

Insufficient Magneto Voltage Due to Excessive Crankshaft Endplay — diagnoses of the problem and a solution

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Introduction

Unlike many of you reading this article, I am a novice when it comes to repair and maintenance of the Ford Model T, but like most of you, I enjoy the challenge of owning and operating these fine automobiles in the 21st century. Learning about and understanding Model T period technology, theory of operation, and the idiosyncrasies these cars display in their day-to-day operation is half the fun of ownership, and forms the foundation from which the cars can be maintained today.

My Model T voyage began in 2003 with the purchase of a 1926 coupe. Little by little I restored enough of the car to permit safe operation and was first able to drive the car during the summer of 2005. This car has provided all of my Model T driving experiences to date.

My first drive of the summer of 2006 didn't go as well as I hoped. During the previous winter, I had performed a valve job with new valves/tappets and camshaft gear, installed rebuilt ignition coils, a new fan belt, and adjusted generator output per the Ford Service Manual. The car ran great initially, but after driving a while, as I was slowing to turn into a parking lot, the engine died. It restarted fine on battery, but immediately died again when switching to magneto. On the second start, it ran fine when switching to magneto. Off I went for a few more miles. Eventually, the engine died again at a stop, and it would not run on magneto after that. I drove back home on battery with the engine running fine and a great new opportunity to learn more about the Model T!

Initial Observations and Diagnoses

When it comes to electrical system diagnoses, the Model T offers a real treat compared to modern automobiles. I have found no engine control modules, data buses, or emissions sensors to complicate matters. In fact, there are very few wiring harnesses and a limited number of connections.

I started my diagnosis by looking at all wires and connections between the magneto and coils. Since the car was running well on battery, I could eliminate shared wiring in this circumstance (although I actually went through a thorough check of all wiring in the ignition system). A real help in this process are the Model T wiring diagrams noted at the end of this article. Key wires to check for continuity (remembering vibration could show an intermittent break) or shorts to ground are:

- Magneto post to terminal block
- Terminal block to switch
- Switch to bottom of coil box (used on battery or magneto)

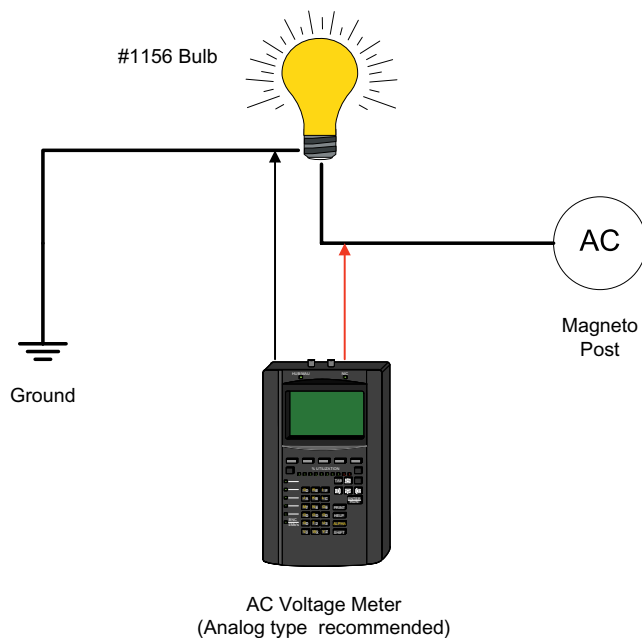
Connections at the magneto post, terminal block, and switch must all be checked for looseness or corrosion. Make repairs to any suspect wires or connections. Another good reference is the MTFCA Electrical System manual.

Two other areas need particular attention at this point. First is the magneto post. The post must make solid contact with the solder pad on the magneto coil ring. Sometimes fuzz from the transmission bands can lodge between the spring contact of the original type posts and the pad, prohibiting a good connection. Sometimes, the spring of the post can be stretched a little bit for a more positive connection. Furthermore, the post must be insulated from ground. I have heard that auxiliary oil lines attached to the post unit can sometimes inadvertently ground the post although I have no first-hand experience with this type of problem. By the way, be careful when tightening the magneto post nut. I broke the insulator on my original post during this check and had to replace it with a modern replacement that is somewhat different from the original, although it functions normally. Why can't replacement parts be the same as original?

The second area of special interest is the switch. If connections on the back of the switch are corrosion free and tight, try jiggling the switch to simulate operating vibrations. Intermittent contact could indicate wear or corrosion inside the switch, which must be repaired or replaced. If you are unsure, a wiring harness with toggle switch can be made to replace the key switch in ignition operation while the car is being driven. One word of extreme caution: While building and installing this type of test wiring harness, do not allow battery current to flow through the magneto coil. This can demagnetize the magnets, leading you down another path of Model T fun.

If all wiring, connections, and switch appear to be in good shape, the next step in the diagnosis is to measure the magneto output voltage. I used the John Regan method. First, you must have a #1156 modern light bulb with a socket to make a test light. This bulb will simulate the electric load of a typical Model T coil. Connect one wire from the bulb socket to the magneto post. Connect the other wire to ground. Start and run the engine on battery with the emergency brake pulled all the way back and set. Using a voltmeter, check the AC voltage across the bulb. I strongly recommend using only an analog voltmeter. Most modern digital voltmeters cannot operate reliably with the varying frequency AC current output of the magneto and the electromagnetic mayhem created by the Model T ignition system. Following is a diagram of the test circuit.

John Regan Magneto Voltage Test Circuit



Here is the data I measured on my car:

Engine Speed	Observed Lamp Brightness	Measured Voltage V (AC)	Expected Voltage V (AC)*
Idle	Dull orange	2.97	9.8 @ 400 RPM
Moderate Speed	Somewhat bright	6.42	18.8 @ 800 RPM
High Speed	Somewhat bright	8.56	26.2 @ 1200 RPM

* This data is from "The Model T Ford Owner"

The voltage I measured was definitely low. The general belief is that 7 to 8 volts AC and a dim bulb at a brisk idle is usually good for reliable operation. At moderate speed, expect 12 to 15 V and a bright bulb, and 20 plus volts at high speed with the bulb burning out. But why was my voltage low? Are the magnets too weak? Is there too much space between the coils of the magneto and the magnets on the flywheel? Why did the engine run on magneto for a while during my drive described above?

Next, I jacked up the rear end of the car and set it on jack stands. Front wheels were blocked. This would allow me to operate the engine while driving the rear wheels with the clutch spring released so there is less pull back on the crankshaft, which increases the gap between magneto coils and flywheel magnets. I started the car and was surprised by the results. I observed the magneto voltage as it should be and even blew a test bulb with over 30 volts revving the engine. I also observed the voltage dropping off to the levels I had recorded earlier.

This happened several times through the test although I couldn't seem to cause it to happen through throttle or clutch use. It had a mind of its own. At this point, I believed that either the magneto output was sometimes reduced because of an intermittent short in the magneto coil or that crankshaft endplay was such that at times, the gap between the magneto coil and the magnets on the flywheel was too large. At least some of the time, I had good magneto output, so I did not feel that weak magnets were a problem.

Removing the starting crank and inserting a dial indicator in its place allows measurement of the crankshaft endplay. With the emergency brake pulled all the way back and set, use a pry bar behind the fan belt pulley to move the crankshaft forward. I measured the endplay at .022", enough to cause a problem. The Ford service manual recommends only .002" to .004" endplay between the end of the rear main bearing and the flange on the crankshaft when building an engine. The manual also recommends replacement of

the rear main bearing cap if endplay is greater than .015". Under particular conditions of wear, this much play is flirting with disaster in the form of the magnets contacting the magneto coils, which usually results in a catastrophic failure and expensive repair.

How did I drive the car last summer without any problems? A few things changed which could cause a crank with excessive endplay to move about. First, the new fan belt provided a different level of tension and ride position on the fan belt pulley. Second, adjusting the generator has changed the load put on the crank from that point of interface. There doesn't seem to be any way to really know.

Removal of the Rear Main Bearing Cap

Normally, the replacement of the rear main bearing cap requires the removal of the engine. I did not have the facilities and equipment to do this, so I began to explore other ways to tackle the problem. According to the *Model T Ford Owner*, a number of accessories were available to "fix" the endplay problem during the Model T period. Unfortunately, none of these devices are readily available today. However, a method of rear bearing cap removal is described in detail in this book. The crankcase cover is first removed, which provides access to the rear

main bearing cap. At this point, I made an attempt to get a feeler gauge between the bearing cap and the thrust surface of the crankshaft. This is extremely difficult, but I was able to insert a .013" gauge in the gap, confirming the external measurements I had made earlier. Cotter pins are removed from the two nuts, and the nuts can be removed with a modern wrench. However, the cap cannot be removed until one of the four bolts which hold the flywheel in place is removed. These are safety wired together. First, you must cut the wire and carefully remove it. I stuffed rags into the pan under the transmission so that if I fumbled a wire, it would not fall down out of reach. With the wire removed, a flywheel bolt can be removed, and the bearing cap will slide off the cap bolts. The factory specification length of the rear main bearing cap is 3.125". Mine measured 3.117", .008" under spec. I then sent the cap to Steve Coniff for restoration.

Photo 1 is a picture of the inside of the engine with the rear main bearing cap removed. Unfortunately, the picture does not convey the cramped area in which you must work.

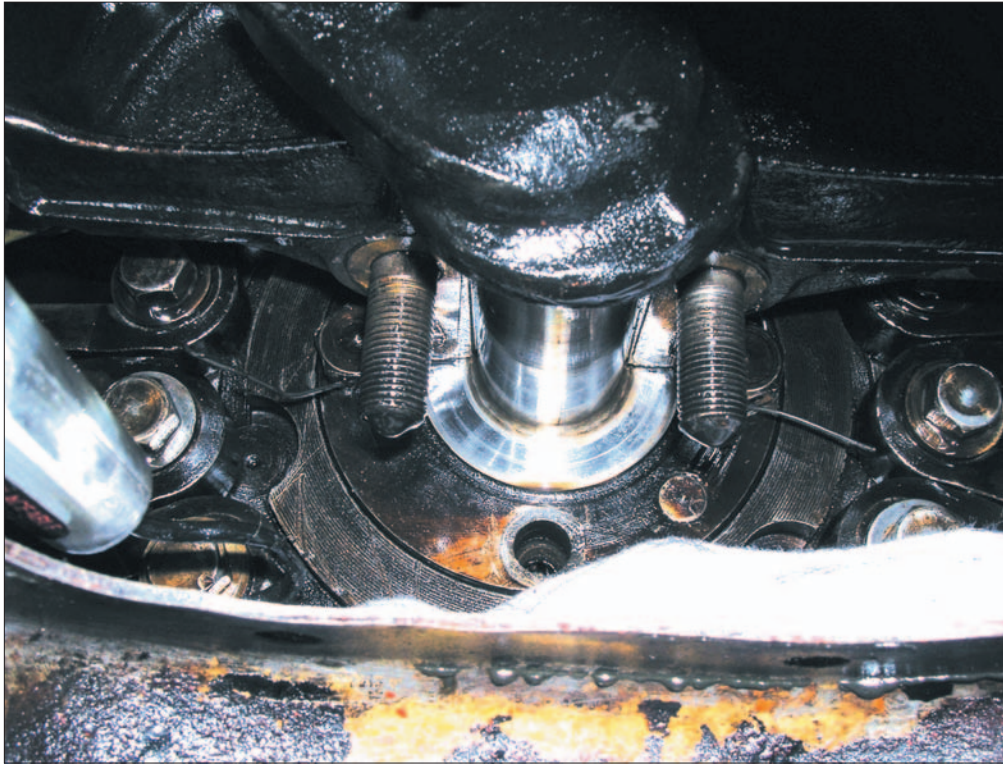


Photo 1: Inside of the engine with the rear main bearing cap removed

Restoration of the Rear Main Bearing Cap

The length of the rear main bearing cap provides for the proper placement of the crankshaft within the Model T engine block. The bearing cap has babbitt thrust surfaces at either end. Most of the wear on the rear main bearing cap thrust surfaces occurs on the inboard or front thrust surface. This is explained by the mechanical action of the Model T clutch. As the clutch pedal is depressed, a pull is

exerted on the spring in the transmission to release the clutch. This in turn pulls the crankshaft to the rear, resulting in wear on the front thrust surface. This also pulls the flywheel and magnets away from the magneto coil with the increased gap reducing the voltage output. The basis of this repair is to rebuild the babbitt thrust surface on the cap to return the flywheel/magnets to magneto coil gap to specification, and thus restore the magneto output to normal.

The following equipment will be required for this repair:

- Heavy duty soldering iron, 175 to 200 Amp
- Liquid soldering flux available from a welding supply or plumbing store
- Several babbitt bars. The easiest way to make babbitt bars is to melt some babbitt and pour it into an inverted piece of angle iron
- Lathe or K. R. Wilson Thrust Cutter
- Rod stock to simulate crankshaft journal
- Extra front or middle main bearing cap

Measure the length of the rear main bearing cap and record this so you know what size you started with. You can compare this length with the measured length between the crankshaft journals and the completed length of the repaired rear main bearing cap. Place the cap in a vise to hold it while you are working on the thrust. Scrape the original babbitt with a pocket knife to clean off any scale or discoloration that may be present. Paint the thrust surface with a coating of flux and plunge the tip of the hot soldering iron into the thrust. Move over and do it again. Melt a few drops of new babbitt onto the thrust surface while you are plunging the iron into the old babbitt. Care must be exercised that the

babbitt on the journal part of the cap is not melted. Repeat this operation until you have covered the entire thrust surface as shown in Photo 2.

The next step is to build up the thrust with new babbitt. Reflux the cap and start applying babbitt with the soldering iron. The surface will be rough until you lay the iron down onto the thrust and rotate it. Again, care must be exercised that the babbitt on the journal part of the cap is not melted.



Photo 2: Adding babbitt to the thrust surface of the rear main bearing cap

When the thrust has been built up high enough, flip the cap 180 degrees and rebabbitt the other end following the same process.

The next step (See Photos 3 & 4) is to cut the thrust surface. Measure the inside of the two crank flanges so you know how long to make the cap. When new, the rear main bearing cap had about .003" end play. Typically, a rebabbitted rear main bearing cap

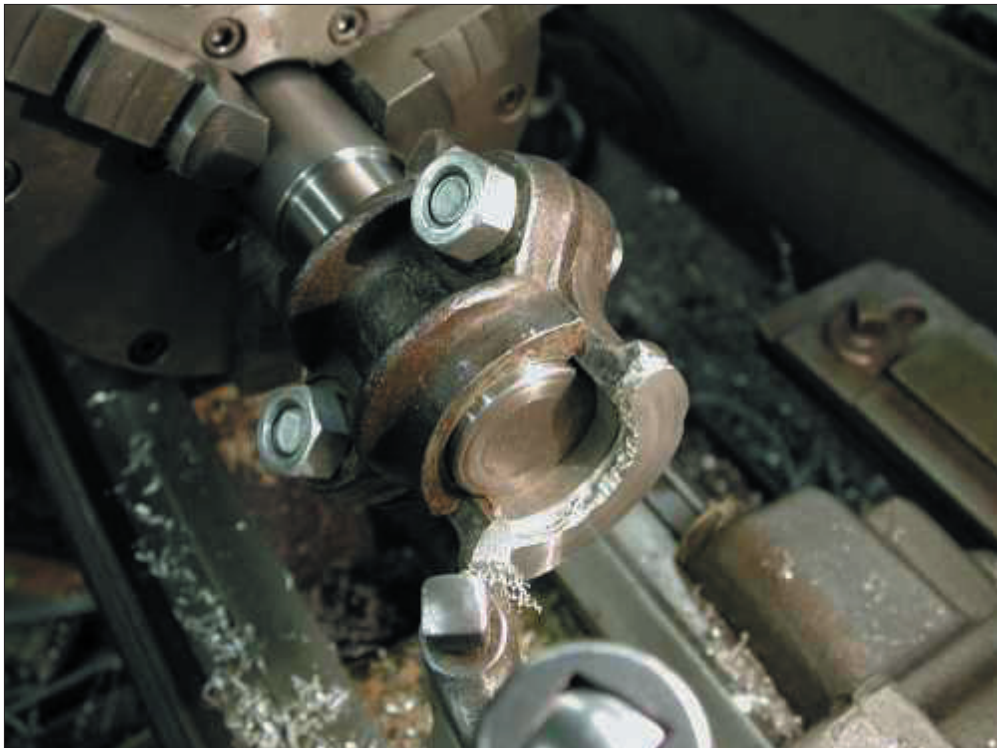


Photo 3: Cutting the thrust surface

will have .006" to .007" end play because of wear on the crankshaft. There are several ways to cut the thrusts. You can use a K.R. Wilson thrust cutter or cut the cap in a lathe. Cutting the cap in a lathe will result in a more parallel surface. Machine a bar the size of your crank journal and mount it in a chuck. Place the cap on the bar and secure it tight with another main cap. Face the cap until both sides are parallel and smooth. The thrust surfaces should be equal distance from the bolt hole left to right and the total cap length should meet the required length measured earlier. There may be a little work to do with a file to clean up a few rough places.

Photo 4 is a picture of the completed rear main bearing cap:

Installation of the Rear Main Bearing Cap

When the cap was returned from Steve, it measured about 3.128" in length and I could not fit it into place. I removed about .0015" of cap length by carefully rubbing each end of the cap on 320 grit wet sandpaper on a piece of glass. It then would slip into place. Note that at this step the clutch pressure should be released with the emergency brake lever all the way forward. The crankshaft can be moved forward and back slightly to facilitate the cap installation. Nuts are reinstalled and cotter pins replaced. The flywheel bolt removed is reinstalled, and the safety wire is replaced.

Sounds easy, right? This job is the most awkward task I've ever done on a car. In a perfect world, you'd like to have light to see what you are doing, a visual line of sight to what you are working on, and the ability to get your hands and tools to where they are needed. In this job, it seems like you can only ever have one of those three things at any



Photo 4: Squaring up the thrust surface



Photo 5: Finished bearing cap

one time! Be sure that children and pets are clear from the work area. You will probably use some of those expletives reserved for very special occasions. The *Model T Ford Owner* calls for wiring pairs of these bolts together, but I found it easier to wire all four together as it was originally. Remove the rags from the crankcase, reinstall the cover, and replace oil if you have drained it.

At the completion of the work, I measured the crankshaft endplay again using the dial indicator. Final crankshaft endplay measurement was .007", which I think is mostly flexing of the throws. I was cautiously optimistic.

**Gentlemen
Start Your Engines!
and
Final Observations**

Finally, the repaired engine was started. Again, using the Regan method, I measured the magneto output voltage as shown on the table at the bottom of this page.

The magneto voltage readings look great. The car has been on a number of drives with the engine running well. The crankshaft endplay issue has been corrected.

References

- *Model T Ford Service Manual*
- *The Electrical System — a Comprehensive Guide For the Repair and Restoration of the Model T Ford Electrical System*, MTFCA
- *Ford Model T 1926-1927 Wiring Diagram with Starter*, Lincoln Publishing Co. Inc.
- *The Model T Ford Owner — The Best of Murray Fahnestock*, Lincoln Publishing Co. Inc.

Special Thanks To

Steve Coniff
Ron Patterson
John Regan

Engine Speed	Observed Lamp Brightness	Measured Voltage V (AC)	Expected Voltage V (AC)*
Idle	Bright	9.4	9.8 @ 400 RPM
Moderate Speed	Very bright	17.2	18.8 @ 800 RPM
High Speed	Bulb blown	>30	26.2 @1200 RPM

* This data is from "The Model T Ford Owner"