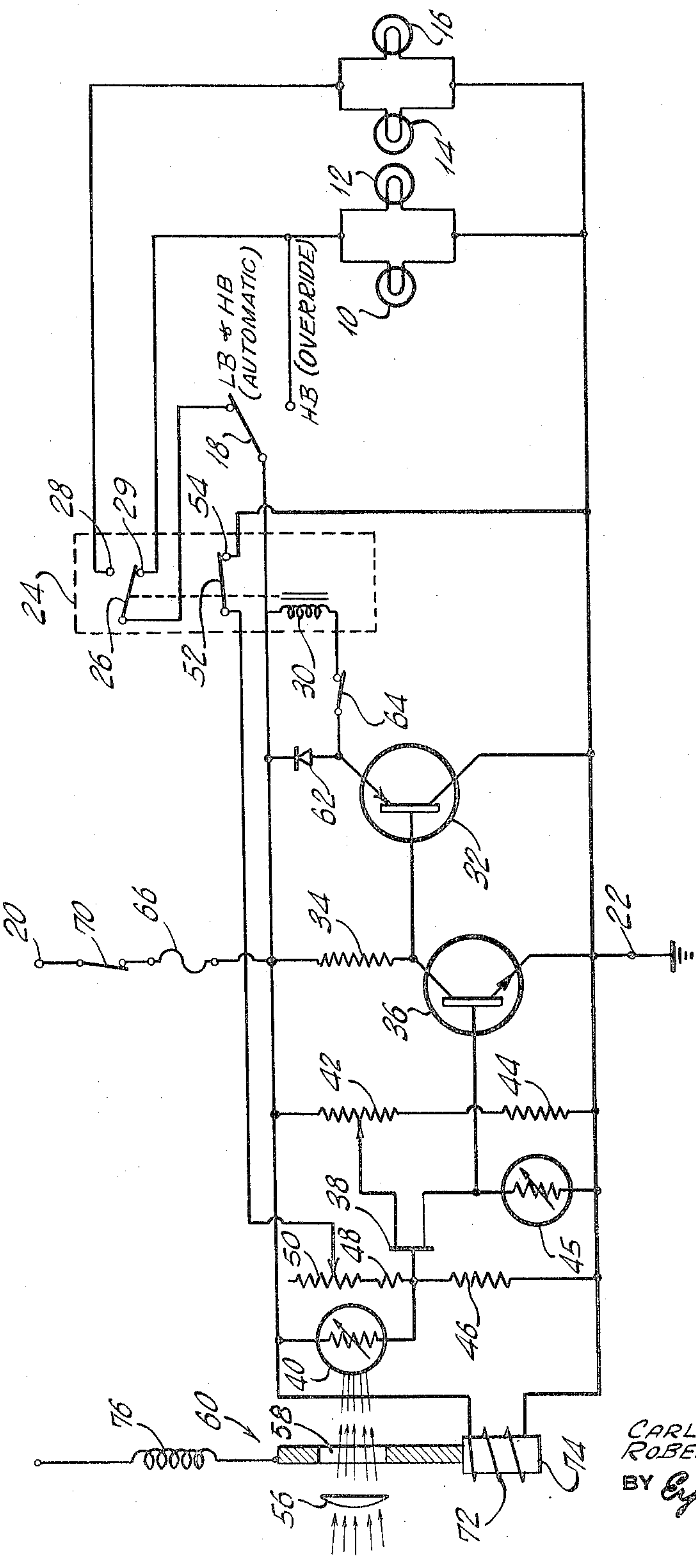
HEADLIGHT DIMMER USING FIELD EFFECT TRANSISTOR

Filed Feb. 21, 1964



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3,303,346
HEADLIGHT DIMMER USING FIELD EFFECT TRANSISTOR

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Filed Feb. 21, 1964, Ser. No. 346,527
5 Claims. (Cl. 250—214)

The present invention relates to the automatic switching of automobile headlamps in response to light from the headlamps of other motor vehicles as they approach and pass and, for this purpose, provides a non-oscillatory circuit which is very reliable, compact, inexpensive, and simple and which will operate directly off an automobile battery.

This circuit employs a field effect transistor whose gate is back biased with respect to its source by a circuit including a photosensitive resistive element positioned in an automobile to pick-up light from the headlamps of oncoming motor vehicles. When the light from the headlamps of an approaching motor vehicle strikes the photosensitive resistive element and thereby decreases the resistance of the photosensitive resistive element, the magnitude of the back bias on the gate is increased thereby decreasing the current flow through the field effect transistor. When the motor vehicle passes, the increase in resistance of the photosensitive resistive element, due to the drop in the intensity of the light reaching the photosensitive resistive element decreases the back bias on the gate of the field effect transistor thereby increasing current flow through the field effect transistor. This variation in current flow through the field effect transistor with changes in light intensity is used to control the energization and deenergization of a relay which in turn controls the flow of current through the filaments of the headlamps so as to cause the headlamps to dim upon the approach of the motor vehicle and to brighten upon the passing of the motor vehicle.

In the preferred embodiment the photosensitive resistor is provided with an electromagnetic shutter. When the headlamps are on, this shutter permits light to reach the photosensitive resistive element to switch the headlamps as outlined above. However, when the headlamps are turned off the shutter shields the photosensitive resistive element from light, protecting the photosensitive resistive element from deterioration due to the adverse effect of sunlight.

For a better understanding of our invention and other advantages thereof reference should be had to the accompanying schematic diagram of the preferred embodiment.

In the schematic diagram, the high beam filaments of the headlamps of the automobile are illustrated by the two filaments 10 and 12, the low beam filaments of the headlamps are illustrated by the two filaments 14 and 16, and the headlamp override foot switch of the automobile is illustrated by the switch 18. With the foot switch 18 in the high beam position, current flows directly from the positive terminal 20 of the battery through the foot switch 18 and the high beam filaments 10 and 12 to the negative, or grounded, terminal 22 of the battery to light the high beams.

With the foot switch 18 in its low or high beam automatic position, the position of the armature 26 of the relay 24 will determine whether the high or low beam filaments are energized. With the relay 24 deenergized, the armature is positioned against a normally closed contact 28 and current flows from the positive terminal 20 of the battery through the foot switch 18, the armature 26, the normally closed contact 28, and the low beam filaments 14 and 16 to the negative terminal 22 of the battery to light the low beam filaments. With the relay energized, the armature is positioned against a normally open contact 29 and current flows from the positive terminal 20 of the battery through the foot switch 18, the armature 26, the normally open contact 29, and the high beam filaments 10 and 12 to the negative terminal 22 of the battery to light the high beam filaments.

The coil 30 of the relay 24 is connected between the positive terminal 20 and the emitter of a PNP transistor 32. The collector of the PNP transistor 32 is connected directly to the negative terminal 22. The base of the PNP transistor 32 is connected directly to the collector of NPN transistor 36 whose emitter is connected directly to the negative terminal 22 and through a biasing resistor 34 to the positive terminal 20. Therefore, the energization of the relay 30 will depend on the voltage drop across biasing resistor 34 which in turn depends on the current flow through the NPN transistor 36.

In accordance with the present invention, current flow through the NPN transistor 36 is controlled by a circuit including a field effect transistor 38 and a photosensitive resistive element 40. The source terminal of the field effect transistor 38 is connected to a sliding tap on a resistor 42 which is connected in series with another resistor 44 between the positive and negative terminals 20 and 22. The drain terminal of the field effect transistor 38 is connected directly to the base of the NPN transistor 36 and through a thermistor 45 to the negative terminal 22. Current flows from the positive terminal 20 through resistor 42 and its sliding tap, the source to drain path of the field effect transistor, and the thermistor 45 to the grounded terminal 22 thereby providing a voltage drop across the thermistor 45 to control the current flow through the NPN transistor 36.

The magnitude of the voltage drop across thermistor 45 depends on the biasing circuit for the gate of the field effect transistor. This biasing circuit includes the photosensitive resistive element 40 which is connected between the gate of the field effect transistor 38 and the positive terminal 20 and a resistor 46 which is connected between the gate of the field effect transistor and the negative terminal 22. It also includes, a fixed resistor 48 and a variable resistor 50 connected in series between the gate of the field effect transistor 38 and the negative terminal 22 with a second armature 52 of the relay 24 and the normally open contact 54 of that armature.

With no light impinging on the photosensitive resistive element 40, the relay 24 is kept energized by the back bias on the gate of the field effect transistor provided by the above-described biasing circuit. Therefore, if the foot switch is in its automatic position, the high beam filaments 10 and 12 are thereby energized. However, when a motor vehicle approaches, the light from its headlamps is picked up by a lens 56 positioned in front of the photosensitive resistive element 40 and is transmitted through the aperture 58 in an electromagnetically controlled shutter to the photosensitive resistive element 40. The light impinging on the photosensitive resistive element 40 causes it to decrease in resistance. This decrease in resistance causes an increase in the magnitude of the back bias on the gate of the field effect transistor 38 thereby decreasing the current flow through the field effect transistor. The decrease in current flow through the field effect transistor 38 drops the potential across the thermistor 45 which in turn cuts the current flow through the NPN transistor 36. A drop in current flow through NPN transistor 36 decreases the potential across the resistor 34 reducing the magnitude of the current through transistor 32 and the coil 30 of the relay 24 causing the relay to become deenergized.

With deenergization of the relay, the circuit through the high beam filaments **10** and **12** is broken by the armature **26**, and the circuit through the low beam filaments **14** and **16** is completed by the armature **26** thereby dimming the headlamps.

The deenergization of the relay also breaks the ground connection to the base of the field effect transistor **38** through resistors **48** and **50**, removing these resistors from the biasing circuit for the field effect transistor **38**. This further increases the back bias on the gate of the field effect transistor **38** assuring that the relay will not be reenergized by the dimming of the approaching motor vehicles headlamps. Of course, when the vehicles pass each other, the decrease in light intensity will be sufficient to cause the relay **24** to be reenergized turning on the high beams **10** and **12** and restoring the ground circuit through the armature **52**.

The taps on resistors **42** and **50** permit adjustment of the circuits for variations in sensitivity from circuit to circuit. The tap on resistor **42** allows adjustment of the light intensity level at which the high beams will go on and the tap on resistor **50** permits adjustment of the light intensity level at which the headlamps will be switched to the low beams. The thermistor **45** is employed instead of a normal resistor to compensate for variations in the characteristics of circuit elements with temperature. To prevent the NPN transistor from being burnt out, a diode **62** is connected across the coil of the relay **30** to shunt current transients.

In certain cases it is desirable that the switching of headlamps not be automatically controlled. For this purpose a switch **64** is connected between the coil **30** of the relay and the emitter of the PNP transistor **32**. When this switch is open it prevents energization of the coil of the relay therefore leaving the low beam filaments energized unless the foot switch **18** is changed to its high beam position.

The circuit as shown at **66**, is fused and is provided with a panel switch **70** for extinguishing the lights altogether. When the lights are extinguished, the coil **72** of the electromagnetic shutter **60** is deenergized since it is connected to the battery in series with the switch **70**. This ends the magnetic force the coil **72** exerted on the paramagnetic plunger **74** allowing the shutter to be drawn upwardly by a spring **76** connected under tension between the shutter and a fixed support. This moves the aperture **58** upwardly, blocking the flow of light to the photosensitive resistive element **40**. Photosensitive resistance elements have a tendency to deteriorate when exposed to light and this is to protect the photosensitive resistive element from light when it is not performing its function.

The invention has now been described in its preferred embodiment. It will be understood that the present application is not limited to the preferred embodiment of the invention but it is intended to cover all changes and modifications of the preferred embodiment which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A control circuit for the headlamps of an automobile

powered directly from the car carried battery and which will automatically dim the high beams at the approach of oncoming motor vehicles and will automatically return the high beams when oncoming motor vehicles pass comprising a photosensitive resistive element positioned in the automobile so that light from the headlamps of oncoming motor vehicles will strike the photosensitive resistive element and decrease its resistance, an amplifying means having an input stage with a field effect transistor and an output terminal at which the magnitude of current flow will vary with changes in the magnitude of current flow through the field effect transistor, biasing means including said photosensitive resistive element connected to the field effect transistor so as to vary the magnitude of current flow at the output terminals of the amplifying means as motor vehicles approach and pass, and an electromagnetic relay having armature means connected to the battery of the automobile, first contact means connected to the low beam filaments of the headlamps of the automobile, second contact means connected to the high beam filaments of the headlamps of the automobile and an electromagnetic coil connected to the output terminals of the amplifying means so that the relay can be energized and deenergized by the changes in current flow at the output terminals of said amplifying means to position the armature means either against the first contact means or against the second contact means.

2. The headlamp control circuit of claim **1** including an electromagnetically actuated shutter means which shields the photosensitive resistive element from light when the automobile's headlamps are off but which permits light to reach the photosensitive resistive element when the automobile's headlamps are on.

3. The headlamp control circuit of claim **1** wherein said biasing circuit back biases said field effect transistor, said back bias being increased by light impinging in the photo resistive element.

4. The headlamp control crcuit of claim **3** wherein said biasing circuit varies as a function the position of the armature to increase the back bias on the field effect transistor when the armature is against the first of the contacts.

5. The headlamp control circuit of claim **4** wherein said biasing circuit includes said photosensitive resistive element connected between the gate terminal and source terminal of the field effect transistor, a first resistance means connected between the gate terminal and the drain terminal of the field effect transistor and a second resistance means which is coupled between the gate terminal and the drain terminal of said field effect transistor only when the armature is positioned against the second contact means.

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