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IGNITION SYSTEM OVERVIEW

Ignition System Components and Operation

If the components and tasks of the ignition system are visualized, it is easier to understand the ignition, and where to test the ignition.

The main components of the ignition circuit are the battery, primary windings of the coil, secondary windings of the coil, pulse generator, ignition module, spark plug wires and spark plugs.

The electronic ignition module, or computer-controlled ignition module, controls the timing of the ignition system. A transistor inside both of these ignitions will switch the current off in the primary circuit of the coil. This will trigger the ignition spark.

Vintage motorcycles rely on mechanical points for switching the coil primary circuit.

The transistor is simply a switch. It allows current to flow from the battery to the primary ignition circuit. The transistor turns on and off in response to electrical pulses that come from the pulse generator located on the crankshaft (or camshaft).

The **primary ignition circuit** consists of the battery, the primary windings of the coil, and the electronic ignition module or computerized ignition circuit.

The **secondary ignition circuit** consists of the secondary windings of the coil, the spark plug wires, and the spark plug.

When the transistor in the ignition module turns off the roughly 13 volts of battery current flowing into the primary coil windings, the magnetic field in the primary windings collapses. This collapse generates 200 to 500 volts of current. This current then flows into - and is induced into - the fine secondary windings.

The secondary windings step up the voltage to 10,000 volts or more. This high voltage then flows through the spark plug wires to the spark plugs. The high voltage jumps the spark plug gap and creates the spark that ignites the air-fuel mixture in the combustion chamber.

Ignition System Testing

Where should testing begin if testing the ignition circuit?

As listed, the main components of the ignition circuit are the battery, primary windings of the coil, secondary windings of the coil, pulse generator, ignition module or computerized ignition circuit, spark plug wires and spark plugs.

Consider for a moment the first component in a typical ignition signal chain – the pulse generator. A pulse generator, such as an AC pickup coil, sends electrical pulses to the ignition module. These electrical pulses control the switching of the transistor in the ignition module. The ignition transistor turns off the current to the primary circuit in order to fire the ignition.

First of all, the AC pickup coil is not located in an easily accessible place in the engine. It would not be a wise expenditure of time to start ignition testing by checking out the pulse generator.

Secondly, electronic ignition modules and computer-controlled ignition circuits are typically well built and strongly made. They do not break often. Coming to a quick conclusion that “the ignition module must be bad” is not a highly probable cause of ignition problems.

If computer controlled circuits – including the ignition circuit - become defective, it will likely result in multiple different and “contradictory” malfunctions on the motorcycle that don’t make sense. Onboard computer malfunctions will likely cause erratic failures in different motorcycle systems.

First one problem starts, then all of a sudden a different problem develops. This may tell the technician that “the brain” has gone bad. The computer

can’t think logically anymore to perform all of its’ many functions properly and on time.

A loose wire connection to, or from, the ignition is more likely to be a problem that a bad ignition. A visual check can be done quickly for loose wire connections, a corroded connection, broken ignition wires, or a corroded ignition wire. Push connectors together firmly.

The most logical place to begin testing the performance of the ignition is to test the secondary. The secondary is where the final product of the ignition is displayed. The secondary involves the continual delivery of 10,000 volts or more to the spark plugs. The secondary voltage must be strong, and the voltage must be delivered consistently – one spark after the other.

TESTING THE SECONDARY CIRCUIT

Testing The Secondary

On most bikes, the spark plugs are relatively easy to access – especially big-twin cruisers. With V-twins, it is typically very easy and fast to pull the spark plug out, ground it to the engine, and turn over the engine. If a spark is produced, this assures the tester that, at least on the surface, the ignition system seems to be working.

The question now, is how strong the spark is. Is it a weak spark due to carbon fouling? If the plugs are covered with dry black soot, or oiled up and greasy, it may be best to just replace the plugs and continue testing. This takes the spark plug itself out of the troubleshooting loop. Fouled plugs are the most common cause of ignition problems. Spark plugs are not expensive when compared with the labor cost of extended troubleshooting.

It is up to the technician to decide whether the plug is fouled, worn out, plug gap is too wide or too narrow, or whether the wrong type of plug is being used.

There are various types of testers that can test the secondary voltage without pulling the plug out. The easiest to use is the inline spark tester that attaches to the spark plug wire cap on one end, and is grounded to the engine on the other end. A window will display a spark firing across the gap of this “fake spark plug” as the engine is turned over.

The inline spark tester simply shows whether the spark plug is, or is not, receiving current from the secondary. That is of course good to know.

However, an inline spark tester only confirms that voltage is flowing to the spark plug. It does not measure the amount of voltage, or whether the voltage is being delivered consistently and on time to the spark plug. It does not quantify spark plug performance. *(See photo on page 9)*

Another secondary tester is designed like a spark plug with an adjustable air gap. It attaches to the end of the spark plug wire and measures the strength of the voltage by testing how far the spark can jump a gap.

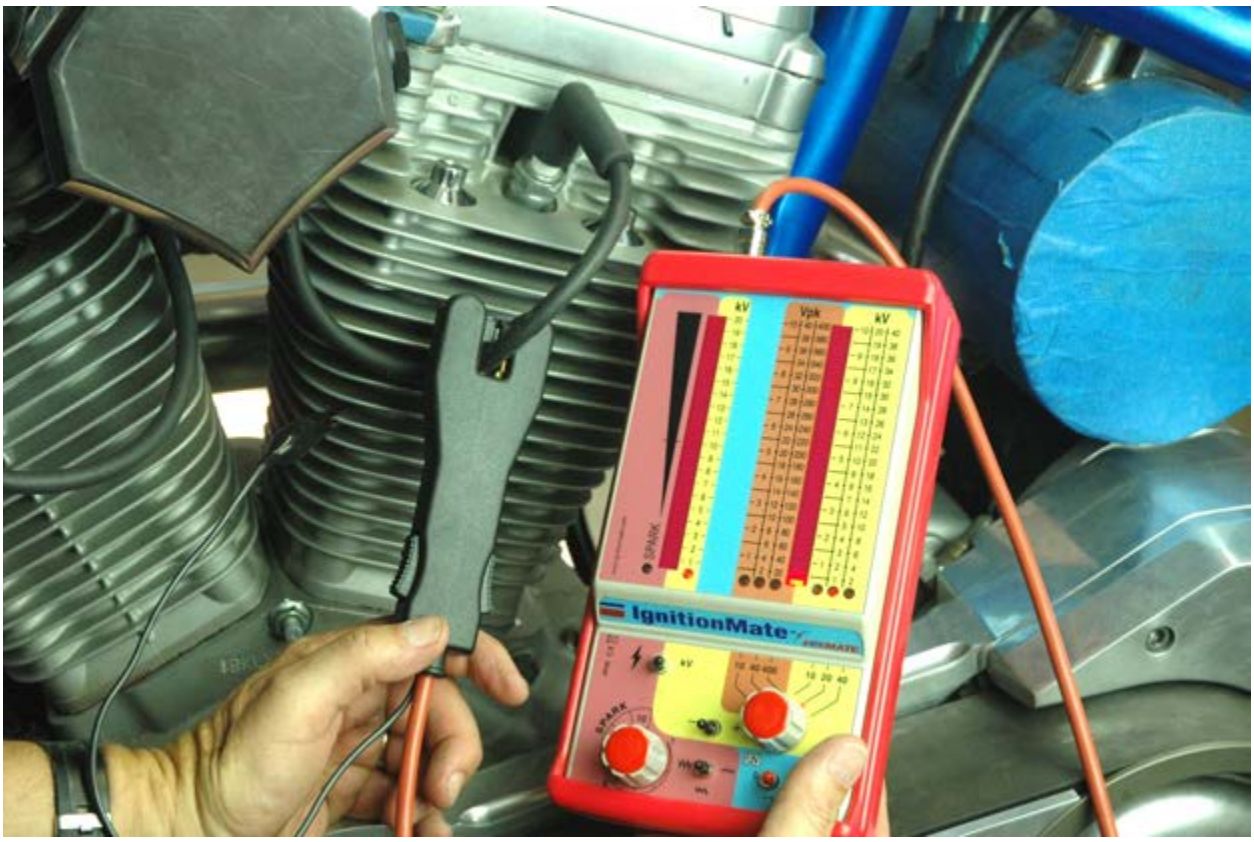
This tester supplies a little more information about the strength of voltage production in the secondary. It is a good testing tool, although the amount of voltage is not quantified precisely. *(See photo on page 10)*

The best secondary ignition tester is made by Tecmate in Canada. It is called the IgnitionMate. The IgnitionMate measures the number of volts produced by the secondary circuit of the coil. It can measure up to a staggering 40,000 volts.

The IgnitionMate quantifies the performance of the ignition system as a whole, based on the strength of secondary voltage to the spark plug.

The IgnitionMate can also analyze the consistency of the coil voltage production, and whether the ignition is misfiring.

On many models of motorcycles, there is relatively easy access to the spark plug wires for the IgnitionMate. However, access to the spark plugs that use a coil-over-plug secondary design can take a little more time.



The IgnitionMate measures the number of volts produced by the secondary circuit of the ignition coil. It can measure up to 40,000 volts. This test quantifies the performance of the ignition system as a whole, based on the strength of the secondary voltage to the spark plug.

The IgnitionMate comes with an adaptor that will access the recessed spark plugs in a coil-over-plug (stick coil) secondary, such as found in an inline 4-cylinder sport bike. Testing with an IgnitionMate provides very revealing information about ignition system performance.

If the voltage being put out by the coil is below the service manual specifications, then it is likely that the coil has either 1) a short circuit to ground, or, 2) it contains a break in either the primary windings of the coil or the secondary windings of the coil. This is an “open circuit” and results in “infinite resistance”.