Further Enhancing The Yeasu FTDX-560 Transceiver

BY RICHARD A. YOEMANS,* W2DMK

With a minimum of work and expense, the already excellent Yeasu FTDX-560 transceiver can be improved to give more power output, better audio, more receiver gain on 10 and 15 meters, and sharp selectivity for c.w. work without the optional 600 Hz c.w. filter.

THE following modifications to the ever-so-popular Yeasu FTDX-560 transceiver being enjoyed most extensively in ham-dom these days are a matter of individual tastes. Some amateurs may not feel the need for some or all of them, but collectively they improve the already-excellent performance of the rig.

The basic transceiver, dollar-for-dollar, is a terrific value with many extras that would rate an additional charge with many competitive manufacturers. Over all design and construction techniques are excellent, exhibiting many fine features not generally found in the price range of $450.

To be honest, the author was rather apprehensive about modifying the nice shiny piece of gear. The feeling soon passed after the newness began to wear off, about 2 weeks plus or minus a day.

Any modifications had to avoid defiling the overall appearance of the equipment, both inside and out. Doing so would detract from the pride of ownership, and the resaleability of the transceiver.

Areas that were covered in modifications are:

1. Improved h.v. power supply regulation.
2. Output power increased by 28%.
3. Speech amplifier gain improvements.
4. Adding tape recorder take off points.
5. Addition of r.f. preamp for improved 10 and 15 m. performance.
6. Addition of a regenerative filter.

Power Supply Regulation

The h.v. power supply regulation was found to be fairly good considering the varying current demands involved: from 50 ma (static current) to a full load of 550 to 600 ma. Trying to reduce voltage drop under load, we tried paralleling the filter capacitors C_{601}, C_{602} (80 mf at 450v. each) with two 250 mf at 450 v. electrolytics. This increase in capacity was justifiable as the regulation on s.s.b. improved by 6-7%. This proved advantageous as the next modification requires further demands on the h.v. supply.

It should be mentioned if one has a 220 volt line available in the shack it should be used. The modified transceiver draws close to 1000 watts from the a.c. line in the TUNE position. Fortunately, the manufacturer incorporated a tapped 115-230 volt primary on the power transformer, a nice feature.

Power Output Increase

Having had some experience with a variety of sweep tubes over the years including one of the later ones, the 6KD6, we realized the transceiver wasn't seeing its full output potential.

Desiring to increase output power by a profitable percentage and not to just dissipate more input power as heat, we decided to increase the screen voltage to final stage from 150 volts to a regulated 210 volts. This is accomplished by removing the existing +150 volt line from screen grids of 6KD6's and installing two 0B2 voltage regulators on a small aluminum angle bracket mounted on the back of cabinet between the power transformer and r.f. cage, with an appropriate dropping resistor mounted under chassis or on a bracket nearby. Voltage is then taken from the 300 volt source.

*4 Park St., Binghamton, N.Y. 13905

Front view of the modified FTDX-560 shows the c.w. audio filter peak control mounted between the meter and v.f.o. dial. Other filter components are mounted on a small piece of p.c. board behind the panel. At the rear of the cabinet (center) may be seen the two OB2 voltage regulators mounted on an aluminum bracket. The OB2's stabilize the new 210 volt screen supply for the power amplifiers.

A stock, fresh-out-of-the box, FTDX-560 will deliver maximum output power between 550 to 600 ma cathode current; beyond this point extra power input to final stage is worthless and could damage the final amplifier tubes. At the rated current the output power into a 50 ohm dummy load is about 270 watts. With the screen grid modification, the maximum output power occurs at 850-900 ma. The efficiency of final stage drops beyond this point. The average output power is increased to approximately 390 watts or by about 28%.

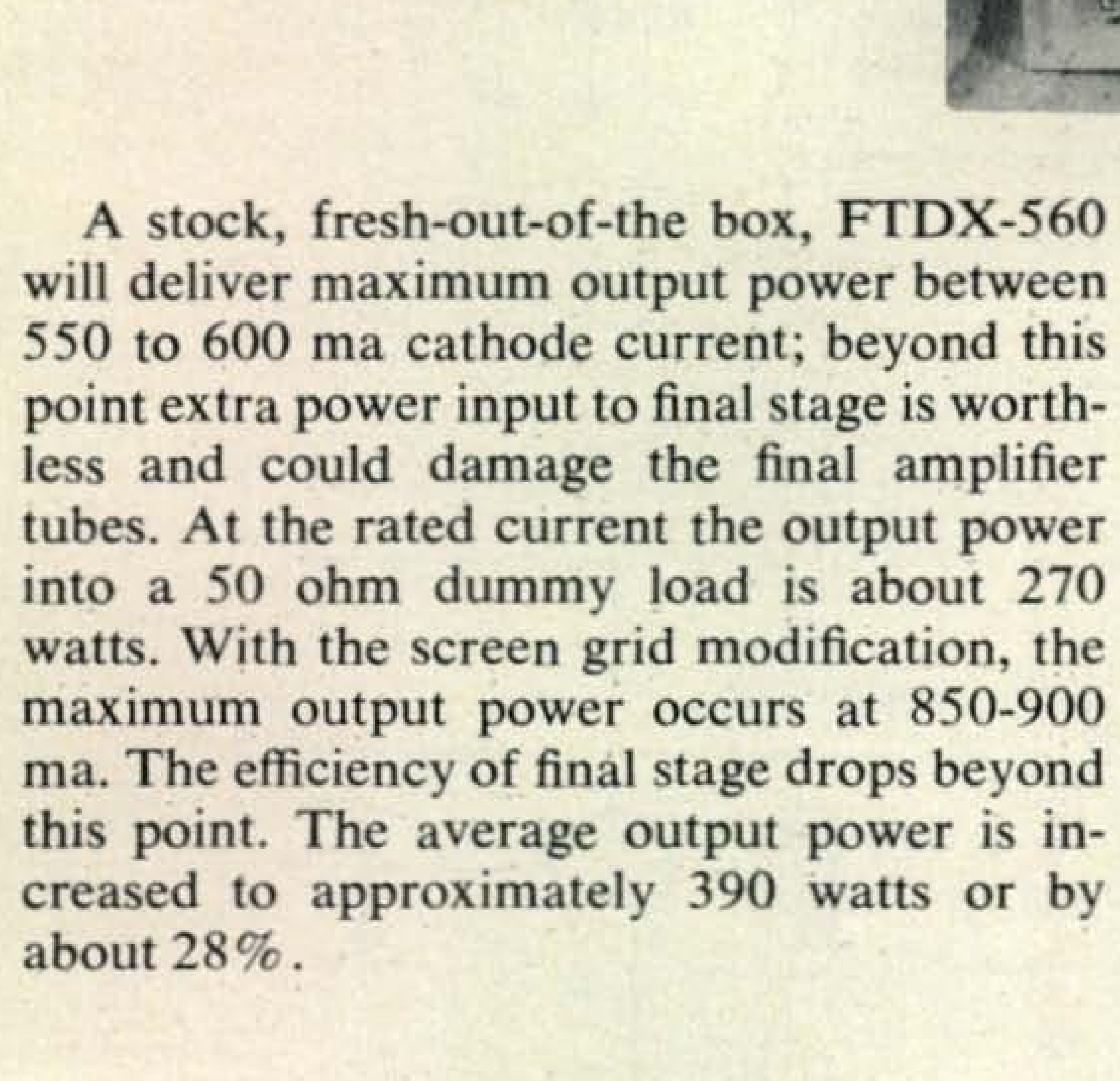

Fig. 1—Modification of the screen supply for the power amplifiers of the FTDX-560 will produce a significant increase in power output. The original unregulated 150 volt screen supply is replaced with 210 volts regulated taken from the transceiver's 300 v. l.v. line. Grid bias is also changed as described in the text.

True, the db difference on an S-meter at some distant spot would not really be too significant, yet the extra talk power of 28% is worth the investment of a little time plus the outlay of approximately 4 bucks.

It was fortunate, too, that the meter reading cathode current to final stage is calibrated to 1 amp.—so no shunting of the meter was required to extend its range.

Attention was paid to the tubes in the r.f. cage to detect any signs of "red plating," but this condition did not exist. RTTY service at this power level is not recommended.

The transceiver has been operated continually for over 30 hours during DX contests both on c.w. and s.s.b. with no apparent signs of overheating. The power transformer shows a slight temperature increase compared to a stock unit. This system has been in use with the original tubes for over 8 months with no decrease in power output.

Another modification must be made in the bias supply after the screen voltage has been increased: R_{513}, a 4.7K 1w. resistor on the power supply diode board should be changed to a 1K 2w. This will bring the bias control in range so proper static current may be obtained at about 1/4 rotation of the pot, or can be fully cut-off if desired. Good linearity is found at a static current of 40 ma.

The selection or choice of the 6KD6 tubes is important. Other than the manufacturer's direct replacement it was found that General Electric and Motorola types worked well. Sylvania tubes proved to be bad news. Their overall design was different, employing 2 tubes in parallel in the same envelope and not connected internally. If plugged into a stock FTDX-560 the tubes will not deliver rated power input, and will prove difficult to neutralize. The tube sockets require jumpers to

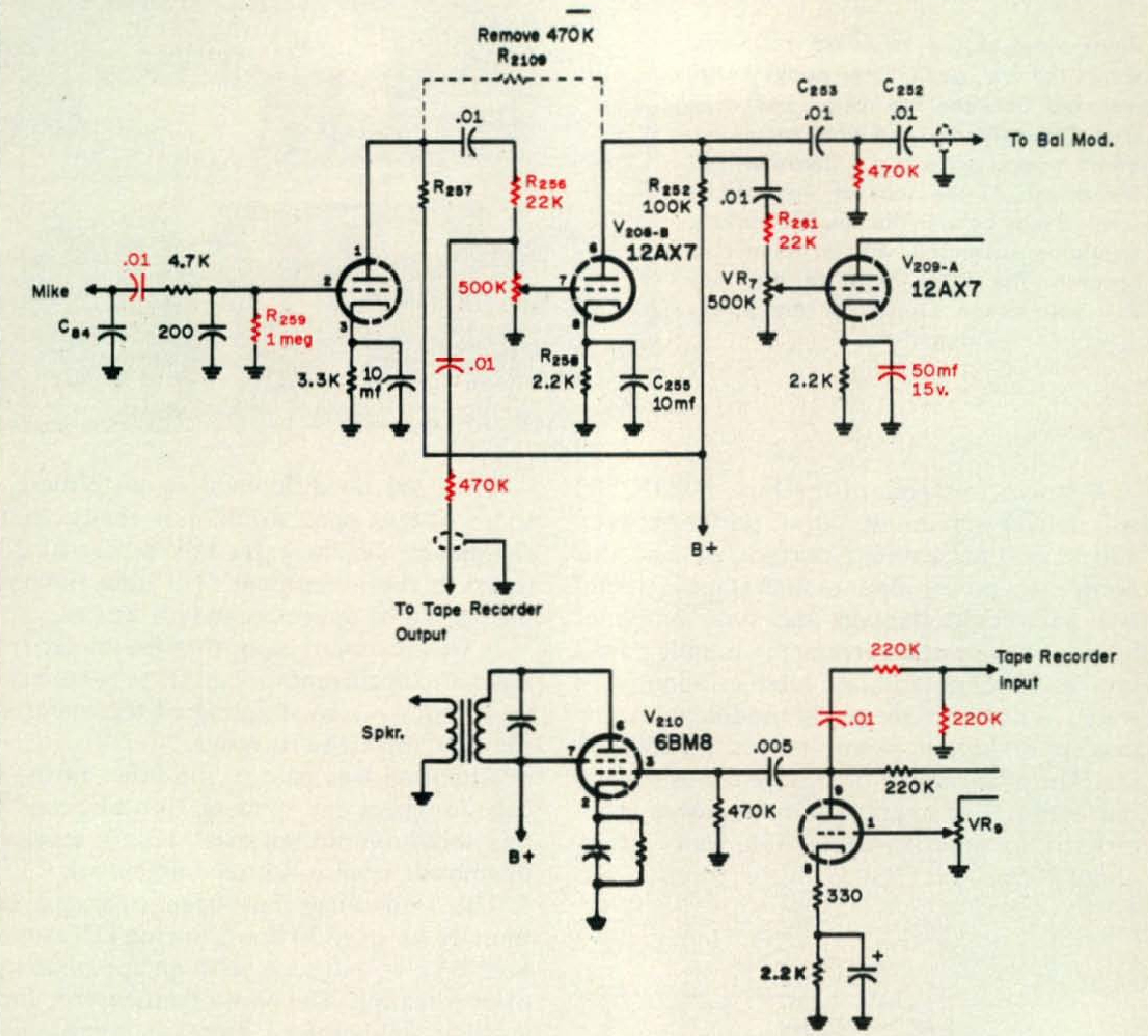

Fig. 2—Changes to the audio circuitry provide more audio gain without clipping and add tape recorder take-off points on receive and transmit. Changed and added components are shown in red.

parallel both sections of the tube. Even after this was done, the tubes were found to be erratic. It is our understanding at this writing that Sylvania has discontinued the design for more than one reason.

Speech Amplifier

It was apparent immediately after putting the transceiver on the air that the speech amplifier lacked sufficient gain. Many microphones were tried with a wide range of output voltages, but to no avail. To talk the plate current to half the recommended tune plate current or 250 to 300 ma was almost impossible. The a.l.c. meter reading was extremely low compared to nominal readings given in the instruction manual.

Prior to purchase, many stations we had chatted with using the 560 complained of having to run the mike gain wide open and having to crowd the microphone. Personally, the audio response left me cold whenever one was heard on the air.

Taking all the above into consideration, the first change made was R_{259} 47K to ground at the grid of the first speech amplifier. This value was too low and was replaced with a 1 meg 1/2w. resistor. A .01 mf ceramic capacitor should be inserted between R_{266} (4.7K) and the mike jack. Next, remove the 470K 1/2w. resistor (R_{2109}) between pins 1 and 6 of 12AX7 speech amplifier. If desired, merely clip one end free from the board. The transceiver was then put on the air and tests made with local ham buddies, along with tape recordings.

Speech quality was much fuller, though it still didn't sound natural. The gain control became more responsive inasmuch as it now could be turned down about half way with proper a.l.c. being indicated. The scope showed an outstanding display of a Christmas tree even when audio gain was turned up to over-drive the final stage.

Hearing the tape recordings and comments, we were far from elated. Further investigation showed that the microphone gain control VR_6 was not at the right location in the speech amplifier. The original circuit employs two stages of audio, then the gain control into the 7360 balanced modulator. This system has always been found by the author to exhibit some clipping. But, running the first and second stages wide open eliminates the need for an extra stage of voltage amplification for proper sensitivity of the circuit. It was decided to make the changes and worry about the vox gain problems later. The mike gain pot was then rewired between first and second speech amp stages as shown in fig. 2. This entailed running two shielded wires from the mike gain pot over the top of the p.c. board to the appropriate points on the board. The green and blue wires are removed from the pot, tied together and then to ground through a 470K 1/2w. resistor.

Prior to on-the-air test, we found that the vox gain had to be run almost full on. R_{256} and R_{261} were then changed from 100K to 22K 1/2w. C_{260} in the cathode of V_{209} vox amplifier was omitted on later production runs, but the p.c. board is drilled and marked for this capacitor. A 50 mf 15 volt electrolytic was installed here which brings stage gain up by a high percentage. The vox gain setting proved to be about same as before any modifications. Note that no vox operation will take place until mike gain is set to at least 3. This was no problem as mike gain setting proved to be best from 5 to 6.

After modifying the speech amplifier, the a.c. line to on-off switch on front panel should be re-routed. The original lead dress runs parallel to the cable harness containing audio lines. With the increased audio gain, hum pick-up from this line is quite apparent on the speech waveform. Also vox will activate at a lower than normal setting. Route the two-conductor zip cord around to bottom of the cabinet away from the printed board.

While working in this immediate area, the idea occurred to tap the speech amplifier and receiver audio stages for direct tape recorder take off points as shown at fig. 2. The values used will not drastically load down the stages to which they are wired. Reproduction is excellent with a medium-priced cassette tape recorder.

The unit was fired up once more with the cooperation of a few local boys. A new set of tapes was run for comparison.

The results were what we had sought. No clipping was detected. The new tapes immediately indicated the improvements. Spontaneous comments from nearby and DX stations indicated the audio was excellent.

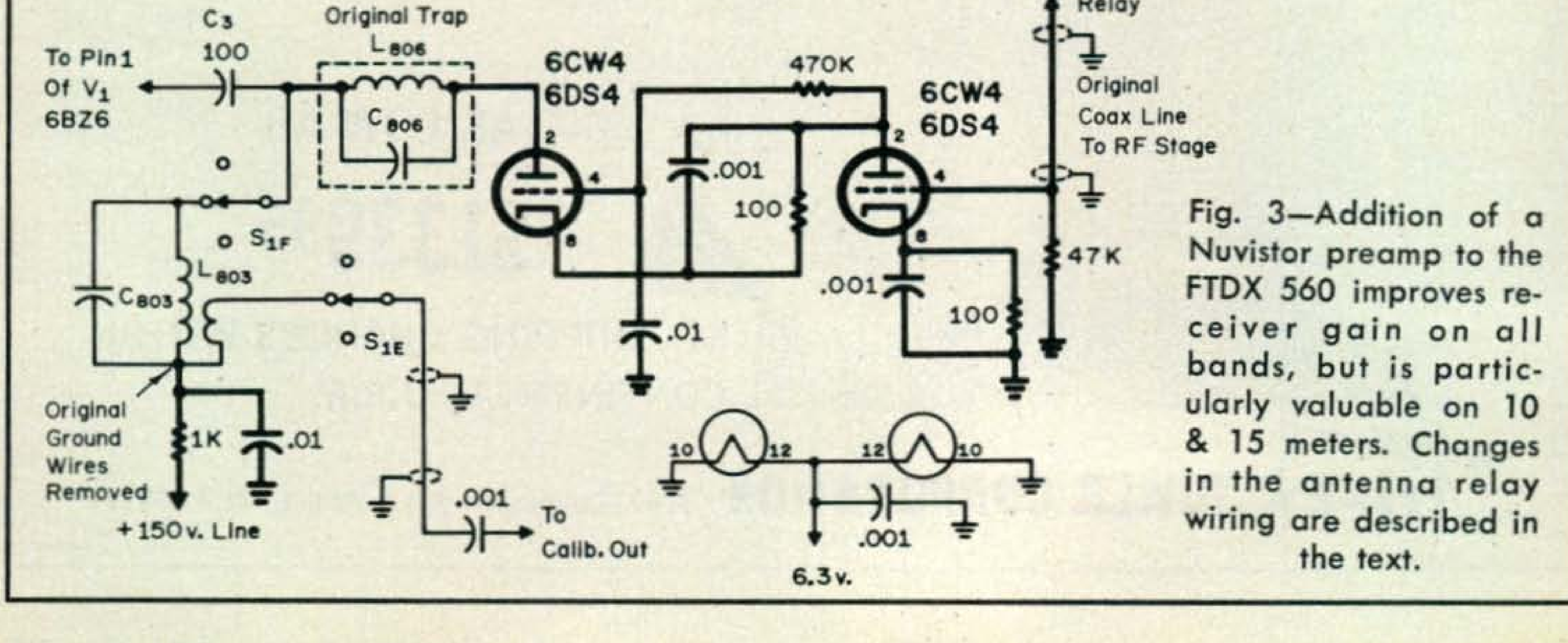

Fig. 3—Addition of a Nuvistor preamp to the FTDX 560 improves receiver gain on all bands, but is particularly valuable on 10 & 15 meters. Changes in the antenna relay wiring are described in the text.

Receiver Preamp

Though the receiver has fairly good sensitivity, over-all, the 10- and 15-meter bands are lacking in sensitivity; not unusual with most receivers or transceivers.

An outboard pre-amp could have been built, but after some deliberation, it was decided to build-in a preamp using a pair of Nuvistors in cascade. To keep it simple, no additional coils or switches are used.

The antenna relay is rewired slightly. The output lead going to J_4 (ant. connector) is directly tied to the output side of tank coil and L_{15}, is completely removed from the transmit side of antenna relay. The receive side is left as is. The armature or pole of the relay is then cleared of any wiring originally tied to J_4. Now place a15 pf 6KV disc capacitor between the relay pole and the wiper of S_{1k} of the bandswitch (keep the leads short).

The Nuvistor preamp is mounted on a small angle bracket. The r.f. coil for 10 mHz WWV, L_{807}, originally occupied this space. L_{807} is brought forward to the front of the receiver r.f. stage shielded compartment. Leads are amply long.

The original yellow coax line from the antenna relay is removed from the wiper of band-switch S_{1e}. Also, the outer braid connection of this same coax line is removed from the r.f. coil printed circuit board. Remove the ground buss at the same point. The outer shield of the coax is then soldered directly to the chassis; the inner conductor is soldered to the grid of first Nuvistor preamp. To the point where the grounds were lifted from the r.f. coil board, a .01 mf 1 kv disc and a 1K 1/2 w. resistor are soldered. The other end of the capacitor is tied to the chassis. The other end of 1K 1/2 w. resistor is soldered to the junction of L_1 (250 μh choke) and C_9 (.01 mf cap.). This in turn furnishes the +150 volts for operation of the preamp. Filament voltage is taken at the 6BZ6 r.f. stage.

Trap coil L_{806} is disconnected from the circuit and its two leads replaced with insulated hook-up wire. One lead goes to the plate on the second 6DS4. The remaining wire is soldered to the wiper of S_{1f}. The coax lead from the crystal calibrator is connected through a .001 mf disc capacitor to S_{1e} wiper.

No signs of instability were found on any band even with no antenna connected to transceiver. Average gain is between 20 to 30 db. This extra gain isn't really any advantage on 80/40 meter bands and if it becomes objectionable shunt L_{801}, and L_{802} with 4.7K 1/2 w. resistors. With short, direct wiring, proper tracking is realized over the full 500 kHz segment of each band. The r.f. coils L_{801} through L_{806} should be re-peaked at the center of each band. It should not be necessary to peak the mixer coils. Trap L_{806} should not require adjustment.

Since the transmitter tank circuit becomes the first tuned circuit of the pre-amp, you can almost load the transceiver by peaking the antenna load and plate tuning while watching the S-meter.

Unfortunately, we are unable to give any correct figures on signal-to-noise ratio or sensitivity, but we *can* hear signals ON 10 and 15 meters that were non-existent before. About five S-units can be realized on these bands, or approximately 30 db. Some noise increase is noticeable. In the event the gain is too great or background rush appears too high, drop the plate voltage to the preamp until the rushing noise subsides somewhat.

Regenerative C.W. Filter

This simple regenerative amplifier stage is well worth the time and slight effort involved.

For those who did not purchase the optional c.w. filter with their unit, this addition is a must if one enjoys c.w. operation, because the s.s.b. filter's band-pass is rather broad for c.w. The regenerative audio filter described has variable gain and produces a single signal effect just prior to oscillation. The circuit was taken from the *Radio Amateur's Handbook* for 1970.

Circuit, it is straight-forward so there is no point to a detailed description of the circuit. Most any audio stage can be made to feed back to produce regeneration. At a point just before oscillation occurs, gain becomes extremely high with a very narrow band-pass. Using a variable control such as a pot, the regeneration and band-pass can be varied as needed.

Figure 4 shows two pots in series at the emitter of the transistor. The one at ground is the coarse range control (10K $^1/_{10}$ w). The second or vernier is part of a d.p.d.t. switch control assembly.

In the original article, it is stated that the filter exhibits a 40 cycle band-width at 800 cycles, which is just fine for c.w. work. The filter is switched between the product detector output and the volume control.

Between +9 and 12 volts are required for the filter. This voltage can be tapped from the +9.1 volt line supplying the v.f.o. It's well regulated and easy to locate at the bottom of the v.f.o. shielded case where the feed-through capacitors are mounted. The whole circuit can be built around the switch and pot assembly if desired, because it uses a minimum of parts.

By removing the manufacturers' emblem between the two front panel windows on the front bezel, (remove two screws), the emblem mounting hole may be reamed or drilled to ¼" diameter to accommodate the shaft of the control. Fortunately, the front panel is used for other models made by the manufacturer, so there exists a 5/16" diameter hole directly behind the emblem. If one can procure miniature 200 ohm control with a d.p.d.t. switch, the task is simple. In our case, we could not, so a small bracket was shaped to mount the control to the front panel.

This pretty well sums up the changes incorporated and it is the author's wish that in some way they will be beneficial to a few members of our fraternity. ■

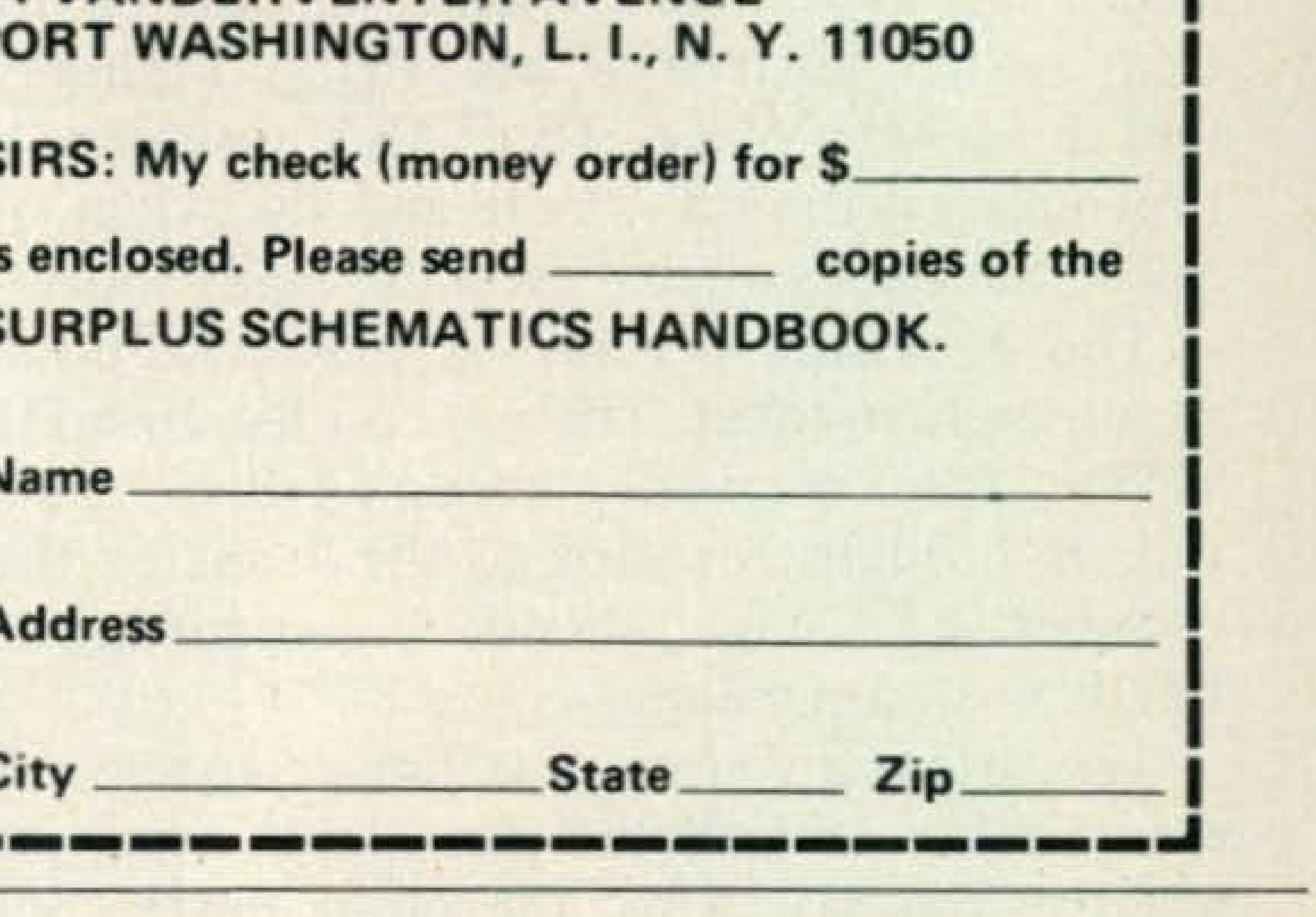

Fig. 4—Regenerative audio filter for c.w. operation with the s.s.b. filter is switched between the product detector and audio gain control. All resistors are 1/2 w. or less; all capacitors are in mf. Construction may be on a small piece of p.c. board mounted near the front panel peaking control R_1 which should be an audio taper pot. Q_1 is not critical and other similar types may be substituted.