in the room that the double wound armature motor 16 has no tendency to rotate.

The battery 12 in the grid circuit of tube 6 is of such a value and is so poled that the grid 8 is normally maintained at its cut-off point and no current will flow in the plate circuit through one of the armature windings of the motor 16. Under such conditions, the other armature of the motor 16 would give rise to the only turning torque in the motor which would tend to make the motor rotate in such a direction as to cut in some of the lamps. An adjustable frictional load is applied to the shaft 24' by means of the prony 25 to prevent any tendency of the device to hunt. In operation, the load applied by the prony 25 serves to act as a time delay device to prevent any of the lamps from being turned on or off due to extremely minute light intensity changes on the cell 1.

A stop device is provided at 44 on the cylinder 41 which engages with the fixed lug 44' for preventing the shaft 24' from making a full revolution. When shaft 24' has turned to either of the extreme positions, representing all lights on or all lights off, it is stopped by the stop device 44 which coacts with lug 44'.

A graduated light filter is shown at 45. This filter may or may not be used, depending upon the service for which the system is intended. In case it is desirable to have the room illuminated at one constant intensity and it is never desired to have any other degree of illumination, the graduated filter 45 may be dispensed with. The graduated filter beginning at one end is transparent and changes, as a light wedge, to become opaque at the opposite end. By adjusting the graduated filter longitudinally so that the rays of light from the room will be made to pass through a selected portion of the filter before entering the photo-electric cell 1, it is possible to adjust the intensity at which the illumination of the room is to be maintained.

It is not intended to limit the invention to the specific mechanism disclosed inasmuch as it is possible to vary from the embodiment shown by other and equivalent means. For instance, a photo-resistive or photo-voltaic cell or the like may be used in place of the photo-electric cell 1. Also, a grid glow tube or double grid tube or other type of tube or relay may be used in place of the conventional three-element tube shown in Fig. 6, and several amplifier stages or relays may be used instead of the single stage shown in the drawing. The armature windings connected to the commutators on shaft 22 may be wound in different slots or in the same slots or extend for the full length of the armature or for only a portion thereof. The field 17 may be made in one or two parts, while the worm gear speed reducing device shown at 23 and 24 may be replaced with any appropriate type of gear reduction, etc.

In the above description the terms "light" and "illumination" contemplate the whole of the visible spectrum together with those invisible parts of the solar spectrum that are desirable because of their beneficial effects upon the health of humans or because of their destructive effects upon undesired organisms. Obviously if natural illumination is deficient in only portions of the desired spectrum it will be desirable to provide lamps that emit only such portions.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes, without the payment of any royalty thereon.

I claim:

1. A system for maintaining the intensity of illumination substantially constant over a predetermined area notwithstanding wide variations in the uncontrolled components of the illumination, comprising, a plurality of lamps, a source of power for energizing said lamps, a multi-position switch for connecting all or a part of said lamps in circuit with said source of power, means for urging said multi-position switch toward the position in which all of said lamps are connected in circuit with said source of power, a light sensitive device, means controlled by said light sensitive device for urging said multi-position switch toward the position in which none of said lamps are connected in circuit by a force proportional to the illumination on said device, whereby the forces tending to urge said multi-position switch in opposite directions are balanced at the position of the multi-position switch in which the uncontrolled components of illumination are supplemented by just the proper amount of illumination from said lamps to provide a predetermined desired intensity of illumination over said area, and an adjustable light filter over said light sensitive device whereby said system may be adjusted to maintain any predetermined intensity of illumination.

2. A system for maintaining the intensity of illumination substantially constant over a predetermined area notwithstanding wide variations in the uncontrolled components of the illumination, comprising a plurality of lamps, a source of power for energizing said lamps, a multi-position switch for connecting all or a part of said lamps in circuit with said source of power, means for urging said multi-position switch toward the

position in which all of said lamps are connected in circuit with said source of power comprising an electric motor having a field winding and two armature windings, the field winding and one armature winding of which are connected to a source of potential, a light sensitive device and means controlled by said light sensitive device for applying an electric current to the other of said armature windings for urging said multi-position switch toward the position in which none of said lamps are connected in circuit responsive to an illumination intensity on said device greater than the desired constant illumination, whereby the uncontrolled component of the illumination is supplemented by light from said lamps by a sufficient amount to maintain the illumination constant.

GEORGE W. CALVER.