

## 2. Secondary Circuit

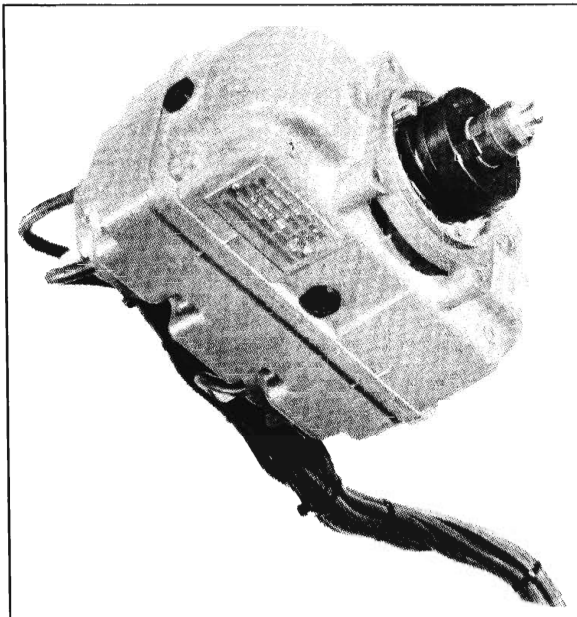
Secondary voltage is taken from the high-voltage terminal of the coil through a carbon brush, to the rotor of the distributor, and then across an air gap to the high-voltage lead, which attaches to the spark plug. The distributor gear has teeth marked to align with a chamfered tooth on the magneto drive gear. There are usually two marks on the distributor gear; one for the right-hand rotation magnetos and one for the left-hand rotation. And when assembling the magneto, care must be taken in order to have the correct marks aligned. Provisions are usually made using a chamfered or otherwise marked tooth, visible through an inspection opening in the magneto housing, to identify the number one distributor position.

## D. Special Forms Of Magnetos

### 1. Dual Magneto

In the interest of both safety and better combustion characteristics in the cylinder, all certificated aircraft engines have dual ignition. This requires two separate and independent ignition systems. Some early engines used a combination of battery ignition and a high-tension magneto; the battery system for starting, and then both systems for normal operation. Two separate magnetos are used on most modern engines, but with the need for more accessories and the limited number of drive pads available, the dual magneto is becoming popular.

**Figure 3-6.**  
***The Bendix D-3000 dual magneto is actually two separate ignition systems, having only the rotating magnet, cams, and housing in common.***



This concept is not new, as dual magnetos were used on radial engines in World War II, including the Pratt and Whitney R-4360, a twenty-eight cylinder, four-row radial engine, which used seven dual, four-cylinder magnetos mounted around its nose section.

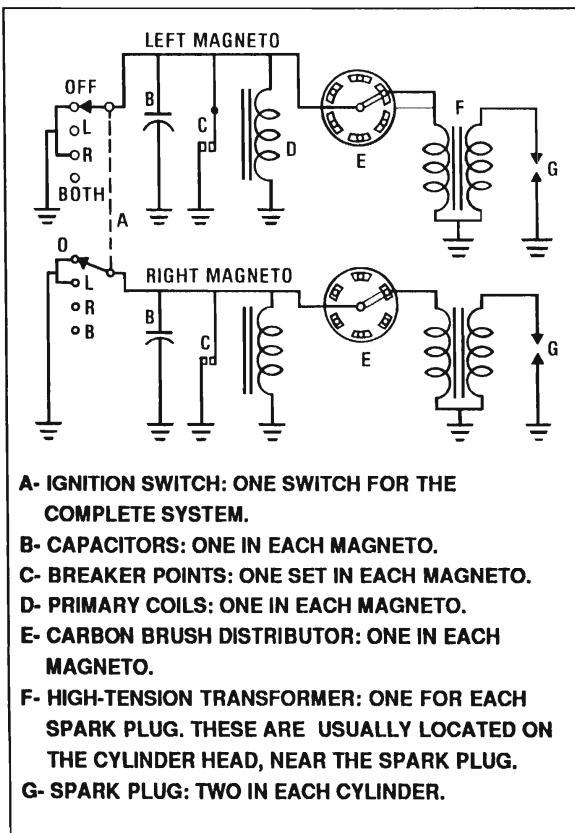
Dual magnetos may be considered as two separate ignition systems, as only the housing, rotating magnet, and cam are common to both systems. There are two sets of breaker points, two coils, two capacitors, and two distributors. The magnetos are similar in principle and operation to single magnetos. Only in their timing to the engine are they unique. Their timing will be covered in detail in the appropriate section of this book.

## 2. Low-tension Magneto

The majority of the magnetos used on general aviation engines are of the rotating-magnet, high-tension, single-magneto configuration, but there are others.

One of the problems inherent with high-tension magnetos has been the inability of the harness and distributor to contain high voltage in the thin air of high altitudes. As the air becomes less dense, its insulating capability decreases, and sparks jump from the distributor finger to the housing, or an electrical

**Figure 3-7.**  
**Low-tension Ignition system.**



breakdown occurs within the harness itself. Steps have been taken to prevent this, such as making the distributor physically larger, so there will be a greater distance for the spark to travel. Magnetos, distributors, and harnesses have been pressurized with compressed air to increase their resistance to breakdown. But one of the more practical developments, which has allowed magneto ignition to function at high altitude, has been the low-tension magneto.

Similar to the high-tension magneto in the generation of primary current, the low-tension magneto has a rotating magnet, cam-operated breaker points, and a capacitor. But it differs in the production of the spark in the secondary.

The coil in the low-tension magneto has only the primary winding, with its output going to a carbon-brush distributor. Primary current is carried to individual coils or transformers, one for each spark plug, mounted on the cylinder near the plug. When the breaker points open, the primary current through a specific coil is interrupted, its field collapses and generates a high voltage in the secondary winding, which is taken to the spark plug by a very short lead.

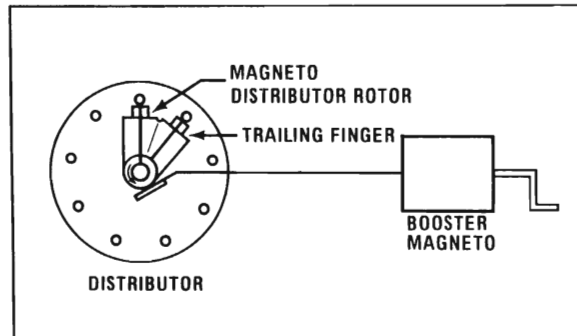
## E. Aids To Starting

### 1. Booster Magneto

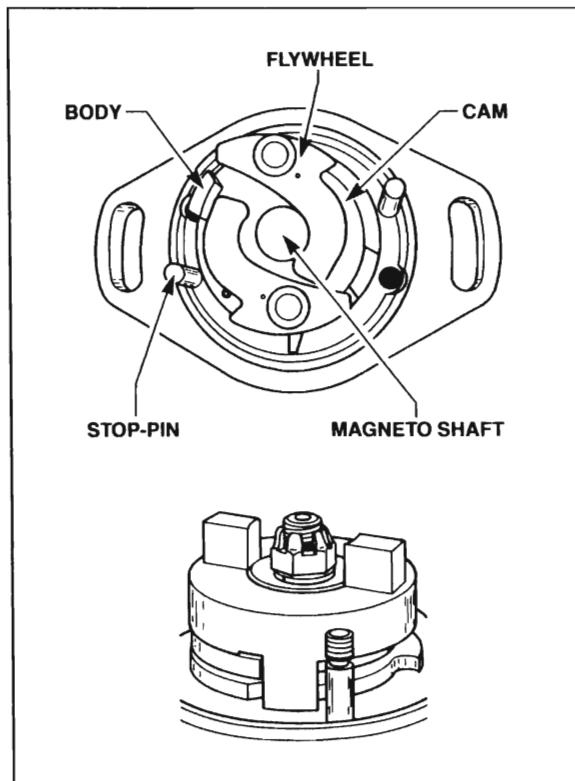
Aircraft magnetos provide a good, hot spark at idle, at cruise, and at high speeds; but some provision must be made for getting a hot spark when the engine first turns over in starting. This spark must not only be hot, independent of the rotational speed of the engine, but it must come later than the normal spark. This allows the piston to be beyond top center when the pressure from the expanding gases exerts its push on it.

Some early engines used a regular high-tension magneto, hand-cranked by the pilot, to provide a hot spark while the engine was being cranked (Fig. 3-8). The output of this booster magneto, as it was called, went directly to a trailing finger on the rotor of one of the distributors. This allowed the high-voltage booster output to fire the cylinder whose piston was near top center or which had just passed it, providing a hot, late spark *for* starting, and preventing kick-back *while* starting.

**Figure 3-8.**  
**Hand-cranked**  
**booster magneto.**



**Figure 3-9.**  
**Impulse coupling.**



## 2. Impulse Coupling

As smaller engines became popular in general aviation, starting procedures were simplified, and the booster magneto was replaced with the impulse coupling (Fig. 3-9).

A cam plate with two flyweights attached is keyed to the magnet shaft. The impulse coupling body rides over the cam and flyweight assembly and is the part driven by the engine.

The body and cam plate are connected through a heavy-duty, clock-type spring. Two stop pins are placed in the magneto housing, in such a position that as the starter rotates the engine, the flyweights move out and contact the stop pins.

This holds the magnet and cam plate still as the engine continues to turn, winding the spring. After a predetermined amount of rotation, projections on the coupling body contact the flyweights and release them from the stop pins. The spring now spins the magnet, producing a hot, late spark. As soon as the engine starts to fire and pick up speed, centrifugal force on the flyweights holds them away from the stop pins.

They lock the body and cam plate together so that the magneto operates as though it had a solid coupling. Magnetos with impulse couplings may be

identified by an audible snapping, when the engine is pulled through by hand. When checking the timing of impulse coupled magnetos, the engine must be pulled through in the normal direction of rotation until the coupling snaps, then backed up beyond the point of ignition advance, but not enough to engage the flyweights. After this, timing is done in the normal way.

### 3. Shower Of Sparks System

Impulse couplings provide good hot, late sparks for starting small engines. But as engine size increases and operational conditions become more severe, better starting systems are required.

The vibrator starting system is an improvement over the booster magneto, and has become pretty well standard. The induction vibrator produces pulsating direct current from pure DC (Fig. 3-10A). Pulsating DC from the induction vibrator is directed into the magneto to produce a high voltage in the magneto coil (Fig. 3-10B). Since this system does not put out a single spark, but instead a stream of sparks, it is called by the Bendix Corporation the "Shower of Sparks" system.

When voltage is applied to the coil, current flows and energizes it, making the core an electromagnet. The lower point is attracted to the core and opens the circuit, de-energizing the coil so the points will close and start the cycle over. The current output is in the form of pulsating direct current with about 200 pulses per second, and when it is fed into the primary of a magneto coil it is transformed into high voltage in the secondary.

The complete primary circuit (refer again to Fig. 3-10) includes not only the primary coil but the cam-operated breaker points, the capacitor and the ignition

**Figure 3-10.**  
**Induction vibrator**  
**system.**

