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ELECTRIC CIRCUIT FOR AUTOMOBILE LIGHTING SYSTEMS

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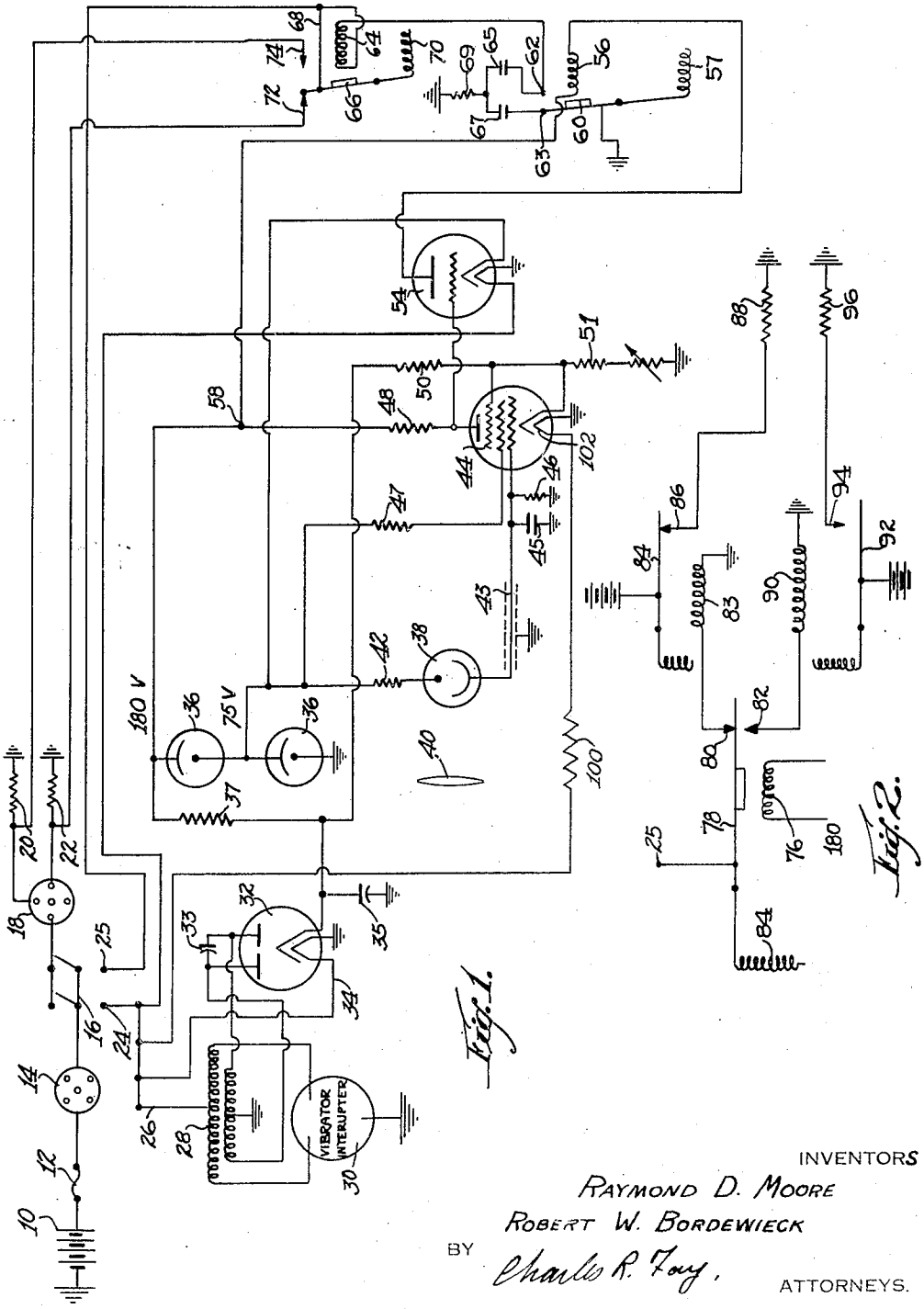

Fig. 1.

Fig. 2.

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ELECTRIC CIRCUIT FOR AUTOMOBILE LIGHTING SYSTEMS

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6 Claims. (Cl. 315—83)

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This invention relates to an electric circuit which has for its principal object the automatic dimming of the vehicle headlights in multiple filament headlight lamps so that when a light beam of predetermined intensity falls on a photoelectric tube the electric power is automatically switched from the high to the low beam.

A further object of the invention is the provision of an electronic system for automatically dimming headlights, this system being such that light beams of a predetermined low intensity will always actuate the same for dimming the headlights at the required distance for safe driving at night.

Another object of the invention is the provision of an automatic headlight dimmer which overcomes the difficulty encountered when one vehicle approaches another and both of the vehicles are equipped with such automatic means, wherein the energizing current for the headlight filaments will be directed back and forth between the filaments in an oscillating manner due to the fact that the dim lights of one vehicle have been, in the past, not sufficient for maintaining the automatic electric system of the other car in dimmed condition.

Other objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawing in which

Fig. 1 is a circuit diagram of a form of the invention; and

Fig. 2 shows a modification of a part of a switching arrangement thereof.

As shown in the drawing, reference numeral 10 indicates a battery of an automobile or truck such as the familiar storage battery. The numeral 12 indicates a fuse and 14 indicates a manual switching arrangement such as is found on the dashboard of the usual automobile. The switch at 16 is a double pole, double throw switch which is used as a selector for cutting in or out the automatic system, whereby the operator of the vehicle may go by the well-known system of foot operation for dimming the headlights, or by throwing switch 16 he may cut in the automatic system. The numeral 18 indicates the usual foot-operated dimmer switch and 20 and 22 indicate high and low beams, respectively, of a multiple beam vehicle lamp. It is to be understood that there will, of course, be two headlights and the same automatic system will operate on both simultaneously.

When the switch 16 is connected to contacts 24 and 25 the automatic system is thrown into operation and these contacts apply power for the unit. At 26 there is a line going into a vibrator transformer 28 for a vibrator interrupter 30. The transformer leads into the plates of a rectifier tube 32, having a buffer condenser 33 to assist commutation in the vibrator. The tube 32 is energized as by a lead 34 from the contact 24. The condenser 35 filters the rectified direct current. From the rectifier 32 the current is passed through a pair of voltage regulator tubes 36 to stabilize the voltage applied to the amplifier and pickup stages and in this particular case these voltages are determined at 75 and 180 volts. The resistor 37 serves as a ballast resistor limiting the current to the voltage regulator tubes.

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The 75 volt line leads into a photoelectric tube 38 and causes the current flowing therethrough to be dependent on the amount of light striking it, which light is arranged to come only through a lens 40 according to the teaching of Patent No. 2,375,677, May 8, 1945. A resistor 42 is a protective resistor limiting the maximum value of phototube current and preventing a short on the 75 volt supply.

At 43 there is shown a lead having a grounded shield and going to the grid of a tube 44, the shield preventing stray pickup in the conductor and D. C. leakage to the conductor. Condenser 45 and resistor 46 are connected to the grid also. This condenser and resistor together perform the function of providing a predetermined time delay after the light through lens 40 effects a phototube current to impress a small voltage signal between the grid and cathode of the tube 44. By this means the tube is energized a short interval after the phototube current starts, and also the tube remains energized for a period after the phototube current stops. This result is very important to a proper functioning of the apparatus because it obviates intermittent operation of the relays to be described. Resistor 47 is provided to determine the proper operating point of tube 44.

The tube 44 amplifies the signal obtained from the phototube causing the voltage across a resistor 48 to vary directly with the strength of the signal. 180 volts is applied to the resistor 48 to supply plate current to tube 44. Voltage is appled also to resistor 50 from the cathode of tube 32 in series with resistor 51 to stabilize the circuit and reduce the degeneration caused by using 100 per cent. cathode bias.

Because thermal changes affect the values of resistors and the characteristics of tubes a great deal of trouble would be expected to obtain a temperature-stable amplifier. A method of at-

tacking this problem is to insert a thermistor or a resistor which has definite predictable thermal characteristics in the cathode of the first amplifier 44 to correct the instability of the unit over normal operating temperature ranges. The resistance change in the cathode changes the grid bias to correct for other thermal changes.

To produce a stable amplifier for amplification of small voltage signals at a high impedance level as from the phototube pickup, it is necessary to prevent variations in heater current from causing changes in the tube characteristics of the first amplifier tube 44. To accomplish this end, a special ballast tube 100 which keeps a constant current though it may be connected in series with the heater 102 of the first amplifier tube.

Another method of stabilizing the first amplifier tube over small changes in the 6 volt supply as might appear in an automobile battery when the car is under power is to decrease the bias on the tube when the 6 volt supply decreases and bias decreases. The value of this bleeder resistor is quite critical.

The voltage at the plate of tube 44 varies inversely with the light signal and this varying voltage is applied to a current amplifier tube 54 which converts the varying voltage into a varying current through a relay 56. This relay is connected to the plate of the amplifying tube 54 and at the other end is connected to the 180 volt line as at 58. As the current through the relay increases, it pulls the armature 60 down making a contact at 62 so as to energize a second relay 64, which is connected to contact 25, and has an armature 66 connected as at 68 to the switch terminal contact 25. A spring 70 is used to hold the armature 66 so as to make contact at 72, thus energizing the low filament of the lamp 22, but when the contact 74 is energized, the current is switched from the low filament to the high filament. Hence, it will be seen that the power is used in the circuit to maintain the high filament on, but the current in the system is so modified upon light striking the phototube as to allow the spring 70 to operate.

By sacrificing a small degree of sensitivity, it is possible to use only relay 56 simply by connecting contact 63 directly to low beam filament 22 and contact 62 directly to high beam filament 20.

Condensers 65 and 67 combined with resistor 69 prevent arcing at the contacts of relay 56, and eliminate inference which would be due to such arcing.

The switch system may be modified as shown in Fig. 2, wherein the relay coil 76 is energized in the same manner as before described as to the amplifier tube 54 to shift an armature 78 energized from the contact 25 from a contact 80 to contact 82 against the action of spring 84. When the relay 76 is not sufficiently energized to shift the armature 78, a relay 83 is continuously energized from the battery to maintain an armature 84 in contact with a contact 86 on the low beam of the lamp 88, but when the coil of relay 76 is energized sufficiently to bring the armature 78 to break contact at 80 and make it at 82, another relay 90 is energized similar to relay 82 to bring armature 92 into contact with contact 94 so as to energize the high filament 96.

Whereas leakage currents across phototube sockets and bases and the leads thereto are a great source of instability in the automatic headlight control as well as any other phototube circuit which is exposed to the atmosphere, and whereas this instability causes a change in sensitivity dependent upon the humidity and temperature, means to surmount this obstacle are of considerable importance.

Therefore, the ground shielded lead 43 running from the phototube cathode to the grid of the amplifier tube is a method of eliminating part of this trouble. The shielding prevents current from flowing from the anode lead which connects through resistor 42, to the 75 volt supply to the center conductor which is shielded. The principle involved is that of a guard circuit in that the shield acts to conduct any leakage from the anode lead directly to ground instead of allowing it to leak to ground through resistance 46 which if allowed would amount to a signal voltage applied to the grid of the tube.

Having thus described our invention and the advantages thereof, we do not wish to be limited to the details herein disclosed otherwise than as set forth in the claims, but what we claims is:

1. A photoelectric relay circuit for automatic dimming of multiple filament headlights, comprising a photoelectric pickup device, a voltage regulated power supply, a voltage amplifier tube connected to the regulated power supply, and having the cathode of the pickup device connected to the control grid of the voltage amplifier tube, a current amplifier tube having the control grid thereof connected to the plate of the voltage amplifier tube, a relay in the plate circuit of the current amplifier tube, said relay being normally electrically energized in the absence of light and de-energized upon the application of light to the phototube, and a switch operated by the relay to change the power source from the headlight high beam filament to the headlight low beam filament when it is de-energized by light falling on the pickup device, and upon the removal of the light to change the power source back to high beam filament.

2. A two stage D. C. amplifier circuit comprising a power supply, two voltage regulator tubes and a ballast resistor connected in series across the high voltage supply, a voltage amplifier tube, a plate load resistor therein connected to the voltage regulated supply, a current amplifier tube having the control grid thereof connected to the plate of the voltage amplifier tube, a relay connecting the plate of the current amplifier tube to the regulated power supply, the cathode of the current amplifier tube being connected to the junction point between the two voltage regulated tubes establishing a fixed reference potential for the cathode of the current amplifier tube, a feedback resistor connected from the unregulated high voltage to the cathode of the voltage amplifier tube, said feedback resistor being effective to make the plate voltage of the voltage amplifier tube constant regardless of reasonable variations in the heater voltage in the voltage amplifier tube and variations in the high voltage supply.

3. A photoelectric relay circuit comprising a vibrator power supply, and two voltage regulator tubes connected thereto in series with a ballast resistor, a two stage D. C. amplifier connected to the voltage regulated power supply, a phototube connected to the voltage regulated power supply and a ground shielded wire connecting the phototube cathode to the grid of the voltage amplifier tube, a phototube load resistor connected in parallel with a time delay condenser and connected to the grid of the voltage amplifier tube, a current amplifier tube connected by the control grid thereof to the plate of the voltage amplifier tube, and a relay connected from the plate of the current amplifier tube to the voltage regulated power

supply, said relay being normally energized, becoming de-energized on the application of light to the phototube, the cathode of the current amplifier tube being connected to the junction between the two voltage regulator tubes,a lens and housing employed to concentrate light upon the phototube and provide directional properties to its response, a feedback resistor connecting the unregulated high voltage supply to the cathode of the voltage amplifier tube to stabilize its plate voltage, making the amplifier insensitive to variation in the heater voltage of the voltage amplifier tube.

4. A photoelectric relay circuit for automatic dimming of multiple filament headlights comprising a phototube, a voltage regulated power supply, a voltage amplifier tube connected to the regulated power supply, the cathode of the phototube being connected to the control grid of the voltage amplifier tube, a current amplifier tube connected by the control grid thereof to the plate of the voltage amplifier tube, a relay in the plate circuit of the current amplifier tube, said relay being normally electrically energized in the absence of light on the phototube and de-energized upon the application of light to the phototube, a switch operated by the relay to change the power source from the high beam filament to the low beam filament of the headlamps when the relay de-energized by light falling on the phototube, and upon the removal of the light to change the power source back to high beam filaments, a time delay condenser operative connected to the voltage amplifier tube to slow up the operation thereof, and a guard circuit comprising a ground shield around the grid connections to the voltage amplifier, and a ballast tube in series with the heater of the voltage amplifier tube.

5. Circuit of claim 2 including relay controlled means switching vehicle headlight filaments from high beam to low beam on the application of light and returning the same to high beam when the light is removed.

6. In an automatic vehicle headlight control system, the combination of power supply, a phototube connected thereto, a dark actuated amplifier circuit connected between the phototube and the power supply, a relay in the output circuit of the amplifier, and an electronic means to pull on the relay armature in the absence of light on the phototube, wherein, said relay armature operating as a means to automatically switch lights from high beam to low beam upon the application of light and returning them to high beam when the light is removed.

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