

Theory and Advantages of Breaker Point-Triggered, Transistorized Ignition Systems

By J. David Kirk
Kirk Engines, Inc.

For engines equipped with battery and coil ignition systems that utilize breaker points, several significant benefits may be obtained by implementation of a transistorized ignition circuit. Such a device still employs the breaker points but they are converted to function as a switch, controlling a transistor that is designed to handle the coil primary current. By proper component selection and circuit design, the points can be arranged to handle only a fraction of the current they formally did, greatly increasing their working life span. Thus, the transistor may be thought of as functioning as solid-state relay and the points become a trigger. Other important advantages are realized as well and will subsequently be discussed.

In the conventional system, points can see currents of 3-4 amps and break voltages of up to 200 volts when the coil discharges. This "back emf" (electromotive force) is due to the design of the ignition coil and its inherent inductance. This feedback of electrical energy causes a spark to occur at the points that pits and erodes the contact surfaces over time. To suppress this energy, a condenser is used. Its purpose is to provide a low-loss shunt path to ground (absorbing the back emf), and in so doing it interrupts the primary current as quickly as possible when the points open. Without the condenser, the back emf would form an arc across the points as they separate, slowing the collapse of the coil's field, thus delaying and thereby reducing the voltage rise in the secondary coil winding. The condenser suppresses most, but not all of the back emf. Hence, contact deterioration still occurs, continually degrading ignition system potential. The effects of contaminated points are particularly noticeable during cold weather starting when cranking speeds are low. Poor electrically conducting contacts combined with slow breaker opening greatly reduces (or even eliminates) production of an adequate secondary coil voltage to fire the spark plug, resulting in poor (or no) engine starting.

To summarize, the faults of the conventional system are as follows:

- Relatively short life of breaker points due to high current flow through small surface area.
- Poor starting due to slow opening of points at cranking speeds.
- Continued degradation of secondary voltage rise and maximum energy attainable due to deteriorating breaker point contact surfaces over time.
- Inability to fire partially fouled spark plugs due to slow voltage rise time.

All of these faults are primarily due to an inefficient method of rapidly interrupting the primary circuit current, this being a function of the mechanical breaker points.

The fundamental challenge is to reduce the primary coil current to zero as quickly as possible, and so obtain a rapid collapse of the magnetic field, thus producing the maximum energy in the secondary winding, and therefore the highest energy at the spark plug.

Enter The Power Transistor

The ability of a transistor to switch high currents efficiently makes it perfectly suitable for use in an ignition system. In the transistorized system, all of the above mentioned disadvantages are eliminated or greatly improved upon. As previously stated, a circuit is designed such that breaker points only handle the base triggering current for the transistor – this amounts to only 100 milliamps for the PointSaver module (versus 4 amps in the conventional system). The breaker points now control a low current, non-inductive circuit that produces minimal arcing, thus the condenser is no longer required. The life of the contact surfaces is thus vastly increased. The power transistor, functioning as a relay in the primary, grounds the circuit when points are closed and opens the circuit when the points break, thus mimicking the action of the breakers. It can easily handle the back emf generated by the coil without even getting warm. Switching action is extremely rapid due to the nature of semiconductor action and the elimination of the condenser from the circuit (coil field collapse time is a function of time required to charge the condenser). The faster switching produces a faster voltage rise time (by a factor of 5) at the coil. The effect is a higher secondary voltage (with shorter current duration) delivered to the spark plug.

The overall improvements compared to the conventional system are summarized as follows:

- Breaker point contact surfaces last the life of the engine.
- Improved cold starting due to faster rise time offered by transistor switching.
- Improved consistency and repeatability of secondary voltage energy and waveform without degradation over time.
- Ability to fire partially fouled plugs due to aforementioned rise time improvement.

Another added benefit of this system is that inductive tachometers may now be used and will read accurately. This is attributed to elimination of the condenser and the inductive-capacitive circuit thereby formed that causes error-producing current oscillations.

Modern semiconductor components like those used in the PointSaver module offer high reliability in service. Normally destructive heat is not generated in this design allowing all components to be epoxy potted for moisture and vibration protection. The module is installed between the coil and breaker points, known as a “hot” coil circuit. This simplifies installation, as only a 3-wire hook-up is

necessary. Over a given time, this economically priced system will pay for itself by eliminating costs associated with replacement of breaker points and condensers. This is accomplished within two tune-up intervals with a conventional ignition system.