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ELECTRIC COUNTING APPARATUS

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Fig. 1.

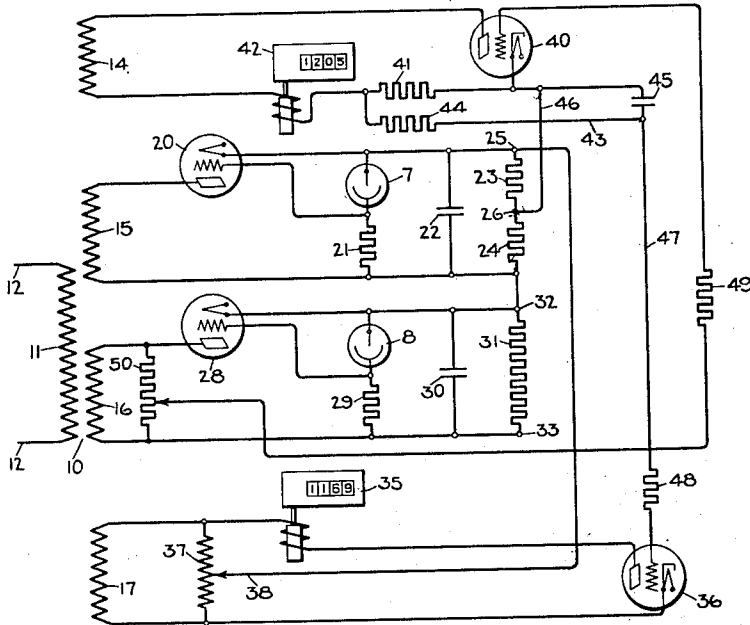
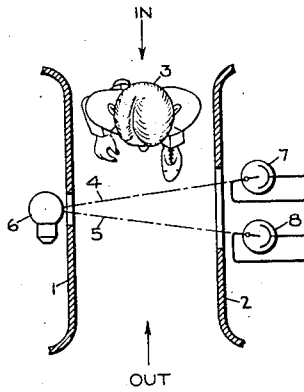


Fig 2.



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UNITED STATES PATENT OFFICE

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ELECTRIC COUNTING APPARATUS

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4 Claims. (Cl. 250—41.5)

My invention relates to apparatus for counting passing objects being of the type which employs light sensitive devices for effecting a response to the passage of the objects.

One object of my invention is the provision of improved apparatus of this character which is devoid of any moving parts and which counts those passing objects which move in one direction only. Another object is the provision of such apparatus by which a separate count is made of the total number of objects passing in both directions and the total number of objects passing in a single direction.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing Fig. 1 is a circuit diagram illustrating my invention; and Fig. 2 is a diagram representing one form of apparatus by which my invention may be used to count persons or objects.

Referring first to Fig. 2 which by way of example shows my invention adapted to count persons entering a theater but disregarding those leaving the theater, I have shown a passageway formed by the two guides 1 and 2, a person being represented at 3 in the passageway. Two beams of light 4 and 5 are directed across the passageway from a single light source 6, or from two separate light sources if desired, into the photo-electric devices 7 and 8 respectively, which for example may be photo-electric tubes. The two light beams 4 and 5 are spaced apart so that the person moving through the passageway successively interrupts the two beams; however, the spacing between the beams is such that the second beam is in all cases intercepted before the first beam is reestablished. By the apparatus now to be described a counter is operated to give a count of the total number of persons who enter the theater, that is, who move in the passageway in the direction of the arrow marked "in" while disregarding the number of persons who move in the direction marked "out". I also provide a separate counter which gives the total count of persons moving in both directions.

Referring now to Fig. 1 I have shown the transformer 10 having the primary winding 11 connected to a suitable source of alternating current supply 12, which for example may be a 60 cycle 110 volt source, and having a plurality of secondary windings 14, 15, 16 and 17. Photo-electric tube 7 is supplied from winding 15 being connected therewith through the grid controlled electron discharge device 20. In circuit with the photo tube 7 is the resistor 21, which for example may be 10 megohms, the grid of device 20 being connected with the circuit at a point between the

phototube and resistor 21. Connected across the phototube and resistor 21 is the capacitor 22 which for example may have a capacitance of 1 mf. and the resistors 23 and 24 whose values each may be 20,000 ohms. As long as phototube 7 is exposed to light beam 4 the grid voltage of device 20 will be such as to cause the device to pass a maximum current. Hence the potential drop across resistor 23 will be a maximum and the point 25 at one end of the resistor will be positive with respect to the point 26 at the other end thereof.

Phototube 8 is connected with winding 16 in a similar circuit including the grid controlled electron discharge device 28 the phototube being arranged in series with the resistor 29 whose value, for example, may be 10 megohms. Connected across the phototube 8 and resistor 29 is the capacitor 30 whose capacitance, for example, may be 1 mf. and the resistor 31 whose resistance may, for example, be 50,000 ohms. As long as phototube 8 is exposed to light beam 5 the grid voltage of device 28 will be such as to cause the device to pass a maximum current. Hence the potential drop across resistor 31 will be a maximum and the point 32 at one end of the resistor will be positive with respect to the point 33 at the other end thereof.

The electric counter 35 which counts only the persons moving in the "in" direction is energized from the secondary winding 17 and is connected therewith in series with the grid controlled vapor electric discharge device 36. Across the secondary 17 is the potentiometer 37 whose arm 38 connects with the point 25 whereby the cathode of device 36 is controlled by the voltage of that point. Connected in series with the secondary 14 is the grid controlled vapor electric discharge device 40, resistor 41 which, for example, may have a resistance of 1000 ohms, and the electric counter 42, which counter is adapted to count the total number of persons moving in both the "in" and the "out" directions. Bridged across the resistor 41 is the circuit 43 including the resistor 44 whose resistance, for example, may be 50,000 ohms and the capacitor 45 whose capacitance, for example, may be 2 mf. One side of the capacitor 45 connects by conductor 46 with the point 26 and the other side of the capacitor connects by the conductor 47 through the limiting resistor 48 with the grid of device 36. The grid of device 40 connects through the limiting resistor 49 and the potentiometer 50, connected across secondary winding 16, with the point 33.

The operation of the above described apparatus is as follows. As long as both light beams 4 and 5 are not interrupted the resistances of the phototubes 7 and 8 are a minimum and the 60

currents passed by devices 20 and 28 each is a maximum; hence point 25 is positive with respect to point 26. Device 36 therefore will not pass current since its cathode which connects with the point 25 is positive with respect to its grid which connects through circuit 43 with the point 26. Likewise since the current passing resistor 31 is a maximum, device 40 will not pass current since its cathode which connects with the point 32 will be positive with respect to its grid which connects through potentiometer 50 with the point 33.

When a person moving in the "in" direction intercepts beam 4 the current flow through resistors 23 and 24 drops to a minimum and as a result thereof the grid voltage of device 36 becomes less negative or more positive to such an extent that this device begins passing current, thus energizing the counter 35. Simultaneously device 40 begins passing current since its grid voltage is also made less negative or more positive because of the decrease in potential drop across resistor 24. Due to the passing of current by device 40 counter 42 is operated and the potential drop across resistor 41 begins to charge the capacitor 45 in circuit 43. Due to the time constant of circuit 43 which is dependent upon the value of the resistor 44 and capacitor 45 a certain time elapses before a sufficient negative voltage is applied through conductor 47 to the grid of device 36 to cause it to turn off, thus opening the circuit of counter 35. As the person moves on through the passageway and intercepts beam 5 while still intercepting beam 4 the current flow through resistor 31 becomes a minimum and as a result thereof the grid voltage of device 40 is held sufficiently positive to cause that device to continue passing current even after light beam 4 has been reestablished by the person passing on in the "in" direction. Thus the grid voltage of device 36 is maintained sufficiently negative to prevent this device from passing current. When beam 5 is interrupted by movement of a person in the "out" direction, device 36 is prevented from conducting current because of the operation of device 40, and device 40 continues to conduct as long as beam 5 is interrupted. When the person intercepts beam 4 device 40 remains conducting even after beam 5 is reestablished. Thus counter 35 operates only in response to each person moving in the "in" direction. However, counter 42 which operates each time that device 40 becomes conducting counts the total number of persons moving in both "in" and "out" directions.

Should one desire to know the number of persons moving in the "out" direction it is simply necessary to subtract the reading of counter 35 from that of counter 42. As a result of the arrangement of the phototubes 7 and 8 whereby they are supplied from the secondary windings 15 and 16 through the electron discharge devices 20 and 28 respectively which are rectifying in character, objectionable capacity effects of the leads to the phototubes are lessened if not entirely eliminated. This feature however is disclosed and claimed in my Patent No. 1,988,349, dated January 15, 1935, and assigned to the same assignee as my present invention.

From the above description it will be seen that I have provided an apparatus for energizing the electric counters 35 and 42 in response to the operation of the photoelectric devices which

apparatus is devoid of any moving parts and is entirely electrical in its operation.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various other modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

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

1. Apparatus for counting objects moving in one direction only in a predetermined path comprising a plurality of photoelectric devices arranged to become shadowed successively by each object, a counter having an actuating circuit, means responsive to the shadowing of one of said devices by an object while the other device is not shadowed for energizing and promptly de-energizing said circuit and means responsive to the shadowing of the other of said devices by an object while the first device is not shadowed for preventing the energization of said circuit.

2. Apparatus for counting objects moving in one direction only in a predetermined path comprising a plurality of photoelectric devices arranged to become shadowed successively and to remain shadowed for a predetermined time in common by each object, a counter having an actuating circuit, a source of current therefor, means responsive to the shadowing of one of said devices by an object prior to the shadowing of the other object thereby for closing said circuit, means also responsive to the shadowing of said one device for subsequently opening said circuit after a brief interval and means responsive to the shadowing of the other of said devices by an object prior to the shadowing of said one device thereby for preventing the closing of said circuit.

3. Apparatus for counting objects moving in one direction only in a predetermined path comprising a plurality of photoelectric devices arranged to become shadowed successively and to remain shadowed for a predetermined time in common by each object, a counter having an actuating circuit, a source of current therefor, means including an electron discharge device responsive to the shadowing of one of said devices by an object prior to the shadowing of the other object thereby for closing said circuit, a capacitor, means also responsive to the shadowing of said one device for applying a charge to said capacitor, means connecting said capacitor with said discharge device whereby the latter opens said circuit in response to a predetermined charge on the capacitor, and means responsive to the shadowing of the other of said devices by an object prior to the shadowing of said one device thereby also for applying a charge to said capacitor thereby preventing the closing of said circuit.

4. Apparatus for counting objects moving in one direction only in a predetermined path comprising a plurality of photo-electric devices arranged to be shadowed successively by each object, a counter, an energizing circuit therefor, a grid controlled electron discharge valve in said circuit, means for applying a positive voltage to said grid in response to the operation of said devices in one order and means for applying a negative voltage to said grid in response to the operation of said devices in a different order.