HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, **HSN** has expanded to include industrial, military, and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. **HSN** includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of **HSN**. See page 8 for submissions, disclaimers, reprinting, copyrights, subscriptions, reprints, and the Editor's and Publisher's Corner.

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CALIBRATION OF THE COSMOS PERMEABILITY TUNED OSCILLATOR FOR THE R-390A

(Reprinted with Permission from Electric Radio Magazine)

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----Part 1 of 2----

This article will focus upon the calibration of the Cosmos permeability tuned oscillator (PTO) for both linearity and endpoint adjustments.

Collins designed and built the first R-390A receivers utilizing its own 70H-12 PTO. This PTO covers a frequency range of 3.455 Kcs to 2.455 Kcs in ten clockwise turns. It is a robust device constructed of the highest quality materials, including an encapsulated main coil, sturdy compensating stack, and a temperature controlled oven.

Collins made about 6,300 R-390A's. However, approximately 48,000 sets were produced by many manufacturers other than Collins. These manufacturers were at liberty to employ the PTO's of suppliers other than Collins, as long as their performance met the specification MIL-R-13947. Consequently, PTO's employed in the R-390A were supplied by many other manufacturers including Motorola, Progresstron, Dubrow, Cosmos and Raytheon. Of all PTO types, the Cosmos seems to be the most common. The Electronics Assistance Corporation used these PTO's exclusively in its production run of 11,000 R-390A's around 1967.

Cosmos Industries was a New York manufacturer of radio equipment located at 31-28 Queens Boulevard, Long Island. Among its products was the well known Cosmophone HF-SSB transceiver. The improvements made in the Cosmos PTO over the original Collins device were employed by Lewis Metzger and Harold Goodman, both instrumental in the development of the Cosmophone. They received US patent number 3,098,989 in July, 1963 for their idea and working model of a PTO that could be linearized with external adjustments, unlike the Collins PTO.

Anyone who has ever worked on a R-390A PTO soon finds out that there are two important adjustments. The first is that the PTO must be adjusted such that its output is exactly 1000 Kcs in ten turns. This is commonly referred to as the endpoint adjustment, and is as far as most users will go in PTO calibration. Endpoint adjustment is important as it not only affects dial calibration, but can also compromise front end track tuning on the lower bands. The second important adjustment is linearity. If one were to graph the ideal PTO output frequency versus the shaft position in number of turns, the graph would make a straight line. This was the goal of Collins Radio in all of its designs of the era, including the 75A, 32V and all of the later models. Art Collins wanted a linear output, and that was that. The Collins PTO was famous for being able to achieve this goal, as well it had to, because the inherently linear Veeder-Root counter used in the R-390A exposed nonlinear PTOs with errors as low as 0.1 Kcs.

All PTO's employed in R-390A service have an endpoint adjustment screw. This screw is typically located underneath a sealed screw hole behind the PTO's transformer can. As a PTO ages, its output will typically decrease, i.e., it will have an output of less than 1000 Kcs in ten turns. To remedy this, the endpoint adjustment screw must be turned (usually clockwise) until the PTO's output is increased to exactly 1000 Kcs in ten turns. The turning of this screw moves a tuning core into a second coil in the PTO to make the adjustment. PTOs of the Collins design will have two inductor coils, a main coil and an endpoint adjustment coil.

Adjustment of the PTO's linearity is another matter entirely. In the Collins PTO, the company employed an internal corrector stack that accomplished this task. This robust stack is constructed from a set of adjustable shims upon which a cam follower rides. As the PTO shaft is turned, the main tuning slug is advanced axially on a lead screw, and the cam follower is simultaneously advanced on the corrector stack. Naturally, advancement of the main slug on the lead screw is exactly linear, but unfortunately the coil and powdered iron tuning slug do not usually cooperate in linear fashion. The cam follower mechanism allows the tuning slug to either increase or decrease the overall rate of advancement on the lead screw by imposing a slight twist of the tuning slug. This increase or decrease in tuning rate is determined by the shape of the corrector stack and is what accomplishes the linearity correction. If a graph were made of the nonlinear response of the PTO, it might look very much like the profile of the Collins corrector stack when properly adjusted.

Linearity correction is necessary because it is virtually impossible to wind the main tuning coil and match it with an iron slug for an overall linear output. The only problem with the Collins design is that the corrector stack is inside the PTO cover. Naturally, adjustments must be done with the cover off, but unfortunately, replacement of the cover influences the adjustment requiring multiple attempts and no shortage of frustration. Metzger and Goodman solved this problem by improving the Collins PTO design. The Cosmos endpoint adjustment is similar to the Collins adjustment, however the real innovation is

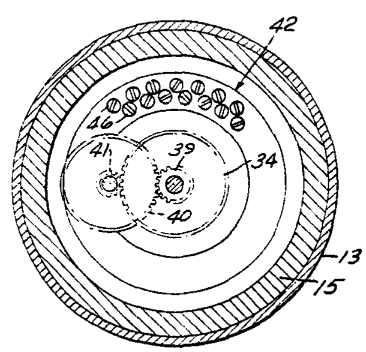

FIG 3 DISK WITH ADJUSTING SCREWS (14 OF 42 TOTAL SHOWN FOR BREVITY)

found in their external adjustment for linearity. This is the most misunderstood feature of the Cosmos PTO.

Upon careful examination of the Cosmos PTO, one will find the endpoint adjustment in its usual location as described above. To the left of the endpoint screw hole will be found an additional screw cover. Underneath this second screw cover will be found a series of very small screws (see Fig 3). During clockwise rotation of the PTO shaft, this series of screws passes underneath this window from left to right. One screw will pass with every 90 degree turn (25 Kcs) of the PTO shaft. It is this series of screws that are used to adjust linearity of the Cosmos PTO. Some Cosmos PTO's have as many as 60 adjusting screws. The later units will have about 42 screws.

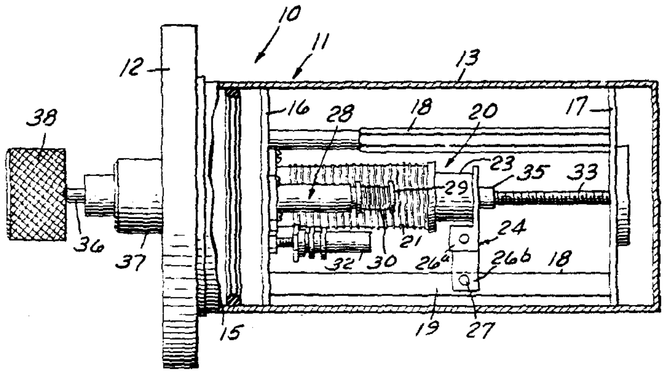

FIG 1 COSMOS PTO

21 MAIN TUNING COIL
30 LINEARITY ADJUSTMENT COIL
32 ENDPOINT ADJUSTMENT COIL

The Cosmos PTO has three inductor coils instead of two employed by Collins (refer to drawing in Fig. \ and schematic in Fig. 2). There is the familiar main tuning coil (item 21), an endpoint

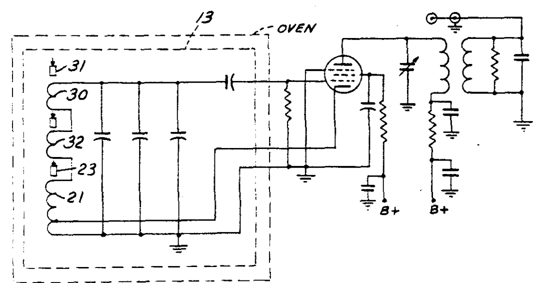

FIG 2 SCHEMATIC DIAGRAM

adjustment coil (item 32), and a third coil (item 30) that is part of the linearizing device. Like the endpoint coil, the linearizing coil is in series with the others. The inductance change of the corrector coil is controlled by a core which goes in or out as the PTO is rotated through its ten turns.

Part 2 of this article will be in HSN Issue 46

QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which responses are solicited. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

Nothing this issue

SHORT SUBJECTS

SUPPLEMENTARY GROUNDING OF THE R-390A ANTENNA TRIMMER *by Ron Reeland*

After a thorough cleaning and alignment of my Fair Radio Imperial R-390A in accordance with TM 11-5820-358-35, the receiver performed quite well except for one problem. The signal level (and audio output) would fluctuate drastically. I suspected tubes or other circuit problems, but found by chance that a slight touch of the "Antenna Trimmer" knob would cause the fluctuations to begin or temporarily cease. I removed the antenna trimmer capacitor unit and thoroughly cleaned it. I suspected dirty ground or wiper springs on the capacitor itself. WD-40, tuner cleaner, and so on did not help. I could find nothing amiss visually or with my ohmmeter.

Fair Radio furnished a replacement trimmer unit. I still experienced the extreme signal fluctuations with the slightest touch of the trimmer knob. By experimenting, I discovered that an additional ground connection between the radio frame and the gear-driven shaft of the trimmer capacitor eliminated the fluctuations.

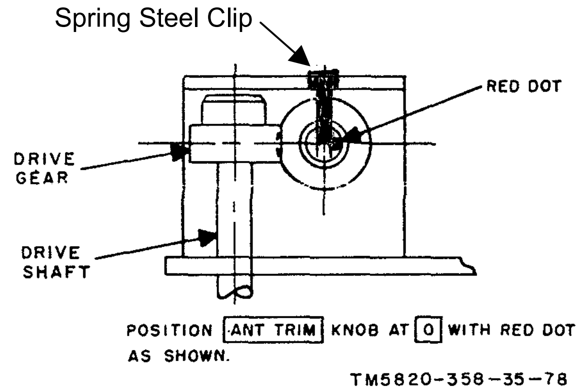

Figure 74. ANT TRIM control adjustment.

I added a small spring steel clip to the trimmer assembly. The clip is secured to the framework with its free end bearing down on the capacitor shaft at the center of the drive gear. The wiping action provides the apparent reliable ground required. I was not totally satisfied with this 'jury rigged' fix, but was happy to have a steady signal.

SP-600 SERIAL NUMBER SURVEY RESULTS *by Alan S. Douglas*

Perhaps it's time to publish the results of the SP-600 serial number survey that Les Locklear and I have been compiling, with help from several other Hammar-lund owners. Nothing startling has emerged from this exercise but a few things stand out:

- Serial numbers are apparently "real" since they track very well with the date codes on the electrolytic capacitors.
- There were probably not more than 25,000 SP-600's made, and production lagged after 1955.
- Various contracts were filled simultaneously, so the model designations (JX-) are hopelessly scrambled. Luckily the factory notes are still extant (I was sent a copy but it's not my prerogative to publish them). In the main, model differences are minor, sometimes no more than the location of a nameplate or a new military contract.
- Although a few SP-600's were made without crystal control (no "X" in the model) they are extremely uncommon. The receiver simply wasn't stable enough for point-to-point use as originally designed.

A couple of personal notes: I suspect that serial numbers began with 1000, or even 1100 if the first were reserved for prototypes. And I would still love to know how the SP-600 came to be. To recapitulate, both the SP-600 and the Hallicrafters SX-73 have the same electrical specs, and show the same evidence of the crystal-control feature being shoehorned in, after the basic mechanical designs had been fixed. The SX-73 especially "took it on the chin" as it had no panel space for two more control knobs, and required double-decking to get chassis space. However, the SP-600 wins the booby prize for one of the hardest-to-service radios ever made. Both were supplied to the Signal Corps under the same R-274/FRR nomencla-ture, but Hammarlund got the lion's share of the contracts, for reasons not entirely clear since the Halli-crafters was in some ways the better model (longer tuning scale, easier to service). Thanks to everyone who provided input.

ANTENNA BALANCING IN THE R-390A

Some of you may have wondered what the trimmers labeled "BAL" on the antenna coils in the RF deck are for. Frequent HSN contributor, Chuck Rippel, has run across the following alignment procedure in the Army technical manual TM 11-856A, page 172, dated January, 1956 which is duplicated below:

164. Antenna Balance Ratio

a. Set the receiver controls as instructed in paragraph 85[1], except set the MEGACYCLE CHANGE control to 00, the KILOCYCLE CHANGE control to +000, and FUNCTION switch to MGC.

b. Connect the output of the signal generator between ground and the junction of two 68-ohm composition resistors. Connect the free ends of each 69-ohm resistor to the two contacts on the BALANCED ANTENNA connector on the rear panel of the receiver.

c. Connect the vtvm to DIODE LOAD terminal 14 and chassis ground.

d. Tune the signal generator to the receiver frequency, and set the attenuator to the level that gives –7 volts indication on the vtvm. Note the output of the signal generator.

e. Disconnect the 68-ohm resistors and reconnect the signal generator to the BALANCED ANTENNA jack. Repeat the procedure in *d* and note the output of the signal generator.

f. Calculate the db ratio according to the following formula:

$$\text{Db} = 20\log\frac{\text{microvolts}(d\text{ above})}{\text{microvolts}(e\text{ above})}$$

g. Compare the results with the data in the chart below. Perform the same test for all the other frequencies listed in the chart.

Dial Reading	*Trans-former*	*Trimmer*	*Ratio (minimum db)*
00 +000	T201	C201A	45
01 +000	T202	C205A	40
03 +000	T203	C209A	40
07 +000	T204	C213A	35
15 +000	T205	C217A	30
31 +000	T206	C221A	20

h. If the balance ratio for any antenna transformer is below that specified in the chart, adjust the balance trimmer for a minimum with the signal generator connected as instructed in *b* above.

Note: Be sure a true balance is obtained, and not a maximum or minimum trimmer capacity condition.

[1] Paragraph 85 provides the following control settings for this adjustment:

LINE METER	OFF	ANT TRIM	0, or max output
LINE GAIN	0	BFO	OFF
AGC	MED	DIAL LOCK	Unlocked, fully ccw
LIMITER	OFF	ZERO ADJ	Disengaged, fully ccw
AUDIO RESPONSE	WIDE	LOCAL GAIN	5, or desired volume

BANDWIDTH	8 KC	OVENS	OFF
BFO PITCH	0	MEGACYCLE CHANGE	01, or as specified
BREAK IN	OFF	KILOCYCLE CHANGE	.510, or as specified
FUNCTION	AGC	RF GAIN	10

SP-600....WITHOUT BLACK TUBULAR CAPACITORS *by Art Delibert*

Most articles about the SP-600 comment on the problem of the black tubular (BT) capacitors. These things split and leak, ruining performance of the receiver and creating a potential fire hazard. They have to be replaced – a job that takes many hours, even for an experienced hand.

Yet some SP-600's apparently were manufactured without BT's. I bought an SP-600 JX-36 (sn 19861) at the 1996 Baltimore hamfest that had disc ceramics where others had BT's. Careful examination of the solder joints convinced me that the ceramics were original equipment, not replacements.

This is confirmed by the tech manuals. The Parts Catalog (TO 31R2-4-18-4) has two photos of many of the subassemblies. One has BT's, the other has disc ceramics labeled "Superceding part". The manual pages with these photos are dated September 10, 1955.

So there may be a number of SP-600's out there that do not need the dreaded capacitor replacement surgery. If you find one, grab it! It's a great radio.

IERC TUBE SHIELDS FOR THE R-390A *by Chuck Rippel, WA4HHG, Board Member and Secretary to The Collins Collectors Association E-mail to: crippel@usa.net*

I recently made an addition to the "Care & Feeding" document that I return with each completed R390A I restore. This additional information addresses beneficial IERC tube shields which, according to Collins study, increase vacuum tube life by as much as 55%. While the list quantities are specific to the R390A, the types are collateral with the tubes commonly found in Collins and other vintage vacuum tube equipment.

Also, save for the hot running audio tubes, don't wholesale add a shield to every tube in your radios. Tubes that require shields will have a collar attached to the tube socket, which extends about 1/2" up the side of the tube. If there is no collar, think twice about adding a shield, as the circuit involved may not have been designed to employ a shielded tube. At the very least, adding a shield could introduce additional capacitance into a circuit that may cause improper operation.

I have added additional commonly used tubes in parentheses as an additional cross-reference.

The R390A uses 5 different kinds of heat dissipating, black, IERC tube shields. Installing the correct type and part number shield can dramatically decrease the operating temperature and in turn, increase the life of the vacuum tubes. Collins addressed this back in the early 50's in service bulletin #303 that graphically compared the beneficial performance of various types of tube shields with not using shields at all.

The proper tube shields can easily identified. They are anodized black (or deep purple), have an open top with a series of tabs folded over a thin, octagonal metal tube inserted longways inside the shield. Some may also have a series of internal "fingers" which also serve to grip and sink heat away from the glass bottle. These are both plainly labeled "IERC." There is also a unique model number stamped on the outside of the shield denoting which size vacuum tube it is designed to fit. Refer to this number when obtaining the shields.

Below is an inventory with individual quantities and part numbers of the 5 different IERC tube shields used in the R390A:

(1)	6025-B	Tall 9 Pin, used for the 3TF7 ballast tube
(9)	6020-B	Medium 9 pin, used on 5814A's and 26Z5W's (6U8A)
(2)	5015-B	Short 7 pin, used on the 5654's (6AL5, 5670)
(13)	5020-B	Medium 7 pin, used on 6BA6's, 6C4, 6AK5, 6DC6
(1)	5025-B	Tall 7 pin, used on the OA2 (6AQ5, 6BF5)

Black tube shields labeled "WPM" my also be found. While I don't personally feel these are quite as effective as the IERC design, they are still far and away better than the shiny ones described below.

Radios which still have shiny, nickel plated tube shields installed should have them replaced with the above IERC shields or even "WPM" shields as soon as possible. Even if they have been painted black on the outside, these shields have no internal structure to grip the tube bottle and sink heat away from it. Also, the bright insides of the shield actually reflect the heat back into tube and on to the dark internal plate structure which could cause it to over dissipate and shorten tube life.

The very best place to find these is at hamfests. I hope this information is helpful.

CLEANING THE R-390A GEAR TRAIN *Richard Biddle, KB5WLH, Midland TX*
The most common complaint among R-390A owners is the rather stiff feel of the kilocycle change knob. Assuming no gear train damage, a good cleaning and lubrication coupled with a floating alignment will usually yield a silky smooth one finger action.

1. Remove the front panel and remove the RF deck.

2. Clean the gears to remove all the crud. Kerosene has often be suggested but I prefer environmentally friendly degreaser/ cleaners similar to trichloroethane. Some brushing with a toothbrush can help as needed. It's a good idea the keep the solvent out of the electronics.

3. Lubricate the gear train with top grade light gun grease. Lubricate the bearings with top grade gun oil. Be sure to oil the shafts of the band switch. Hoppe's works well and seems to last quite a while under hot conditions.

4. Pull each slug rack. Cleaned the metal cams and lobes to remove the gunk. Lubricate the cams and rollers with gun grease. Lubricate the bearings with gun oil.

5. Use a cotton swab dipped in dilute isopropyl alcohol to gently clean out the coil forms. Wipe off the slugs with a rag. Lubricate the slugs with a very light (!) coating of silicon grease.

6. Loosen the screws holding the RF deck front plate slightly and spin the big gear behind the KC knob with a finger. If everything seems to be smooth carefully tighten the screws. This aligns/floats the gear train in the RF deck.

7. Loosen the bushings on the front panel to let them float. Lubricate them with gun grease. Putt the RF

deck back in and tightened all screws finger tight.

8. Replace the front panel and tighten the front panel screws. Then tighten the bushings. This aligns/floats the shafts in the bushings.

9. Snug the RF deck screws. Action should feel very smooth with no grabbing. If not, check for damaged gears

PUBLICATIONS OF INTEREST

Nothing this issue

WANTED TO BUY / SELL / TRADE / WHATEVER

WANTED Scrap Telechron clock timer as fitted to Hammarlund receivers for spare parts especially clock dial, hands and clock gears. Also clock window. Well pay costs including shipping to my address. George Brown, 6 Glassel Park Road, Longniddry, East Lothian, Scotland.

EDITOR'S AND PUBLISHER'S CORNER

Please note that Ralph Sanserino's e-mail address has changed. It is now *sanser@GTE.net*. For what it's worth, we are a little behind in getting #45 out as I suffered a severe computer system crash that required replacing both the motherboard and the video card. Fortunately there was no damage to the hard drive which hosts all this HSN stuff. I was also lucky that I had done a recent tape backup of my full system and was able to restore all of the operating system software instead of re-installing it all....but it took a lot work. New material submittal have been pretty meager lately, but between what little is submitted, bits and pieces from the internet, and selected items from the 'slush' pile, we are still getting by. Remember – this is your publication. I can only print what I get.

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