Repairing Jaeger & Smiths Speedometers

2017 version Updated and Enhanced.

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This manual covers mechanical Jaeger/Smiths speedometers from the early 1960's through (at least) the late 1970's. I have worked mostly with Triumph parts, but also MG as well. I found that they have essentially the same works inside their different size cases. Therefore, servicing these two types uses similar procedures.

After reading this, PLEASE give me some feedback. I want this manual to be as explicit and accurate as possible. Your comments, both good and critical, will be very useful for my attempts to refine this monograph. If you find that your speedometer differs from my description, please let me know what you found, and the speedometer serial number and the make/year of your car. I want to hear everything! Please email me at Rhodes AT comcast DOT net.

THE MALFUNCTIONING SPEEDOMETER

Non-speedometer Issues

You have almost nothing to fear except fear itself. You CAN fix your own speedometer. Here is some information that may help you. The first issue is to decide whether the speedometer itself is actually the cause of the problem. Some faults that are thought to be due to a malfunctioning speedometer are actually due to a problem with the cable running to the speedometer, or with the drive gear in the transmission.

Frequently the cable itself is the cause of a wavering speedometer pointer. It is unfortunately somewhat difficult to service the cable. You must be prepared to get under the car and remove the cable from the transmission. However, it is sometimes possible to service the cable simply from the speedometer end. You need to remove the speedometer, then pull up some slack in the cable so the end of the cable is protruding slightly from the dash. Then you may pull out the wire cable from the outer sheath. Lubricate the cable with white lithium grease or gear oil and then slide the cable back into the sheath. As you get to the last couple of inches you need to slowly spin the cable as you insert it. This will allow the square end of the cable to seat in the square orifice in the transmission drive gear (hopefully). If, after multiple attempts, you can not get the cable to seat, then you will have to get under the car, and unscrew the cable from the transmission. Then press the cable fully in the sheath, and attach the speedometer. Then, back under the car, you must gently seat the cable into the drive on the transmission and screw it down securely. Test the speedometer with the newly lubricated cable. Test this before fully re-installing the speedometer in the dash.

Other causes of a wavering speedometer needle lie inside the speedometer itself. Any of the moving parts can be the culprit in causing binding. I have seen binding of the input shaft cause wavering as it slows down. The cable then winds-up and then breaks free and turns faster briefly. Binding can also occur between the shaft and the retaining flange. Binding can also be caused by insufficient lubrication of the worm gear. I have also seen binding in the odometer wheels (particularly the "old" style) cause cyclic resistance against turning, resulting in wavering. There can also be a dirt or lack of lubrication in the needle bushing between the magnet wheel and the pointer spindle. Binding odometer wheels and needle bearings often will cause speedometer wavering that is proportional to road speed.

I have also found that excessive end-float of the main shaft/magnet bar or of the pointer spindle can allow the drag cup to move closer or further from the magnet bar. This results in greater or lesser magnetic drag on the drag cup and a variable pointer position for the same main shaft RPM. In a worst-case scenario of excessive end-float, the drag cup can strike the magnet bar or the frame.

PARTS EXCHANGE GUIDE

Repairs of the speedometer and odometer sub-sections can be made by exchange with intact/functional parts from other Smiths or Jaeger speedometers. Many parts will be common across a broad range of models and years. There are four main variations (that I know of) that will influence the possibility of exchange. Within a specific type, parts seem to be completely interchangeable. “Old” models have all metal construction except for the worm gear and also have separately driven main and trip odometers. “Intermediate” have plastic odometer wheels, and the trip odometer wheels are more widely spaced. The “new” models have mostly plastic construction and the trip odometer is driven by a gear from the main odometer, so there is only one worm and pawl. The spindle bearing in the magnet wheel is more shallowly set in the “new” type of speedometers.

Triumphs seem to have had a slightly different variant speedometer than the MGs. The primary difference is that the spindle to which the pointer is attached is longer (.180” vs. .150”) and has a somewhat narrower taper (.035 to .032 vs .035 to .030). This makes it less than optimal to move the works from an MG to a Triumph because the Triumph pointer fits slightly loosely. The move of a Triumph works to an MG is even less possible due to the MG pointer being too tight to fit on the TR works. The diameter of the base of the long and short spindles is approximately the same, so the longer one reaches a more narrow tip. It is possible to shorten the MG spindle to the Triumph length and thereby have the diameter correct for the Triumph pointer. Use a file or rotary stone on a Dremel tool to shorten the spindle by a 30 thousandths or so, and try refitting the pointer. If it will not slide on, there may be a burr on the tip, so use a fine file to chamfer the edge.

Depending on the calibration required, the worm on the input shaft may have 20, 25 or 32 teeth (there could be others but I have not seen them). It appears that 32 teeth were very commonly used on the “old” and “intermediate” versions, with 20 and 25 are also seen. 20 and 32 teeth were used on the “new” styles. There was a wide variety of gears used on the odometer wheels to provide the final calibration. The calibration of the odometer is the number of teeth on the worm gear multiplied by the number of teeth on the odometer wheel gear. This gives the number of input shaft turns for each odometer shaft turn.

Of course parts are completely interchangeable between identical units, but many parts are carried across a broad range of speedometers, and will be completely interchangeable. For instance there are only two types of magnet wheels that I have identified. One type has a shallowly set spindle bearing, and the other is more deeply set, so the magnet wheel can be interchanged quite freely with a similar type from any source. The main speedometer frame is identical across all models as far as I can tell, and are completely interchangeable. In the “old” and “intermediate” units, the spindle/main odometer frames are interchangeable as long as the pointer fits properly. In the end, it is usually possible to obtain sufficient parts to repair your speedometer without great difficulty or expense by visiting the tables of instruments at flea markets.

KPH and MPH speedometers are essentially the same and parts exchange guidelines apply here as well. As far as I can tell, the actual speedometer function is exactly the same. Only the printing on the dial face is different. The odometers are also essentially the same. The KPH units have 62% fewer teeth on the gear mounted on with the odometer wheels so there will be more turns of the odometer for the same distance traveled. It is fair-

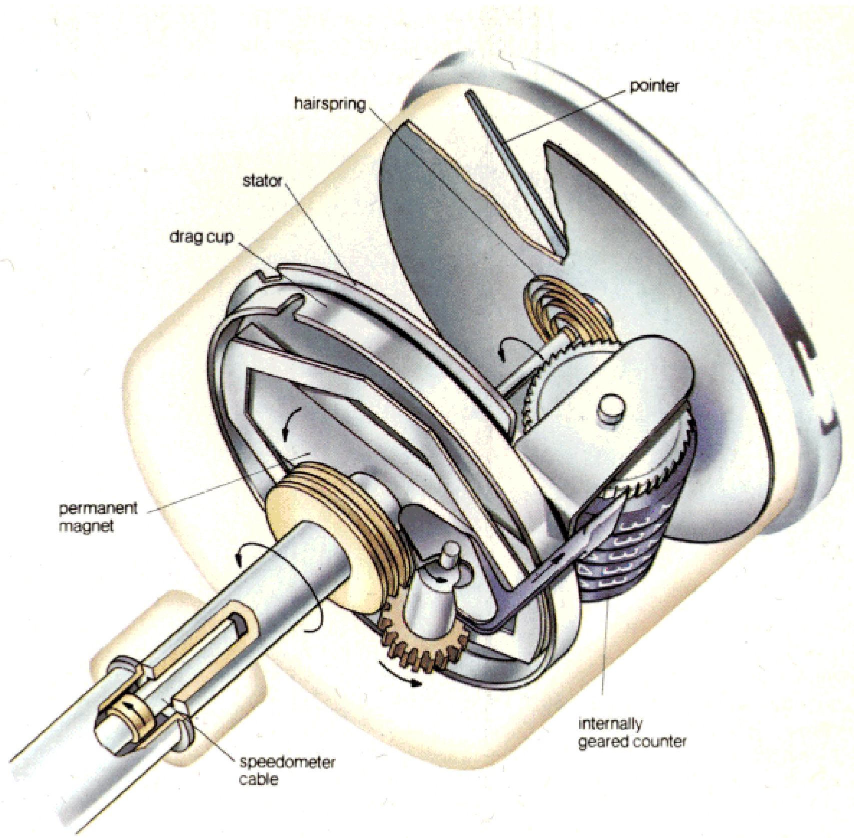


Figure 1.Cut away view of a typical speedometer.

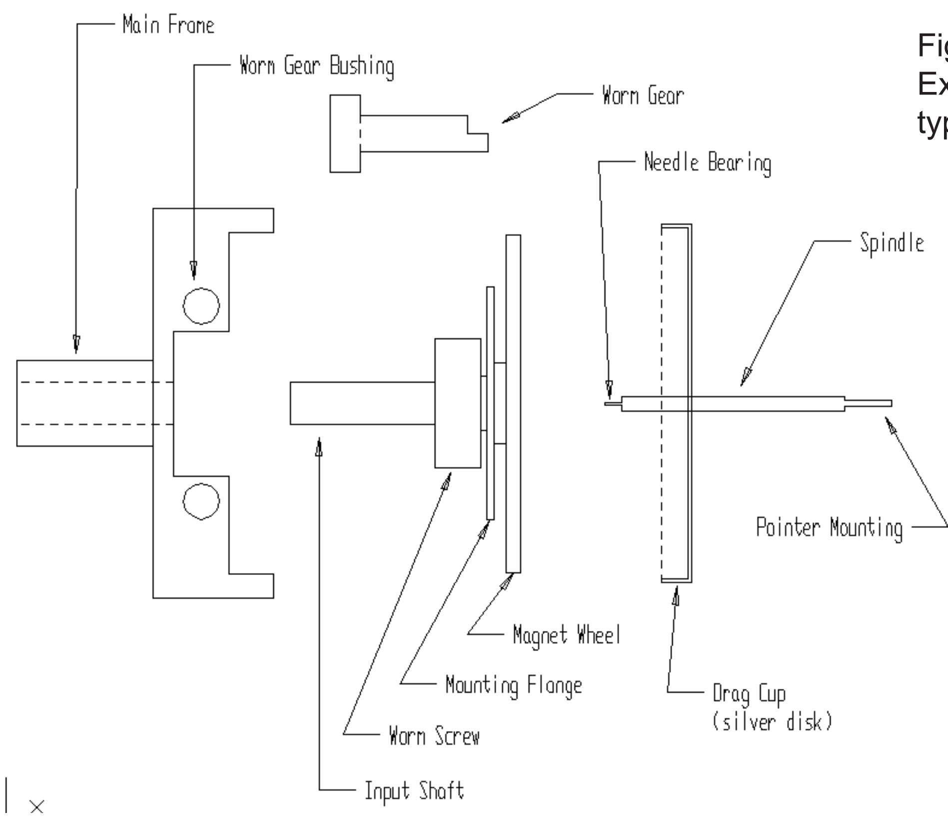


Figure 2.
Exploded diagram of a typical speedometer

ly easily to convert a KPH speedometer to an MPH unit. All you need to do is exchange the dial face and install the proper odometer gear to set the desired calibration. To convert from KPH to MPH, you can calculate the desired calibration by multiplying the calibration printed on the dial of the KPH speedometer by 1.609. The reverse calculation may be made by dividing by the same number. The resulting number usually will not correspond to an actual calibration that was available on speedometers. You need to round to the nearest 20, 25,or 32 (the number of teeth on your worm gear). For example, a common TR6 KPH speedometer has a calibration of 740. This corresponds to an MPH calibration of 1190.6. This is just about centered between the two possible calibrations of 1180 and 1200. To settle the issue of the what calibration you REALLY should have, you ought to calculate your ideal calibration as described later in this manual, then translate that into a MPH/KPH calibration and then look for the best possible calibration available.

List of Smiths/Jaeger types:

Old Style: Separate main & trip odometer frames and drives (all 120 mph?) TR2 thru 3A

Type 1: 25 tooth worm gear
Type 2: 20 tooth worm gear

Intermediate style: Separate main & trip odometer frames and drives (all 120 mph?) All 32 tooth worm gear (?) TR4 and TR4A (probably TR3B)

Type 1: Narrow trip odometer wheels (early)
Type 2: Wide trip odometer wheels (late)

New Style: Single main & trip odometer frame and drive (TR5/250? and TR6)

Type 1: 32 tooth worm gear (all 100, 120 mph) (MG only?)
Type 2 20 tooth worm gear (all 140 mph?) (TR only?)

Note: This summarizes the extent of my experience with TR and MG speedometers Any additional information will be greatly appreciated and incorporated into the next edition of this manual.

THE SPEEDOMETER: Mechanical Description

The speedometer (speed indicator, not odometer) functions in just the same way as a tachometer. The cable spins a thin bar magnet. Just in front of the bar magnet is a disk mounted on a spindle. Also attached to this, on the same spindle, is the pointer that is visible over the dial face. When the bar magnet spins, it causes the disk (drag cup) just in front of it to try to spin as well. The amount of twisting force (torque) imparted by the magnet to the disk is proportional to the rotational speed of the magnet. If the magnet spins twice as fast, the torque is approximately twice as great. The spindle is attached to a flat coiled return spring to resist rotation. The amount the spring winds is proportional to the torque. In this manner, the pointer moves progressively farther as the magnet spins faster. There are several areas where a speedometer can fail:

1) The magnet wheel may not spin. In this case all functions cease and the drive cable (or angle drive) will break.

2) The spindle may not move freely due to the disk binding against an obstruction. In this case the pointer is stuck in one place or will not rise above a certain level. The spindle pivot may lack lubrication and this will cause the needle to jump from one speed to the next rather than move smoothly. Lack of lubrication between the spindle needle tip and the bearing in the center of the magnet wheel may cause chatter at certain speeds, or the pointer swinging suddenly to full scale.

3) The bearing in the center of the magnet wheel may be worn causing excessive end-float of the pointer spindle, or lateral wobble of the spindle. This can cause binding of the pointer, or a variable pointer reading for a constant magnet RPM.

4) There may be excessive wear around the main shaft collar which holds the main shaft to the frame. This will result in excessive end-float of the main shaft which in turn may cause binding of the pointer spindle if the main shaft moves and eliminates all end float of the spindle..

5) The return spring (hair spring) may be broken. In this case the pointer will wind completely around until it hits the stop. A professional repair is required.

6) If everything moves normally, but it indicates the wrong speed, it is probably out of calibration. This is unusual unless the pointer has been touched directly or you are using tires that vary substantially in rolling diameter from the originals. Also, violent swinging of the pointer may cause it to shift if it hits the stop forcefully.

7) Calibration errors of the pointer may come from weakening of the hair spring. A weakened spring will move more for a given speed than expected by the markings on the face. While you can calibrate the pointer for a certain speed, it will register low below that speed and high above the speed. The fix for this is to reduce the magnetism of the bar magnet. In addition, it is possible for the bar magnet to lose its magnetism over time. If this happens, it is as if the hair spring is too strong, and you will see the opposite problem than the weak spring described above. You can remagnetize/demagnetize the bar magnet as described in Appendix V

SPEEDOMETER: Inspection

To remove the speedometer works, first remove the metal bezel and the glass. Remove the two screws on the back and, if necessary, the tiny screw holding the reset cable (TR2-4). Then press the reset shaft (TR2-4) into the case and then push the threaded end (where the speedometer cable attaches) inward. The works should slide forward out of the case. There may be some adhesion to the rubber gasket inside the case, If the works do

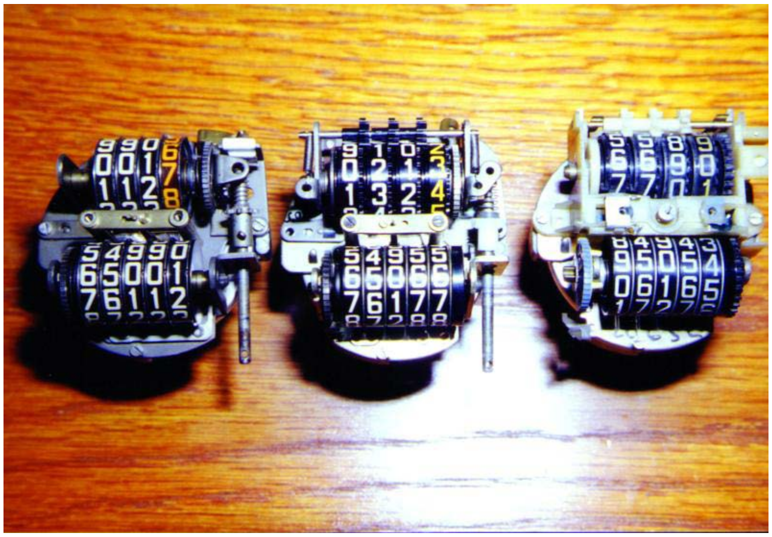


Figure 3. This shows the works of the three major variations of speedometers. “Early” on the left, “Intermediate” in the middle, and “Late on the right.

Figure 4. This is a view of the underside of the odometer wheel frame with the attached drag cup. In the center of the drag cup is the thin spindle which fits into the bushing in the center of the magnet wheel. The light-colored burnishing on the top right of the cup is from the magnet bar striking the cup.

Figure 5. This is a view of the front of the magnet wheel after removal of the odometer wheel frame. In the center is the brass bushing in which the spindle of the pointer rides.

not move freely check the reset shaft and be sure that it is not catching on the case. Use a screwdriver to press it free.

When the works are free of the case you can now inspect them. The disk to which the pointer is attached should move freely. Twist the entire works back and forth. The pointer should move. You can use your finger to gently move the silver disc (drag cup). That should make the pointer move as well. Turn the speedometer drive at the attachment point of the cable by hand. This can be achieved by inserting a screwdriver into the square end of the input shaft and twisting counterclockwise. You should see the worm move and after 32 turns (or 20/25) the pawl(s) should have gone through one complete cycle. As the pawl cycles, it should push the 1/10's wheel ahead by one tooth. The wheel ought to have a ratcheting action to prevent the wheel from rolling backward.

You should test the end float of the main shaft. Use a small diameter screwdriver to push the main shaft toward the pointer while holding the frame. Then press the pointer end of the spindle backward toward the main shaft. There should be very little play ("end float"). It should move a slightly perceptible amount, less than 0.005". Then press the main shaft toward the frame again and hold it at the limit of its travel. Now try to move the spindle along its axis. It should have a VERY slight amount of end float, maybe 0.001" to 0.002".

I am not sure how much end float the factory used. But I was testing a tachometer that functioned quite well, and I had lubricated everything, and it should have been perfect. But the pointer reading varied a lot depending on the position of the tachometer. If it was face-up the RPM reading was about 4000 and varied wildly. When tilted face down a bit, the reading was about 2000 and fairly steady. I realized this was due to excessive end-float of the spindle. It had about 0.080" float. I found a well functioning tachometer and the end float tolerances were much tighter. I had on hand several other tachometer works and EVERY one of them had excessive end-float. And some of the spindles were damaged (see figures 6 to 10).

I suppose it makes sense that the tachometers might wear out before speedometers. The average speed of a passenger vehicle might be about 30 mph (this is what my daily driver averages). If the speedometer calibration is 1184, then the speedometer averages about 592 RPM. At the same time, my engine is turning at between 2000 and 2500 RPM, lets call it 2250 RPM. Since the tachometer turns at half the engine RPM, it is turning at about 1125 RPM, or nearly 2 times as much as the speedometer. Therefore, the tachometer will wear out twice as fast as the speedometer.

SPEEDOMETER: Dismantling

Pull the thin wire pointer stop back away from the pointer from the back of the dial face. Observe where the pointer rests. It ought to rest at the small white dot (or while line on MG speedometers). When you reassemble the unit, have the pointer rest at the same location. This will allow you to reinstall the pointer without any significant loss of calibration. Remove the pointer by gently turning the drag cup until the pointer is at 60 mph. Then gently hold the drag cup in place. Hold the pointer by the hub and pull and twist the pointer until it pops free of the spindle. If this does not work then you can use a puller. See Appendix VII for a suggestion of a design you may be able to fabricate. Other people have used a fork as a lever to lift the pointer hub from behind.

Figure 6. This is a photo of the needle tip of the spindle that rides in a brass bushing recessed in the magnet bar.

Figure 7. This is a photo of a mildly damaged needle. This one is probably still serviceable after cleaning.

Figure 8. This is a photo of a severely damaged needle. This one is ruined and can not be used because it will not stay positively centered in the bushing.

Now remove the two small screws attaching the face to the frame. The works are now free to work on. Much of the service can be done with no further disassembly.

Removing the odometer wheel sets will allow access to the magnet wheel and the seat of the needle pivot. Depending on the vintage of the speedometer the two wheel sets may be separate (early) or connected (late). You can tell if they are separate by looking for two separate gears driven off the worm on the shaft of the magnet wheel. The wheel sets and their frames are held in place by 4 small screws oriented on the top, bottom, left and right sides. These may be removed. If it uses a separate frame, the trip odometer may be lifted free after removing the small spring retaining the pawl. Remove the spring holding the pawl on main odometer. The spring is not present on the “new” style units.

Gently turn the works upside down while supporting the upper part of the frame and then lift the bottom half of the frame free. You will have to move the main odometer pawl to allow the parts to separate. You may rest the upper frame and the main odometer wheels out of the way canted to one side upside down. Just do not allow it to rest on the spindle where the pointer attaches. To do so may stretch out the flat coil return spring.

NOTE: IT IS ESSENTIAL TO AVOID DAMAGE TO THE RETURN SPRING. WHEN THE SPEEDOMETER IS DISMANTLED THE DRAG CUP AND THE RETURN SPRING ATTACHED TO IT ARE POORLY SUPPORTED. IT IS EASY TO DAMAGE THE SPRING UNLESS YOU ARE CAREFUL TO SUPPORT THE DRAG CUP AT ALL TIMES.

The older speedometers had two screws holding the retaining flange of the magnet wheel and the input shaft to the frame. The newer ones are riveted. If you strongly suspect a problem with the input shaft bushing lubrication, you can drill out the rivets and then maybe it is possible to tap threads into the frame to replace the rivets with screws. I have never done this, so I can not comment on its feasibility. You will need to be very selective about which brass (non-magnetic) screws to use to re-secure the flange as protruding heads will interfere with the magnet wheel. If your unit has screws, they may be removed and the magnet wheel and shaft may be withdrawn from the frame. Clean the highly polished input shaft and the bushing in the frame. You may use light grease to re-lubricate it. Apply ample grease in the narrow mid-sections to provide lubrication for the long term. I am not positive what sort of lubrication the factory used. I believe they did use some form of light grease in this location.

Once greased, shaft can be replaced in the frame. Try spinning the magnet wheel. It should move freely, but the close tolerance of the input shaft as well as the grease do not allow it to spin multiple revolutions without constant pushing. Nevertheless, the resistance to movement should be very small.

The speedometer pointer spindle rides in a small bushing in the center of the magnet wheel. Again, I do not know what sort of lubrication was used originally. They may have used none. The bushing may be cleaned with a jet spray of electrical contact cleaner. I got some from Radio Shack that included mineral oil lubricant. I think that “Brakleen” could also be used, and then you may need to use a very light machine oil. Engine oil will be too thick. Since the magnet wheel is constantly spinning, you want to have as little transfer of torque to the pointer spindle as possible. Viscous lubricant would cause significant torque on the spindle. This is the reason that I suspect that the spindle originally had no lubricant between the hardened steel needle-tipped spindle and the brass bushing.

Now you may reassemble the lower frame to the odometer frame(s). Be sure to avoid

Figure 9. This is a photo of a the bushing recessed in the magnet bar. The needle tip of the spindle rides in the tiny hole in the center and the conical concavity receives the conical end of the spindle. There should be no actual end-loading of the spindle against the bushing.

Figure 10. This is the end of the spindle to which the pointer attaches. The amount of end float visible here is excessive. It should be about 1/3 of what is shown. The screw to the left of the spindle is used to pull the top bar downward toward the shoulder on the spindle, reducing end float..

damage to the spindle as you refit the frames. Also you need to have the lower frame rotated to the proper position on the upper frame. If you use the wrong orientation, only the upper and lower screw holes will line up. Once the frames are properly aligned, they may be secured with one screw below the main odometer. If your odometer has a separate trip odometer, it may be installed now as well. Use the other three screws when it is in place. Now install the two return springs on the pawls. A fine forceps will make this job much easier!

Replace the face and pointer and re-index the pointer to the proper location based on the rest position noted in the beginning. Ideally you will set the pointer to the zero dot or line and check calibration from there. If necessary calibrate the speedometer as listed below.

SPEEDOMETER: Calibration

As stated above, there is a small dot at about -5 mph on the dial (on tachometers too). When the stop post on which the pointer rests when reading “zero” is withdrawn, the pointer should come to balance pointing at the dot. MG speedometers have a line in about the same position. If you are restoring a speedometer without appreciably changing its calibration, then you can probably use that dot to set the speedometer. Unless the hair spring (return spring) or the magnet have lost strength over the years, then that dot ought to provide a fairly accurate initial calibration.

If you find that there is a significant error in the pointer reading at speed, then the magnet wheel’s magnetism and hair spring are incorrectly matched. Refer to Appendix IV for one reader’s approach to this problem, and Appendix V for the most complete method to calibrate the speed indication.

Driving Calibration

Calibration of your speedometer is easy if it is not far off, i.e. +/- 2 mph. If you have not serviced it, it ought to be close to the correct speed unless you have installed tires of a significantly different rolling diameter. To fine-tune your calibration, you need to drive a measured mile at exactly 60 mph indicated on the dial (you may use any other speed as well, but 60 is a nice mid-range number to use). Use a stopwatch to time your mile trip. Your actual speed is 3600 divided by the number of seconds it took to drive the mile. Now remove the speedometer from the dash, and remove the works from the case. Do not remove the pointer or face. Move the pointer to the indicated speed you used in the mile trip (60mph). This is done by gently holding the drag cup in the works. Double check that the pointer is still at the indicated speed. Now gently push the pointer to the calculated speed while being sure that the disk does not move. Now pull up some slack speedometer cable into the dash and reconnect the works of the speedometer without reinstalling the case. Carefully perch the speedometer in the dash opening without allowing the dash to contact any moving parts. Time another measured mile at exactly 60. If the time is not very close to 60 seconds readjust the speedometer. You should be getting very close to perfectly calibrated with one or two resettings of the pointer.

Bench Calibration

If your speedometer has been serviced, you can do a bench calibration quite easily. You need the speedometer, a tachometer, a speedometer or tachometer cable, and a drill that will turn about 1000 to 2000 rpm. First you need to find out exactly how fast your drill turns. Attach the drill to the drive end of the cable and attach the tachometer to the other end. Turn on the drill to maximum RPM in REVERSE. Watch the pointer of the tachometer. It should be quite steady. If it wavers significantly, either the drill does not turn a constant speed or the cable is binding. You can lube the cable by removing the center wire and greasing it lightly with lithium grease. Once you achieve a fairly constant reading, you can determine your drill RPM by dividing the reading by two (the ratio is indicated on the tachometer dial face: “2-1”). For instance my drill showed exactly 2400 rpm, so it was turning exactly 1200. This happens to be the maximum speed listed on its label.

Now you need to calculate what the speedometer OUGHT to be reading at that RPM. You need to know one of two things. One is the calibration number printer on the dial face of the speedometer just above the “MPH”. This is the cable RPM that it takes to indicate 60 MPH. If you know that your tires are substantially different from those originally supplied with the car, you can not use that number as your final setting. If you DO know the engine RPM that corresponds with 60 MPH, then divide that by 2.5 (known correct for the TR2-6 series, other transmissions may differ. I suspect that Spitfires used 3.5) to determine the cable RPM that corresponds to 60 MPH. If you are not sure of this data, then set the speedometer to the printed calibration and then do the driving calibration discussed above. As an example, you want to set your speedometer to 1152 calibration. You need to calculate what MPH should be indicated when you run the drill at its maximum speed. The MPH will be 60 * RPM / 1152. So, in this case the MPH = 60 * 1200 / 1152 = 62.5. Now turn on the drill and look at the indicated speed on the speedometer. Turn off the drill and hold the disk with the pointer at the observed speed. Gently push the pointer to the calculated speed (62.5) and retest. Adjust the pointer until it reads exactly the calculated speed. Now you can attach the speedometer to the cable in the car and drive a measured mile and adjust as outlined above. These adjustments will set the speedometer only. It will not set the odometer, which is gear driven as stated below.

UPDATE: See Appendix V for a more complete method to calibrate the speed indication

THE ODOMETER: Mechanical Description

The odometer is gear driven. The cable turns a worm screw which turns a 32 (sometimes 20 or 25) tooth gear. This gear is directly attached to a pawl via an eccentric pivot. Every turn of the gear will pull the pawl once. The pawl turns a gear at the end of the odometer wheels. This gear has a different number of teeth depending on the calibration of the odometer. This calibration is written in small letters on the dial face above the “MPH”. 1152 and 1184 are the most common on the TR4 series, Other speedometers may use a 20 or 25 tooth gear and more teeth on the odometer wheel gear. Fewer teeth on the worm gear makes the movement of the odometer wheels much smoother. The calibration is always a whole multiple of the 32 (or 20,25) tooth gear. For instance, 1152 is 32*36.

There are a few places where problems can occur.

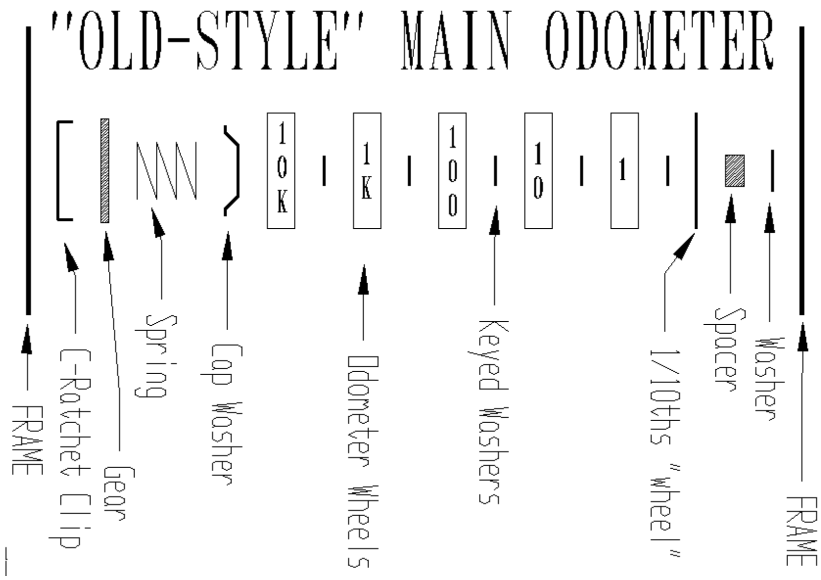


Figure 11. Diagram of "old-style" main odometer components

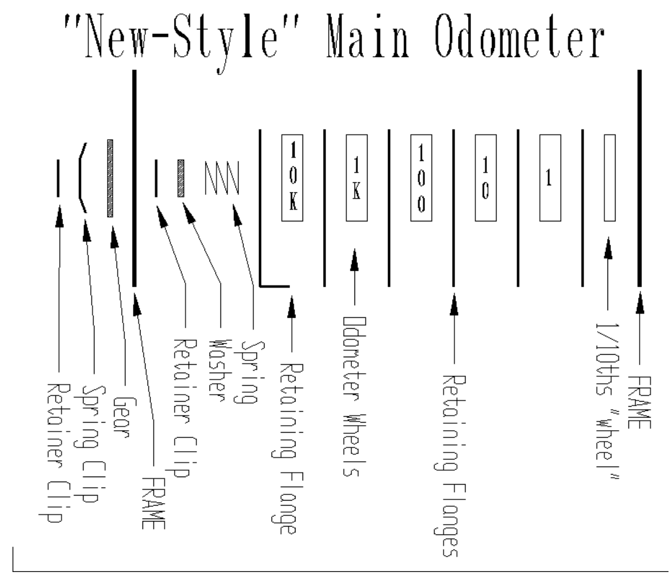


Figure 12. Diagram of "intermediate-style" odometer components.

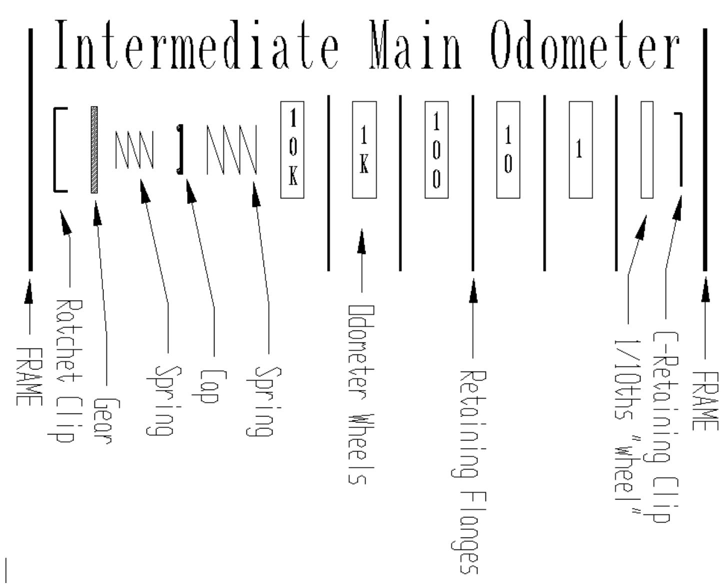


Figure 13. Diagram of "new-style" odometer components

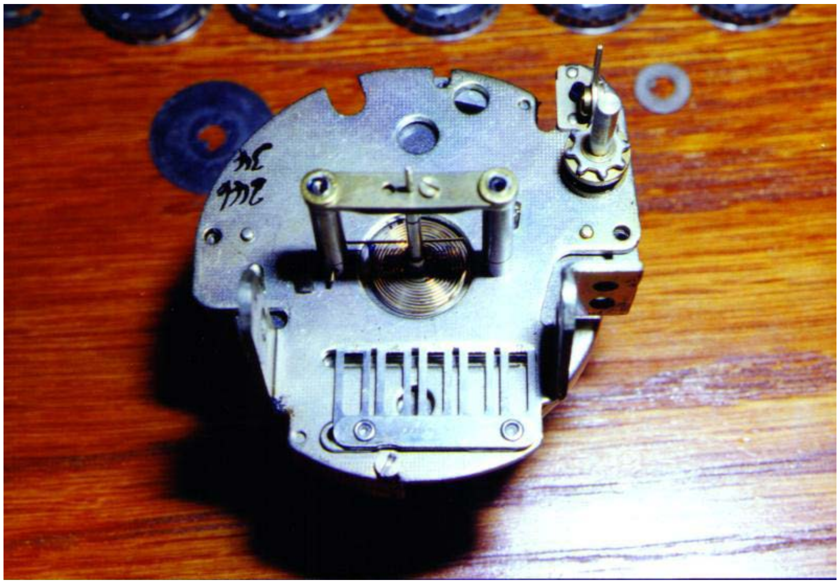


Figure 14. The main frame of the “Early” speedometer with the main odometer disassembled and the trip odometer frame removed. The “hair spring” is visible. On the other side of the frame is the drag cup. This frame is from an MGA and has the trip reset wheel entering straight into the frame. The metal fingers which allow indexing of the odometer wheels are visible on the lower section of the frame.

Figure 15. The disassembled parts of an “early” main odometer. The order of parts is from left to right and top to bottom. The brass keyed washers rest on top of each odometer wheel. These drag on the wheels and allow each to index when the wheel to the left releases the finger underneath.

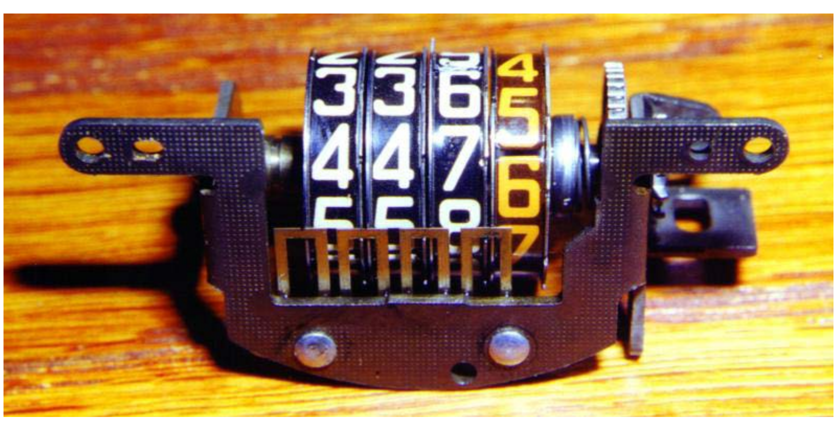


Figure 16. An “early” trip odometer incorporating wheels identical to the main odometer. The trip odometer is mounted on its own sub-frame. The metal fingers are shown holding the wheels. It is clear how each wheel can release the finger restraining the wheel to the left.

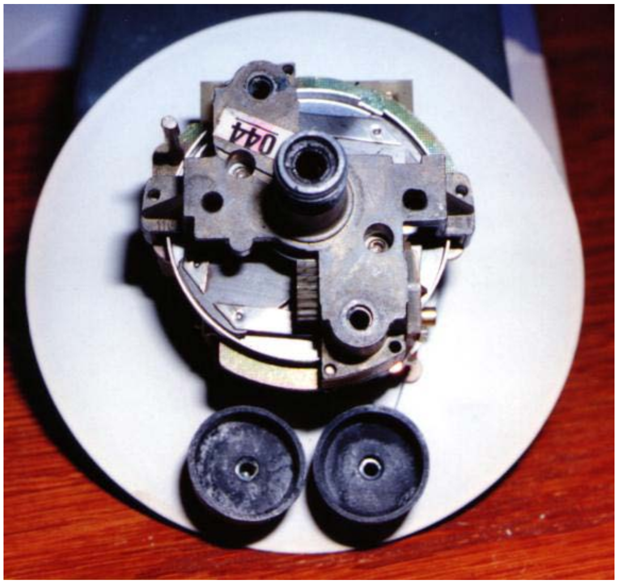
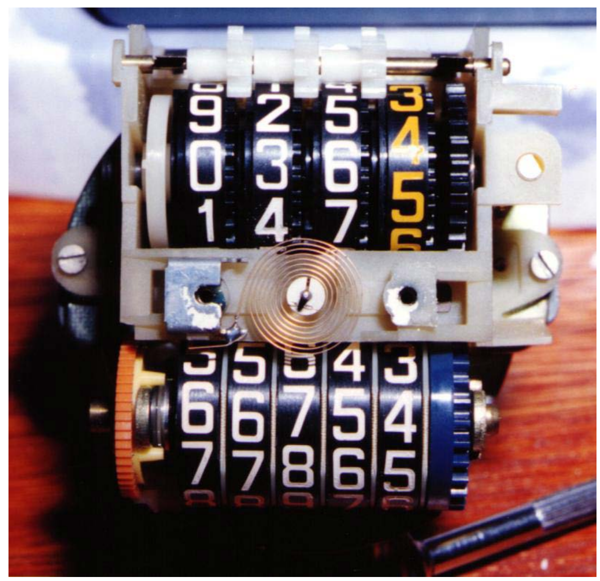


Figure 17. This is from a TR6 (New-style). Viewed from the rear with the case removed. You can see the input shaft in the center. You also see the gray plastic gear which is driven off the worm. Also visible here are the magnet wheel and the drag cup (silver). These will be shown in greater detail in upcoming photographs.

Figure 18. This is the same TR6 speedometer with the dial face removed. You can see the all plastic construction, and the single orange odometer drive gear on the left of the lower odometer set. You can also see the flat-coiled brass return spring in the center.



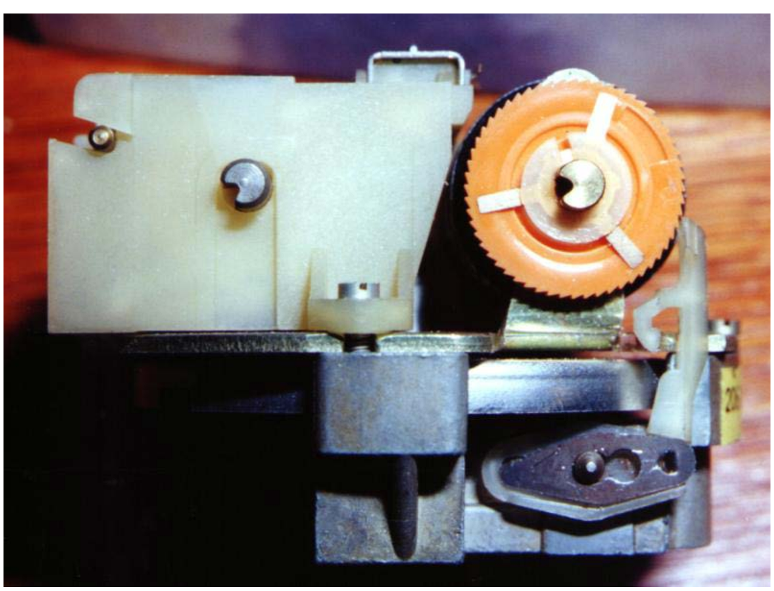


Figure 19. A view of the left side of the same speedometer. You can see the orange speedometer drive gear, the gray plastic retaining washer, the white plastic pawl which pushes the drive gear, and the dark metal retaining clip on the base of the pawl.

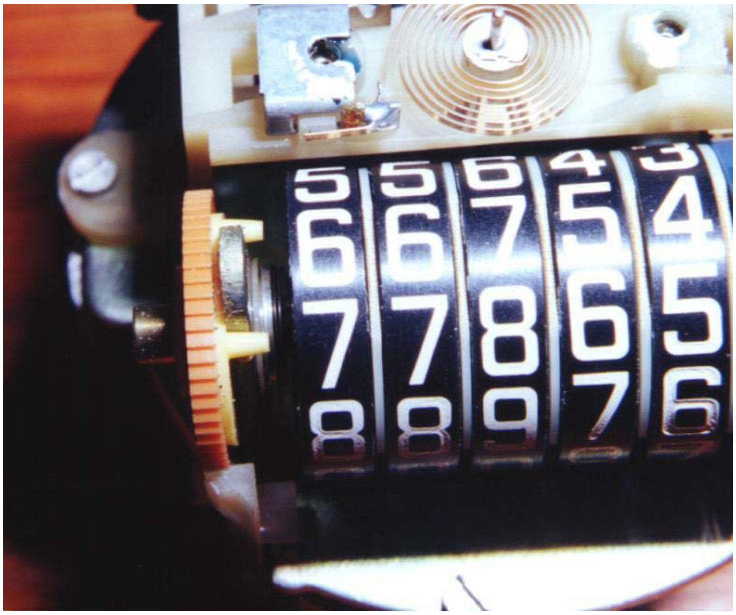
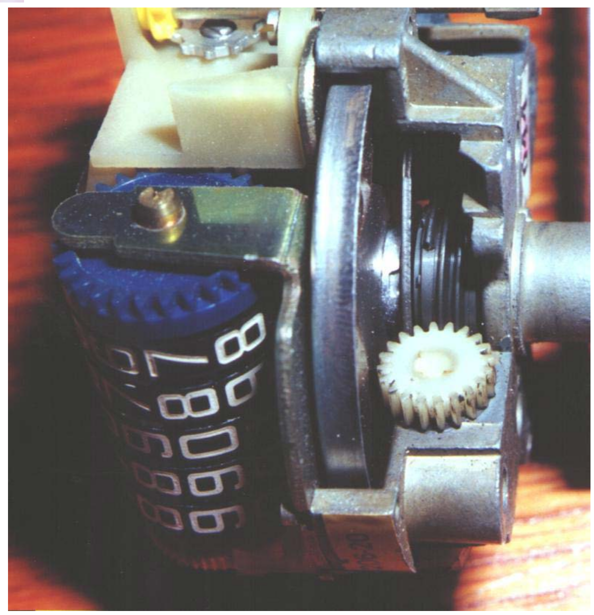


Figure 20. A close up of the front of the odometer drive gear. The yellow plastic legs to the right of the gear are attached to a plastic which has a splined surface and provided a ratcheting action to the gear. The legs prevent rotation of the yellow . Just to the right of the metal arm of the frame you can see the edge of a second gray plastic retaining washer.

Figure 21. A close up of the worm on the input shaft. The white gear is the 20 tooth worm gear. On the opposite end of this gear is the eccentric pivot to which the pawl attaches. The silver rim visible to the left of the gear is the drag cup which is turned by the magnetic action of the magnet wheel. The magnet wheel is not clearly visible here as it is recessed into the drag cup.



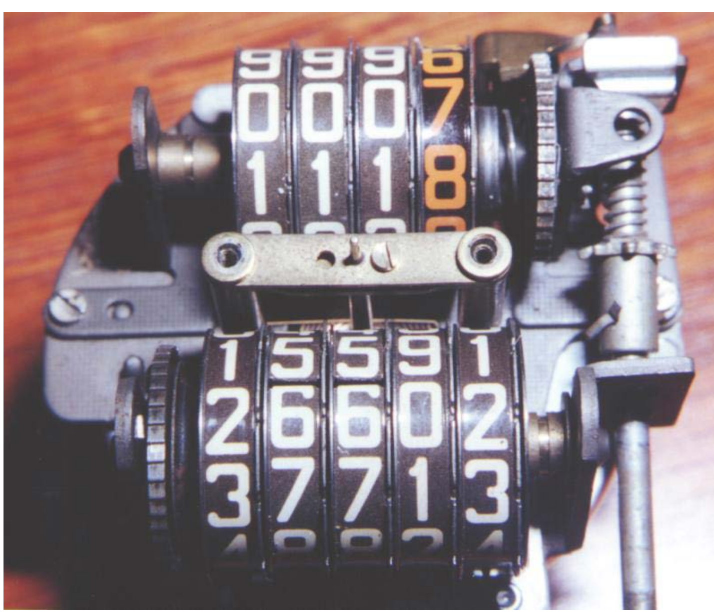


Figure 22. A view of the front of an “Old-style” speedometer. Note the separate odometer drive gears for each wheel set. Also note the all metal construction. The trip odometer wheels are set immediately next to each other in contrast to later speedometers such as the new-style one in the earlier photographs (fig. 2). The shaft on the right is the trip odometer reset. The return spring is not in the same place as the later speedometer. It is just above the pointer under the odometer wheels.

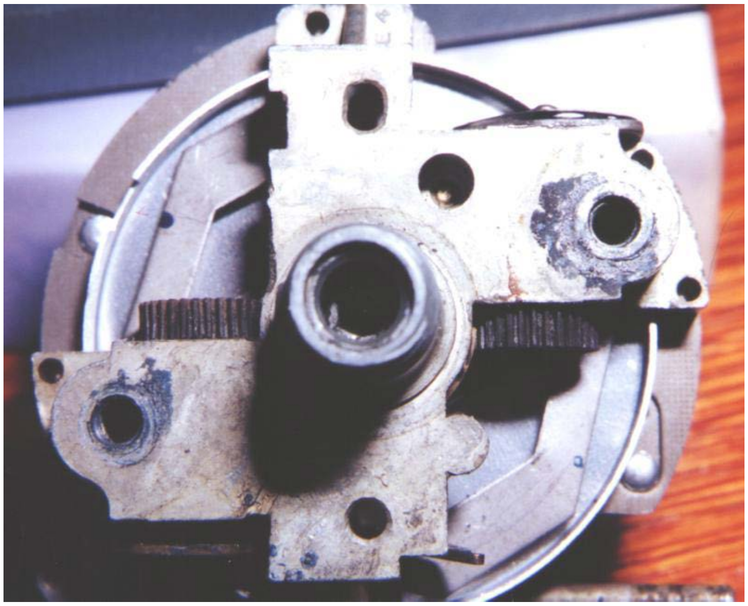
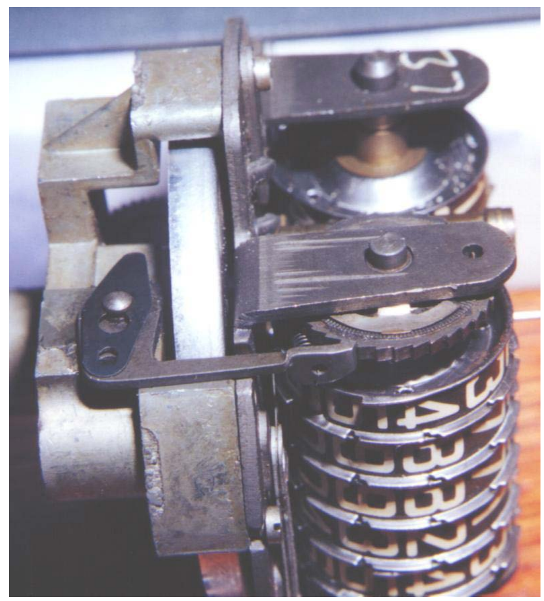


Figure 23. A view of the rear of an old-style speedometer. Note the twin 32 tooth worm gears. One for each wheel set.

Figure 24. A view of the left of an old-style speedometer.. Note the all-metal construction. The shiny thin metal against the left side of the odometer drive gear is the combination retaining washer/ratcheting lock. The number “37” written (by the manufacturer) on the frame is the number of teeth on the odometer drive gears.



1) The worm may not turn, and this is the same problem as #1 in the speedometer section.

2) The plastic 32 tooth gear can be stripped, or the clip that holds the pawl to the eccentric pivot may have fallen off allowing the pawl to fall from the eccentric.

3) The spring pulling the pawl to the gear on the wheels may be weak or missing. This may prevent the pawl from touching the gear and thereby prevent any motion of the wheels.

4) There is the very unlikely possibility that the wheels themselves no longer index properly.

ODOMETER: Calibration

Calibration of the odometer is not as simple as making an adjustment in the works somewhere. Being completely gear driven, you need to replace the gear on the odometer wheel axle that is moved by the pawl. To do this you need the appropriate gear from an otherwise identical speedometer with the proper calibration. The simplest method to do this is to determine what calibration you need. This can be calculated by driving a measured distance of road. The longer the better, ten miles minimum. Then compare the actual mileage to the indicated mileage. The calibration you will need will be: Old Calibration * Indicated Miles / Actual Miles. If you drive 20 miles and read your odometer to about 1/2 of a tenth, then you will get your correction factor to better than a half a percent and probably close to a quarter of a percent. This is certainly a better calibration than the car had originally.

You can calculate the THEORETICAL calibration you need by finding the “turns-per-mile” (TPM) specification of your tires. See APPENDIX I & III for calculating and measuring the TPI for your tires. Your driveshaft RPM (at 60 mph) is TPM * Differential Ratio. The differential for the TR2-4 series is usually 3.7. It will vary in other cars. You also need to know the number of driveshaft turns per cable turn. On the TR2 through early 6 series it is 2.5 drive shaft turns to 1 cable turn (possibly 3.5 for Spits). For a TR2-4, the odometer calibration you will need is calculated by TPM * 3.7/2.5. This is a very theoretical number and you are much better off by driving a distance on a marked highway (at any speed) and comparing the indicated milage to the real mileage.

Unless you are very lucky, you will not be able to find a speedometer with exactly the required calibration. See APPENDIX II for a chart showing odometer calibrations. You can calculate the closest POSSIBLE (but not necessarily available) calibration by dividing the calibration you think you need by 32 (or 20, or whatever the number of teeth of the worm gear) then rounding to the nearest whole number. For instance, if you find that your speedometer reads 11 miles when you drove 10, and the calibration is 1184, then you need a new calibration of 1184*11/10 = 1302. When divided by 32, this is 40.7. This rounds to 41, which tells us that the closest possible calibration is 32*41= 1312. You need to look for a real speedometer with a calibration of 1312, or at least as close as possible to the calculated 1302. Any Smiths or Jaeger speedometer of the same vintage ought to be very similar in the works and may be able to be swapped. For example, I needed a 1280 speedometer and found one from an MGB of the 70's vintage. It would have been a perfect match for a TR6 speedometer and was a serviceable match for a TR4 speedometer. One from the 1960's probably would have been a perfect match. I will keep looking. After I did a 30 mile odometer calibration trip, I found that I need a calibration of 1344. This just happens to be a whole multiple of 32 (32*42), and it might be possible to find an odometer gear to give the exact calibration. Between all the cars that used these basic styles of works, there is a wide variety of calibrations to be found at flea markets. You should keep looking, but if you find a unit that has an odometer gear that is within one tooth of your "ideal" calibration (around 2.5% variance), it will probably be quite sufficient.

Another option you have is to have a "ratio adapter" made. It will have gears with a certain number of teeth to convert a certain input cable RPM into a certain output RPM. For instance, if I need a 1312 and I have a 1184 speedometer. They would probably make an adapter with 41 teeth on the input gear and 37 teeth on the output wheel. One manufacturer of these is APT Instruments in Bloomington, MN (612-881-7095). The cost for one is reported to be about $40. I spoke with them about the construction of an adapter. It seems that there is difficulty due to the difference between English drive cables and US types. They made it sound rather complicated, and I did not spend the time (I was paying long distance charges) to resolve the details of the difficulty. They suggested that the speedometer "head" be recalibrated. I am not sure that the guy I talked to understood the exact construction of a vintage Smiths/Jaeger speedometer. He did say that if I were to give him the true miles and odometer miles reading they would be calibrate it perfectly for $120, and for that price, throw in a cleaning too! They would also then check, calibrate, and if necessary repair the speedometer as well as to calibrate the odometer. With an adapter, you do not need to look for scarce or impossible speedometer calibrations and still keep your original equipment completely original. I am told that another advantage of a "ratio adapter" is that the internal gearing is interchangeable. When you get different tires, it is possible to optimize the ratios with some simple drop-in gear replacements.

Of course, during the calibration tests you need to be using the tires you plan on keeping on the car and they need to be properly inflated. As the tires wear, the speedometer calibration will vary. It is not worth getting too picky about the exact accuracy of the calibration since tires of the same nominal size may differ by many tenths of a percent in their "turns-per-mile".

ODOMETER: inspection

Remove the works from the speedometer as described in the prior section. Turn the input shaft by hand as described previously. You should be able to twist the magnet wheel easily. As you turn the wheel, it should drive one or two gears from a worm. As each gear turns it should move a pawl via an eccentric pivot. The pawl should be seen to advance the 1/10's wheel of the odometer one tooth for each pull.

To further test the odometer wheels, you will need to be able to spin the works at a reasonable speed. The only way to do this without crashing your car is to use a spare tachometer or speedometer cable and a drill set to reverse. Run the drill about 1000 rpm. As the drill turns the cable, you should see the worm gears turning and the pawls advancing the 1/10's wheel every few seconds. As the 1/10's passes 9, you should see the miles wheel advance by one.

If the gears and pawls are moving the wheels correctly, but the wheels fail to advance, then there is a problem with the wheels themselves. The best correction is to swap the entire wheel sets with a different speedometer of the same calibration. If that is not possible, then the wheels themselves may be changed by dismantling the wheel sets. You will need a wheel set from a similar speedometer, though the calibration will not matter.

Odometer: Mechanism

The “old” style odometers work by friction trying to turn all the odometer wheels and then a restraining clip underneath the wheel prevents motion except at certain times. The drive gear is keyed to the shaft and there are keyed washers between each of the wheels. The wheels themselves are not keyed and can turn freely. As the drive gear turns, it turns the shaft. The shaft turns the washers between the wheels. By friction, the wheels try to turn, but the clips prevent turning. The restraining clips underlie two adjacent wheels, so one wheel can disengage the clip under the next wheel to the left. The left and right edge of each wheel have a thin metal edge with notches. These notches engage the clips. On the right side of each wheel the edge has ten notches. The left side of each wheel has one notch. When looking at two wheels, as the right wheel turns one entire revolution, it disengages the clip under the left wheel once. The right wheel moves ahead by one notch, then the clip re-engages and prevents further forward motion until again disengaged.

The “intermediate” and “new” main and trip odometers function similarly. The “new” type has a different layout for the drive gear, but the odometer wheels function similarly. The drive gear spins the shaft, then the shaft turns the 1/10ths wheel. The main odometer has a 1/10ths wheel that is fairly narrow and has no lettering. The odometer wheels turn freely on the shaft and are indexed by a cog between adjacent wheels. The main odometer has the cog between the wheels so there is no gap between the wheels. The trip odometer has more widely spaced wheels and the cogs are external to the wheels. These odometers turn much more freely than the “old” types as they do not rely on friction to make any movement.

Odometer: Dismantling

It is usually only necessary to remove the pointer and face in order to access the odometer wheels. Further disassembly usually does not improve access to the odometer wheels, and exposes the pointer spindle and the coiled hair spring to potential damage.

The worm-driven gears are held in place by a spring clip (see the exploded diagrams). Remove this clip and then the gear may be withdrawn from the frame. Clean the bushing in the frame and the gear. Lubricate it with light grease and reinstall it. The spring clip is difficult to install, but with patience it will snap in place. Damage to the odometer works is most likely to occur to this gear as it is the only plastic part in the pre-1968 (or so) units. In later units, the entire works is plastic and damage can occur anywhere.

The odometer wheels turn on an axle. This axle is held in place by a spring clip on the left side of the wheels. In the older units this clip is a metal snap that has a finger which locks into a recess in the yoke holding the axle. The top edge is lifted away from the yoke to unlock the snap, then it is pulled upward to remove. Then the axle may be slid out to the

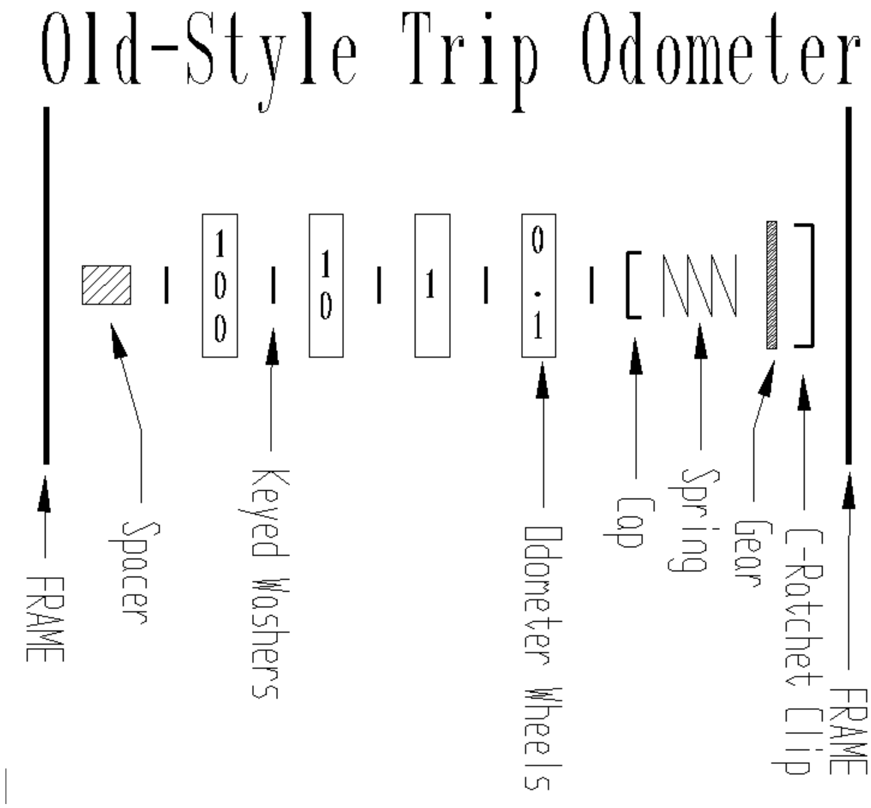


Figure 25. Exploded diagram of “Old-style” trip odometer.

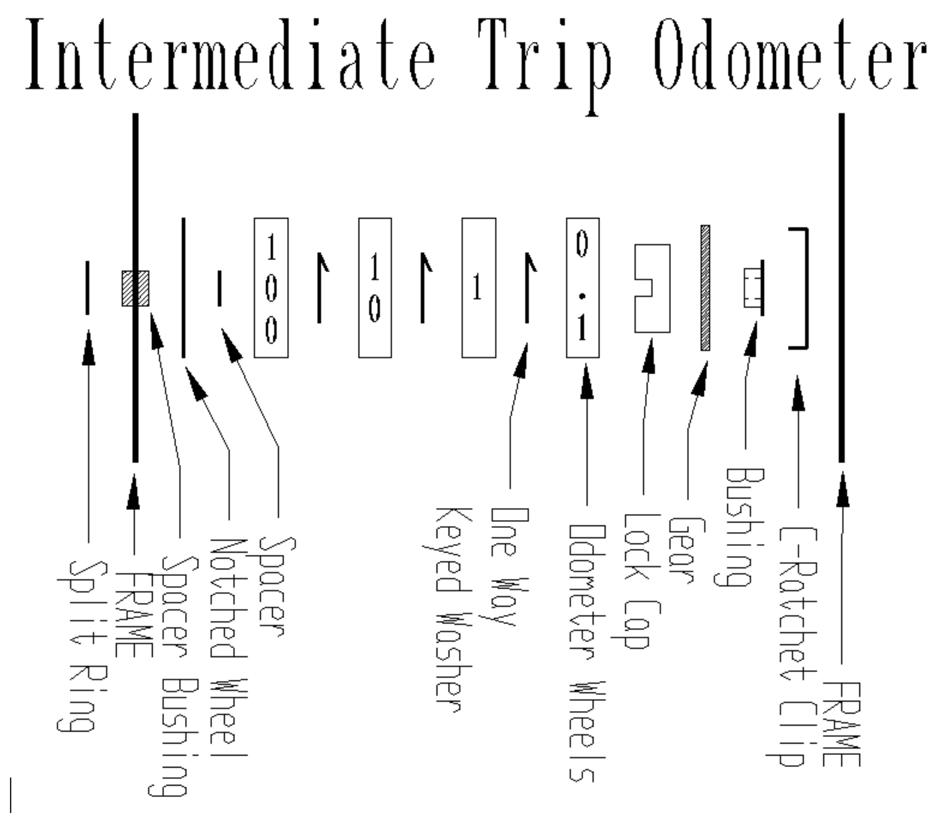


Figure 26. Exploded diagram of “Intermediate-style” trip odometer. The “New-style” trip odometer is essentially the same in a different frame.

left or right. Depending on your needs one direction may be more useful than the other. For instance, if you simply need to replace the gear to the left of the wheels, then pressing the axle to the right slightly will allow the gear to be removed without disturbing the odometer wheels themselves.

In newer units, the axle is retained by a split nylon washer. This washer is more difficult to unlock from the axle. You need to use a fine screwdriver to displace the leading edge of the washer out of its groove in the axle and then continue the displacement around the perimeter of the washer. Once it is out of the groove, the axle may be slid out through the washer. Again, depending on the direction you need to move the axle, you will need to displace the washer one way or the other on the axle.

When the axle is free, you will see that the gear is pressed against a washer by a spring. This washer has indentations which match similar ridges on the gear. This causes the gear to “ratchet” forward and inhibits motion of the gear without the pull of the pawl. When reinstalling the gear, washer, and spring, the spring tends to fly across the room if given the opportunity. Be very careful then compressing the spring and attempting to re-insert the axle through the spring. The wire of the spring will tend to snap into the groove for the locking snap/washer. A little fiddling with the axle and spring will allow the axle to move past the spring.

It is possible to change the odometer reading by rotating the wheels. The wheels have a locking mechanism that needs to be addressed in order to make the adjustment. Early speedometers have brass fingers under the wheels between the frame and the wheels which prevent forward movement, or backward movement past zero. You can rotate the wheels backward by simply turning the wheel, but you can not back up past zero. To rotate forward or backward at will, you need to press the brass finger underneath the wheel to disengage the lock and then spin the wheel

Newer odometers have cogs between the wheels. It is necessary to completely remove the wheels from the axle, then turn each wheel individually to the proper orientation, then re-stack the wheels and remount them on the axle.

The trip odometers are essentially the same except that only the gear on the end (in this case the gear is to the right of the 1/10ths wheel) will ever need to be changed unless there is a damaged wheel. Newer odometers do not have a drive gear for the trip odometer. Instead there are gears in the works between the two odometer mechanisms to drive the trip 1/10ths wheel off the unlabeled 1/10ths wheel of the main odometer.

This completes the article about speedometer calibration, maintenance, and repair. If you have any further questions, please feel free to Email me at Rhodes AT comcast DOT net.

APPENDIX I

CALCULATION OF TIRE TURNS-PER-MILE

The number of turns your tire makes when traveling a mile directly influences the speedometer and odometer readings. The speedometer and odometer assume a specific number of turns in a mile. If your tires turn at some other speed, you will induce a measurement error. If the tire size is significantly different, the measurement error will be significant as well. The number of turns-per-mile is inversely proportional to the tire circumference. The circumference is based up tread width and aspect ratio as well as the rim diameter. If you make a calculation of circumference based only on these numbers, you will get the “unloaded” circumference. The “loaded circumference is less than that. The industry standard for estimating the loaded vs. unloaded difference is 3.1%. The loaded circumference is 3.1% less. Therefore there are about 3.1% more turns-per-mile than the uncorrected calculation predicts. The actual difference for a particular set of tires will depend on the inflation pressure, driving speed, treadwear, and flexibility of the particular tire sidewall. 3.1% is just an average number across many sizes and brands of tires.

Here are the formulas you can use for your turns-per-mile calculation.

$$\text{Overall Diameter}_{\text{inches}} = \text{Rim Diameter}_{\text{inches}} + \frac{\text{Section Width}_{\text{mm}} \times \text{Aspect Ratio}_{\text{percent}}}{1270}$$

$$\text{No-Load Turns-Per-Mile} = \frac{20168}{\text{Overall Diameter}_{\text{inches}}}$$

$$\text{Loaded Turns-Per-Mile} = \frac{20800}{\text{Overall Diameter}_{\text{inches}}}$$

I recently reviewed specifications for a range of tires. I found that, overall, the formula agrees well with the printed data. However, there is a rather wide variability in the actual Turns-Per-Mile between different brands for the same width and aspect ratio. For historical comparison, I have data on some “165” tires (presumably about 78 series) indicating Turns-Per-Mile of 808, 820, and 820. Here is the modern data.

Size	Median TPM	Range TPM
165	818	816-833
195/65	833	821-848
205/60	842	833-848
205/65	816	813-827

APPENDIX II

TIRE	Turns Per Mile	DIFF	DRIVESHAFT	SPEEDO DRIVE	SPEEDOMETER	ERROR
165/83-15 (RADIAL)	807	1:3.7	2985	2.5:1	1194 (1152)	3.6%
165/78-15 (BIAS)	819	1:3.7	3031	2.5:1	1212 (1184)	3.5%
185/70-15	826	1:3.7	3054	2.5:1	1222 (1184)	3.2%
Above worn 1/4”	842	1:3.7	3116	2.5:1	1246 (1184)	4.4%
185/70-15	826	**1:4.1**	3385	2.5:1	1354 (1312)	3.2%
195/65-15	833	1:3.7	3081	2.5:1	1232 (1184)	4.1%
195/60-15	859	1:3.7	3179	2.5:1	1271 (1184)	7.3%
205/60-15	843	1:3.7	3118	2.5:1	1247 (1184)	5.3%
185/80-15	780	1:3.7	2887	2.5:1	1155 (1120)	3.1%
185/80-15	780	**1:4.1**	3200	2.5:1	1280 (1120)	14.3%
195/75-15	784	1:3.7	2902	2.5:1	1161 (1120)	3.7%
205/70-15	791	1:3.7	2926	2.5:1	1171 (1120)	4.6%

I adjusted the aspect ratio of the 165 tires to match the published TR4 TPM. I can not explain the rather significant deviation of the calculated speedometer calibration from the speedometers that were used in the cars. If I use their “Rolling Radius”, the 165 radials and bias tires would have aspect ratios of 77 and 74 respectively. Under that circumstance the calculated calibration is even further away from the supplied speedometers. If I work backward from the stock speedometers, I get an aspect ratio of 90 and 85 respectively!

Please note that these numbers above are for descriptive use only. You need to test each set of tires at your chosen inflation pressure and load to determine the actual turns-per-mile and speedometer calibration.

APPENDIX III

WORM GEAR * ODOMETER GEAR = CALIBRATION

Worm	Odometer	Calibration	Worm	Odometer	Calibration	Worm	Odometer	Calibration
20	50	1000	25	38	950	32	27	864
20	51	1020	25	39	975	32	28	896
20	52	1040	25	40	1000	32	29	928
20	53	1060	25	41	1025	32	30	960
20	54	1080	25	42	1050	32	31	992
20	55	1100	25	43	1075	32	32	1024
20	56	1120	25	44	1100	32	33	1056
20	57	1140	25	45	1125	32	34	1088
20	58	1160	25	46	1150	32	35	1120
20	59	1180	25	47	1175	32	36	1152
20	60	1200	25	48	1200	32	37	1184
20	61	1220	25	49	1225	32	38	1216
20	62	1240	25	50	1250	32	39	1248
20	63	1260	25	51	1275	32	40	1280
20	64	1280	25	52	1300	32	41	1312
20	65	1300	25	53	1325	32	42	1344
20	66	1320	25	54	1350	32	43	1376
20	67	1340	25	55	1375	32	44	1408
20	68	1360	25	56	1400	32	45	1440
20	69	1380	25	57	1425	32	46	1472
20	70	1400	25	58	1450	32	47	1504

If your odometer reads too **MANY** miles: You need **MORE** teeth on the odometer gear.
If your odometer reads too **FEW** miles: You need **FEWER** teeth on the odometer gear.

New Odometer Gear = your odometer gear * your odometer reading / correct odometer reading
NOTE: you will need to round the answer to the closest whole number.

APPENDIX IV

Adding Magnets to the Magnet Bar

I was recently contacted by someone who wished to do a major recalibration of his speedometer. He had replaced his Jaguar E-Type series III transmission with one from a Toyota Supra. Afterward he found a serious speedometer error. When he had to drive 17.5 miles to register 10 miles on the odometer. He was getting 694.8 speedometer turns per mile while it was calibrated for 1216! Clearly some significant work would be required to correct the error. He told me how he approached the problem and sent some photos.

Probably the best method to correct the error is to get a “ratio box” as discussed in the odometer calibration section. Using this approach the speedometer and odometer errors are simultaneously corrected. By interchanging the gears, the ratio can be fine-tuned. If the odometer is reading too high, then a ratio adapter is probably the only reasonable alternative.

However, as in the case above, the problem can be attacked by changing the gearing of the odometer and adding magnets to the magnet wheel. The magnet wheel does not have much magnetism in its stock configuration, so it does not take much extra to add significant responsiveness to the speedometer. This person used some small and thin (0.25” x 0.10”) rare earth magnets. This type of magnet is extremely strong and significantly over-corrected the speedometer. He had to break the magnets and use fragments. In this manner he was able to tune the speedometer by trial and error.

For most people, rare-earth magnets may be too strong for any use, though very tiny ones are available. The smallest I have found are 1/16” x 1/32” Most speedometer errors will be 10% or 20%. For this sort of correction,

Left: The contributor sent this photograph of his initial magnets. These were much too strong. He then broke one in half and that gave approximately the proper correction.

Right: A slightly sharper photo of a magnet on the magnet bar frame. NOTE: it is probably best to have the magnets symmetrically placed to minimize vibration. In this case another magnet ought to be placed on the opposite side.

just a little extra magnetism is all that is required, and these tiny magnets placed close to the center of rotation of the bar magnet may be sufficient.

APPENDIX V

Definitive Method to Recalibrate the Speed Indication

Since the original publication of this monograph, I have encountered more information regarding the factory procedure of calibrating a magnetic speedometer (Smiths called the design “NEMAG”). The factory used a standard hair spring to provide the pointer’s resistance to rotation. There may have been a variety of hair springs used in different speedometer models, but for an individual speedometer, the spring itself was not individually calibrated. Instead, the magnet was calibrated by increasing or decreasing its magnetism so it would impart more or less torque to the drag cup for a given RPM

When the factory assembled a new speedometer, the magnet bars were already strongly magnetized so that no matter what the calibration of the final speedometer, the magnet was too strong. The pointer was expected to read higher than the desired calibration. This is because the same magnet might get used in a speedometer calibrated to 800 turns per mile which will require more magnetism than a similar speedometer calibrated to 1600 turns per mile. Additionally, some speedometers might have a face indicating 80 MPH at full scale, while others might indicate 140 or more MPH at full scale. The 80 MPH face will require a stronger magnet to achieve a full scale reading than the 140. These variations in magnetism are required to provide the proper torque to move the pointer with a single standard hair spring for all models.

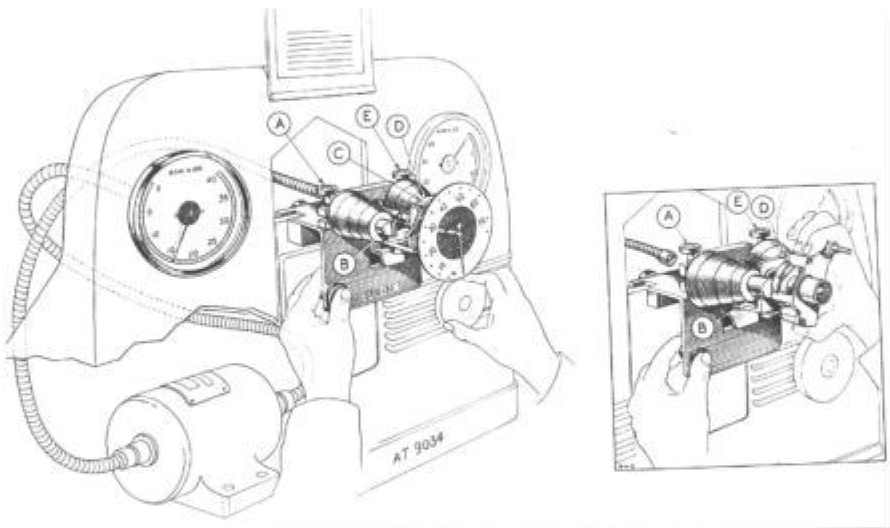


Fig. 16. Speedometer Run Over Test Board and Magnetiser.

Calibration of the speed indication was one of the final steps in the assembly process for the speedometer. The entire works was assembled, and the dial face was attached. The pointer was attached and it was adjusted to point to the “zero” mark on the dial face at rest. Then the works was attached to a test machine. This machine had a variable speed drive and it was set to a certain RPM, probably the calibration number indicated on the dial face. The calibration machine also had a powerful electromagnet surrounding the speedometer.

As the calibration machine operated the speedometer, the pointer would initially show a value in excess of the proper speed. The machine operator would then turn on the electromagnet running in a mode that would slowly demagnetize the speedometer’s bar magnet. The pointer would then gradually drop down to the desired speed. Once the pointer was at the correct position, then the demagnetization was halted, and the speedometer was properly calibrated! The calibration operation would take maybe a minute to set up the speedometer for calibration and another 30 seconds to demagnetize. The test machine could also operate the powerful electromagnet in a mode to strongly re-magnetize the speedometer’s bar magnet if needed.

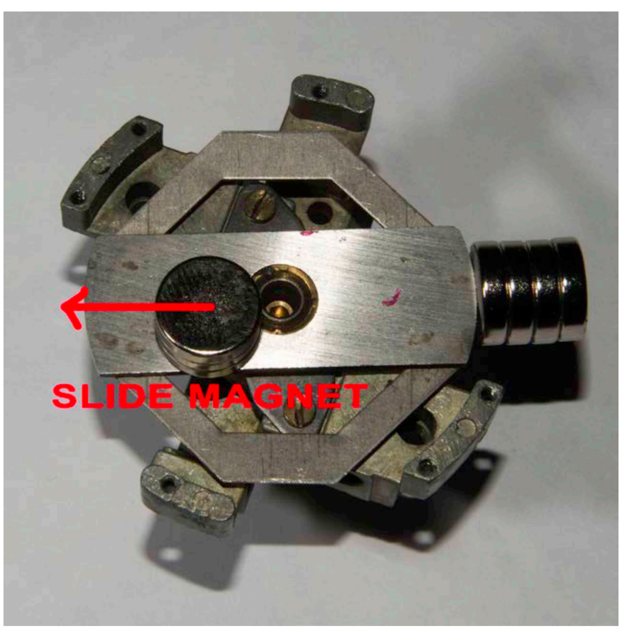
So how do we, in the 21st century re-calibrate the speed indication. As previously suggested in Appendix IV, one can add tiny magnets to the bar magnet to add magnetism. But this requires a tedious reiterative process of adjusting the size and position of the added magnets. It would be better to do it the way the factory did it!

I tried fabricating an electromagnet using about a pound if magnet wire, but even with about 2000 Amp-Turns (a measure of the amount of magnetism created), it was pitifully weak. It had much less pull than a Neodymium rare earth magnet. And this gave me an idea. When I was young I was told that I could make a magnet by dragging a strong magnet across iron or steel (pulling in one direction repeatedly). So I tried this technique on the speedometer bar magnet. And it worked! I was able to get the bar magnet much stronger then I needed. It was giving a full scale deflection of the needle at about 750 RPM of the magnet.

To do this I used several 1/2" diameter, 1/8" thick, grade N52 Neodymium rare earth magnets. Grade N52 is stronger than N42, and you need the strongest magnet you can reasonably get. The thickness is not critical, as long as it is at least 1/8" thickness. A taller magnet (or a stack of thinner magnets) will create a stronger field, though there are diminishing returns over about 1/2" thickness. Longer magnets (or a stack of them) are much easier to hold than the 1/8" thickness. The stronger the magnetic field, the more magnetism it will impart to the bar magnet, but these magnets are STRONG and they will jump quite a distance of you pass a magnetic object anywhere near them! You can be injured by them if you get pinched, and they WILL demagnetize your credit cards.

To perform the re-magnetization operation, you should first carefully determine the side of the magnet bar that is attracted to a particular side of the disc magnet. Pick one side of the disc magnet (stack a few of them together to make a stronger field). Mark it with a Sharpie or paint and let it dry. Then gently bring the disc magnet closer to one end of the magnet bar and see if the magnet bar tries to swing away. If you can't tell switch sides of the magnet bar and try it from that side. If you still can't tell, flip the disc magnet and repeat. If you get too close, the strong rare earth magnet's field will overcome the bar magnet and it will attract even the "wrong" end of the bar magnet. Mark the bar magnet that is attracted to the disc magnet so that the marked side of the bar magnet is attracted to the marked side of the disc magnet.

Once you have determined which side of the disc magnet goes to which side of the bar magnet, then place the disc magnet near the center of the bar magnet and slide it outward to-



ward the end of the bar (the marked side). Repeat this several times. Then flip the disc magnet and repeat everything on the other side of the bar magnet. If you have done this properly then you will have overly recharged the bar magnet. Now reassemble the speedometer, reattach the dial face, and attach the pointer with it pointing to the zero dot or line at rest.

Now you will need to de-magnetize it precisely to get the pointer to the exact position required for a given calibration. Ideally this is done with a degaussing tool, like a powerful old-fashioned tape head demagnetizer (degausser). An 12 to 24VAC-powered homemade electromagnet may do the job too, but I have not tested this.

During my first tests of this technique, To demagnetize, I simply used the stack of rare earth magnets (I had about 10 of them on hand), and brought the magnet SLOWLY and progressively closer to the speedometer bar magnet while I was turning the speedometer at a certain RPM. I had previously calculated what the proper speed indication should be based on the desired calibration and the RPM I was using. As the magnet stack got closer to the spinning bar magnet, the pointer suddenly dropped a few MPH. Then I did not drop much more. I then reversed the stack of magnets in my hand and repeated the process, this caused the pointer to drop further. I repeated this process just a few times and the pointer was about right. I then put the magnet away (far away) and checked the speedometer calibration over a range of RPM. On several occasions I overly demagnetized the speedometer bar magnet and needed to start all over again by disassembling the speedometer and re-magnetizing the bar magnet.

I am confident that a true degaussing tool would be much superior and more controllable. The technique would be the same: With the degausser operating, it should be waved slowly near the spinning bar magnet and the pointer should slowly drop to the desired indication. Tape head demagnetizers are readily available on eBay reasonably cheaply. The bigger, heavier units (higher wattage too) are likely to be more powerful, and may be easier to use.

APPENDIX VI

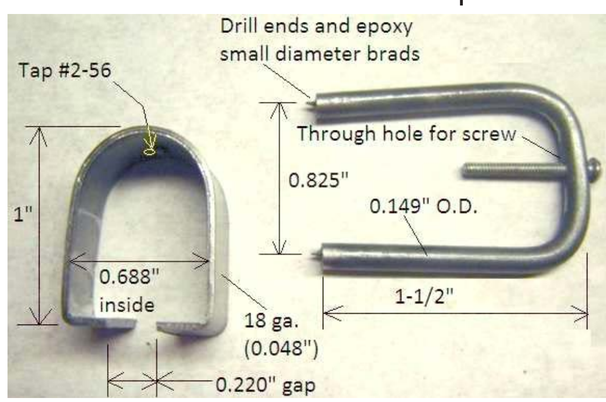
Pointer Puller

Removing the pointer. from the spindle can be difficult. I have broken one spindle in the attempt to remove the pointer. The pointer mounts to the spindle on a VERY small diameter pin. It is easy to break this off, and I think it is inevitable that some of spindles will be broken because I am sure that some pointers are corroded onto the spindle so securely that they can never be removed.

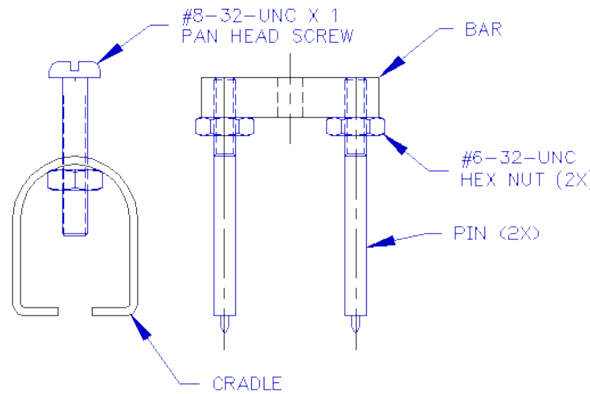
I think that the factory used two methods to pull the pointers. Probably the most common was to use two small lever tools to lift up on the pointer from underneath on opposite sides. The only safe leverage points on the dial face are the two mounting screw locations. All other places on the face are unsupported soft aluminum.

The other factory method to remove pointers was a puller, much like a gear puller. Some needles had a tiny pin hole on the front surface in line with the spindle. The puller would hold the pointer from behind, while a threaded pin would get screwed downward toward the pointer, going through the pin hole, and pressing directly on the spindle, pressing it backward out of the pointer.

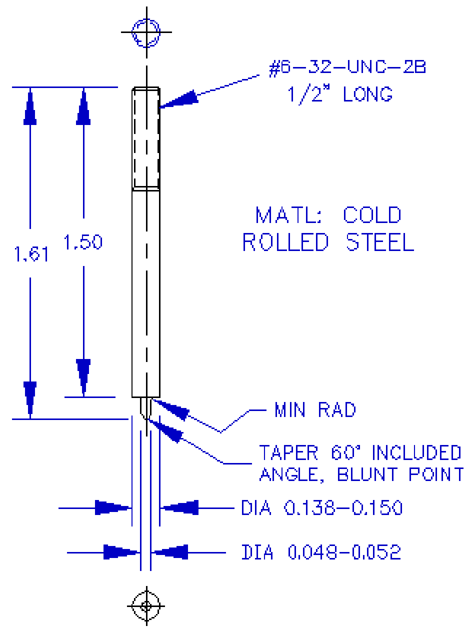
I have found a reference on the internet at: **http://mgaguru.com/mgtech/tools/ts211.htm**. This was a submission to mgaguru.com by Dave Headrick from Lexington, SC in 2010. He had designed a wonderful puller which looks as if it will work perfectly, though I have not made this puller myself. Because the internet is subject to change over the years, and links become defunct, I am placing some of the most vital information about the puller here.



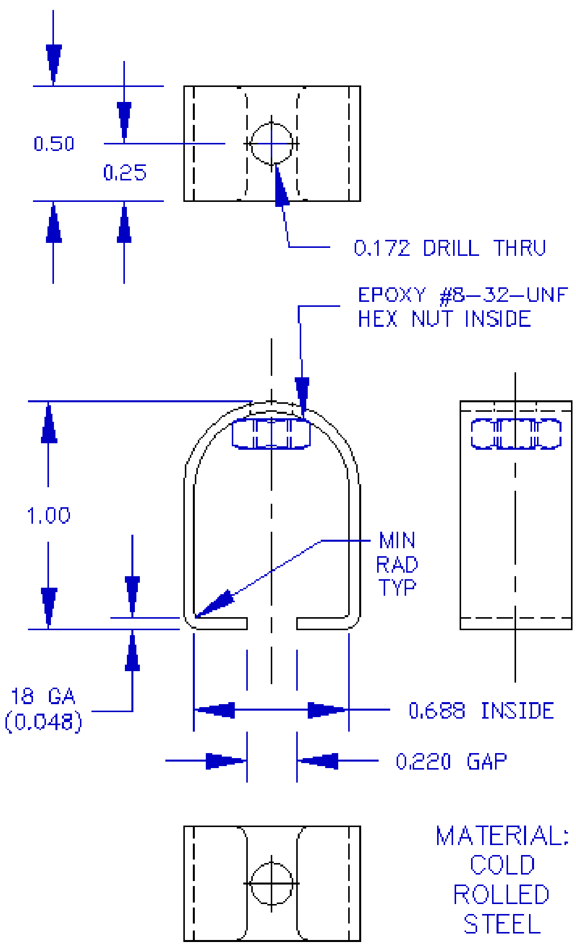
The website also shows a more refined version of the same puller which uses bar stock as the crossbar instead of a curved rod. If I were to fabricate this puller, I might use slots in the cross bar, instead of threaded holes which require fairly precise alignment and placement. To simplify fabrication (and improve strength a bit), I would consider using 10-24 or 1/4”-20 threaded rod. On a lathe I would consider turning down only the last 1/4” to the indicated approximately 0.145” diameter.



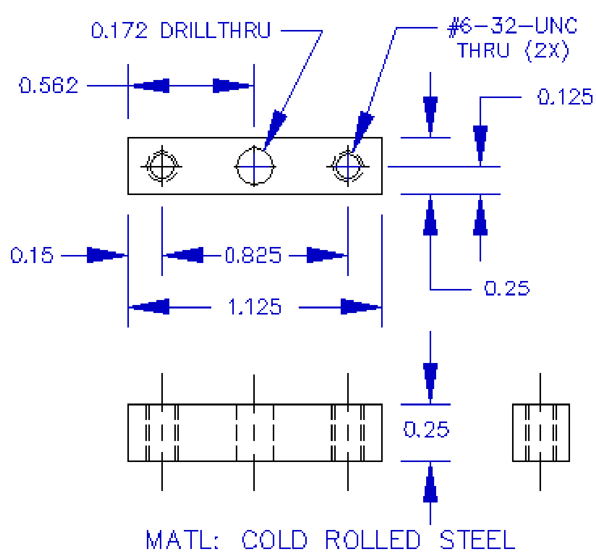
#8-32-UNC X 1
PAN HEAD SCREW
BAR
#6-32-UNC
HEX NUT (2X)
PIN (2X)
CRADLE



#6-32-UNC-2B
1/2" LONG
MATL: COLD
ROLLED STEEL
1.61
1.50
MIN RAD
TAPER 60° INCLUDED
ANGLE, BLUNT POINT
DIA 0.138-0.150
DIA 0.048-0.052



0.50
0.25
0.172 DRILL THRU
EPOXY #8-32-UNF
HEX NUT INSIDE
1.00
MIN
RAD
TYP
18 GA
(0.048)
0.688 INSIDE
0.220 GAP
MATERIAL:
COLD
ROLLED
STEEL



0.172 DRILLTHRU
#6-32-UNC
THRU (2X)
0.562
0.125
0.15
0.825
1.125
0.25
0.25
MATL: COLD ROLLED STEEL