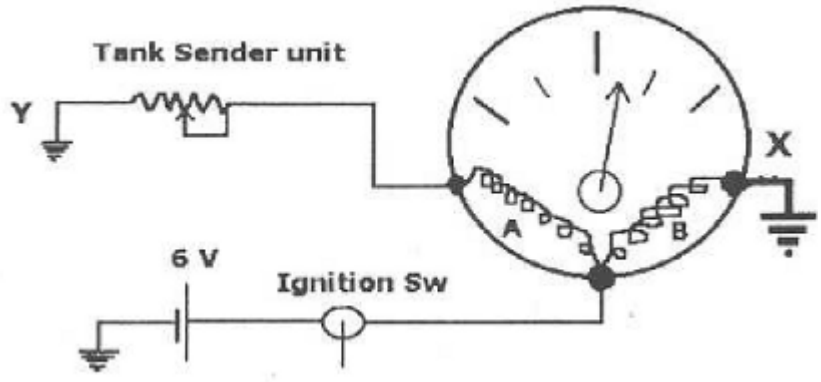
Fuel gauge problems

Mon, 2009-10-12 14:42 — Anonymous

FuelgaugeIf you own a WW2 vintage MB / GPW Jeep you will be well aware of the annoying guessometer in the dash panel - otherwise known as the fuel gauge . The silly thing is either permanently showing full no matter what level of fuel is in the tank , or the other common problem is the wandering pointer . The pointer seems to have a mind of its own jumping up and down the dial face making you wonder what is going on .

Why does it behave like this ? By modern standards The WW2 Jeeps and military Dodges and Chevs used a very basic fuel gauge system but with a bit of work it can be made to perform satisfactorily . If you own a Ford of this vintage (not Jeep) you are lucky as they used a different method of doing the job and it worked !

I have collected a number of WW2 vintage Jeep fuel gauges over the years and I decided to set them up on a test bench to try and work out what was actually happening. Firstly I needed to work out what was supposed to happen when the designers had it all on the drawing board . The Jeep manual didn't show a detailed circuit or description of the system but I found a similar circuit in a old 1930's car manual. The car book gave a basic explanation of the theory of operation and the circuit drawing will help to explain it.



The pointer needle is mounted on a armature which is surrounded by two coils of wire marked A and B on the circuit . The coils are so arranged that when a current flows

through them their magnetic fields have a attract / repel effect on the armature causing it to rotate , thus making the pointer move .When you turn the ignition switch on current flows from the battery through the coils to ground . The current flowing through coil A rotates the pointer towards the Full mark on the gauge, the current in coil B rotates the pointer towards the Empty mark .The position of the pointer is dependant on the ratio of currents flowing through these coils and when the two magnetic fields are balanced or equal the pointer will show half full. .If you look at the circuit you will notice that Coil B is connected directly to ground . Looking again you will see that coil A is connected in series (in line) with the tank sender unit . Coil A is shunted across coil B (in parallel) through the sender unit which is a simple variable resistor called a rheostat . The current flowing through it is dependant on what value of resistance it has , this is controlled by the float in the tank which moves a wiper arm across a coil of wire inside the sender unit . If your gauge is showing empty then obviously coil B has a stronger magnetic field than coil A has . This means that the wiper arm on the tank unit is at the high resistance end of its travel and is limiting the current flowing through coil A . If you fill your tank with petrol , the float will rise thus moving the wiper arm on the rheostat towards the low resistance end . The current flowing through coil A will increase and decrease in coil B. A's magnetic field will now be stronger than that of coil B pulling the pointer to the full mark .

If your gauge is permanently stuck on the full mark it most likely is not making electrical contact with the dash panel . A clean metal to metal contact between the gauge body and dash panel is needed to provide a current path for coil B to ground at X on the circuit . If the pointer is jumping upwards towards the full mark there may be some paint or rust causing a intermittent path to ground at X . Conversely if you have a dirty or intermittent ground connection at the sender unit your gauge will jump around or be permanently stuck on empty . Another thing to be aware of is , if you are using a 50 year old original gauge both Ford and Willys gauges used a piece of cardboard to insulate the ignition and tank wires from ground .

Carefully inspect the cardboard and clean up any dirt or rust surrounding the threaded terminal posts . At this point a multimeter will be usefull , these electrical test instruments are easy to buy at any electronics store for a few dollars . A cheap analogue meter will suffice for our needs . We will make some quick tests with the multimeter to check that both coils inside the gauge are intact and are not open circuit , a open coil will certainly cause problems . Put your multimeter on the lowest OHMS range and check between the ignition terminal and tank terminal , you should see around 30 to 40 ohms . Between the ignition terminal and gauge body (ground) you should see around 50 ohms (plus or minus 10 ohms either way). If you get readings quite different to these throw the gauge away and use another one .

Getting back to the test bench I set up a circuit as per the drawing using a adjustable regulated voltage source with a milli-ammeter in series with the gauge . I tried a few different old gauges both Ford and Willys type using a wire wound pot substituted for the tank sender unit . The results were quite interesting . After first checking the gauges with a multimeter I connected them up and they all worked . I used 7 volts as a base voltage

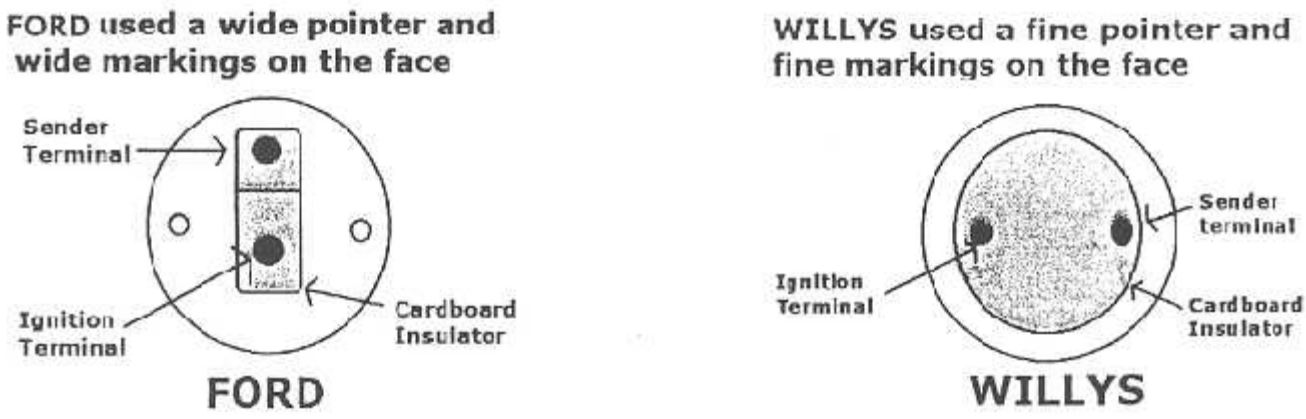
because the Jeep battery voltage will vary from 6 up to around 8 depending on the battery state of charge and the regulator setting . By varying the voltage I noted they had a good tolerance to different voltages . They worked from 6 v up to 8 v without much movement of the pointer . This is because the ratio of currents in the two coils is independent of voltage . Its the ratio of current that determines the pointer position not how much current there is . It should be noted here that because these gauges were mass produced and the manufacturing standards were not very high - the electrical tolerances of each gauge will vary by 10% or more.

The results tabled here are for a Ford gauge - the Willys gauge I tested showed about a 15% higher current for a given voltage than the Ford one did and also a had lower tolerance to varying the input voltage but that is not important . The figures are a rough " in the ball park " guide because the gauges do vary in tolerances and each individual will be different . I noticed that the Ford gauge had a more stable pointer when moved or knocked . The Willys type had a tendency to wobble around when moved , it had a poor damping characteristic . This is probably a design problem beyond the scope of this article . You can see that if the system is to work as the designers intended the sender unit needs to have a OHMS range from about 50 down to 1 . I suggest using a brand new repro or new old stock sender unit because after 55 years of dirt and rust using a original unit would be asking for problems . Before buying and installing it use a multimeter to check its resistance range and make sure it is the correct one for a Jeep , don't buy a similar looking unit for another make and hope it works OK as each car maker used their own version .

	empty	¼	½	¾	full
Current in circuit	156 ma	175 ma	200 ma	230 ma	260 ma
Sender unit resistance	52 ohms	37 ohms	27 ohms	15 ohms	.5 ohms

Note: 1000 ma = 1 Amp

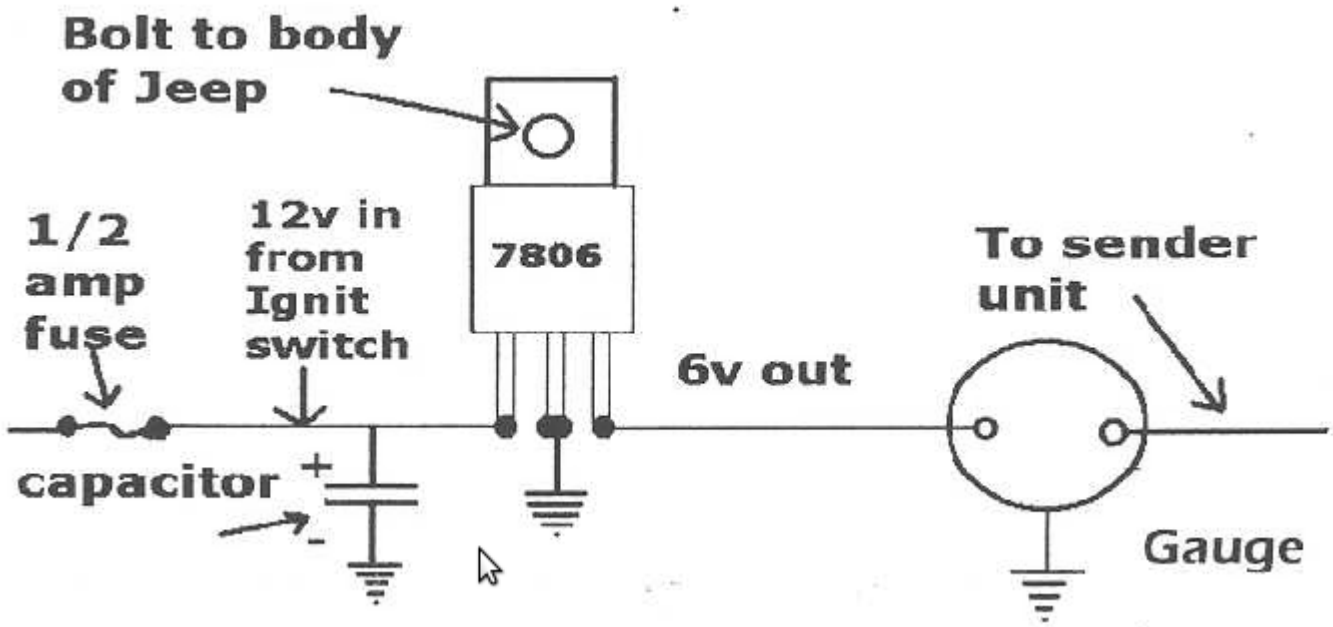
If you still have problems after checking everything out it may be caused by having a mismatched sender / gauge combination , the gauge may be too far out of its specification to be useable . Try using another gauge if you have one . Another problem is that many Jeeps are now converted to a 12V system and that means the original gauge is usually disconnected . It would be possible to solve this problem by using a resistor in series with the supply voltage but a much better solution is to use a simple solid state voltage regulator . These devices are easily available at any electronics shop such as Dick Smith . For a couple of dollars and a few minutes of soldering a few wires you will have a stable 6v voltage source that will happily run your fuel gauge .
Ford used a wide pointer and wide markings on the face Willys used a fine pointer and fine markings on the face



The 7806 voltage regulator in the TO 220 package is obtainable from most electronic stores like Tandy and Dick Smith for a few dollars . A 7805 5v regulator is also suitable and will work just as well . The center terminal is internally connected to the mounting tab so if you clean a bare metal attachment point on the body under the dash somewhere you can leave the center terminal alone . Because the device is dropping 6 v and has around 1/4 of a amp flowing through it it will heat up slightly but this current is well within specifications of its 1 amp limit. A clean mounting point will help to dissipate the heat into the Jeep body .

Because the Jeep 12v voltage regulator will probably be a mechanical device with coils it may generate some high voltage spikes that normally do not worry the Jeeps electrical system . The 7806 is a solid state device and like any other solid state device is very easily knocked out by a tiny voltage spike above its tolerance . A simple capacitor will help to smooth out the 12v supply and also protect the 7806 from voltage spikes . A capacitor of around 100v rating or more and 50 uf (microfarads) or above will do OK . Electrolytic caps must be connected the correct way and are marked + and - so be sure to connect the positive end marked + to the the 12v positive line . A 1/2 amp fuse in line with the supply voltage will protect the gauge in case a short circuit occurs. Make sure all connections and wires are well insulated from ground .

A final tip. To make a perfect trouble free circuit use two core wire from the gauge to the sender unit and use one wire as a earth return. In other words connect points X and Y together . This will overcome any bad earth problems around the fuel tank .



Note for Chevrolet owners
For 1940's Chev owners ie. Blitz , Lend-Lease , car or utes (pickups) . The fuel gauge circuit is similar in operation to the Jeep one . Except for the following important differences . The coils in the gauge are so arranged that the tank sender unit has the opposite resistance characteristic . At the EMPTY end of its range it will be around . 5 or half a ohm . At the FULL end of its range it will be around 30 ohms . The two gauge coils will show a lower ohms reading than Jeep type ie. When checking for open circuit around 20 to 30 ohms is OK . Also the coil polarity is opposite to the Jeep circuit . Apart from these differences if you check everything out as per the Jeep circuit the gauge should function properly . Look at a Chev manual to see the circuit .

For Dodge owners
For Dodge enthusiasts i.e. Weapons carrier . I do not have a original tank sender unit on hand but if you check one with a multimeter and look in the Dodge manual you should be able to test the circuit as per the Jeep / Chev . Be aware that some WW2 Dodge WC series trucks had a original 12V voltage system . The tank sender units on these 12 V trucks have a high resistance of around 120 ohms to compensate for the extra 6 Volts .

Written by Mike Kelly