Henry G. Elwell, Jr. N4UH
Rte. 2, Box 20G
Cleveland NC 27013

The Hesitator: A Windshield Wiper Control

—a rainy day project

This article is for the amateur who wants to make an inexpensive electronic device, using an integrated circuit, for his own pleasure or as a gift to a friend or friends. It is a hesitation circuit for your automobile windshield wiper and will cause delays of 2 seconds up to 15 seconds in the repetition cycle of the windshield wiper. It's great for misty or very light rainfalls.

It was mounted in a small box, fitted behind the instrument panel, and mounted by the potentiometer-securing nut. The wiring changes require the cutting of one wire in the wiper motor circuit and the soldering of ground and 12-volt power leads. I've built three for my friends and one for myself; they work great.

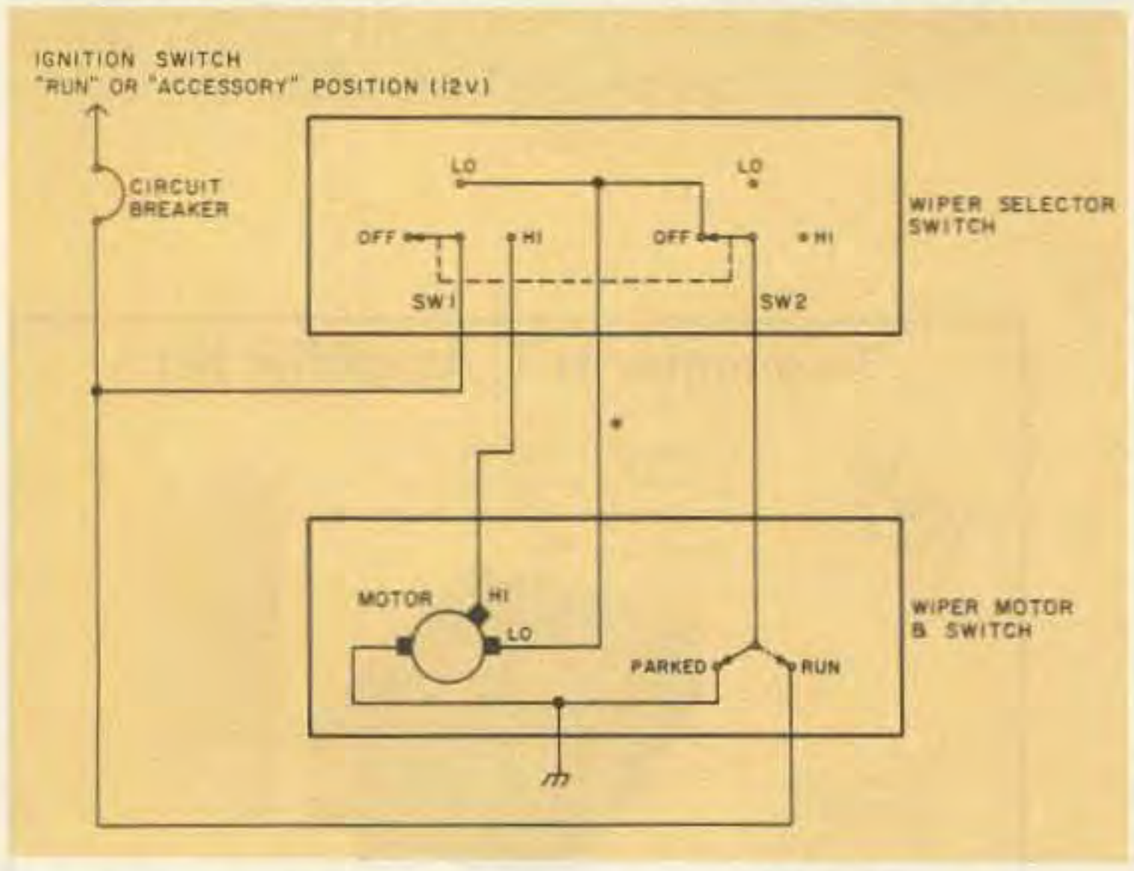

*Fig. 1. Automobile wiring circuit of windshield wiper control. The * indicates the point at which the hesitation control unit is installed.*

Automobile Wiring

The standard wiring for an automobile windshield wiper circuit is shown in Fig. 1. To understand the simplicity of the required wiring changes, let's go through the circuit. The ignition switch is in engine run or accessory position. To make the wiper motor run, it is necessary to have a complete circuit from 12 volts to the motor and then to ground. Notice that two switches are involved: the wiper selector switch, which permits selecting a low-speed, high-speed, or off position, and a wiper motor switch with parked and run positions.

In the off position of the wiper selector switch and parked position of the wiper motor switch, 12 volts cannot be supplied to the wiper motor.

If the wiper selector switch is turned to LO, 12 volts is supplied to the LO connection of the motor, then to ground, and the wiper motor moves the windshield wiper across the face of the windshield. When the selector switch is turned to HI, 12 volts is connected to the HI winding of the motor, which moves the windshield wiper at the higher speed.

Anytime the motor is running, it actuates an SPDT switch that alternately moves from ground to 12 volts. The ground position is known as the parked position and the 12-volt position as the run position. The run position takes up approximately 95% of the total time for one cycle of movement of the wiper.

When the wiper selector switch is moved to the OFF position, 12 volts is no longer applied to the motor from the SW1 contacts. If, as is the usual case, the wiper blades are not in the nest-

ed position at turn-off time, the wiper motor switch will be in the run position. While in this position, 12 volts will be connected through the switch, through the OFF position SW2 contacts of the wiper selector switch, and to the LO winding of the motor. The motor will continue to run until the motor switch is automatically moved to the parked position. At that time, voltage is no longer applied to the motor, and the wiper blades stop at their nested position.

To put in a hesitation control circuit, it is necessary to break and insert such a control at the point shown in Fig. 1. (See the asterisk.)

Fig. 2 shows the insertion of the control unit, which essentially is an SPDT switch contact operated by a relay, at that point.

In the unenergized condition of the relay, as shown, the contacts look like a straight-through connection, and the wiper selector switch is in control as already explained. (Keep the wiper selector switch in the OFF position.) When we momentarily (1/2 second, or so) switch the control unit contacts to 12 volts manually, the wiper motor will run and move the wiper motor switch to the run position. The wiper blades will make one complete cycle and return to the nested position. Power to complete the cycle is from 12 volts, through the wiper motor switch run position, the OFF position of wiper selector switch SW2, through the unenergized position of the control unit switch, and to the wiper motor. The motor stops when the wiper motor switch goes to the parked position.

All we have to do to make a hesitation controller is to devise a periodic short-term on-condition of its output so as to momentarily connect the LO motor lead to 12 volts to get it into a run/park cycle and to vary the time delay between repeating cycles.

Hesitation Control Unit

The hesitation control unit is designed around the faithful 555 timer. I learned how to use the timer from references 1, 2, 3, and 4. I know that there are a lot more articles on 555 applications, but these were enough.

Fig. 3 shows the schematic of the circuit used with the 555 timer in the astable, or oscillatory, mode. Two diodes in the timing circuit, CR1 and CR2, are used to select the charge and discharge times independent of each other's time constant.

Assume that the timing capacitor, C1, is charging towards 12 volts through CR1 and R1. The timer output (pin 3) will be high, and the length of time it is high is a function of R1 and C1. With the values shown, it is about 1/2 second. When C1 charges to the threshold trip level of the timer, both pin 3 and pin 7 go low. Then timing capacitor C1 will discharge to ground (pin 7) through CR2, R2, and R3. The length of time the timer is off is a function of the values of C1, R2, and R3. R3 is a potentiometer which is varied to control the amount of "hesitation" of the output. In the design shown, it is approximately 2 to 15 seconds. R2 is used to provide a minimum time delay when R3 is at its zero Ohms position.

As soon as the capacitor discharges to the lower trip level of the 555, pin 3 again goes high, completing the cycle. This oscillation continues as long as power is applied to the circuit.

For those who might want to change the above times: charge time = .67C1R1; discharge time = .67(R2 + R3)C1, where C is in farads and R is in Ohms.

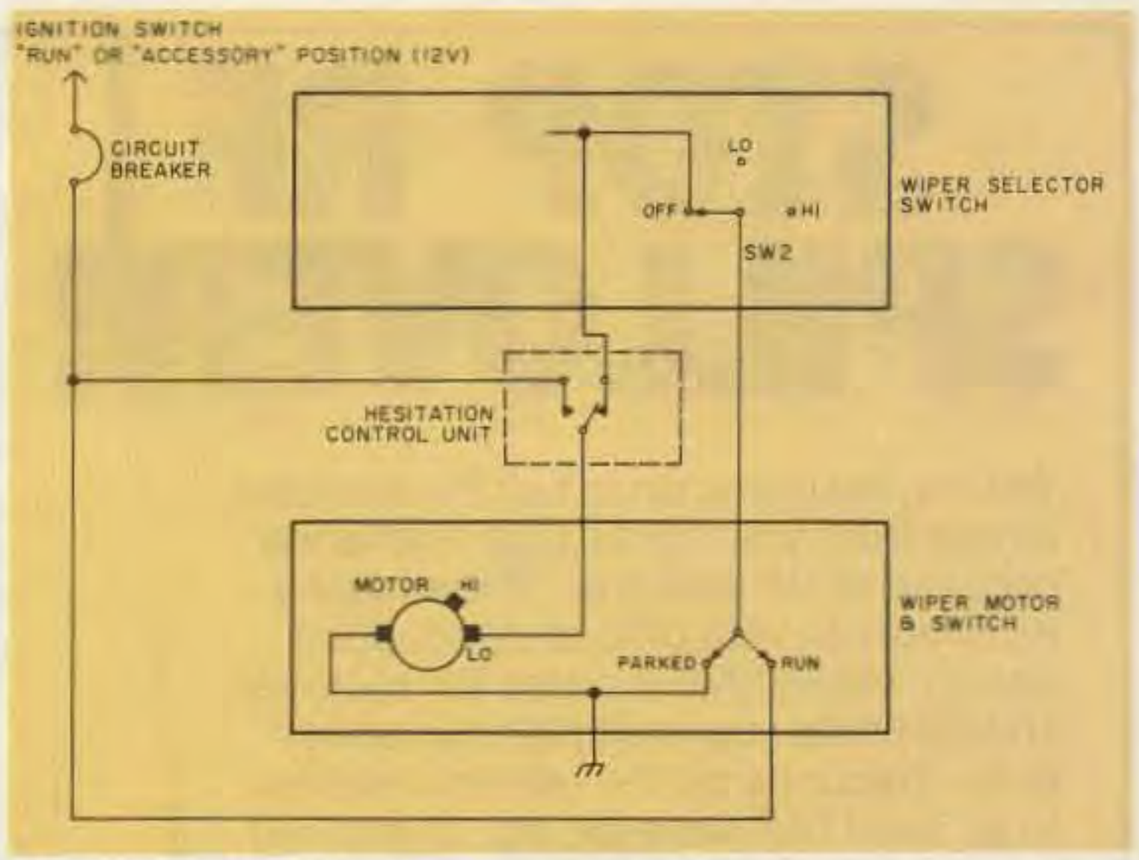

Fig. 2. Windshield wiper control with hesitation control unit added.

Because the relay which pin 3 drives is an inductive load, protective diodes are required to prevent the inductive kick at turn-off from latching or otherwise damaging the output of the timer.

Construction

Construction of the control unit was made as simple and inexpensive as possible. A chassis box 2-3/4" × 2-1/8" × 1-5/8" was used. Prepunched perfboard with holes spaced on a 0.1" × 0.1" grid measuring 1-3/8" × 1-7/8" was used as the mounting board for all components except the relay and its two diodes. The board was selected to permit an 8-pin IC socket to be used for the 555. The board was mounted on the back of the switch/potentiometer by drilling two holes in the board to clear the switch lugs. Using #16 solid wire to the lugs was sufficient to hold the board securely to the potentiometer/switch combination. Point-to-point wiring was used for the components.

The relay used is of the plastic-cased type. It was mounted to the box by removing its plastic cover and drilling a hole in the top of it to pass a #6 machine screw. The screw must be a flat-head type, with the head on the inside of the plastic cover. Use of a flat-head screw provides suffi-

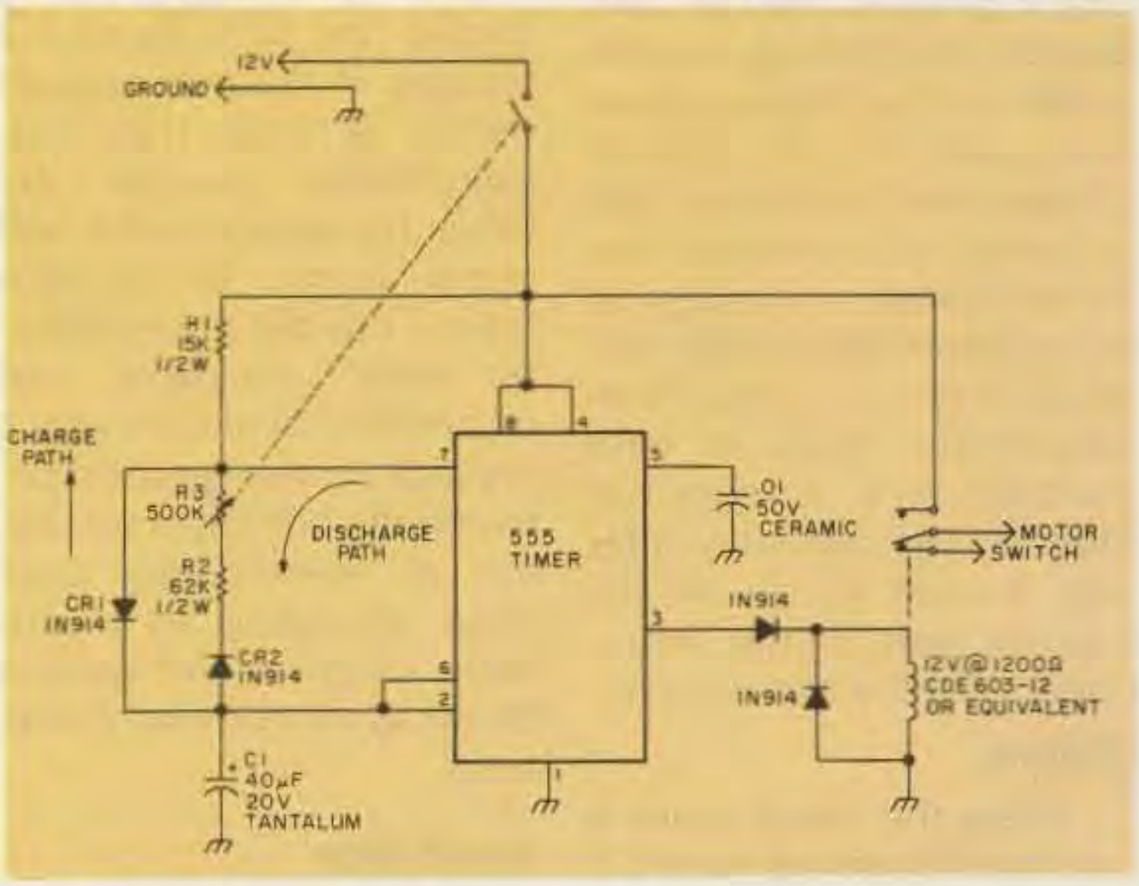

Fig. 3. Windshield wiper hesitation control schematic.

cient clearance between the relay and the screw head. When the cover is reassembled with the relay, the whole thing is mounted on the side of the chassis box with an external nut.

Four connections are required between the control unit and the automobile: 12 volts, ground, motor, and switch. A solder lug secured under a chassis box screw was used for the ground connection. I could not find a suitable three-post terminal board, so I ended up using three phono jacks and plugs; it is nice to be able to disconnect leads in case maintenance is ever required. The potentiometer nut is used to secure the control unit to the instrument panel of the vehicle.

Testing

When the control unit is completely wired, check it with an ohmmeter between the positive power connection and ground to ensure that there are no shorts. Then connect 12 volts and ground to the proper leads, as well as a voltmeter between ground and the "motor" lead of the unit. Turn on the switch. The voltmeters should indicate an initial 12-volt reading, as C1 begins to charge, but it should last only about 1/2 second. If the potentiometer is left in the just-switched-on position, another 1/2-second pulse will occur about 15 seconds later. Turn the potentiometer fully clockwise, and pulses should occur every 2 seconds. Pulse pauses between the pot limits will occur at intermediate positions, providing an adjustment range to suit various damp to wet driving conditions.

Installation

The wiper motor usually is mounted on the engine side of the fire wall and on the driver's side of the car. To help locate it, try this: With the car engine off and the ignition switch in the accessory or run position, actuate the wipers. By feeling the running wiper motor, you can verify the fact you found it from the vibration on your hand.

It is necessary to identify two leads on the motor (there are usually four): the low-voltage lead and the 12-volt lead.

Most cars have a connector and plug at the motor; disconnect them. If there is no disconnect, the insulation of the leads will have to be cut to make voltmeter connections. With the ignition switch on and the wiper selector switch off, determine which of the four leads has 12 volts on it. That is the lead to the "run" connection of the wiper motor switch. It is always hot (12 volts) when the ignition is on and will be used to power the control unit.

Next, with the wiper selector switch in the low-speed position, determine which additional lead now has 12 volts on it. This is the lead which must be cut.

Now find a suitable mounting place for the control unit on the instrument panel. A 3/8"-diameter hole (or one to match the shaft of the pot you used) is drilled in the panel and the control unit secured by the nut on the potentiometer.

In addition, a hole through the fire wall must be found to pass the four wires connecting the control unit to the wiper motor. In some cars, a spare blank rubber grommet may be used by drilling a hole through it for the cable. In other cars, a large existing grommet may be drilled to pass the additional wires. If a new hole must be drilled, use a rubber grommet to provide a tight fit around the wires to prevent engine fumes from getting into the interior of the car.

Determine the wire length needed to go from the control unit to the wiper motor and pass them through the fire wall. Cut the low-speed motor wire and put solderless quick-disconnects on the two separated wires, as well as the two mating wires in the cable. The wire still connected to the motor goes to the "motor" lead of the control unit. The other cut wire is designated as "switch" and goes to that label on the control unit. The ground lead from the control unit is connected (or better, soldered) to a lug placed under a grounded screw on the motor.

The insulation of the hot wire (12 volts) must be removed over a 1/2", or so, length, and the 12-volt lead from the control unit soldered to it. Tape all leads and secure the cable in some manner so that it will not vibrate excessively. Cut off the excess length of the potentiometer shaft and put a nice knob on it. Now you can enjoy driving in a misty or slight rainfall instead of fiddling with the wiper switch. The adjustable wiper rate will keep the windshield clear without needless use of your wipers. You also will have the satisfaction that as an amateur you can make something "practical" to use or to give to your non-technical friends. ■

References

1. "IC Timer Review," H. M. Berlin W3HB, January, 1978, *73 Magazine*.

2. "555 Basics—and More," David Keeler WB4CEO, November, 1978, *73 Magazine*.

3. "Operational Characteristics of the 555 Timer," Bob Marshall WB6FOC, March, 1979, *Ham Radio*.

4. *TTL Cookbook*, Don Lancaster, pp. 171-175.

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