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● NEWS & COMMENT

● CONSTRUCTIONAL

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CAR WIPER DELAY UNIT

J. B. HARVEY B. Sc.

HAVE you ever driven a car in heavy mist or spotty rain (typical British weather!), and found that instead of providing a clear view the wipers merely smear the windscreen, making visibility even worse than ever? The reason for this is that the average car's windscreen wipers may function well in heavy rain, but when it is only raining lightly not enough rain lands on the windscreen between one sweep of the wipers and the following one to lubricate the wiper blades as they travel across the screen.

The Car Wiper Delay Unit described here solves this problem and provides clear visibility in all types of rain. The wipers are allowed to sweep across the screen at their normal speed, but a delay is introduced in between wiper sweeps, where the delay can be adjusted to suit the prevailing weather.

The circuit is suitable for all vehicles, whether positively or negatively earthed, equipped with electrically driven self-parking wipers (i.e. virtually all vehicles, but apologies to owners of 100E's with vacuum driven wipers!).

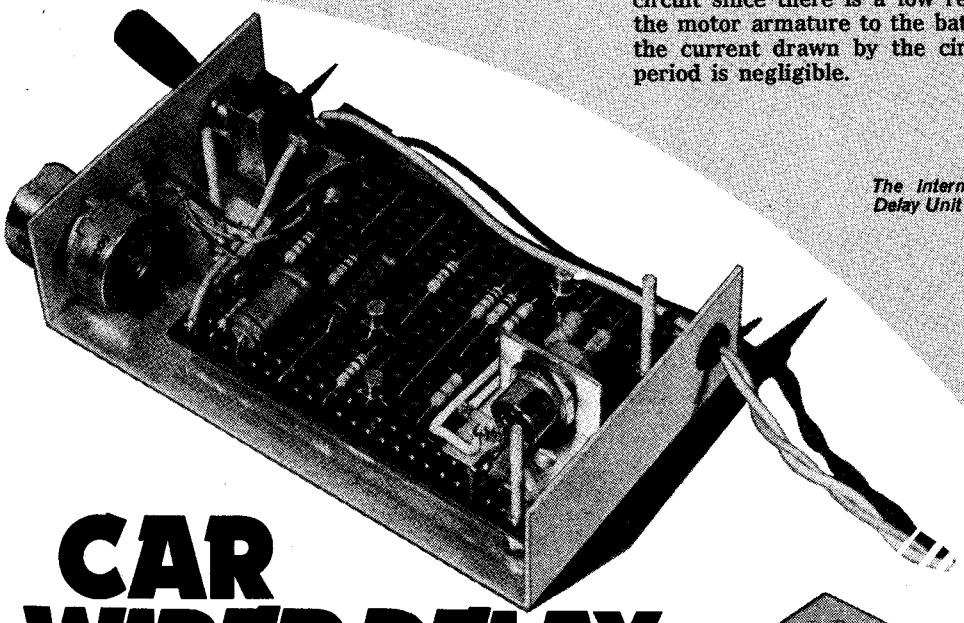
CIRCUIT DESCRIPTION

The circuit is connected across the existing wiper switch as shown in Fig. 1, which shows the arrangement for a vehicle having a negative earth.

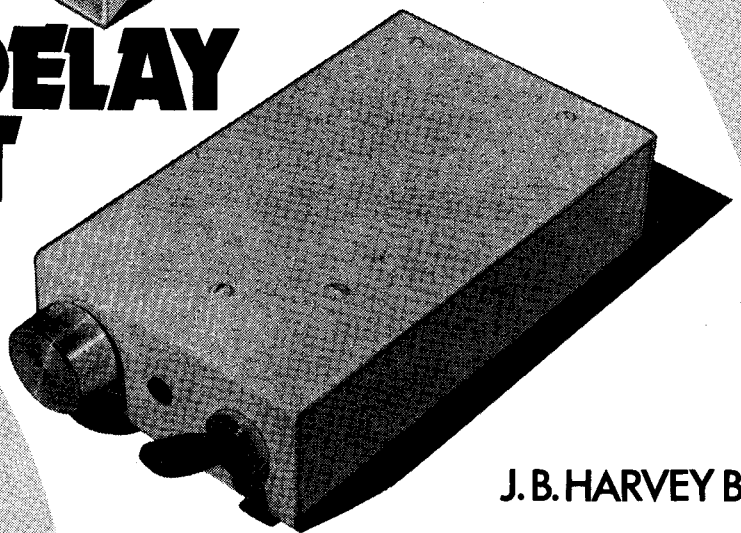
The wiper motor is normally connected via the ignition switch to the live terminal of the car battery, so that when the wiper switch is closed the other motor lead is earthed and the wipers are brought into operation.

A rotary switch is connected to the wiper mechanism which ensures that when the wipers are switched off the motor continues to run until the wiper blades are parked. This self-parking mechanism operates in conjunction with the Wiper Delay Unit and enables a cheap thyristor to be used in place of the relay which is usually found in simple timing circuits.

When S1 is closed, 12 volts appears across the circuit since there is a low resistance path through the motor armature to the battery live terminal and the current drawn by the circuit during the delay period is negligible.



The internal view of the Car Wiper Delay Unit is shown left



The completed unit with the cover fitted is shown right

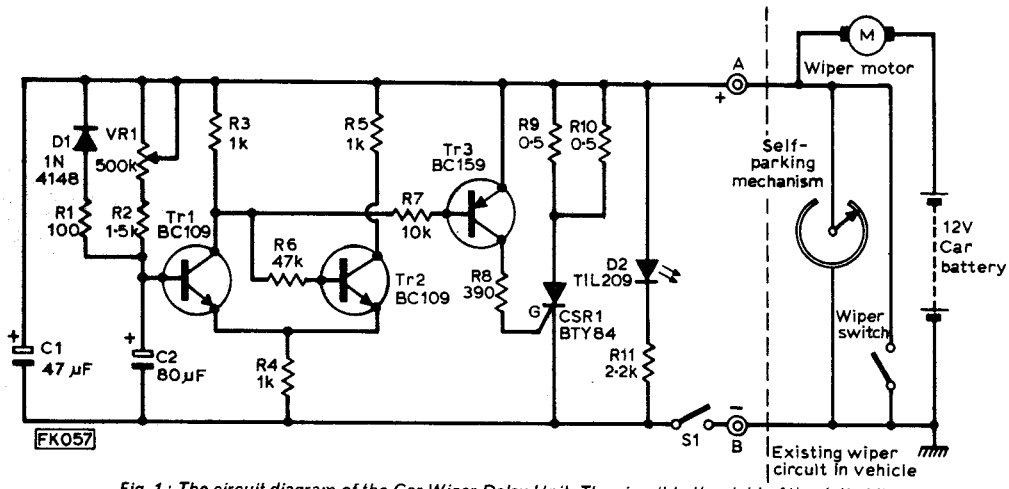


Fig. 1 : The circuit diagram of the Car Wiper Delay Unit. The circuit to the right of the dotted line is typical for a car with negative earth and the wiper switch in the earth lead

The voltage across C2 is initially zero but rises exponentially due to the charging current through VR1 and R2. This voltage is monitored by the level detecting circuit consisting of Tr1 and Tr2.

SCHMITT TRIGGER

This part of the circuit is known as a "Schmitt trigger" and operates as follows. Initially Tr1 is cut off, since the voltage on C2 is low. Tr1 collector is high and is coupled via R6 to Tr2 base, so that Tr2 is turned hard on.

Since R4 and R5 are equal, the voltage at the junction of the two emitters is half the supply voltage i.e. 6 volts. Now when the voltage on the base of Tr1 approaches $(6+V_{be})$ volts, i.e. 6·6 volts, Tr1 begins to conduct. Its collector voltage falls and Tr2 is turned off, causing Tr1 to conduct even harder until it is saturated.

The negative going voltage at the collector of Tr1 is applied via R7 to the base of Tr3, which amplifies the current available to drive the gate of the thyristor CSR1; thus the thyristor conducts and the wiper motor operates. R9 is included to protect the thyristor against current surge when the motor first conducts.

THYRISTOR OPERATION

When a thyristor is made to conduct it will continue to do so even if the gate current is removed until the anode current falls below a threshold known as the "holding current". Consequently if the Delay Unit were being used to drive, say, a lamp then the lamp would remain on until the current were interrupted by opening S1, and similarly if the wipers were not of the self-parking variety then they would continue to function. However, at this point the self-parking mechanism comes to the rescue.

A fraction of a second after the thyristor conducts the self-parking switch makes contact, shorting out points A and B. The switch thus diverts the motor current from the thyristor and removes the gate current, turning off the thyristor but allowing the wipers to complete one sweep of the windscreen. In addition C2 discharges through D1 and R1 in readiness for the next delay period. (R1 limits the discharge current to a safe value for D1.)

At the end of the sweep the self-parking mechanism switches off the wiper motor, 12 volts is restored across the circuit and the cycle of events is repeated.

Capacitor C1 is included to protect the circuit against possible voltage spikes from the car's ignition circuits, although no trouble has been experienced in the prototypes.

DELAY PERIOD

The delay period is determined by the time taken for the voltage on C2 to reach 6·6 volts, and is approximately equal to $0{\cdot}7\times CR$ (C in farads, R in ohms). Thus with the components specified the maximum delay is 28 seconds.

A delay of several minutes may be obtained by increasing C2; e.g. 500 µF gives three minutes. However, such a long delay is rarely required and adjustment in the most useful range of approximately one to ten seconds becomes very critical. VR1 should not be increased in value to obtain a greater delay since there may then be insufficient base current to turn on Tr1.

★ components list

Resistors

R1	100Ω	R7	10kΩ
R2	1·5kΩ	R8	390Ω
R3	1kΩ	R9	0·5Ω 3W
R4	1kΩ	R10	0·5Ω 3W
R5	1kΩ	R11	2·2kΩ
R6	47kΩ		

All resistors 5% ¼W except where stated
VR1 500kΩ linear

Capacitors

C1 47µF 25V elect.
C2 80µF 25V elect.

Semiconductors

Tr1 BC109 (or BC149)
Tr2 BC109 (or BC149)
Tr3 BC187 (or BC159)
D1 1N4148
D2 TIL209 light emitting diode
CSR1 BTY84 100V 12A (Henry's Radio)

Miscellaneous

Veroboard 63 x 95mm (2½ x 3¾in), 0·15in matrix.
S1 Single pole on/off switch
Knob. Materials for case and heatsink.

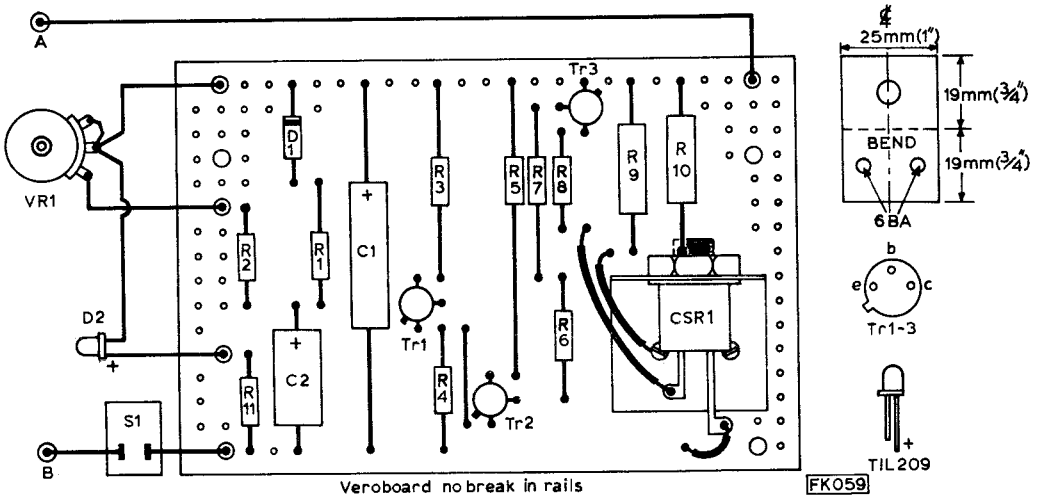


Fig. 2: Layout of the components on the Veroboard panel and interwiring details. The copper strips run horizontally. The connection to the thyristor anode is made via a solder tag on the heatsink

An indicator is optional, but useful to show when the Wiper Delay Unit is in operation: a small red light-emitting diode D2 was used in the prototype. LEDs have now become comparable in price to a bulb plus bulb-holder and are widely advertised; the one used in the prototype came complete with a little plastic clip for panel mounting.

A bulb could, of course, be used instead, but note that since the indicator will turn off during the course of each wiper sweep, the bulb or LED should be run at a reduced current to avoid distraction at night: hence the high value for R11.

CONSTRUCTION

The circuit may conveniently be constructed on a $3\frac{3}{4} \times 2\frac{1}{2}$in piece of 0·15in pitch Veroboard. If the layout in Fig. 2 is used then no track breaks will be necessary to accommodate the circuit, although care must be taken to ensure that any nuts and bolts used do not make contact with the tracks.

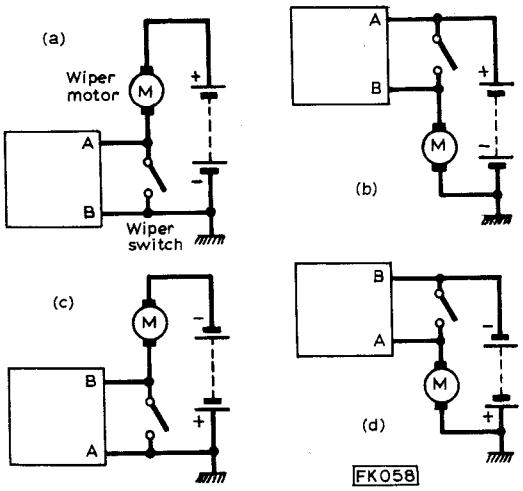


Fig.3: Connections for the four types of wiper arrangements Negative encountered. (a) Negative earth, wiper switch in earth lead (b) normally earth, wiper switch in live lead (c) Positive earth, wiper switch in earth lead (d) Positive earth, wiper switch in live lead.

The thyristor is mounted on the board using a small bracket. Note that although the wiper motor typically draws 5A the thyristor and R9, R10 run quite cold, because they only conduct for a fraction of a second during each wiper sweep, the self-parking switch taking over for the rest of the sweep.

The thyristor specified is rated at 12A which is over twice the current drawn in this circuit. However it is readily available for less than 50p which is considerably cheaper than any thyristor in the 5A range, with the added bonus of substantial overload protection.

INSTALLATION

The method used to install the completed circuit will depend on the vehicle for which it is intended. The prototype was mounted in a simple box formed from two pieces of aluminium sheet and sprayed with aerosol paint to match the car: if this is done then it is a good idea to rough up the aluminium surface with fine glasspaper to improve paint adhesion. Alternatively the controls may be mounted directly onto the dashboard and connected to the circuit board by flying leads.

The circuit should be constructed so as to be entirely isolated from the car chassis, the earth connection being provided by a single lead from point A or B, depending on the polarity of the car's electrical system.

In view of the current drawn fairly thick wire should be used to connect up the Wiper Delay Unit to the vehicle. The circuit is identical for systems of either polarity, only the connections being different (see Fig. 3). Thus it is not necessary to construct another circuit if you exchange your elderly positively earthed car for a newer model with a negative earth. Neither is it necessary to have one side of the circuit at chassis potential: so long as the circuit is fully isolated from the chassis it may be used with a vehicle whose wiper switch is connected to the live side of the wiper motor, provided of course that the wipers are self-parking.

The circuit will work without modification in vehicles using 6 volt or 24 volt electrical systems, the delay time being almost independent of supply voltage. PW