

## Changing Mags

✓ **Mike Stolle (NM)** - I recently decided to change magnetos because of high time in service and because I wanted the improved starting characteristics of a second impulse coupled mag.

My first surprise was finding that an impulse coupled mag uses a different drive gear than a non impulse coupled mag. The gear runs over \$300 new, but there are several parts houses that sell a used gear for about \$150. The part number is 61665. Since the impulse coupled mag is longer than the non impulse coupled mag, you also need longer mounting studs (part number M-2639) and an adapter/spacer (part number 61666). Also required are a pair of gaskets (part numbers 62224 and LW12681) for each mag, one between the mag and the adapter and one between the adapter and the back of the engine accessory case (see drawing). I got all my parts from El Reno Aviation in El Reno, OK (405) 262-2387. The salesman's name was Ted and he was very helpful.

My engine was remanufactured by Lycoming in 1981 and had Slick 4200 series mags on it when I got it back in 1982. I looked at several magneto applications charts to find out what mag I should look for as a replacement. Light Plane Maintenance magazine had a good issue on magnetos in March 92, so I knew Slick had upgraded their mags recently and I wanted to get the latest version available.

Just a note, when shopping for mags, I found that some suppliers will attempt to sell you rebuilt Slick mags for the same price as new ones.

Don't be set on replacing with the exact model of mags that you remove. There are some really old mags still in use out there. Slick has made some real improvements in their new mags (see LPM articles). After getting confused by talking to several suppliers about the best mag for my engine, I decided to call Slick

and talk to the people there. I'm glad I did that because I found out some things I had wondered about before. For instance, did you ever wonder what "lag angle: 25 degrees" on the name plate of your mag means? You will notice that it is only applicable to a mag that has an impulse coupling. It is the angular delay between where the mag fires normally (when the engine is running) and where the impulse coupler fires during starting. For example, if your engine timing is normally set to 25 degrees before top dead center (BTDC), and your magneto has a lag of 25 degrees, then for starting, the impulse coupler on your mag will fire close to top dead center, ie 25 degrees after the normal timing setting. Since the purpose of the impulse coupler is to fire the spark close to TDC for starting you want to look for a lag angle that is close to the magnitude of the timing angle. NOTE: I did note, though, looking at the Slick Application Data Sheet that there are impulse mags with 15, 20, 25, 30, 37, and 45 degree lags. So be sure to check with someone knowledgeable before selecting the proper lag angle for your application.

For my O-235-L2C I bought two new Slick 4373's with a 25 degree lag since I usually set my timing at about 23 degrees. The best price I found was through San-Val in Van Nuys, CA. By the time they add on the core charge (\$150 per mag) you end up with a healthy charge on your credit card. I also bought a new Ignition harness.

To start the installation process, I removed the top plugs and all the spark plug wires. This will make timing the mags easier in the end. It also makes sure you don't have any compression or parks in the cylinders in case you accidentally get a spark from a mag that you weren't expecting. I then decided that working on the back of the engine would be a lot easier if I removed the oil screen housing and the vacuum pump. This next step is optional but will save you some time if you have access to an engine hoist.

Using an engine hoist, you can loosen the engine mount bolts and move the engine away from the firewall an inch or so. This small movement does make a difference in being able to get the harness cap screws off the backs of the mags (especially the longer mags with the impulse couplers). You have to remove the harness cap from the mag in order to have enough room to slide the mag out of the engine. I have talked with a Long-EZ pilot who said he can change mags without removing the cap first, so there are some exceptions.

Another item that makes a significant difference is whether or not you replaced the harness cap screws with socket head screws as Mike Melvill recommended in the Canard Pusher. The difficulty comes from the fact that you can't see the screw heads. Therefore, using a straight slot screwdriver blade is almost impossible. If you have the regular slotted head screws, try using one of the small thin offset ratchet screwdrivers as sold at Sears. With the socket head screws, it is easier to get the 3/32" allen wrench in there. No matter how you do it, plan on spending at least 20 minutes getting the three screws out of each mag.

Once you have removed the harness caps from each mag, remove the mag P lead, loosen the two 1/2" nuts on each mag remove the locking ear hardware from the studs and slide each mag out. If you are changing one of the mags to an impulse coupled mag as I did, now is the time to remove the old accessory case studs, insert the new longer studs, and install the gaskets and adapter (see drawing). I'd recommend you replace all the gaskets while you have everything apart, even if you don't disturb the one between the one adapter and the case. I sprayed the old studs with Liquid Wrench, waited 20 minutes or so and they came out easily with a pair of vice grips.



The next process was perhaps the most difficult. You have to remove the drive gears from the old mags and install them on the new mags. The first step is to remove the cotter pin in the castle nut holding the gear to the mag. Then loosen the castle nut. To loosen this nut you will need an other set of hands or access to a vice. I clamped a large Crescent wrench in my vice and used it to hold the flange on the mag that the slot on the drive gear fits on (see drawing). This keeps the mag from turning and allows you to loosen the nut. If your mag is non impulse coupled it won't have the flange to hold with the Crescent wrench. In this case I secured the drive gear with a couple pieces of wood clamped in a large C-clamp while I loosened the nut. Install the gears in the reverse order and torque the castle nuts to the value called for in the instructions. Mine called for 120-250 inch pounds. As you torque down these nuts, keep in mind that you will have to line up the nut on the studs so you can get a cotter pin back in there. I found that the cotter pin was easier to insert if I "pre curved" it so I could get it started through the hole. I then used a small punch and a hammer to gently tap it through the slot and bend the ends over. My mags came with new cotter pins to replace the ones I destroyed when getting the gears off.

*Editor note: For those of you with Bendix mags be advised that special stainless steel cotter pins are to be used - not the regular steel ones.*

Once you have installed the drive gears on the new mags you are ready to prepare the mags for installation on the engine and prepare the engine to accept the mags. What we'd like to do is to set up both the mag and the engine so they are in the proper position to fire for one of the cylinders. For convenience, let's use cylinder number one. I'm going to assume that the reader knows how to set the timing on his engine. Since an impulse coupled mag fires close to TDC, let's set up the number one cylinder at TDC. There are different

ways of doing this but I use one of the indicators that screw into the spark plug hole along with a protractor that attaches to the prop hub.

Once you have determined TDC on the engine, leave it there, ie. don't move the prop. As you are determining TDC make sure you are on the compression stroke and not the exhaust stroke. This is easily determined by placing your finger over the top spark plug hole as you are moving the prop toward TDC. If you are on the compression stroke, you will feel a rush of air trying to get out of the top plug hole. This, of course, assumes you have the bottom spark plug in place.

Now we need to set up the mags so they are in the correct orientation to fire cylinder number one. While the mag is on the workbench, attach the harness cap. If you aren't replacing the harness, you'll have to take the mag over to the plane to attach the cap. The cap only fits on one way and the back of the cap is marked for cylinder number one. With the cap on, position the spark plug end of the number one lead next to the case of the mag near the flange where it isn't painted. An extra set of hands is helpful here. Now turn the mag (in the correct direction... check the name plate for the proper rotation direction) until the number one lead sparks. Hold the gear in this position and remove the harness cap. Using the pin supplied with the mag, slip the pin into the hole on the back of the mag to hold the orientation of firing number one cylinder. These mags had two holes on the back for this pin, but the pin would only go all the way in on one of them.

An alternate method of "sparking" the mag is to identify the number one cylinder barrel on the back of the magneto by temporarily holding the harness cap in place. Then remove the harness cap and fit a small piece of safety wire into the barrel and curve the other end around so it rests close to (not touching) the mag case. Now you can turn the mag until the

safety wire sparks to the case. Slip the pin in as described earlier to hold this orientation. You may have to move the gear slightly to get the pin to go in up to its shoulder. Now you are ready to install the mags back on the airplane. **WHEW!!**

Use caution that you don't shock yourself. These mags put out a pretty good jolt! It would be a shame to drop a new mag on the concrete hangar floor.

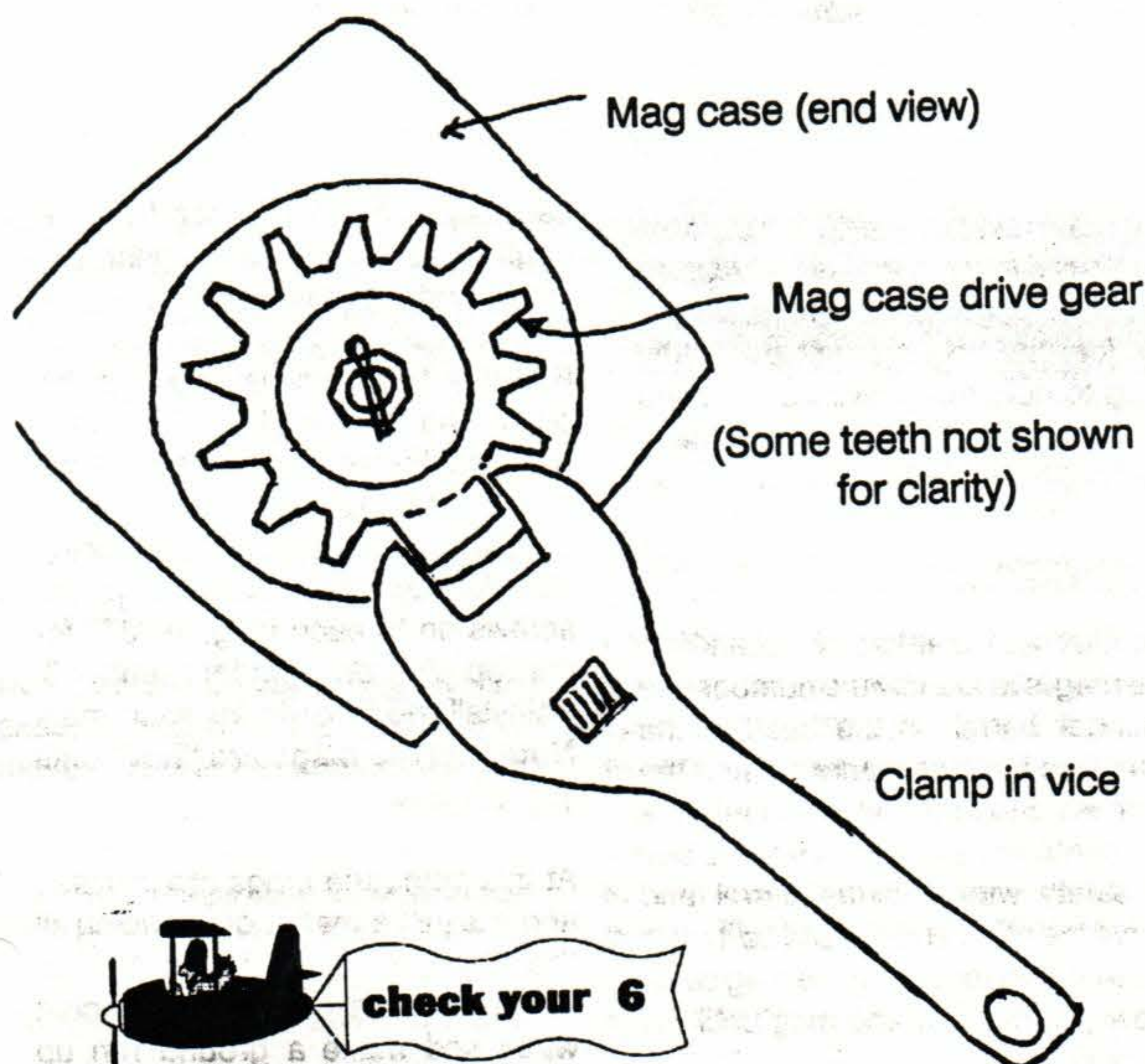
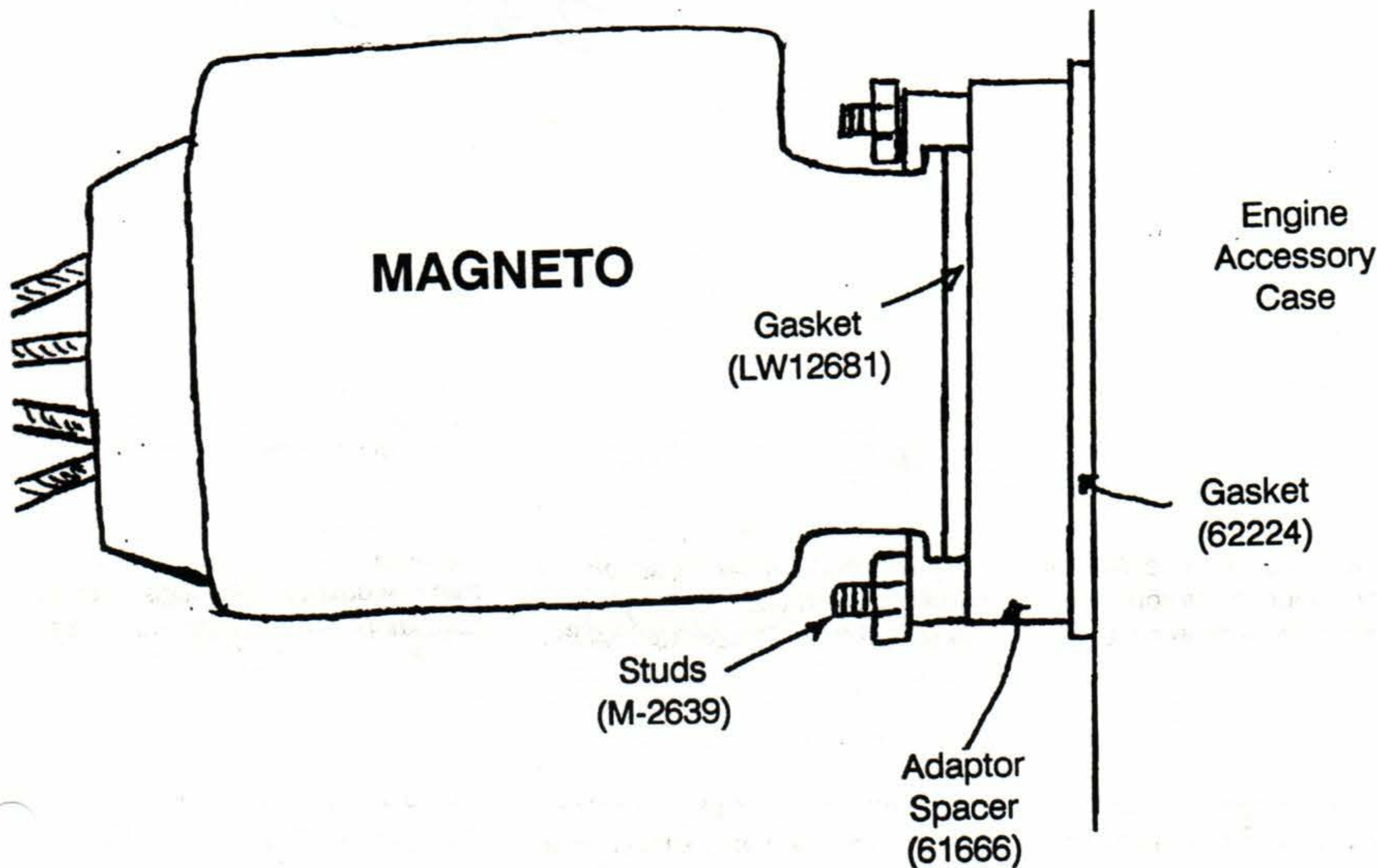
Make sure you have replaced the gaskets and that the adapters are properly seated on the accessory case before replacing each magneto. Reinstall the attach hardware on the two studs and lightly tighten the two nuts... just enough to keep the mags in place. Remove the pins from the back of the mags. Before going any further, we'll time the mags to their proper BTDC setting. Rotate the prop to it's firing position (mine is 23 degrees BTDC) using the protractor temporarily attached to the prop hub. Using a mag timing box, rotate the mags until they "fire" at the BTDC position selected by the prop. Once you are satisfied with the timing, tighten down the 1/2" nuts holding each mag. If you find you don't have enough rotation available to time the mag where you want it, you can, carefully, remove the mag from the engine, rotate the drive gear one tooth, and reinstall the mag.

Reinstall the harness caps, at this point, and run the plug wires to the proper cylinders (if you are installing a new harness). Note that the spark plug wires are marked for their respective cylinders at the cap that screws on to each plug, ie "3T" for the top plug on cylinder number 3. Reinstall the P-leads for each mag. **Note that the mags are "hot" until you do this.**

At this point, the mags are installed and it is just a matter of replacing all the things you took off to get to the mags. Be sure you secure the plug wires and make a ground run up before you reinstall the cowl.



The whole process probably took me about 4-5 man hours to complete, but I was learning as I went along. I probably don't need to remind anyone to box up their old mags and send them in for the core deposit.



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