The purpose of the impulse coupling is:

(1). To snap the magneto through its firing position so it produces a spark even though the engine is being slowly cranked.

(2). To postpone the snap until the piston is near its top center position so that ignition is retarded to prevent a kick-back.

As soon as the engine starts, the impulse disengages, and the coupling functions as a plain drive member.

At starter cranking speed the spring loaded flyweight on the impulse coupling catches on the stop pin. This stops magneto rotation and winds the impulse spring until the drive

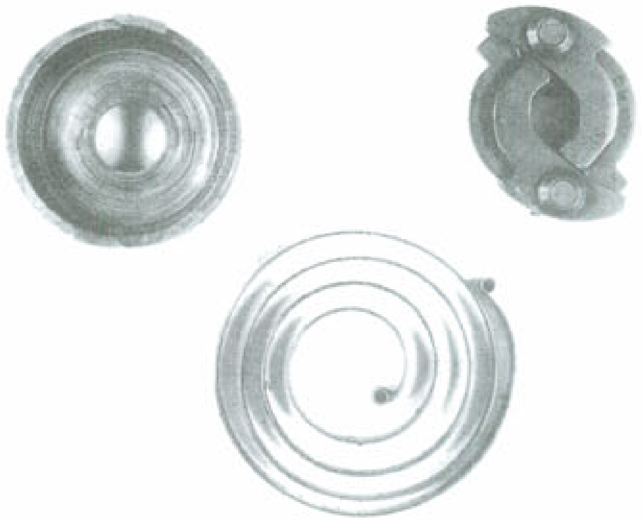

Figure 16. Impulse coupling components. Coupling body, cam assembly and spring.

lug on the coupling body trips the flyweight, disengaging it from the stop pin. Energy stored in the spring accelerates the magneto through the firing position.

The rotational distance between stop pin engagement and drive lug engagement determines how far the engine turns until the magneto snaps. This is called "lag angle". Lag angles for Slick magneto's installed on Lycoming engines range from 5 to 20 degrees. Lag angles for Slick magneto's installed on Continental engines range from 25 to 35 degrees. Lag angles for Bendix magneto's range from 10 to 45 degrees.

The angular relationship between the impulse coupling and the rotor determines at what engine position the stop pin engages. Thus, the mechanical point that the engine fires is determined by lag angle and the angular relationship between the impulse coupling and the rotor. For example, not all Slick

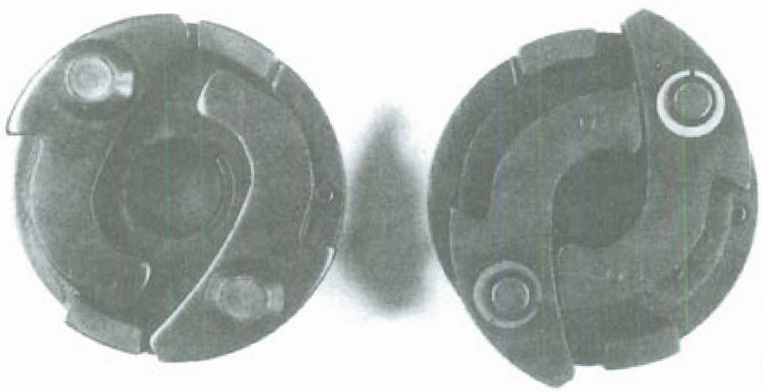

Figure 17. Impulse couplings. Old style on left, new style (per service bulletin 599D) on right.

rotors have the keyway at the same angular relationship with the rotor magnet. Not all Slick impulse couplings have the keyway at the same angular relationship on the impulse coupling. Unsolved starting problems may be traced to an incorrect part number component within the magneto.

So far we have been referring to the mechanical point that the engine should fire. When the impulse coupling snaps, the actual engine rotational point where the magneto fires is different. When the impulse coupling snaps, the impulse spring must accelerate the rotor to the "E" gap. This takes a finite amount of time. During this time the engine is rotating from the action of the starter. If the starter turns the engine too fast, the magneto fires before its intended position. If the starter turns too slow, the engine fires after its intended position.

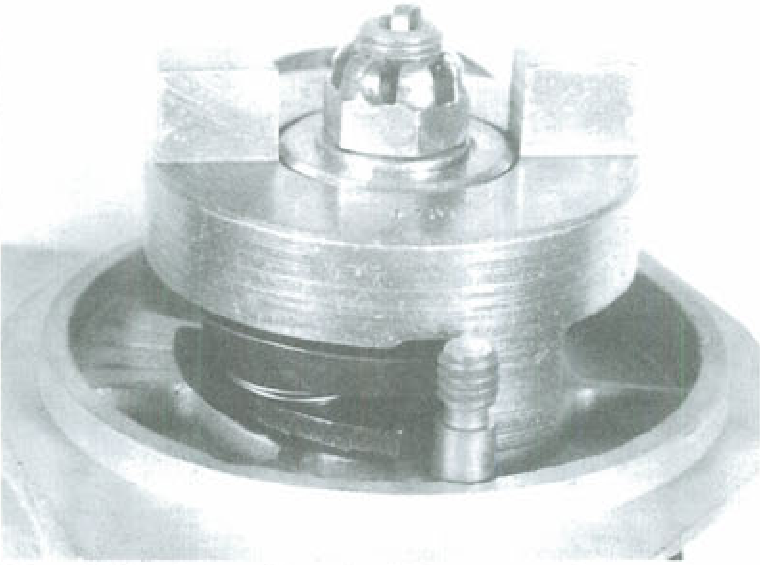

Figure 18. Impulse coupling as installed on magneto. Start position with flyweight toe engaged against stop pin. Magneto is prevented from turning. Impulse coupling spring winds up.

For example, the Lycoming O-235-L2C originally had a fast turning starter (Prestolite MHB-4015). With the 15 degree impulse coupling the engine was hard to start since the magneto fired before top dead center.

Lycoming changed the impulse coupling lag angle from 15 degrees to 5 degrees (Lycoming Service Instruction 1362) to compensate for the fast starter. Now the engine fired closer to top dead center. However, if the engine is turned over slowly, such as hand propping, the engine fires before the piston reaches top dead center. This could be dangerous as the engine will have more of a tendency to "kick-back" at the 5 degree lag angle.

Lycoming introduced a slower turning starter for this engine, the Prestolite MMU-2386. This starter made the

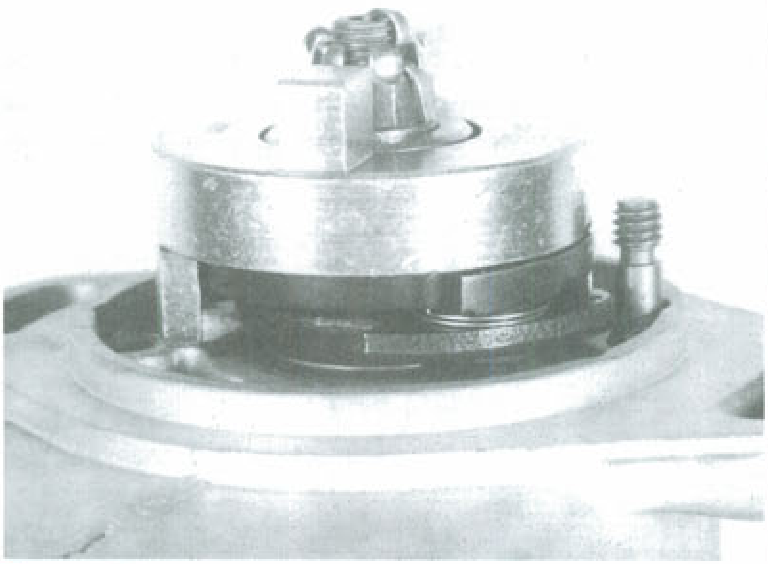

Figure 19. Flyweight heel strikes stop pin, disengaging flyweight from stop pin. Impulse coupling spring spins magneto.

engine easier to start with the 15 degree lag angle. The end result is that the starter and the magneto that you use on the O-235-L2C are interdependent. With the fast MHB-4015 starter you want to have the 5 degree lag angle magneto, part number 4381 (older Slick number 4081,4181, 4281). With the slower starter MMU-2386 you want the 15 degree lag angle magneto, part number 4352 (older Slick number 4052, 4152, 4252)

On engines using impulse couplings, the speed at which the engine is cranked, impulse coupling spring tension, and spring friction determines the engine firing position during start.

Inspecting the Bendix Impulse Coupling

The fewer mechanical devices within the engine the less chance for catastrophic failure. Lycoming, for instance, uses external drive accessories. Starters and alternators on Lycoming engines are external to the engine. This philoso-

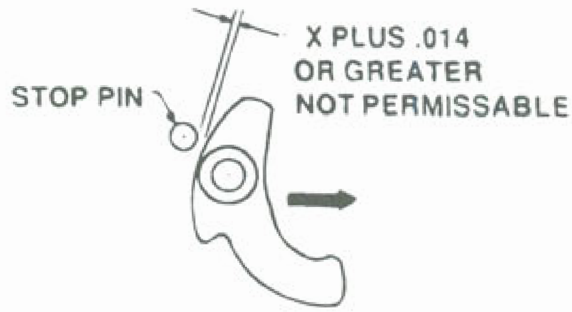

Figure 20. Bendix flyweight axil wear check. Too much wear, and the heal of the flyweight hits the stop pin causing the toe to engage the next stop pin.

phy protects the engine from accessory failure. The impulse coupling, however, is mounted inside the engine and has the capability of causing catastrophic failure.

One would think that when the impulse coupling fails it prevents the engine from starting. It can fail in this manner. But, the impulse coupling has another more serious failure mode - catastrophic within the engine. Catastrophic impulse coupling failure need not occur. It occurs only after a great deal of wear has occurred to the coupling. Failure is prevented by routinely inspecting the coupling.

When starting the engine the impulse coupling flyweights strike against stop pins and are struck by the drive lug. This pounding causes wear to the rivets that attach the flyweight to the body. As these rivets wear the clearance between the flyweight and rivet increases and the flyweight moves laterally outward.

The flyweight moves outward until the heal of the flyweight strikes the stop pin. At first, the heal just grazes the stop pin causing a telltale mark on the flyweight. Eventually, the heal strikes the stop pin with enough force that it pivots the flyweight outward where it engages the stop pin. When this happens during engine cruise, there is enough force that the flyweight disintegrates into the accessory gear train. Pieces of the impulse coupling then lodge into the engine gearing, breaking off gear teeth and decoupling both magnetos from the engine. The engine quits.

This failure is prevented by periodically inspecting the wear to the flyweight attaching rivet. One area to inspect is the telltale mark on the flyweight. It's not that the mark has damaged the flyweight. The mark indicates that the flyweight is close to catastrophic failure. Impulse coupling inspections are described in the Bendix overhaul manual and service bulletins.

Installation Tip for the Bendix Impulse Coupling

In order to avoid damage to the magneto rotor shaft or bearings during disassembly, Bendix recommends using an anti-seize on the tapered section of the rotor shaft during installation of the drive member. The drive member can be the gear, impulse coupling, or dog. Apply a thin coat of Continental part number 646943 to the tapered section of the magneto drive shaft where the impulse coupling installs. This process is described in Bendix service bulletin 631 and 626.

Some don't use anti-seize when installing the drive member. If anti-seize isn't used the impulse coupling cam may crack from the keyway to the outer diameter during nut torquing. When you try to remove an impulse coupling that does not have anti-seize on the shaft you soon realize the importance of using anti-seize.