

ANTIQUE RADIO

By Marc Ellis

The Theremin: A First Look Inside

The May, June, and July issues of this column featured a bibliography of theremin articles, a history of the theremin in this country and a discussion of the instrument's operating theory. Last month, we temporarily interrupted our theremin story for a long-overdue look into the mailbag. But now we're back to our exploration of that fascinating granddaddy of all electronic musical instruments.

In this issue, we're going to begin work on an actual theremin—the one, in fact, that was responsible for all

COSMETIC INSPECTION

Tony's theremin and its accompanying speaker have been reposing in my basement since I acquired them over a year ago. Since I wanted to take some "before" pictures before dismantling the units for inspection, my first official act was to dust off both pieces and bring them upstairs where I would have room to do the photography.

I don't usually invade the upstairs with my projects, so I prudently accomplished that task while my wife was on an errand. She was a pretty good sport when she came home to find the furniture shoved aside to make room for an odd-looking pair of artifacts. She even agreed to pose with the instruments to give the picture a little scale. Needless to say, though, the normal furniture arrangement was restored very quickly after completion of the photography!

Considering that the theremin had been used during the last several years of its active life at a high school, and obviously hadn't exactly been treated with tender loving care by the student stagehands who moved it around, the cabinet is in surprisingly good shape. Although there are a couple of nasty-looking gouges and some loosened leg joints, it's basically quite sound and should be fairly easy to restore to decent appearance.

The speaker system that came with the theremin is an RCA Model 106, which is the type recommended by RCA for best results with the

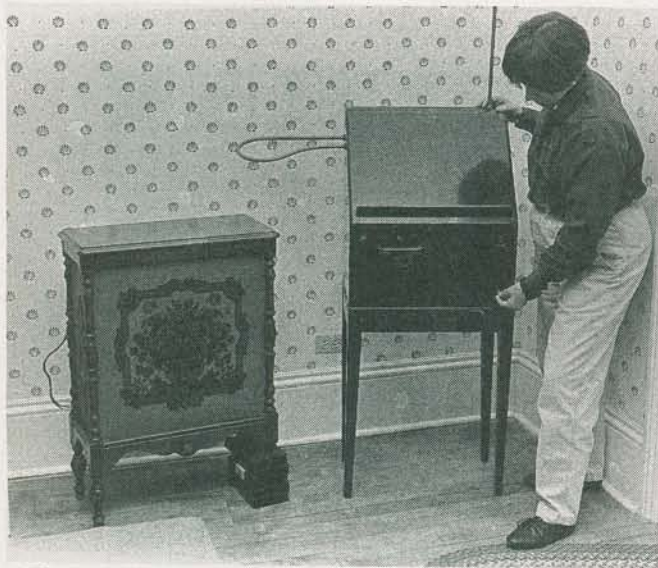
instrument. The Model 106 consists of a hefty dynamic speaker housed in a decorative floor cabinet that has elaborate turned legs and tapestry grille cloths. The 106 speaker isn't as rare a piece as the theremin, since it was widely sold as an optional accessory for RCA 1929-era radios such as the Model 60.

In good condition, the 106 is quite a handsome unit. But the one that came with the theremin has definitely seen better days. The finish is badly scuffed and scratched, the power and audio cords are frayed and patched, the grille cloth for the rear panel (luckily, not tapestry) is hanging in shreds, and the bottom of one leg is missing—probably knocked off in a fall. Fortunately, the tapestry front and side pieces are reasonably intact, if a little faded.

Though a bit more of a restoration challenge than the theremin cabinet, I have no doubt that the Model 106 could be made quite presentable. A good dry cleaning might work wonders with the tapestry pieces, and a clever woodworker might be able to turn a replacement for the missing leg on a small lathe. The rest is simple wood refinishing.

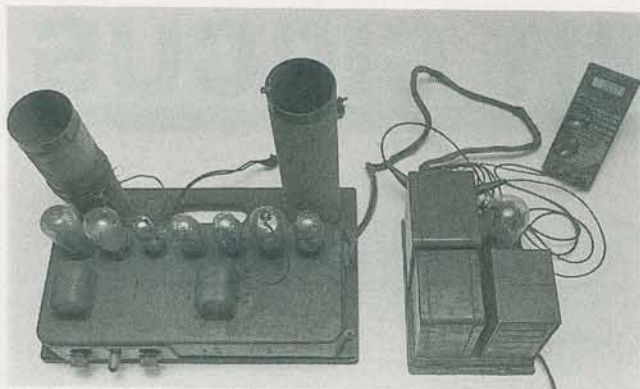
INSIDE THE CABINETS

Removing the speaker cabinet's back panel, I was pleasantly surprised by what I saw. The speaker itself looked quite good and, as I later confirmed by removing the speaker from the enclosure, the cone seemed to be in perfect shape.



The theremin and its model 106 speaker pose for a "before" picture in our living room.

of the earlier articles on that fascinating device. The instrument came into my possession courtesy of reader Tony du Bourg of Summit, NJ. Tony wanted to encourage the development of a series of *Antique Radio* columns devoted to the theremin, and that is exactly what he has accomplished!

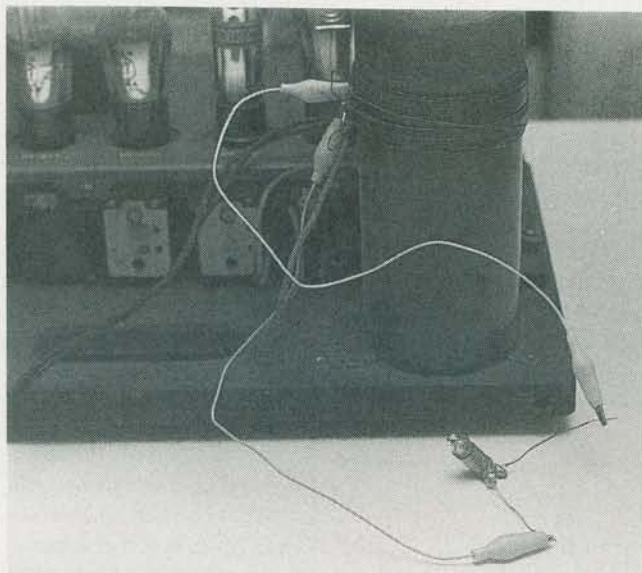


The theremin chassis (left) and its power supply as removed from the cabinet for testing.

Access to the theremin cabinet is gained by swinging open a pair of doors at the back. The space inside is divided by a slide-out wooden shelf holding the theremin chassis and coils. The heavy power supply, which is the same basic model used in RCA AC-operated broadcast receivers of the period, is mounted under the shelf on the cabinet floor.

Physically, all of the theremin and power-supply components appeared to be intact and in good condition—except for one trouble spot. A small coil wound over the bottom of one of the two large resonance coils mounted at the back of the theremin shelf was in disarray. Its turns were loose and jumbled—and closer inspection revealed that they had been wound over several layers of what looked like modern electrical tape.

Consultation of RCA's service notes for the theremin revealed that this coil is the pickup loop for the filament supply of the type-20 volume-control tube. (For more information on the volume-control circuit, please refer to the July, 1991 issue, which discusses the operating principles of the theremin in some detail.) Apparently the coil had become loose at some time in the past, which made it the subject of that not-too-convincing fix.



The test lamp, in holder, is clipped to the terminals of the pickup loop for volume-control tube filament voltage.

POWERING UP THE SPEAKER

Up to this point, I hadn't applied power to any of the theremin components. Powering up long-disused electronic equipment is a chancy business and, according to Tony, this theremin hadn't been used since the 1950's. But I'd taken the visual inspection as far as I could, and it was "smoke test" time. I decided to begin with the loud-speaker.

Like all dynamic speakers, the model 106 requires a source of DC voltage to energize its field magnet. Most dynamic speakers that we come across are built into specific radios and receive their field voltage from that radio's power sup-

ply. The model 106, however, is a free-standing speaker designed to be a radio accessory. So the 106 has its own built-in field supply.

The field supply circuit is made up of two copper-oxide rectifier elements, each the equivalent of two diode rectifiers, mounted on opposite sides of the speaker frame. The four rectifiers are wired in a bridge circuit that converts

rectifiers of later years and the silicon rectifiers that are in use today.)

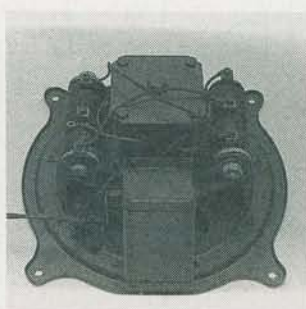
Placing a DC voltmeter across the field coil to monitor the performance of the rectifier, I plugged in the Model 106's AC power cord and gingerly flipped on the power switch. I was ready to cut the power at the slightest sign of smoke or abnormally low field voltage. However, the meter immediately registered 69 volts DC, and there was no smoke or burning smell that I could detect.

Though the reading was well over 10% lower than the 80 volts called for in the RCA specifications, the speaker wasn't humming too badly and it looked like the rectifier wasn't going to fail. I decided to leave the power on for a while to see if things would improve. My patience was rewarded—just before I shut the speaker off about an hour later, the voltage had risen to 79 and the hum had dropped to a very low level.

It'll be interesting to see how the rectifiers perform the next time I turn on the speaker, but indications are that the unit is still going to be capable of making it on the old copper-oxide stacks. If not, of course, I'll always have the option of switching to modern semiconductor rectifiers.

By the way, if you have an RCA 106 (or similar) speaker whose rectifier stacks do need replacing, I'd recommend the short article *Hum in Your Radiola 41 or Similar RCA?* in the February, 1991 *Old Timer's Bulletin* (the official journal of the Antique Wireless Association). In a few well-chosen paragraphs, author Bob Haworth explains how to change over to modern rectifiers while maintaining the original appearance of the speaker as closely as possible.

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The model 106 speaker was removed from its cabinet to check its cone. Note the two cylindrical copper-oxide rectifier stacks.

the 117-volt AC line voltage into the 80 volts of direct current needed to power the field. (The copper oxide rectifier is a primitive semiconductor power rectifier that is functionally equivalent to the selenium

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POWERING UP THE THEREMIN

Next, I decided to try applying power to the theremin unit, now removed from its cabinet. Since the power supply was easy to isolate from the theremin chassis, requiring only disconnection of a 9-wire power cable from its terminal strip, the first tests were conducted on the supply alone.

Had the power supply contained electrolytic filter capacitors, which can be destroyed by sudden application of power after long periods of disuse, I would have used a variable transformer to bring up the line voltage slowly. However, electrolytics weren't common in the era (late 1920's) when this unit was built—and the power supply didn't contain any.

Accordingly, I just crossed my fingers and flipped the switch—having connected a DC voltmeter so that I could monitor power-supply output. The meter almost immediately registered an appropriate value, and there was no sign or smell of smoke. Continuing to make voltage tests as outlined in the RCA service notes, I found all values within specifications for the unloaded power supply.

Now it was time for a round of voltage checks with the theremin chassis connected. In preparation for that, I hooked up the power cable to its terminal strip on the power supply and shorted out the speaker connection. The latter move applied voltage to the plate of the power-output tube under close to operating conditions, but avoided the distraction of having the speaker emitting various unearthly sounds during testing.

I also pulled the type-20 volume-control tube, since its filament power source (that jumbled-up pickup coil) was in question, replacing it with a small penlight bulb that had voltage and current ratings similar to those of the tube filament. That bulb was clipped directly across the coil's output leads and would give an indication of the presence of filament power.

The voltages at all checkpoints agreed closely with RCA's published values for a power supply under load. However, there wasn't a glimmer of light in the penlight bulb filament. I knew that the 420-kHz volume-control oscillator was operating (a necessary condition for power to be available at the pickup coil) because I could hear its second harmonic at about 840 kHz on a transistor radio.

UNTIL NEXT TIME

It's quite obvious that the coil is going to need some work before the theremin can be made to operate properly, and I hope to be able to solve that problem in time for the next column. See you then, but in the meantime don't forget about our contest! Tell us how you catalog and display your radios, how other members of your family relate to them, and what tactics (if any) were needed to gain the support of other members of your family.

Photos are welcome! All entries must be received before the Labor Day holiday, and the eight judged most interesting will receive reprint copies of *100 Radio Hookups*, the same 1924 Gernsback publication sent to the winners of our theremin contest. Write c/o *Antique Radio*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■