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C. REITER ET AL

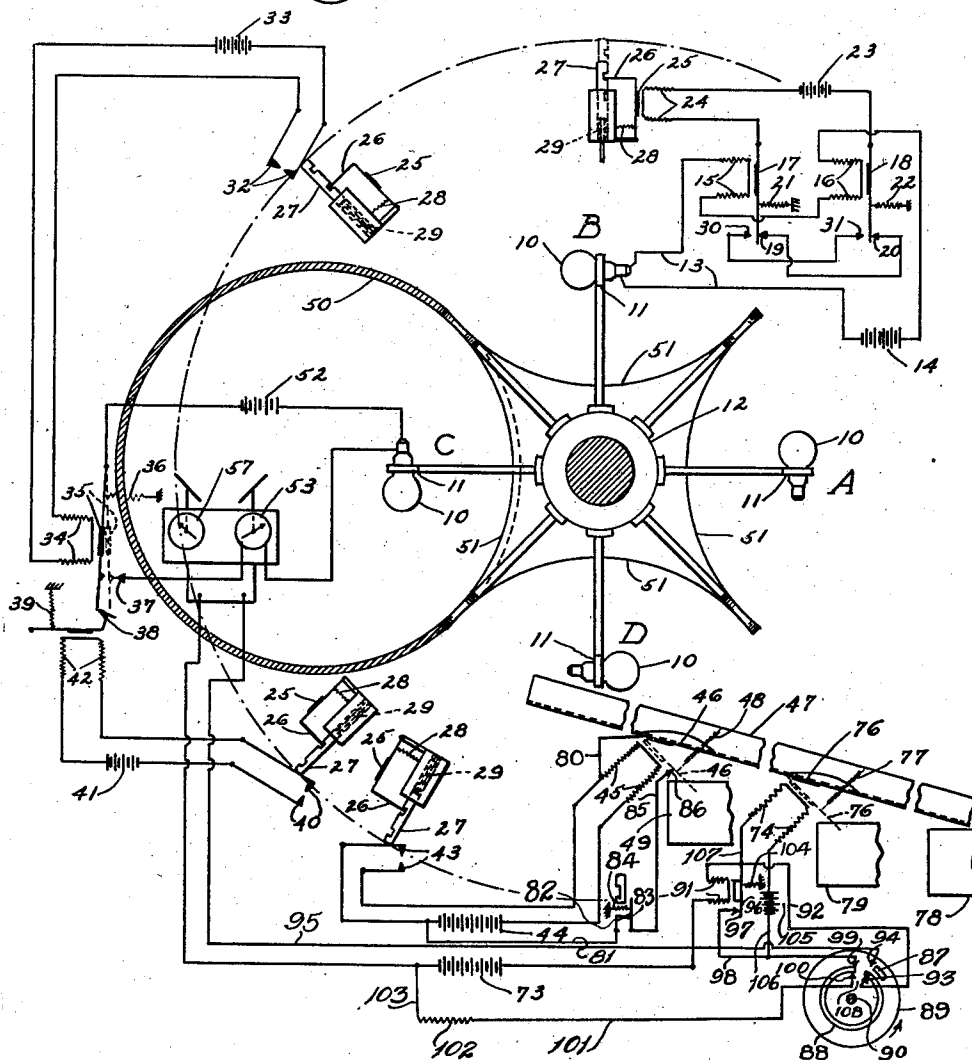
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APPARATUS FOR TESTING AND ASSORTING ELECTRIC INCANDESCENT LAMPS

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2 Sheets-Sheet 1

Fig 1



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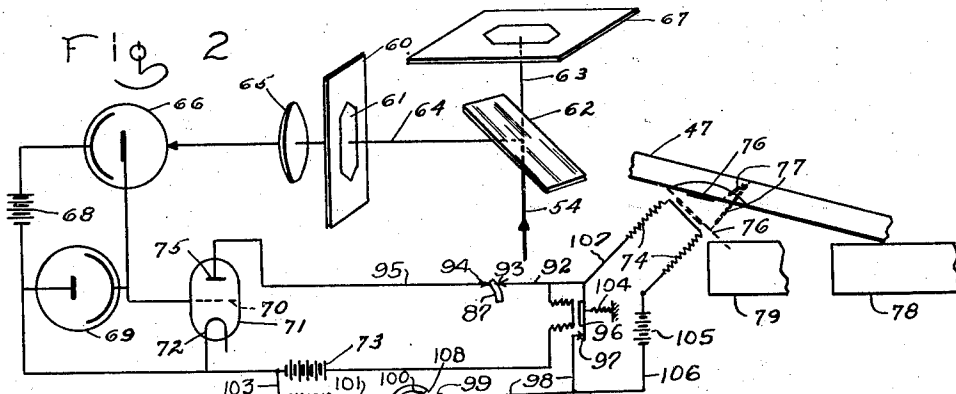
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APPARATUS FOR TESTING AND ASSORTING ELECTRIC INCANDESCENT LAMPS

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UNITED STATES PATENT OFFICE

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APPARATUS FOR TESTING AND ASSORTING
ELECTRIC INCANDESCENT LAMPS

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3 Claims. (Cl. 209—81)

Our invention relates to testing of electric incandescent lamps and more particularly to apparatus for automatically assorting lamps according to their luminous efficiency.

One object of our invention is to provide an apparatus, which will be entirely automatic, for determining the luminous efficiency, that is, the lumens per watt ratio, of electric incandescent lamps and assorting said lamps according to the value of said ratio. The life of an incandescent lamp depends chiefly upon the operating temperature of the filament which, in turn, depends directly upon the luminous efficiency, so that the life of the lamp may be predicted upon the determination of said luminous efficiency. This was formerly done by determining the intensity factor in lumens with a photometer and the input factor with a wattmeter and dividing the lumens by the watts. Our invention dispenses with such a calculation.

We accomplish the above-mentioned objects by supplying the lamps to the jaws of an indexing spider which carries the lamps to a position where they are first tested for broken filaments or short circuits. If a lamp has either of these defects it will continue around with the spider but when released therefrom, diverting means will operate to guide it into a special receptacle. From this preliminary test position, the lamp is introduced into a photometer sphere for determination of the luminous efficiency. Said efficiency is recorded by means of a light beam which is deflected by mirrors which are in turn actuated by a direct reading photometer and a wattmeter, said light beam being directed, after reflection, upon a screen. A portion of the screen which indicates allowable values of luminous efficiency is made transparent while the rest of the screen is impervious to light. If the light beam strikes the transparent portion of the screen it passes there-through to a photo-electric cell which operates to allow the lamp to assume its normal course after delivery. If, on the other hand, the light beam strikes the non-transparent part of the screen, it fails to reach the photo-electric cell and a solenoid becomes energized and opens a trap door through which the defective lamp drops after being released from the jaws of the spider.

Additional features and advantages of our invention will appear from the following detailed description of species thereof.

In the drawings Fig. 1 represents a diagrammatic view of a device comprising our invention; Fig. 2 is a diagrammatic view of the circuit of the automatic means for sorting of lamps accord-

ing to their luminous efficiency; Fig. 3 is a perspective view of the automatic means for luminous efficiency measurement; and Fig. 4 shows a chart used to show the value of luminous efficiency of a lamp under test.

Referring to Fig. 1, lamps 10 to be tested are supplied at position A to jaws 11 mounted on a spider 12, either directly from a base cementing machine (not shown) or by hand. The lamp is indexed to position B, a preliminary test position for the determination of the existence of a broken filament or a short circuit, where it engages contacts of a circuit 13 which is energized by a source of electrical energy 14 operating at approximately half the normal voltage of the lamp. Said circuit 13 also comprises two solenoids 15, 16, the armatures 17, 18 of which are normally held against contacts 19, 20 by springs 21, 22, said contacts 19, 20 being interconnected. The armatures 17, 18 are located in a circuit comprising a source of electric energy 23 and a solenoid 24. An armature 25 of said solenoid 24 is in the form of a pawl, a finger 26 of which normally engages a latch 27 due to the pull of a spring 28. Said latch 27 is actuated by a spring 29 when it is released by the pawl 26. In case the bulb at position B has a broken filament there will of course be no flow of current in the circuit 13, but the solenoid 24 will be energized due to the fact that armatures 17 and 18 remain against the contacts 19, 20. The armature 25 will then be drawn over and disengage finger 26 from the latch 27 which moves up to the position shown in dotted lines. The solenoid 15 is so designed that it is actuated by the flow of a comparatively small amount of current while solenoid 16 does not function unless a comparatively heavy current flows so that if the lamp is not short-circuited, and the filament is intact, only the solenoid 15 will be energized. In this case the armature 17 will be drawn from the contact 19 to a contact 30 and the circuit through solenoid 24 will be broken at a contact 31 which is connected to contact 30, thereby resulting in the non-energization of said solenoid 24. Since solenoid 24 is not energized the armature 25 is not attracted and the finger 26 keeps the latch 27 in place. Finally, if the lamp 10 is short-circuited, both solenoids 15 and 16 will be energized and will draw the armatures 17 and 18 to the contacts 30 and 31, thereby completing the circuit through the solenoid 24 and drawing the finger 26 out of engagement with the latch 27 which moves up. During the subsequent indexing the latch 27 rotates along with the lamp so that said latch may be

mounted on the spider 12. A latch is provided for each of the receiving jaws 11, but only one of said latches is shown in the drawings in several different positions for clearness.

- 5 From position B the lamp 10 is indexed to position C where automatic determination of the luminous efficiency takes place. Between positions B and C are located a pair of contacts 32 which are normally open. If the lamp tested
- 10 at B has neither a broken filament nor a short circuit, the latch 27, being in the down position, will not affect the open position of contacts 32, but if the latch is in the upper position, due to a defective lamp, it will strike the contacts
- 15 32, and bring them together. The purpose of closing said contacts 32 is to render inoperative the efficiency measuring means at position C. The circuit of contacts 32 comprises a source of energy 33 and a solenoid 34. An armature 35 of
- 20 solenoid 34 is drawn from the position shown by dotted lines, where it is normally held by a spring 36, to that shown in full lines, thereby breaking, at contact 37, the measuring circuit which is fully described hereinafter. The end of armature 35,
- 25 in drawing toward the solenoid 34, slides across the face of a pawl 38 which is drawn up by a spring 39 to hold said armature 35 away from the contact 37 during the duration of the bulb
- 30 10 at position C. Between positions C and D are located another pair of contacts 40 which are disposed in a circuit comprising a source of electrical energy 41 and a solenoid 42 having for its armature the pawl 38. As with contacts 32, if
- 35 the lamp 10 has passed the test at position B the latch 27 will not disturb the open position of contacts 40, but if the bulb is defective, said latch 27 will act to close the contacts 40 which will cause the solenoid 42 to be energized, thereby drawing
- 40 down the combined armature and pawl 38 to allow the armature 35 to swing back to contact 37 so that the efficiency measuring circuit at C is rendered operative for the next lamp. Shortly
- 45 after leaving the contacts 40, the latch 27, if it is in its outward position by virtue of a defective bulb, will close a pair of contacts 43 which are located in a circuit comprising a source of electrical energy 44 and a solenoid 45. Said solenoid
- 50 45, becoming energized, will attract an armature 46 which forms a door in the bottom of a delivery chute 47 and is normally held up by
- 55 a spring 48. The lamp 10 is released at position D and slides down the chute 47, so that if said lamp is defective it will drop through the door 46 into a container 49. The solenoid 45 comprises a parallel circuit by means of which current continues to flow through it after the latch
- 60 27 has left the contacts 43 so as to hold open the door 46 until the lamp has been released at position D, after which the parallel or holding circuit is interrupted so that the door 46 may
- 65 be drawn to a closed position by the spring 48. The said parallel or holding circuit comprises a conductor 80 connected to one end of the door or armature 46 and to the side of the solenoid 45
- 70 on which the contact points 43 are located. A conductor 81 is connected to the side of the source 44 of electrical energy on which the contact points 43 are located. Said conductor 81 extends to a contact point 82 which is normally
- 75 in contact with a second point 83, said contact point 83 being held in the closed position by a spring 84. A conductor 85 extends from the contact point 83 to another contact point 86 disposed in the path of travel of the armature 46

so as to be in contact therewith when said arma-

ture 46 is in the position shown in dotted lines. The holding circuit functions as follows:

When the finger 27, in its extended position, passes across the contact points 43 and closes them, the solenoid 45 is energized, as hereinbefore explained, and attracts the armature 46 to the position shown in dotted lines where it establishes contact with the point 86. Thus a parallel circuit is established from source 44 to solenoid 45, through conductor 80, armature 46, 10 conductor 85, contact points 83 and 82, and conductor 81 back to the source 44. This parallel circuit then continues to energize the solenoid 45 and keep open the door or armature 46 after the finger has passed over the contact points 43, 15 until said finger 27 reaches the contact point 83 and draws it away from point 82, thus breaking the said holding circuit through the solenoid 45 and allowing the door 46 to close.

As hereinbefore mentioned, the measurement 20 of the efficiency of the lamp takes place at position C. Here is provided a photometer sphere 50 into which the lamp is introduced, said sphere being made impervious to light by means of curved portions 51 provided on the spider 12 25 which close up a slot provided in said sphere 50 to allow for the passage of the lamp there-through. Said lamp 10 engages the contacts of a circuit comprising a source of electrical energy 52, the armature 35, and a wattmeter 53. Refer- 30 ring to Fig. 3, light rays 54 leave a projector 55 in the form of a small beam of substantially parallel rays and strike a mirror 56 mounted on the axis of the pointer of a direct reading photometer 57, located in the sphere 50. Said beam 54 35 is reflected from said mirror 56 and passes through a reversing prism 58, the base of which is inclined at an angle of 45° to the horizontal, so that the ray 54 which oscillates in a horizontal plane by the movement of the pointer of the 40 photometer 57, oscillates in a vertical plane after leaving said prism 58. The beam 54 then strikes a second mirror 59 mounted on the axis of the pointer of the watt-meter 53, and is reflected to a screen 60. It is also possible to mount the 45 photometer 57 and wattmeter 53 with the axes of the pointers at right angles and dispense with the prism 58.

The screen 60 is calibrated as shown by the chart in Fig. 4 in terms of lumens on the ordinate 50 and watts on the abscissa, so that the beam 54 produces a point of light on said screen 60 which indicates the ratio of lumens to watts. Let us assume that the point of light strikes the chart at E. This would indicate that with an input 55 of 25 watts, the lamp yields a flux of 250 lumens for a luminous efficiency of 10 lumens per watt. Similarly, points of light at F and G would indicate a luminous efficiency of 10 lumens per watt, and a line "a" drawn through said points E, F and G would then indicate a luminous efficiency 60 of 10 lumens per watt for any point falling thereon. Similarly a line "b" would indicate all points at which the efficiency of the lamp is 12 lumens per watt and a line "c" would indicate all points corresponding to an efficiency of 8 lumens per watt. A section 61 of the screen 60 (Fig. 3) 65 represents an area of the chart of Fig. 4 within which the beam 54 would be considered as having an acceptable value, that is, if the beam 54 falls within said area 61, the luminous efficiency of the lamp under test is acceptable.

Referring to Fig. 2, a semi-transparent mirror 62, comprising a glass plate with plane and parallel faces lightly silvered on the front surface, is

placed in the path of the beam of light 54 at an angle of 45° thereto so that a portion 63 of the beam goes through said mirror and a portion 64 is reflected at an angle of 90°. The reflected beam 64 passes through the transparent area 61 of the screen 60 and through a condensing lens 65 to a photo-electric cell 66, provided the luminous efficiency of the lamp is an allowable one as otherwise the beam 64 will strike the non-transparent screen 60 outside the area 61. A screen 67 similar to screen 60 is provided in the path of the beam 63 merely for purposes of providing a visible indication of the exact rating of the lamp being tested apart from the actual control screen 60, so that the mirror 62 and screen 67 could be eliminated and the screen 60 placed in the position of said screen 67 with the photo-electric cell 66 of course disposed behind it. If the light beam 64 passes through the allowable area 61 and strikes the photo-electric cell 66 it sets up a current in the circuit of that cell, which comprises a source of electrical energy 68, a large resistance 69, which is preferably another photo-electric cell, a grid 70 of an amplifying tube 71, and a cathode 72 of said tube 71. The cathode 72 is also in a circuit comprising a source of energy 73, a solenoid 91, which in turn influences a solenoid 74 and an anode 75 of the tube 71. Due to the energization of the grid 70 by the flow of current through the circuit of photo-electric cell 66, said grid assumes a negative potential which results in an interruption of the current flow between the cathode 72 and anode 75. In this event, the solenoid 74, being de-energized by means of an intermediate circuit through solenoid 91, hereinafter described, will not exert a pull on a combined armature and door 76, so that said door is held close against the bottom of the chute 47 (see also Fig. 1) by a spring 77, and a lamp released at position D will pass over said door 76 into a receptacle 78. If, on the other hand, the lamp does not have the desired luminous efficiency, the beam of light 64 will strike the screen 60 outside of the area 61 and will not reach the photo-electric cell 66, with the result that no current will flow in the circuit of said cell 66 and the grid 70 will not have a potential. There will then be a flow of current between the cathode 72 and anode 75, resulting in the energization of the solenoid 74 which pulls open the door 76 and allows the lamp to drop into a receptacle 79. The current impulse which energizes the solenoid 74 and opens the door 76 is arranged to take place just before the lamp leaves position C (Fig. 1) by means of a timed contact. The said time contact mechanism is illustrated as a pair of segments 87-88 mounted on a disc 89 on a shaft 90 which makes one complete revolution for each indexing of spider 12. The direct action of the circuit comprising the source 73 and tube 71 is on a solenoid 91 which is connected on one side to the said source 73 and on the other side to a conductor 92 and contact 93, segment 87, contact 94 and conductor 95 to the anode 75 of tube 71. In order to maintain the setting of the door 76 until a bulb has been released at position D, a parallel holding circuit is provided for solenoid 91 which acts on an armature 96. Said circuit comprises a contact point 97, which the armature 96 engages when attracted by the solenoid 91, a conductor 98, contact 99, the segment 88, a contact point 100, conductor 101, resistance 102 equal to the resistance of the tube 71, and conductor 103 which is connected on the same side of the source 73 as cathode 72. The end of armature 96 is connected

to the end of solenoid 91 on the same side as segment 87. Said armature 96 is normally held open by a spring 104. The solenoid 74 is actuated by a source 105 through a conductor 106, conductor 98, armature 96 and conductor 107. The operation of these circuits is as follows:

Assuming that there is a lamp in position C of unallowable efficiency, the beam of light 64 will not pass through the area 61 of screen 60 (Fig. 2) so that the circuit of the photo-electric cell 66 will not be energized and consequently a potential will not exist at the grid 70, thus allowing a flow of current to pass between the anode 75 and cathode 72. This would then immediately cause the solenoid 91 to be energized by the source 73 and attract the armature 96 to close the circuit through the source 105 and solenoid 74 which would open the door 76. However, this action must not be allowed to take place immediately because a lapse of time must be allowed for the release of a lamp at position D which must slide over the said door 76 if it recorded a proper efficiency in position C. Therefore, the segment 87 is arranged at such a position on the disc 89 that it will not close the circuit through the solenoid 91 and source 73 until a sufficient amount of time has elapsed for a lamp at position D to pass over door 76. After the lapse of said time interval the segment 87 closes the said circuit through the solenoid 91, which is then maintained by the parallel holding circuit through the armature 96 and segment 88. The circuit through the solenoid 74, source 105 and armature 96 is also established, thus opening the door 76. The door is held open by the action of the holding circuit until the lamp under test reaches position D and is released, after which time the segment 88 has been rotated until the gap 108 reaches contacts 99-100. This, of course, breaks the said holding circuit, releasing armature 96, which then releases armature 76, thus clearing the circuits, which are then reset by the segment 87 if another poor lamp is under test at C. When a lamp having an allowable efficiency is under test at C, the fact that the light beam 64 strikes the cell 66 and sets up a potential in the grid 70 of tube 71 will, of course, break the circuit through the said tube 71, source 73, and solenoid 91, so that the armature 96 will not be attracted thus breaking the circuit through solenoid 74 and causing the door 76 to remain in a closed position.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An apparatus for testing and assorting electric lamps comprising a photometer chamber, means for automatically inserting into and removing lamps from said chamber, means for measuring automatically the luminous efficiency of said lamps comprising a measuring instrument indicating lumens and a second measuring instrument indicating energy input, and means for producing a light beam which is deflected by mirrors which are in turn actuated by said measuring instruments and means for assorting said lamps comprising a screen disposed in the path of said light beam which passes said beam to or obstructs it from a photo-electric cell according to the luminous efficiency of the lamp, and means controlled by said cell for determining the path of discharge of the lamp under test from the apparatus.

2. An apparatus for testing and assorting electric lamps comprising a revolving carrier for said lamps, a circuit into which a lamp is introduced for the determination of the existence or non-

existence of a broken filament or short circuit which circuit comprises a plurality of solenoids which operate to reject defective lamps, means for measuring automatically the lumens per watt
5 ratio of said lamps comprising a measuring instrument indicating lumens and a second measuring instrument indicating energy input and means for producing a light beam which is deflected by mirrors which are in turn actuated by
10 said measuring instruments and means for assorting said lamps comprising a screen disposed in the path of said light beam which passes said beam to or obstructs it from a photo-electric cell according to the luminous efficiency of the lamps
15 and means controlled by said cell for determining the path of discharge of the lamp under test from the apparatus.

3. An apparatus for testing and assorting electric lamps comprising a revolving carrier for said
20 lamps, a circuit into which a lamp is introduced for the determination of the existence or non-existence of a broken filament or short circuit which circuit comprises a plurality of solenoids which

operate to reject defective lamps, means cooperating with said circuit for rendering inoperative a light output measuring circuit in case a lamp is defective, means for measuring automatically the lumens per watt ratio of said lamps comprising a measuring instrument indicating lumens and a second measuring instrument indicating energy input and means for producing a light beam which is deflected by mirrors which are in turn actuated by said measuring instruments and
10 means for assorting said lamps comprising a screen disposed in the path of said light beam which passes said beam to or obstructs it from a photo-electric cell according to the luminous efficiency of the lamp and means controlled by said
15 cell for determining the path of discharge of the lamp under test from the apparatus.

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