The Jersey Broadcaster

NEWSLETTER OF THE NEW JERSEY ANTIQUE RADIO CLUB

Fall 1996 Volume 2 Issue 1

MEETING NOTES

Thanks to all who helped us celebrate at our traditional holiday meeting on Dec. 8. A special note goes to Marsha and Jerry Simkin who brought their Radio Pioneers on Stamps exhibit which had taken a Special Award at the AWA Annual Conference in Rochester this past September. Their display included stamps from many countries that honored various contributors to the invention of radio. Of special interest were over 30 stamps that commemorated the work of Guglielmo Marconi. Don Cruse brought in a magnificent ivory Air King Skyscraper complete with clock circa 1933. A beautiful Edison phonograph in an oak case with Morning Glory horn and cylinder records was much admired. We all enjoyed listening to the selection of holiday 45's played on an ivory RCA 45 RPM phonograph with Alice in Wonderland motifs. Other interesting items were a good looking Freshman Masterpiece set and a unique General Radio Frequency Meter - Monitor that came in a copper-lined case. It had an attached magnifying glass to view the settings.

Everyone really enjoyed the 6 ft sub; there wasn't even a crumb left. Kathleen and Tony Flanagan ordered a cake from the famous Mendoker's Bakery in Jamesburg. It was delicious and beautifully decorated for the season. Several members brought additional goodies for our culinary enjoyment including Edith Chase's renown pumpkin bread still warm from the oven. Cookies, cheese, veggies, cheesecake with cherry topping, cinnamon raisin bread, nut bread, popcorn, peanuts, pretzels, potato chips, dips, fruit, soda and coffee rounded out our holiday fare. The food was great as was the fellowship making it an enjoyable evening for all.

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MEETING NOTICE

The next meeting of the NJARC will take place on Friday, January 12, 1995 at 7:30 pm at the Grace Lutheran Church, corner of Route 33 and Main Street in Freehold. Contact Marv Beeferman at (609)-693-9430 for directions. The topic for this month will be "Radio-Related Post Cards" presented by Ray Chase.

A SUPER VINTAGE RECEIVER - THE AR-60

Bob Haworth (W2PUA) with Ludwell Sibley (KB2EVN)

How many operators of such communication receivers as the Sky Buddy or Sky Champion have had a few choice words to say about the "0-100" logging scale used on the bandspread function? It was difficult to locate frequencies by this system and the words used will perhaps be forgiven in view of the situation. However, I wonder how many readers are aware that a communication receiver was built in 1935 that had a 0-100 logging scale not only for the bandspread function but also for the main tuning? That *really* makes it tough to find a frequency! However, that wasn't the only odd feature of this receiver - it cost more than the average working man earned in a year. No surprise, then, that fewer than 300 of these sets were made.

What company would have the brass buttons to produce a receiver of this type in a Depression year? If you said "RCA" you'd be correct. But before you jump to any conclusion about the light-headedness of the company management, let me describe a few details of this expensive low-volume receiver.

In the mid-1930s RCA was heavily engaged in global communication. Such powerful stations as WCC in Chatham, MA, and WSC at Tuckerton, NJ, were daily involved in transworld traffic under the direction of the RCA Communications and RCA Radiomarine arms of the company. As such, RCA needed an ultra-reliable around-the-clock receiving system: a set that was super-stable - once assigned a frequency it maintained it - and one that would function year-in and year-out with only occasional tube changes.

From this requirement, the amateur-radio section of RCA Manufacturing Co. produced the AR-60R, -S and -T (R: rack mount, T: table mount, S: special table mount with two-tone paint).

I was fortunate to fall heir to one of these receivers, owned by a gentleman who had retained every piece of electronic equipment he ever purchased and who happened also

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to be an amateur radio operator. Doing what a large number of amateurs do best - modify equipment to meet their perceived needs - the unit had been outfitted with a National ACN-1 dial, hand-calibrated for the 80-meter band. In addition, an S-meter and its driver circuitry were added. The original bandspread dial had been almost identical to the main dial, tucked above and behind it.

But what's so great about this receiver that it could command a $495 price in 1935, when some of the better known names brought only $50-100?

The secret is that this receiver provided the best of everything for its time. Isolantite tube sockets are used in all RF, IF and detector stages. All coils are wound on rigidly supported Isolantite forms. The eight-section bandswitch is composed of large chunks of Isolantite with silver button-type wiping contacts, insuring a positive low-resistance contact every time. Further, each wafer section has its own bearing controlled by the square-keyed driving shaft. All the smaller-value capacitors (up to 0.01 µF) are mica Faradons, anchored to the chassis with stainless hardware, and all are covered with beeswax to keep out moisture. All transformers and chokes are potted in metal containers. Even the IF transformers are assembled on Isolantite forms with variable *air* capacitors to bring them to resonance.

In short, as far as I can see no one spared a nickel in the electrical design of this radio. Likewise, it's a mechanical marvel. Weighing-in at 60 pounds without a case (add 32 pounds for the special two-tone case with 1" thick wood base!), the chassis is fabricated from 0.095" nickel-plated *brass*. No rust-out to this radio - ever! Add to this the extensive shielding (each RF stage is completely shielded - tubes and all - and the IF and detector circuits likewise), combine these features with the 750-kHz IF, and image-interference problems are practically nonexistent. The stability of a radio depends to a large extent on the tuning capacitors used for main and bandspread functions. No skimping in this department either. The AR-60 has a machined cast-bronze housing for the four-section capacitors, with bronze shafts for both main and bandspread systems, as well as precision bearings for the shaft supports. My guess is that this assembly cost more in 1935 than the complete "bottom of the line" receiver of most manufacturers of the day.

The tube lineup is typical for a 1935-vintage radio. Two 6D6s are used for RF amps, as well as two in the crystal-filter IF stages. The oscillator and mixer are 6C6s, while a 6B7 provides third IF and detector and a 6F7 is audio preamp and beat-frequency oscillator (BFO). The audio output is a 41, while the rectifier is the vintage 84. The radio also incorporates one of the oldest forms of voltage regulation on the oscillator, using a 991 neon tube.

For some strange reason, the original receiver incorporates neither a pilot lamp nor any light for the dial area. If you overlooked the power switch, the radio could remain on or off forever. My unit has had a pilot added. I guess the former owner was apprehensive about receiving a "shocker" electric bill in the event of leaving it on by mistake.

An interesting aspect of the radio is its ability to operate from batteries. Change a few jumpers inside, and it would power-up on a 6-V auto battery and external B-batteries of up to 135 V. (Sounds as if the design engineers had "Field Day" in mind on this operating feature!)

Perhaps the most unique feature is the provision for antenna coupling. The input circuitry will match antennas from 50 to 500 ohms. The coupling of this antenna-match circuitry to the input coils of the first RF stage is provided by a swinging-link arrangement controlled from the front panel. A copper electrostatic shield of the finest mesh I have ever seen is fixed between the variable-coupling input and the RF input, forming an effective Faraday shield for removing electrostatic impulse noise.

As stated, the radio is now in restoration and, as might be expected, in need of a few parts. If any reader can help - there may be someone out there with a "junker" or dial parts - I would appreciate a line!

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An obscure set today, the AR-60 was introduced with an article in the *RCA Radio Service News* and an advertisement on the rear cover of *QST*, both for November 1935. RCA also advertised it in the 1936 Radio Amateur's Handbook. It was written up briefly in *Short Wave Craft* and reviewed in detail in *Radio*, both for January 1936. However, unlike the later AR-77, the AR-60 is not covered in Rider's - the typical radio serviceman was not too likely to need service data on this one.

The set must have been in development for some time, as it did not use the all-metal tubes that RCA introduced in mid-1935 as a main sales feature of its entertainment receivers!

The 0-100 scale on the main tuning becomes less troublesome in view of the wide spread that it provides: the frequency range is in six bands (1.5-2.3, 2.3-3.6, 3.6-5.7, 5.6-9.3, 9.3-15.2, and 15.2-25.0 MHz) - yielding a fairly narrow range of frequencies per division. Only one RF stage is used on the bottom three bands.

An unusual feature is that the automatic volume control was claimed to be usable on CW transmission as well as 'phone - all that shielding and a judicious choice of BFO level, below the threshold voltage of the delayed AVC, apparently kept the AVC circuit in control despite the presence of the BFO signal. - LAS

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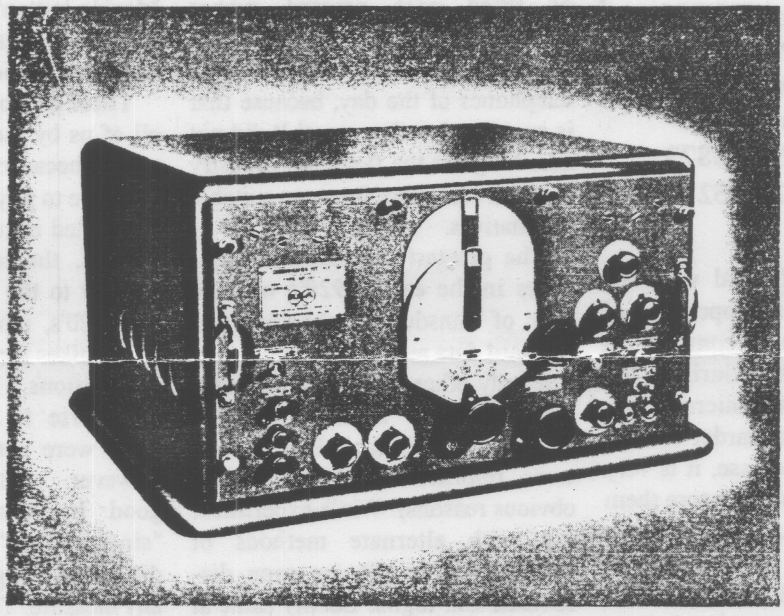
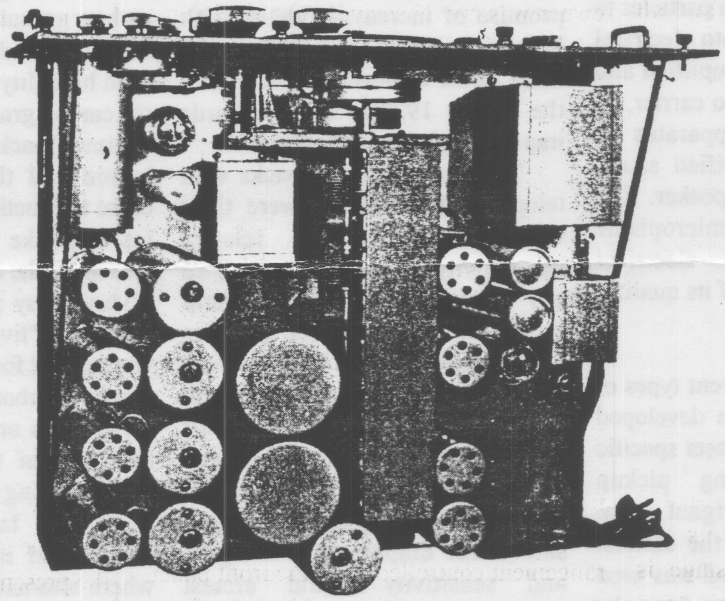
Built To Precision Standards



The new de luxe RCA AR-60 Communications Receiver includes such highly desirable features as continuous electrical band spread, crystal i-f filter and regulated voltage supply. See your RCA Amateur Distributor for details of this remarkable receiver.



The fine workmanship and efficiency of layout are at once apparent when examining the chassis of the AR-60. Note the 8-gang tuning condenser.

RCA RADIO SERVICE NEWS NOVEMBER, 1935

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CARBON MICROPHONE HISTORY AND RESTORATION

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This article will deal with the repair, restoration and operation of carbon microphones, common in radio broadcasting during the 1920's. As these microphones become harder and harder to find and their values increase, it is very much in our interest to restore them to a working state. Further, since this technology is obsolete and no longer used, it should be documented so as not to be lost to present and future radio collectors.

DESCRIPTION

A carbon microphone is an electrical transducer which uses finely granulated carbon particles to convert sound waves into electrical energy which can be amplified and used to modulate a radio carrier, be saved by recording apparatus or reconverted into amplified sound waves through a loudspeaker. The accuracy in which a microphone converts sound into electrical energy is the measure of its quality.

HISTORY

Over the years, different types of microphones have been developed as technology grew to meet specific requirements regarding pickup quality and relative signal gain. The carbon mike was the earliest practical microphone and was used in telephone transmission from the late 1870's and modified for radio application when the need for greater sensitivity and frequency response grew. The earliest radio microphones were actually telephone transmitters, either mounted on modified candlestick telephones, or fitted onto pressed rubber handles as hand-held versions. These early mikes sounded like telephones of the day, because that is exactly what they were! It did not take long for the fledgling industry to begin searching for more suitable alternatives.

The greatest limitation to engineers in the early 1920's was the state of transducer technology and the hard data available to engineers. The only other types of transducers available were solid carbon rod types, and liquid (acid bath). Both were impractical (the latter for obvious reasons). While experiment ing with alternate methods of transduction, engineers soon discovered that higher fidelity came at the price of reduced signal gain. Due to the limited capabilities of amplifiers of the day, greatly reduced signal gain rendered these alternate designs impractical. Only the carbon microphone held the promise of increased fidelity with high signal gain. Therefore, the main thrust of development during the early 1920's went towards improving the carbon mike.

The two main drawbacks with telephone transmitters were their very poor fidelity, and relative insensitivity - it would not pick up any sounds more than several inches away. The carbon granules used to convert sound into electrical energy are held in a small enclosure called a "button" positioned against the center of the metal diaphragm. Engineers found that if you placed a second "button" on the reverse side of the diaphragm, the signal and sensitivity would almost double, and because each button drove only one half of an induction device, the overall fidelity improved dramatically. Engineers also found that by enlarging the diameter of the diaphragm, both fidelity and sensitivity increased further. The result of this development was the "double-button" carbon microphone, and these began appearing in radio work in the mid-1920's.

These microphones are familiar to all of us by their distinctive appearance: because they were highly sensitive to physical shock, they were suspended in round rings with metal springs, the input wires attaching directly to the body of the mike. In the 1920's, most radio stations used these mikes for most general purpose applications, and they were the workhorse in radio's first decade. They were not without drawbacks, however. Although they sounded good by comparison to earlier "single-button" transmitters, they did not give high fidelity response by any measure. The frequency response of a broadcast grade carbon mike was 70 - 7000 Hz. (Today's higher grade dynamic or condenser mike's response is 20-20,000 Hz.) Also, carbon mikes had an annoying habit of "crackling," especially if the carbon granules had become burned from overload or were working in a high humidity environment. Finally, the carbon granules would, from time to time, "pack" at the bottom of the button and the microphone would cease to function. The remedy was to tap the mike with a screwdriver to loosen up the carbon, which could be a very noisy procedure if the mike were still "live." Because of this, it was normal for network broadcasts to use two carbon mikes on a common stand when only one was needed, in case one of the mikes decided to "pack" during a broadcast!

By the late 1920's, amplifier design had improved to the point where alternate types of transducers began to replace the venerable carbon mike. In the later 1920's, condenser mikes took on the role of music and some voice pickup, while

in the early 1930's, the velocity (ribbon) microphone took over for both and became the workhorse of the 30's and 40's.

THEORY OF OPERATION

A carbon microphone works in conjunction with a center-tapped induction transformer in a push-pull circuit. Battery current is applied between the center tap of the transformer primary winding and the metal body of the microphone. Each button is connected to one opposite side of the transformer primary in a classic push-pull arrangement. The battery current passes through the metal body of the mike and onto the metal diaphragm. From the diaphragm, it passes through the granulated carbon in each button and onto the button itself. From each button, the current returns to the battery through the side of the transformer primary winding to which it is connected. The secondary winding of the transformer picks up the signal carried by the battery current (but not the current itself) and sends it back to the input.

When sound waves hit the diaphragm, they cause it to vibrate in resonance with the wave. This vibration causes pressure against the carbon granules, causing them to compress more tightly against each other. When this happens, electrical conductivity increases and more electricity flows through the circuit. When the pressure is relieved , the granules become less tightly contacted, thereby reducing conductivity and causing less electrical current to flow through the circuit. As this happens, at the speed of the sound waves hitting the diaphragm, the resulting fluctuations of electrical current passing through the circuit faithfully copy the sounds picked up. Thus, sound is converted to electrical energy.

RESTORATION

NOTE: Before beginning, please note that you will need new carbon granules to replace the old granules that you will find inside. The best source of the proper carbon (in the proper amount) will be a modern type "T1" telephone transmitter capsule. You can buy these from telephone supply houses, or from antique telephone supply sources, such as Phoneco, Inc. in Galesville, WI, or House of Telephones, Inc. in San Angelo, TX. The cost per piece is usually about $1.50 each. To get at the carbon in a T1 capsule, turn it on its face and, using a screwdriver, pry off the outer contact ring from the back. Then lift off the center contact disc, and there's your carbon!

Usually, any carbon microphone you find will have had many countless hours of use in all climates and degrees of humidity. The carbon granules will be in a relatively poor state, much less sensitive than when new and prone to arcing, which produces static in the pickup. In addition, the contact points of the buttons and diaphragm center will need to be polished for best conductivity.

Begin by examining the front of the mike. It will be round, held together by evenly spaced screws around the outer edge of the front. Across the center of the mike is the "bridge." The bridge holds the front button firmly in place above the diaphragm, while leaving the diaphragm fully exposed for sound waves to hit it. In the center of the bridge is a thin, cylindrical tube extending down to a round raised disk above the diaphragm; this is the front button. This construction is repeated on the backside of the mike, behind the diaphragm, except that the rear the diaphragm is not exposed, so the button is attached to a hole drilled into the solid back piece.

First, remove the screws holding the microphone together, and *slowly and carefully* pull the two halves apart. Most carbon mikes used a durable solid metal diaphragm, but a few cheapies used a thick foiled diaphragm which is very susceptible to damage, so be careful! When the two parts come apart, the upper half will hold the bridge, button and a small ring of cotton used to help hold the carbon granules inside the button. Carefully place these pieces aside. On the diaphragm, which is now facing you, will be a small pile of carbon granules. Place this pile of carbon carefully aside in a small glass or dish - you will be able to use this to measure how much replacement carbon to use.

Now, *carefully* lift the metal diaphragm off with your fingernail or Xact-O-Blade, being careful not to bend or crease it. Place it on a flat surface so it will not be damaged. The rear button with its carbon granules and retaining cotton ring will now be exposed. Pour off the old carbon.

Before replacing the carbon granules, it is a good idea to polish the contact areas of the buttons and the diaphragm. After years of electrical current and years of humidity , these contacts will be pretty dirty and uneven. I recommend a light polishing with "XXXX" finishing steel wool. Polish the inside "cup" of the button, making it shiny and smooth. Repeat this process carefully on the diaphragm, polishing around the body on both sides and the center, if it is not gold plated. . CAUTION! many high quality carbon mikes had gold plating on both the buttons and diaphragm center for improved pickup. The gold will be thick and secure on the buttons, but avoid polishing the gold

plated center of the diaphragm. The plating will not be as sturdy and you can easily rub the plating off, affecting the sound quality of the mike!

When you have finished carefully polishing the buttons and diaphragm, you are ready to begin reassembly. First, note the thin metal foil strips which are attached to the rear body piece of the mike and extend towards the center of the mike. These foil strips allow electrical continuity between the mike body and the diaphragm. Usually you will find two or three of them, each about 1.3 inches long and 1/8 inch wide. Inspect these strips: if they appear excessively worn or broken, replace them with new strips made from aluminum foil. Try to keep them as short as possible while still making good contact with the diaphragm--a poor connection will result in uneven performance!

Now, carefully pour the granulated carbon from one telephone transmitter capsule into the rear button on the mike. (If your mike is a larger, broadcast quality type, the entire contents should be the proper amount; if your mike is a smaller amateur type, you will need to compare the amount of granules with the carbon which you poured off from the top button and put aside in a container.) Be careful not to get carbon granules onto the cotton retainer. Now, replace the metal diaphragm over the rear button and into its place on the rear body piece, making certain that the foil continuity strips are lying flat underneath the diaphragm and extend onto the edge area of the rear body piece.

Next, carefully pour the carbon granules from the second telephone transmitter capsule onto the center of the diaphragm. Using your fingers (and a very steady hand!) push the granules into the center in a little mound. Then, making sure that the cotton retainer is holding securely in the upper button, carefully replace the upper half of the mike onto the lower half, sealing the upper button carbon inside the button. Replace all of the retainer screws to complete the reassembly.

Now, connect your microphone to its interface (I'll describe the interface next), and the interface to the input and crank' er up. Connect the battery lead to a body screw, and one of the button wires to the rear button. Leave the front button disconnected for the moment. Now, loosen the retaining screw which holds the rear button in place and, while speaking into the mike, *slowly* move the rear button in and out a tiny distance until your voice comes in the loudest. (When the button is too close against the diaphragm there will be no output and no hiss. When it's too far out, there is also no hiss but there is periodic loud crackling when you speak into the mike. You want the halfway point between both!) When you have found that delicate point, carefully tighten up the button retainer screw and recheck your pickup level to make sure that the button didn't move when you tightened the screw. Now, disconnect the wire from the rear button and connect the other free wire to the front button and repeat the process. When this is done, your mike is complete and adjusted. Connect each button wire to one button (one wire to the front button, and the other wire to the rear button). Your mike should now be operating at peak efficiency. You will need great patience in performing the adjustment procedure, as this adjustment is difficult and time consuming (it may take an hour or more), but the rewards of a working mike are well worth it!

It is normal to occasionally hear a small amount of crackle, especially when turning or moving the mike. Gently shaking the mike and letting it remain still for a few moments will usually quiet it down. If excessive crackle reappears, it may be necessary to readjust your button settings. Carbon microphones were difficult to adjust and keep in good adjustment. Noticeable hiss is also normal. In fact, current hiss is one of the inherent drawbacks of carbon mikes which hastened their technological demise. You can reduce this hiss to a minimum as well as tweak the overall best frequency response by including a capacitor "clipper" circuit in your interface design.

INTERFACE DESIGN AND CONSTRUCTION

Because the carbon microphone uses battery current to operate, you need a device which will complete the battery circuit and pass the signal through to the input while blocking the actual battery current. To do this, you will need to construct an interface device which will provide the battery current and induction circuit. Refer to the accompanying circuit diagram on the next page as you read this section. For the induction transformer, I recommend one with a primary resistance of about 200 ohms and a secondary winding of about 50K ohms.

For battery current, I recommend 4 - 6 volts. Too much current will cause arcing and premature burning of your carbon granules; too little current will reduce your gain and sensitivity. Connect the battery circuit with the negative to the center tap of the primary winding of the induction transformer. The positive goes directly to the body of the microphone.

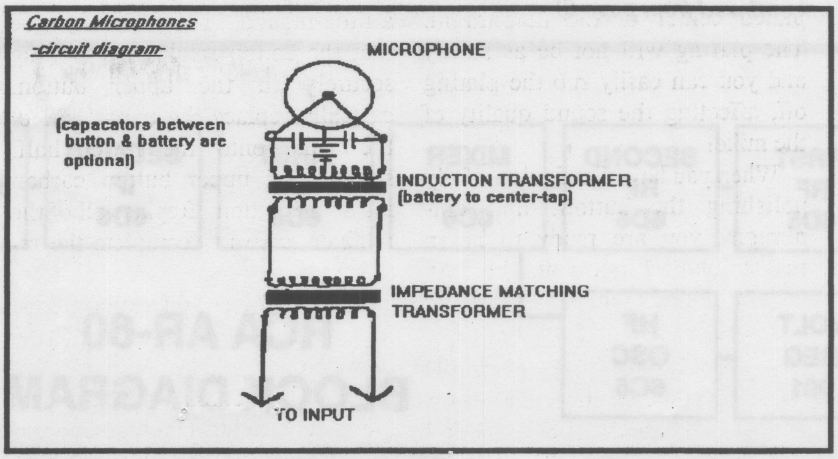
Connect the wire leading from one

of the transformer primaries to one of the button terminals on the microphone and the other transformer primary lead to the other button terminal. This is the primary circuit of your microphone, and is a straight-forward push-pull circuit.

Next, connect the secondary winding with an impedance matching transformer that will reduce your signal resistance to one which will work most efficiently with your audio equipment. Plug the output of your impedance matching transformer into your audio equipment and, voila! your microphone works!!

You will notice quite a bit of hiss coming out of your mike. This is a normal condition caused by the current travelling across the loose coupling of the carbon granules in the microphone. It is impossible to completely eliminate; however, you can take steps to reduce it to tolerable amounts. I recommend the inclusion of a capacitance "clipper" circuit across the button outputs and battery (see diagram). This will not only clip out the extremely high frequencies in which much of the hiss is present, but it will also help to even out the frequency response of the mike, producing a more even, ear - pleasing response. This addition is purely optional and is not necessary in the basic functioning of your microphone.

Carbon microphones are becoming more and more scarce, and their cost is ever rising. A good chrome-plated double button microphone will usually come with a price tag of well over $500 today. The time and relatively minor costs involved with restoration and construction of interface equipment will be well worth your investment and will provide hours of satisfying pleasure! Feel free to contact me for additional information or help.



(MEETING NOTES ... continued)

CORRECTION: Last month's issue credited John Dilks for supplying the club with copies of "Frequently Asked Questions About Repairing and Restoring Antique Radios and Phonographs" compiled from the internet. The real author was new member Lenny Tamulonis who spent about a month putting the booklet together and paid the copying costs as well! In addition, Lenny (a contributing editor) is the one who brought a case of "Listener" magazine to the previous meeting. Sorry for the foul-up ... for those of us (including myself) limited to "cruising" no further than Main Street, this new source of information was greatly appreciated.

One of our more active members, Ludwell Sibley, is recuperating at home from a recent accident. As expected, Lud is in good spirits and mending nicely and would probably appreciate all good wishes. He may be reached at 44 E. Main St., Flemington, NJ, 08822-1224. And please...no ladder jokes!

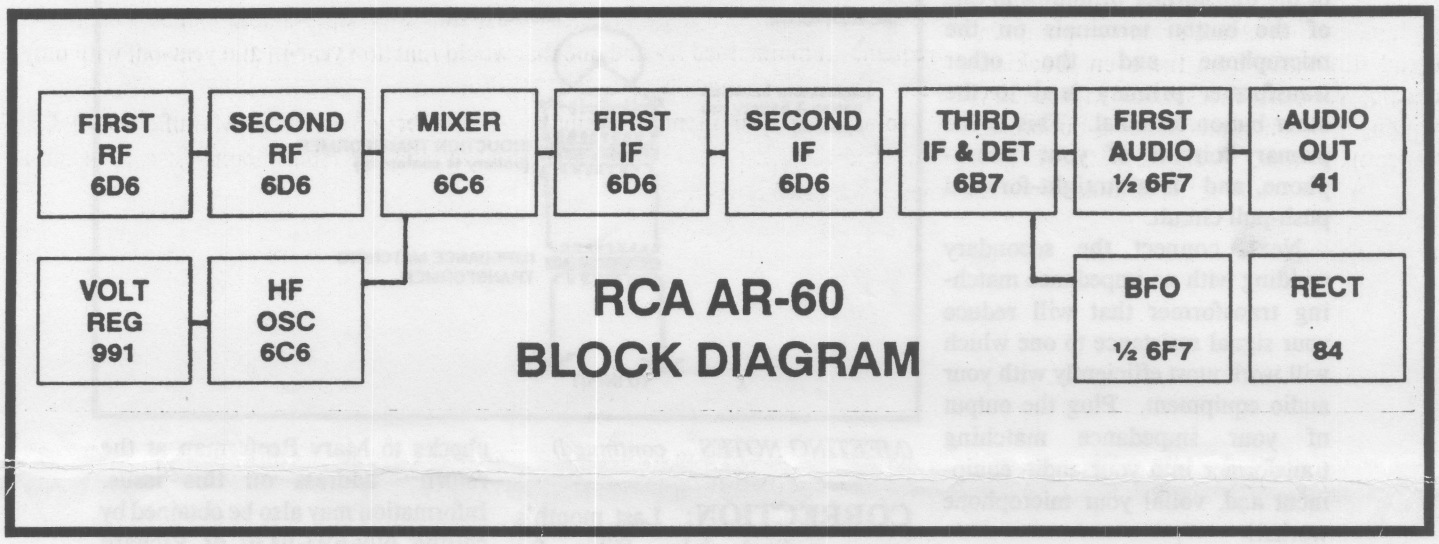
Start making plans for our Spring meet on March 16. Because of an increase in our rental fee, indoor rates are now $20 per table ($15 for members). With weather permitting, overflow vendors may purchase outdoor tables for $15 ($12 for members). Send your reservation checks to Marv Beeferman at the return address on this issue. Information may also be obtained by calling 609-693-9430 or Richard Brill at 908-679-8026. Remember.. it is recommended that you make your reservations early to guarantee an indoor table...outdoor deposits will not be refunded due to bad weather! This year, we plan to expand our old equipment contest and hope that member participation is active. More details will follow in the next issue of the "Broadcaster."

President Tony Flanagan would like to solicit membership help in installing the sound system at the Grace Lutheren Church, tentatively scheduled for the Saturday following this month's meeting. All materials have already been donated, but Tony would still like to obtain a cordless mike and receiver .

Tony and I hope you all had a pleasant New Year and look forward to even more exciting club activities in the following year.

Marv Beeferman (holiday meeting reported by Marsha Simkin)

(AR-60 ....continued from page 2)



CONNECTIONS

Free exposure for buyers and sellers! Unless requested otherwise, each ad will run for two months in both the *Jersey Broadcaster* and the Delaware Valley *Oscillator*. All buying and selling transactions are the responsibility of the parties involved.

WANTED

Collins R-390 parts set or parts, dust covers, rack cabinet. Pick-up within 100 miles of central New Jersey. Tom Provost, 19 Ivanhoe Drive, Robbinsville,

FOR SALE

Entire lot of 6,000 tubes, N.I.O.B. All must go! Call or write for list. J.J. Papovich, 53 Magnolia Ave., Pitman, NJ 08071. 609-582-8279

1958 Grundig model M1 SO US "Musical Instrument." AM/FM/SW lowboy console. Varied light wood cabinet has stereo phono with separate amp for second channel. Works well, looks good. First $20.00 takes it. Marty Friedman, 908-238-1047 (evenings).

MARVIN P. BEEFERMAN
2265 EMERALDA PARK DRIVE
FORKED RIVER, N.J. 08731

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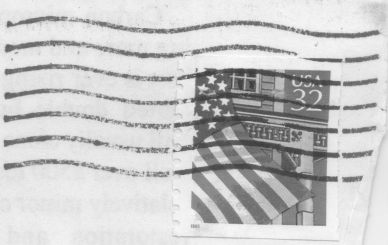

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