Sure-fire ignition system safely limits engine rpm

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For a capacitive-discharge automobile ignition system to work properly, the SCR in the circuit must receive an accurate and stable triggering signal. The circuit shown not only produces a reliable SCR trigger, but also filters point-bounce, limits rpm, and buffers the point opening.

The trigger pulses for the SCR are generated by a conventional unijunction-transistor trigger circuit that contains a UJT having a high intrinsic standoff ratio (η). The values of resistors R_1 and R_2 are chosen to make $R_2/(R_1+R_2)$ less than η.

When the points close, the bipolar transistor turns off and the base-2 voltage (V_{B2}) of the UJT becomes approximately $12R_{BB}/(R_{BB}+1\ k\Omega)$, provided that resistor R_1 is much greater than 1 kilohm. (R_{BB} is the interbase resistance of the UJT.) Capacitor C_1 charges to a voltage that is slightly less than ηV_{B2}.

When the points open, the bipolar transistor saturates, pulling V_{B2} to about 6 V and raising the capacitor's voltage to more than ηV_{B2}. The UJT now goes into avalanche, producing a voltage pulse across resistor R_3 that fires the SCR. The charging rate of capacitor C_1 limits the SCR's firing repetition rate, thereby providing point-bounce filtering and rpm-limiting.

Suppose that an rpm limit of 6,000 is to be imposed on an eight-cylinder engine. For a type-2N4871 UJT, $\eta = 0.75$ and $R_{BB} = 6$ kilohms. Resistor R_1 can be set equal to 21.4 kilohms, and resistor R_2 to 50 kilohms, so that $R_2/(R_1+R_2) = 0.7$, which is less than η. The firing voltage for the UJT is 4.55 V, and capacitor C_1 must charge to this voltage 6,000 times per minute.

Two different charging rates occur because the target capacitor's voltage changes when the points close. If the point gap is adjusted properly, the ratio of the closed period to the open period is ⅔ to ½. Since the total period is 2.5 milliseconds, the points remain open for 0.833 ms and closed for 1.67 ms. The value required for capacitor C_1 can be found by computing capacitor voltage at the end of each of these periods. In this case, a value of 0.05 microfarad has been chosen for C_1.

The exact rpm setting needed for limiting can be obtained by adjusting the value of resistor R_4 slightly. When the limiting speed is reached, the ignition fires every other plug, in this way avoiding the severe transient loads associated with circuits that shut down completely to limit rpm.

Although the circuit shown here is for a point-driven system, it can be adapted easily for a magnetic or optical pickup by removing resistor R_5 and driving the bipolar transistor with a logic-level signal. □

Improving gas mileage. Efficient automobile combustion is provided by this capacitive-discharge electronic ignition, which features reliable SCR-triggering. The charging rate of capacitor C_1, because it determines how often the SCR is fired, provides rpm-limiting and point-bounce filtering. When the limiting speed is reached, only every other plug is fired to avoid the transient loading caused by a complete shutdown.