

Heath Tube-Type LMO Repair

by
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The tube-type Linear Master Oscillators (“LMO”) used in the Heathkit SB-Line equipment is a very stable and accurate means of controlling the frequency in the equipment. Unfortunately, as the units age, many LMOs develop a “warble” when tuning. This “warble” usually stops when the frequency control knob is not rotated. However, accurately “zero-beating” another station is made harder by this “warbling” and it is generally a major distraction from the otherwise excellent performance of the SB-Line equipment.

The primary cause of this “warble” is a break-down of the original lubricant used on the pivot points of the shaft of the main tuning variable capacitor. Removing this unwanted sound is not hard. However, actually getting the LMO removed from the unit can best be described as a “pain in the posterior”! To remove the LMO the round 100 kHz dial has to be loosened, the 3-wires soldered to the terminal strip on the rear of the LMO removed, and then the 4 “nuts” holding the LMO on the chassis have to be removed. At that point, the LMO can be lifted from the chassis.

Next, one of the “L” shaped side panels has to be removed. It is best to remove the panel on the same side as the oscillator tube. There are no internal parts connected to this side whereas there are components attached to the other side. To remove the panel, there are a total of 10 hex-head sheet metal screws that have to be removed. The bottom 2 sheet metal screws also hold the lugs which attach the LMO to the chassis. A 1/4th inch “nut driver” is the tool to use to remove the sheet metal screws.

It will be noted that 2 or 3 of these sheet metal screws are covered with a red lacquer. The purpose of this lacquer was to act as a seal which would be broken if the covers to the LMO were removed and thus the factory warranty on the LMO would be violated. Of course, the warranty has long run out, considering that the LMOs are 40, or more, years old!

After removing the panel, make sure and do not disturb the small variable capacitor inside the unit. Look closely at the rotor of the main variable capacitor. Depending on the actual individual who assembled the LMO, there will be varying amounts of dried lubricant (“grease”) showing. This has to be removed. I generally use WD-40 and a toothbrush to eliminate this old lubricant.

Then, check the “stops” on the main tuning shaft. These rotate as the dial is tuned with each stopping at one full turn of the shaft after the last one stopped. Over the years, these “stops” start sticking to each other and the shaft may not be able to be turned through the slightly over 5 revolutions to tune the 500 kHz frequency range (with a few kHz over at each end). Spray WD-40 on these and make sure that the shaft easily turns the 5+ revolutions. Watch the main tuning capacitor to make sure that it mostly opens and mostly closes. The “stops” actually prevent the capacitor from going completely from open to closed.

Putting a knob on the tuning shaft makes turning it MUCH easier! If the shaft cannot be turned the full 5 revolutions, then use a small screwdriver to separate the ones that are sticking. Spray a little more WD-40 on the “stops”. You may have to force the shaft in the direction which the full 5 revolutions would normally be made. Work the shaft “back and forth” until the “stops” break free. Then, run the shaft back and forth several times the full 5 revolutions. If the shaft is still hard to turn, put a little WD-40 on the “worm gear” at the rear of the shaft which activates the gear which rotates the variable capacitor.

Then, put a lubricant of your choice on the pivot points on the air variable capacitor.

Although cleaning the old lubricant from the pivot points often eliminates the “warble”, it will often return in a relatively short period of time. To prevent the “warble” from returning, a short piece of braid has to be connected between the shaft of the rotor on the variable capacitor and the frame of the capacitor. Various persons have devised ways to connect this braid. The method described herein is pretty simple to do and is very effective.

Before continuing, it is necessary to note that there are at least 2, maybe more, systems of getting from the worm gear of the main tuning shaft and the variable capacitor. Both use a gear on the shaft of the variable capacitors but those gears are very different. The earlier version, Heath part number 110-32, uses a large diameter gear that is relatively thick and the later version, Heath part number 110-40, uses a relatively small diameter gear that is fairly thin. The method of attaching the braid to the shaft is similar, but different approaches have to be made.

There are 2 setscrews which hold the gear onto the variable capacitor shaft. One of those setscrews is exposed when the variable capacitor is almost fully open (minimum capacitance) and the other is exposed when the capacitor is about halfway open. It is the setscrew that is exposed when the capacitor is halfway that is of interest. Remove this setscrew. Sometimes this setscrew has a normal “slot” and sometimes it requires an Allen wrench (NOT a Bristol).

Acquire a piece of braid about 2-inches long. This can be tinned or not. Using braid from a short piece of RG58/U coaxial cable works great.

Now comes the difference between the LMO with the large gear and one with the smaller gear. With the large gear, cut off a length of 8-32 machine screw about 1/2th inch long, so that you just have the thread portion. That is, no “head” on the screw.

Replace the setscrew with this 8-32 rod. Using a pair of needle-nosed pliers, securely tighten the rod. Next, tin just the ends of the braid, not more than about 1/8th inch. Tin the end of the threaded rod with resin core solder (it will “tin” pretty easily). Then, solder one end of the braid to the threaded rod with the braid going in the direction of the frame of the variable capacitor.

Tin the center of the frame of the variable capacitor, about 1/4th inch is plenty. Solder the “other” end of the braid to the frame.

Rotate the main tuning shaft through the entire 5 turns and make sure that the braid doesn’t touch any components. If it does, bend the point at which the braid attaches to the threaded rod so that the braid “clears” everything.

The reason for using just a threaded rod only 1/2th inch long is that if a head was on the screw, it will not clear the gear itself and any longer and the rod will interfere with the worm gear and therefore the full 5 revolutions will not be possible.

The LMO utilizing the smaller gear is somewhat easier in the fact that an 8-32 machine screw that is 1/2th inch long clears both the gear itself and the worm gear. Therefore, the head does not have to be removed.

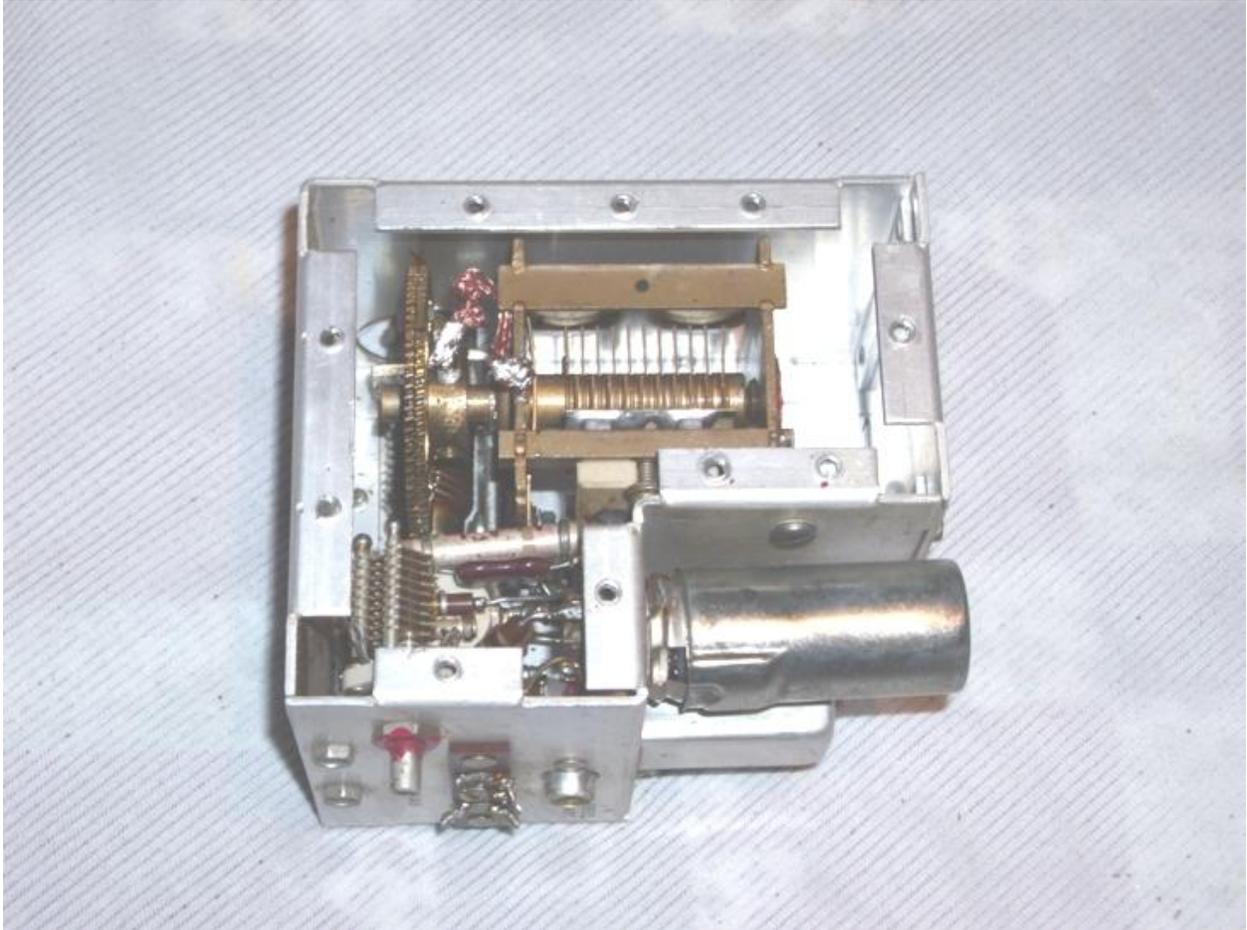
Replace the setscrew with the new machine screw. Using a screwdriver, tighten the machine screw.

Tin the head of the machine screw. Attach the end of the section of braid and follow the above directions to complete the attachment of the braid.

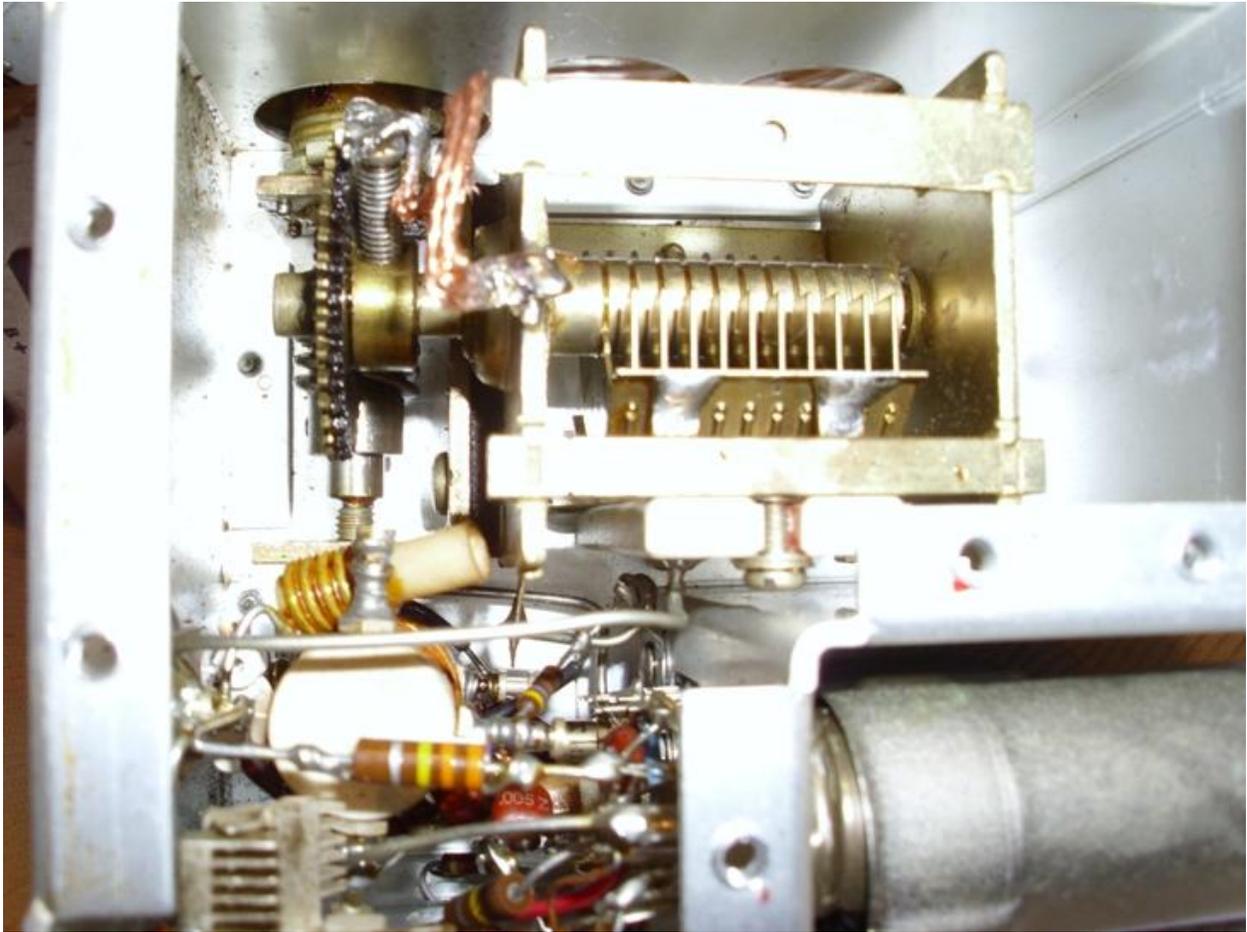
Replace the side panel removed before, making sure to replace the “lugs” which mount the LMO to the chassis.

Finally, reverse the removal procedure to return the LMO to the unit.

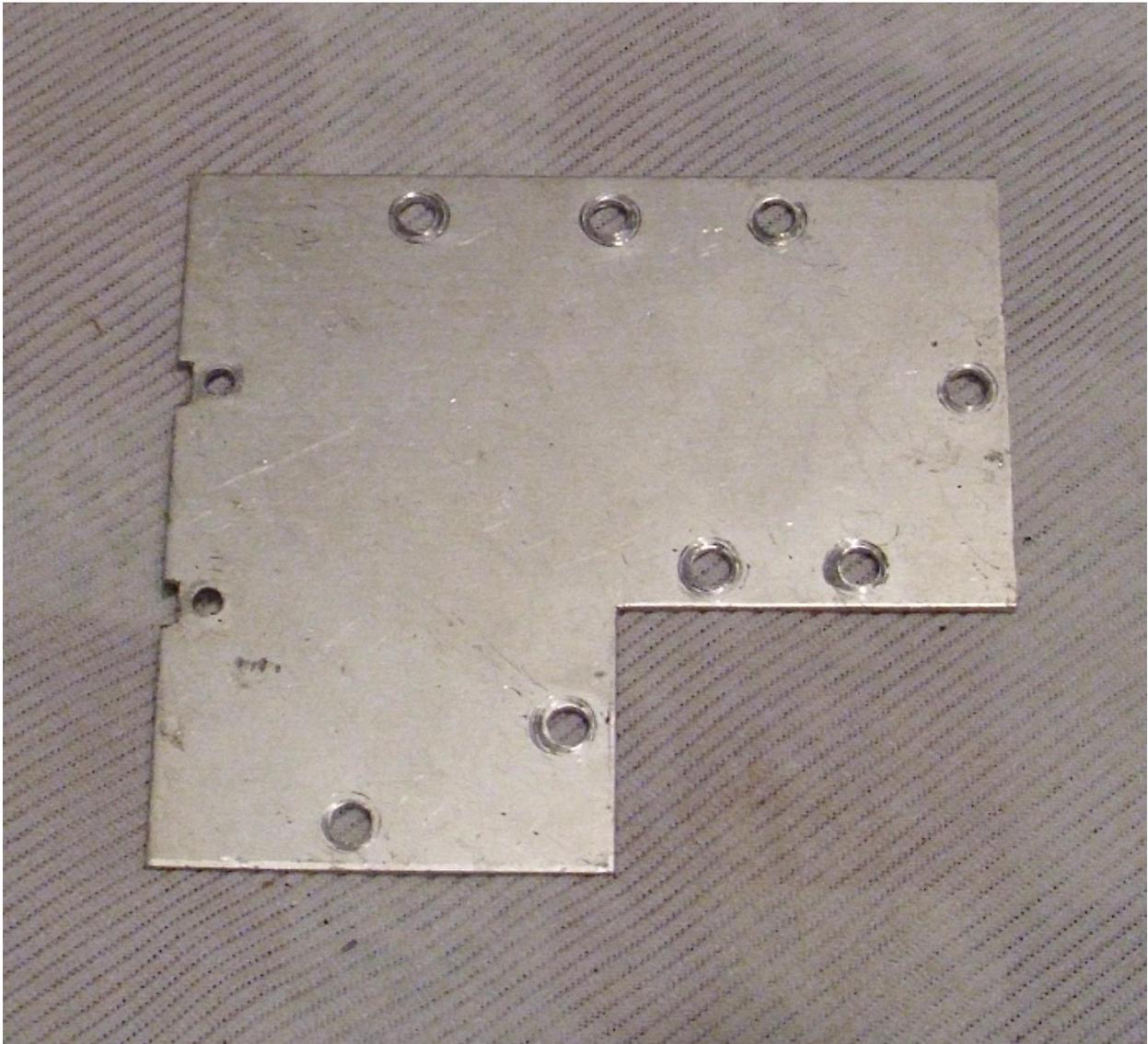
Photos of the braid



The braid can be seen in the upper left-hand corner of the LMO. This is the version with the larger gear, the Heath part number 110-32.



Again, the braid can be seen in the upper left-hand corner. This is the version of the LMO with the smaller gear, the Heath part number 110-40.



This is the side panel which has to be removed to repair the LMO. Note the “notches” on the left-hand side where the “lugs” which hold the LMO on the chassis are attached.