

(Continued from previous page)

Combine that with a shimmy that induces a rapid back-and-forth vibration and the bearing blocks gall with the added stress. The same can be said for steering collars, rod end hardware, and steering tube dampeners.

The cumulative clearances and the extra wear rates result in a dynamic oscillation that starts as a slight lateral shimmy of the nose wheel and ends with a violent shaking of the entire airplane. It's as if everything has come loose in the fuselage and only good living and the blessings of the Almighty are enough to hold the crumbling bird together. It's at times like these that just getting back to the ramp with all the pieces intact is considered a job well done.

Some steering collars can be shimmed to reduce the vertical and lateral play on the strut, and rod ends can be replaced with new parts. Be certain to check the steering rod attach points and the rudder pedal torque tubes for loose bolts, worn linkages, and egg-shaped bearing blocks. If a nose wheel shimmy has been allowed to continue, you can be assured that these components have been adversely affected by the strain.

SHIMMY IN THE EXTREME

Extreme nose wheel shimmy conditions can cause collateral damage to cowl-mount supports, tube steel engine mounts, instrument panel supports, and primary flight instruments. It also makes landing operations much more difficult, even for the experienced pilot.

Heavy braking tends to intensify the problem by loading the nose wheel. The natural reaction is to pull back on the elevator, which will lessen the severity of the shimmy but makes directional control more difficult.

The NTSB has a file dedicated solely to those aircraft that have departed the runway for this very reason. It is in your best interest to determine the cause of any shimmy problem and make the necessary repairs to the nose wheel and steering system as soon as possible.

As always, if in doubt about hardware location, or if you are unsure about how loose or tight an assembly should be, consult your mechanic and the aircraft maintenance and service manual.

Ignition Switches

The key start ignition switch has evolved into a many functioned and complicated piece of gear.

BY LPM STAFF

It will leave you with a nagging doubt until the duties of the take-off roll pry your attention away from that damn loose ignition switch. The magnetos checked fine on run-up but the mag switch tumblers are completely worn out.

The key can be removed at any time, regardless of position, and the switch detent has long since relieved itself from the original design. That dark brood of a thought only comes back for a brief instant as the elevator takes hold and you ease the nose off the ground—knowing full well that any loss in power at this point would put you somewhere between the trees and the dirt.

It has long been known that the key style locks and ignition switches used in aviation applications years ago were not assembled from materials and design criteria that included the idea that you would be flying this bird 40 years later. Weighing only seven ounces, the average key-type ignition switch is a compromise in weight, material, function and purpose; and yet, the little twist-to-start switch will outlast virtually any accessory or component attached to the airframe. It's an enigma to be sure, but in large part, it works, and works well, considering that the average ignition switch will cycle some 5,300 times over the course of an engine's life.

In the early 1940s magneto switches were made by Mil Spec suppliers who built large, heavy, rotating switches, which were used to alternately ground and open the magneto primary leads. Bendix took up the lucrative line in April of 1947 when they introduced a low profile, lightweight switch, which performed the same grounding function as their predecessors

at a better price to the makers.

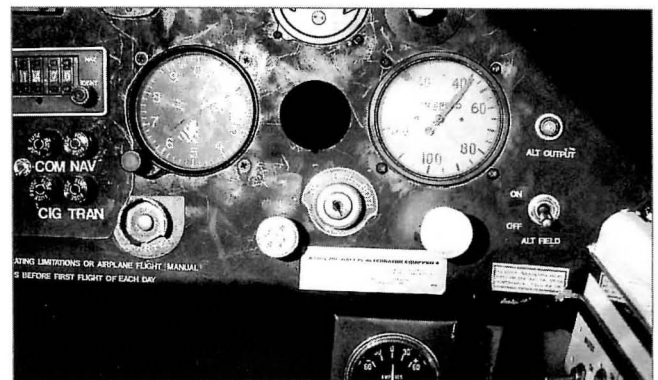
In its simplest form, the Bendix ignition switch provides individual operation of either magneto while providing other detents for both and off. The operation of this switch and all variations of the unit is made up of functions that selectively ground the magneto P-lead (or primary lead) on the magneto you don't want operating and opening the lead to the magneto you want on line.

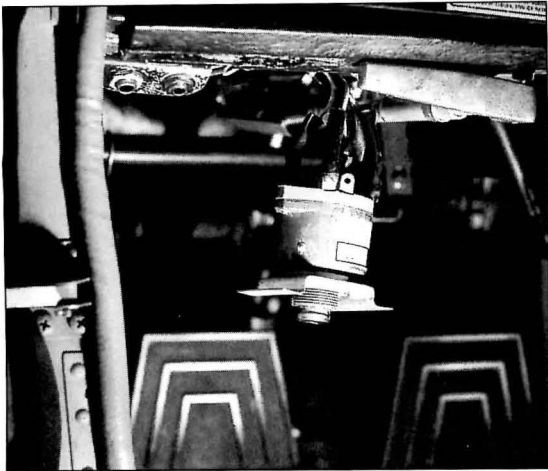
If both mags are to be on line, then "Both" is selected and the left and right P-leads are opened. If "Off" is selected, then both magnetos are grounded through the switch to an airframe ground point and all ignition function is removed. This design criteria has been in place since the dawn of time and is born of the assumption that a wire will break open before it grounds out, thus providing ignition to the engine in a system-fail mode. (Never mind that the magneto P-lead is encased in a steel shield braid intended to limit noise while offering a prime path for ground with only a little bit of chafing.)

TWIST AND START

In 1960, Bendix produced the new generation of magneto switches, which were

The Bendix "Ground Magneto" switch (GM) is an ignition switch in its simplest form. Note the remote starter button located to the left of the mag switch.





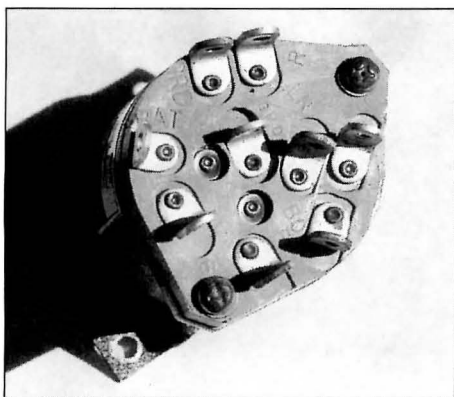
Removing the ignition switch from the panel can be an involved procedure in some aircraft. Once free from its mounting, note the proper location of all wiring.

designed with the same basic function as earlier designs but now included options for starter motor functions and “Shower of Sparks” ignition sequencing. The line continues today with four different Bendix ignition switch configurations offered, all of which are available for use with a key or lever for rotation.

The old standard used in the 1940’s was the off-right-left-both switch (or Ground Magneto style switch), which required the application of hand-proping or use of some remote, push-type starter switch. Used extensively for many years, this simple design and limited function switch was the mainstay of the aviation business. Its sole function was to alternately open and ground the selected magneto, as required.

As systems became more complex and

The back plate of this Gerdes (ACS) switch shows the many terminal connections used in the typical Twist-to-Start switch.



panel space made a premium, the standard ignition switch evolved into a tightly bundled mass of wires, contacts and circuits. We now have twist-to-start, push-to-prime, push-to-start and a couple of individual variations of the lot. With the use of starting vibrators, fuel boost pumps, starting relays and hot wire overrides, the simple on-off ignition switch has become a thing of the past, replaced by a multi-function, hot-wired, impulse-signaling monster wrapped up in coat of pot metal with a plastic end cap attached.

BINDING AND ELECTRICAL FAILURE

Ignition switch problems are generally described as electrical faults or may involve some mechanical failure. Occasionally, one problem leads to the other, especially when the switch carries a start feature with the magneto grounding circuit.

The most common complaints heard about the mag switch are that the internal workings of the tumblers are too loose or that the detent action isn’t well defined. Normal wear and tear contributes to this kind of problem, requiring the replacement of the key action at a minimum and often times requiring whole switch replacement if the detent spring is broken.

The reverse of this situation is found when the switch is so tight that no positive detent is felt during the mag check, leaving you with the uncertain task of finding some null spot where both mags are on line at the same time. Generally, a tight switch is the result of improper lubrication, binding of the tumblers in the case or a mechanical interference due to a broken detent spring in the housing. While the magnetos’ grounding function will usually work fine when the switch has become damaged, the lack of positive selection will always leave you with some anxiety, especially when you absolutely must have both magnetos firing at their maximum potential.

While the mag switch can be damaged by misuse and outright abuse, the most common cause for mechanical failure is repeated use of the switch function. Normal wear and tear is expected and the Bendix switch can take years and years of such use. However, it has long been known that aircraft partners and

maintenance facilities have a difficult time keeping track of keys.

Often enough, mechanics are asked to open doors and start aircraft with tool box keys, security gate devices and an assortment of pins, pliers and instruments of the pointed variety. This takes its toll on the mag switch and eventually switch repair or replacement will be necessary.

Electrical failure of the ignition switch is a direct result of coupling the starter motor circuit to the magneto primary lead circuit. This is accomplished inside the magneto switch by tying a series of contacts together using one or more contact cups. These pie-shaped pieces of metal are spring loaded against the switch contacts and ride over the plate as the switch is rotated.

When the switch is turned to the start function, battery current is passed to the starter contactor, which closes the relay and energizes the starter. At the same time, the switch will open the P-lead to the left magneto and ground the lead to the right.

This is commonly done to engines equipped with a left mag impulse coupling, “Shower of Sparks” ignition system or those supplied with a *retard set* of breaker points. The right magneto is disabled because it will try to kick the engine back during the start sequence if it has no provisions to retard the spark.

Some magnetos are equipped with dual impulse couplings, which would then remove the isolation function of the mag switch during start, allowing both mags to assist in the start sequence. (It should be noted that the wisdom or the need for two impulse couplings has been discussed at length and many of these installations have been changed back to the single coupling arrangement.)

This start feature within the switch has posed some contact problems due to normal arcing that occurs during switch actuation. Burned points, loss of point material and high resistance plague not only the start function but can affect the reliability of magneto grounding and other peripheral circuits controlled by the switch. While the old GM style switch needed no special attention due to the little current carried by the magneto P-lead circuit, the new Ground Battery Magneto (GBM) switches found regular maintenance to be a necessity.

Disassembly, cleaning and proper



Clean the contact cups and back plate with a good oxidation agent or isopropyl alcohol and lubricate with Lubrex or Dow Corning 4 before assembly.

ignition switch. What this means is that for contacts, especially those operating relays, you can expect wear, oxidation and switch contamination unless some means is employed to protect the opening points from a voltage surge during the interruption.

In the case of the Gerdes switch, a simple 50 volt, 30 amp surge-protecting diode is enough. It will also work on any other circuit and with any other switch when arcing is a problem.

CLEANING AND LUBRICATION

The mag switch is held together by two screws attached from the rear of the switch. Removal of these screws will allow the back plate to be opened and the cups and springs to be exposed. Use care when opening the case.

The cups are floating on springs and any rough handling will allow the

Screw starters will aid in reassembly of the switch and aircraft wiring. The need for this tool will become obvious.



contacts to flitter across the room never to be found again. Once removed, clean all parts in isopropyl alcohol or a good de-oxidizing agent like De-Oxit.

Scotch Brite can be used to clean any burned residue from the contacts and the backing plate. Flush completely with plenty of non residue type contact cleaner or alcohol and allow to dry.

Contacts damaged or worn away from arcing should be replaced with new. The typical Bendix Twist-to-Start switch will use repair kit P/N 10-357510 available from any TCM distributor.

The Gerdes or ACS switch will take the P/N A-3650-2 repair kit found at Aircraft Spruce, www.aircraftspruce.com, ph (877) 477-7823. They sell it for \$17. Cessna also has it under part number A 3770. The repair kit includes three new contact cups and spring assemblies.

Once cleaned, the contacts are lubricated with a light coat of Lubrex grease or an equivalent material. Dow Corning DC-4 works very well as a lubricant and a dielectric for most any contact assembly.

While the back of the switch is apart, remove the center screw from the tumbler portion of the switch and remove the cup holder from the switch body. This will allow inspection of the detent spring and tumbler body for wear or damage. If any of these components have failed, plan to purchase a new switch as a complete unit.

ASSEMBLY AND TESTING

Reassemble the switch being sure the cups and springs are properly positioned with respect to the cup holder. Don't force the plate down. All parts will fit together without binding when properly aligned. Attach the back plate with the two screws and check the switch for smooth operation and positive detent action.

Make sure there is a "spring back" action from the start position and there is no drag between detents. An ohm meter or continuity light can be used to check proper electrical action of the switch. With the switch in the off position, the L and R lugs should show continuity to the GND lug. With the Both position selected, L and R should be open.

Check to make sure that each position is activating the proper response to an ohm meter check for the type switch that you have. (Do not use continuity mode.)

Once the switch is found satisfactory,

re-attach the wires to their proper lug positions. Because you're standing on your head, in the dark, and with more things to hold than your hands and feet can manage, you'll find the use of a screw starter to be invaluable.

Screw starters are spring-loaded devices that grip a Phillips or straight-slot screw head internally, allowing for alignment of wire, lug and switch with relative ease. Remember, any dropped screw must be retrieved from underneath the panel. A lost screw falling into any electrical switch or buss bar will only do so while in flight and is guaranteed to give you a light show that'll put St.Elmo's Fire to shame.

After connecting the ground cable to the battery (first clear the propeller), turn the master switch on and rotate the mag switch through off, left, right and both positions.

Don't attempt to start the engine yet. Listen for any electrical noise or note any problems with the circuit breaker panel. If any wires were misplaced on the switch, you'll hear some electrical sizzling and find a plume of smoke rising from beneath the panel.

If all is well, ground run your engine and note proper magneto switch operation and response. Make certain mag drops are consistent and that the electrical system is functioning at the proper voltage and amperage.

FINAL THOUGHTS

Magneto switches don't fail often and routine maintenance isn't an annual event. However, ACS requires lubrication of their switch every 2000 hours, or sooner, if conditions warrant.

Bendix switch maintenance is performed on an as-needed basis but because the installation of a surge protecting diode is not applicable to the Bendix switch, it can be assumed that routine maintenance for these switches would be more frequent than the old Gerdes model. While servicing your magneto switch won't make you a better pilot, it will allow you more time to concentrate on a take-off roll that doesn't include doubts about whether you're Left or Right or Both of the centerline.

And don't forget to get your mechanic to sign off the work in your log book. And, as always, draw and label everything before you take it apart.