NATIONAL RADIO NEWS

IN THIS ISSUE

Playback of Recordings

The First Five Minutes in Radio Customer's Home

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YOUR EFFICIENCY

Thousands of books have been written on the subject of increasing the efficiency of using human energy. Boiled down, however, we arrive at just half a dozen basic rules:

1. Decide what your immediate goal is.
2. Analyze carefully exactly what you have to do to reach that goal.
3. Plan your work ahead, step by step.
4. Do one step at a time in your striving toward the first goal.
5. Finish what you are doing, and definitely reach your first goal before starting on the next goal.
6. Above all, once you get started, keep going!

E. R. HAAS,
Executive Vice-President.

TRUE ADVENTURES OF A SPARE-TIME SERVICEMAN

EDITOR'S NOTE: *These experiences of an N.R.I. student give a true picture of what spare-time servicing is like, and provide many worthwhile ideas. Of course, names and places have been changed in order to avoid any possible embarrassment to the student and his customers. The N.R.I. student is therefore referred to as Bob Jones, and Jennie is the name used for his wife and unofficial partner.*

MOST radio servicemen will agree that bookkeeping is a pain in the neck, particularly in busy seasons when it is so easy to forget the smaller items of income and expense, and so easy to lose the sales slips of radio distributors. Jennie and I started by jotting down all items of income on one page in a notebook, and all items of expense on another page. After a few months of this, however, it appeared that the day of reckoning was inevitable. From time to time we had taken money from income as profit, and performed other manipulations in the bookkeeping system which made it just about impossible to tell how we stood at any time.

It took an entire evening to straighten out the records, but the result was a radio bookkeeping system which now allows us to balance the books in five or ten minutes and see exactly where we stand financially. Here is our recipe for a simple and practical bookkeeping system which so far appears to be entirely adequate for spare-time servicing.

First of all, get a notebook about an inch higher and wider than NATIONAL RADIO NEWS, preferably with a cardboard cover and with vertical lines as shown in Fig. 1. A book without the lines will do just as well, however, because you can draw these lines in a few minutes yourself.

Leave the first page blank, and open up to the second page. Label this left-hand page "Income," and label the opposite (right-hand) page "Expenses." Next, label the columns as indicated in Fig. 1. Now, when you actually receive income, and not before, make an entry of it on the income page as illustrated by the example. Likewise, when you actually spend money from the cash balance in your radio servicing fund, make an entry of this on the expenses page, with date and a few identifying facts in both pages.

Let me emphasize again—if you want this system to work smoothly for you, do not make any entries whatsoever until you have actually received the money or have actually paid it out *from radio servicing funds*, not from your own pocket money. If you borrow money from your personal funds for radio purposes, keep a separate record, and enter this in the radio record only when you have repaid yourself.

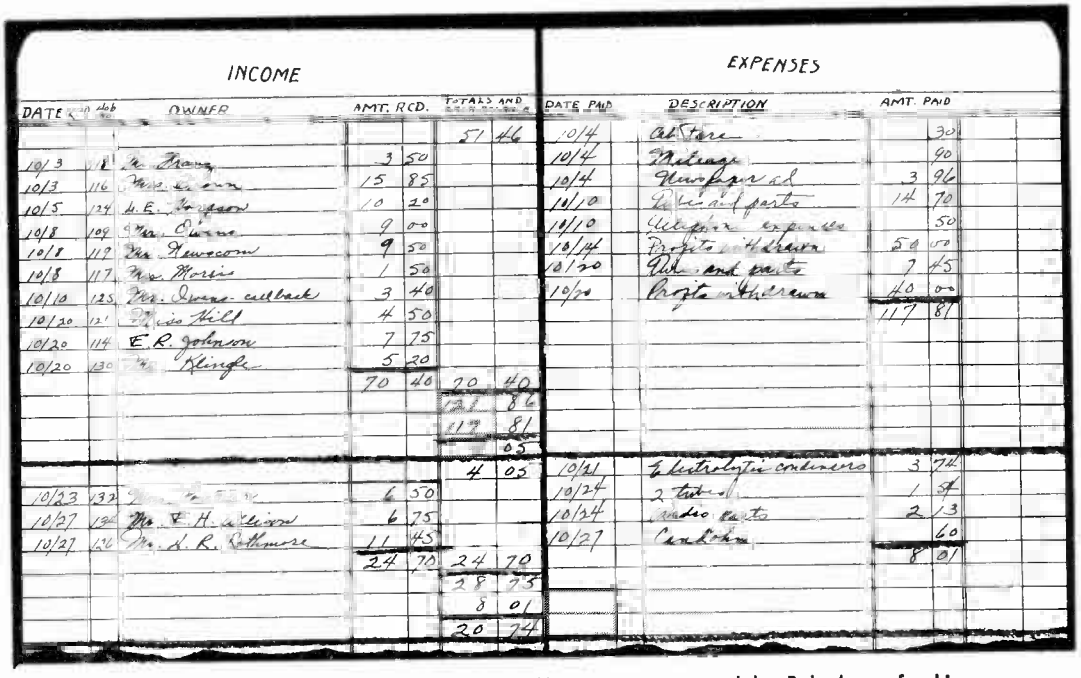
Suppose you want to find out how you stand. Add together all the items of income and write the total in the column provided for that purpose. Add the expense items in the same way, then subtract expense from income to get what should be your cash balance. If this does not agree with the actual money in the radio kitty, you just have to figure out what it was you forgot to record. It might be just a nickel spent for a phone call while out on a job, or it might be a tube you forgot to buy at one radio store, and stopped in at another store to get. The hardest part of this bookkeeping system is simply remembering to record each item from day to day—but then, this is an absolute requirement in any bookkeeping system.

After you've made things check, draw a line clear across the page under the last figures entered on both pages, to indicate that everything above the line is correct. You then continue recording items in the usual manner.

Now suppose that two weeks later, you again want to check up and see if the cash balance is correct. You add the income items as before, just taking those below the line drawn across the page, but this time you add the cash balance of the last period to your total. Now subtract the total of expenses incurred since the last reckoning, to get the new cash balance.

Money which you take from the radio business as salary or profit should be entered as an item of expense, in this simple system of bookkeeping. We found it a good idea to keep radio funds separate from our personal funds; an empty one-pound coffee can is the present undignified repository for our own radio business funds.

Here's another practical tip—there will inevitably be times when you dive into the radio fund for money or change to pay the laundry man, the milk man, or what have you. If you



INCOME

DATE	Job No.	OWNER	AMT. RCD.		TOTALS AND	
					51	46
10/3	118	Mr. Thorp	3	50		
10/3	116	Mrs. Brown	15	85		
10/5	124	L.E. Johnson	10	20		
10/8	109	Mr. Evans	9	00		
10/8	119	Mr. Newcomb	9	50		
10/8	117	Mrs. Morris	1	50		
10/10	125	Mrs. Jones - callback	3	40		
10/20	121	Miss Hill	4	50		
10/20	114	E.R. Johnson	7	75		
10/20	130	Mr. Klingle	5	20		
			70	40	20	40
					121	86
					119	86
						05
					4	05
10/23	132	[illegible]	6	50		
10/27	134	Mr. F. H. Wilson	6	75		
10/27	126	Mr. L.R. Robinson	11	45		
			24	70	24	70
					28	75
					8	01
					20	74

EXPENSES

DATE PAID	DESCRIPTION	AMT. PAID	
10/4	At Store		30
10/4	Mileage		90
10/4	Gasoline & oil	3	96
10/10	Tubes and parts	14	70
10/10	Telephone expense		50
10/14	Profits withdrawn	50	00
10/20	Tubes and parts	7	45
10/20	Profits withdrawn	40	00
		117	81
10/21	6 electrolytic condensers	3	74
10/24	2 tubes	1	84
10/24	Radio parts	2	13
10/27	Car lubrication		60
		8	01

FIG. 1. Sample pages from the ultra-simple bookkeeping system used by Bob Jones for his spare-time radio servicing business. Cash on hand on 10/3 was $51.46; on 10/20 it was $4.05; on 10/27 it was $20.74.

want to avoid a future headache, make a definite rule to write out an IOU on a slip of paper and drop it into the can every time you take money out of it for other than business reasons. Likewise, if you take money out of the fund to pay legitimate radio expenses but haven't the time to make an entry in your book, place the bill of sale in the can or other container as an indication of how much you took out. Samples of our IOU's are shown in Fig. 2.

Your bookkeeping system should definitely not be a life history of each item of income or expense. You will have your job record card for this purpose in the case of income. A file folder containing all bills of sale for radio parts will take care of the details of expenses.

► In the radio business, you just have to believe in yourself and your instruments. Take our Job No. 141, for instance—an RCA-Victor Console suffering from distortion and low volume. All tubes checked okay. D.C. electrode voltage measurements quickly isolated the trouble to the power pack, where the output voltage was about 40% of what it should be. Effect-to-cause reasoning got nowhere, however, and a check of every single part in the power pack had appearances of getting me to the same place until, as a last resort, I measured the filament voltage of the rectifier tube. Three volts for a type 5Y3G was definitely suspicious.

I just didn't want that power transformer to be bad because I didn't think the customer could afford a new power transformer—and anyway, there was just a bare possibility that something inside the tube might be the cause of the trouble.

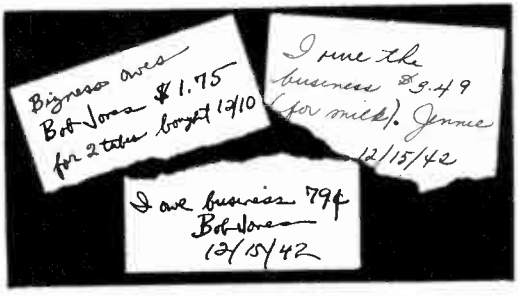


FIG. 2. Examples of IOU's placed in the coffee can which contains the business funds of Jones Radio Service. A word of advice—the fewer of these you use, the fewer bookkeeping headaches you'll have.

Put in a new 5Y3G tube, and presto—the set played as good as the day it left the factory. Why, I don't know. The filament voltage across the new tube was still 3 volts, another mystery to me. The final charge of $3.25 for this job was made on the definite understanding that the work was not guaranteed, that the power transformer might fail in the near future, and that the amount paid would be considered as full credit toward the installation of a power transformer if that part did fail within a reasonable period.

► Output transformers fail quite often in the moist, somewhat corrosive atmosphere of Virginia, so we try to keep a few universal outputs on hand all the time. Here's an example of our charge for an output transformer job:

Check-up and test, including pickup and delivery	$3.50
New output transformer	2.75
Installation of output transformer	3.00
Total	$9.25

This charge would come down to $7.25 if the customer brought the set in to me and picked it up again after the repair work was completed. The charge of $3 for installation is entirely justified when you consider that it must cover those tougher-than-average jobs where it is necessary to make a special mounting bracket for the new transformer. The output transformer, like all new parts, is billed at approximately twice our cost.

► Never did see much use for tube shields until the evening when a customer brought in a Zenith console, but left the tube shields home. Three out of five tubes in the set were bad. Had them in stock, and the customer agreed to pay their respective list prices, so put in the new tubes after first explaining to the customer that they put shields on radio tubes for a reason (I'd read this somewhere in the N.R.I. Course).

Sure enough, when the new tubes were in and the set turned on, it squealed like a dying pig. The customer's face showed complete disapproval of my servicing ability, and even I began to wonder if there could be some other trouble in the receiver. Couldn't find any shields in the shop which would fit the large glass tubes, and couldn't convince the customer that he should take the set home as is and put on the shields, so finally dug up enough scraps of sheet copper and other bendable metals to wrap up each tube completely. Boy! Hearing that set perform at full volume with not a single squeal certainly gave me a thrill, and the customer's face broke out in a huge smile. Yes, practical experience does demonstrate the proof and importance of knowing radio theory as taught in the N.R.I. Course.

► When it comes to figuring charges for repairs on these not-so-rare two-tube universal t.r.f. receivers, this famous phrase of Bobby Burns is quite appropriate: "The best-laid plans of mice and men often go astray." Consider the Arvin Model 40 that became Job No. 146; it arrived at the bench dead as a doorknob, and inspection for surface defects revealed the cutest little pinhole in the rubber-covered line cord, completely severing one of the wires.

A new line cord, obtained by snipping seven feet of cord off a home-made a.c. receiver of mine that had never recovered from being plugged into a d.c. outlet, energized the filament circuit but failed to restore performance. Further investigation revealed an open volume control. Could have estimated cost and called the customer now to get an okay on the job, but past experience proved that it might be wise to get the new control first.

My suspicions proved correct; the new control was not the final solution to our problem of rejuvenating this fist-sized two-tuber. After wasting an hour of time fiddling around with wild hunches and remote possibilities, I finally settled down to check the circuit against the diagram of the set. As a result, removal of a condenser which someone had connected between volume control and ground, and connecting of a new condenser across the power line cleared up the trouble perfectly. It is truly amazing how well this little two-tube Arvin performed after being put in shape. Actually, though, the two tubes in this set give the equivalent of a four-tube t.r.f. receiver.

We were now confronted with the problem of figuring out how much to charge the customer for repairing a receiver which had perhaps cost her only $6 originally. A little preliminary figuring indicated that the condenser removal and replacement had better be a labor of love, or whatever else you might wish to call it. The final charges therefore figured up as follows:

Check-up and test at shop	$1.50
New line cord, including installation	1.00
Installation of new volume control	3.00
One new volume control with switch	1.80
Total	$7.30

Called the customer, and very soon learned that she had only paid $5 for this set. Pointed out, however, that the set was probably a lot better now than when new, because I had put in high-quality parts whereas manufacturers had to use the cheapest possible parts in order to keep the initial cost down to what she paid for it. Also pointed out that it was just as hard to locate troubles in small inexpensive sets as in sets costing several hundred dollars.

Was quite relieved to get an okay here, because I was in the uncomfortable situation of having promised to give an estimate before doing the work, but was now quoting the final price after having done the work. It's about all you can do in cases like this, however, my radio servicing friends tell me. Servicing is always a gamble in one way or another, and this is one more justification for charging full professional rates at all times.

► Another job with a multitude of ailments was a Tiffany Tone table model a.c. superhet. Everything went smoothly here, however, and the customer paid the final charge without complaint. The itemized charges are self-explanatory:

Check-up and test at shop	$1.50
Repair noisy rotor contact of gang tuning condenser	1.50
Stop vibration of laminations in power transformer	1.00
Installation of new screen grid bypass condenser	3.00
Three new tubes	2.95
Total	$9.95

The laminations in this transformer were vibrating like a model T Ford, causing a loud hum. Tightening the lamination bolts reduced the hum somewhat, but not enough. Finally made a perfect cure simply by driving five one-inch wire brads between the laminations. I might point out that the $1 charge was not for the five brads, but for knowing that they were needed and knowing where to drive them!

The noisy rotor contact was repaired by removing the phosphor bronze rotor contact spring completely, a process which required unsoldering of its mounting end, sanding both the rotor shaft and its spring contact, and replacing the contact spring.

►A call-back can be quite embarrassing on a job where the customer was originally quite emphatic about her belief that the original charge was too high. This was a nine-tube Zenith console with three bands and an intricate motor-tuning system. One new tube plus installation of a new output transformer brought the total charge to $10.75, as follows:

Check-up and test, including pickup and delivery of set	$3.50
Installation of new output transformer	3.00
New output transformer	3.00
One new tube	1.25
Total	$10.75

The complaint on call-back was trouble in the tuning mechanism, making it impossible to receive the higher-frequency stations in the broadcast band. Preliminary investigation indicated it would be difficult if not impossible to make the repair in the house, and had to pull out the chassis and bring it to the shop again.

Here, after wasting considerable time due to inexperience with the maze of gears in the tuning mechanism, the trouble was finally isolated to a worn belt. Had to get a new belt of the universal type, which you cut off at the right length, no longer and no shorter. A mistake means you're sunk and you have to get a new belt, because once assembled you can't get it apart, and once cut too short, you can't lengthen it. Fortunately, the manufacturer's instructions for determining the correct length are quite clear, or at least I was lucky in getting it right the first time.

The repair was a success, but what about my charges? This trouble had no relation whatsoever to the failure of the output transformer on the original job, yet the customer was holding me responsible. After deliberation, decided to have a try at a charge of $3.50, and phoned the customer. Soon found that she had other ideas. After a tough fifteen minutes on the phone, finally propositioned her thusly: "*Even though I sincerely believe that this charge is justified under the circumstances, I would much rather have you as a satisfied customer than have the money. Suppose you discuss the matter with your husband when he comes home, and I'll bring the set over and install it tonight. I'll leave the matter of a charge entirely up to you, and accept your decision as final.*"

The lady seemed entirely agreeable to this, and asked how much I had paid for the dial belt. I told her fifty cents, which was the list price of the belt. After the set was all installed, she announced her decision to pay the price of the new belt, and handed me fifty cents. Thanked her for it, and she then gave me a dollar bill —making it quite clear that this was a tip, not a part-payment for the job! People are funny sometimes, aren't they? We parted on best of terms, and I look forward to more business from her.

►An RCA-Victor S11K, one of the first to use motor-driven push-button tuning, proved both an interesting and profitable job. The individual charges tell their own story:

Check-up and test at shop	$1.50
Installation of new volume control	1.75
Resetting eight push buttons	1.00
Repair of reversing switch	.75
One new volume control with switch	1.80
Two pilot lamps	.20
Two new output tubes	2.00
Total	$9.00

Here was a case where I believed a reduction in standard professional rates to be justified. All of the repairs were very simple, and were done in remarkably short time. Thus, the push buttons were reset in less time than it takes to set up trimmers, especially the intricacy of the electromechanical tuning mechanism. The repair of the reversing switch merely involved pushing a piece of fibre paper out of the way of a contact. The volume control was likewise a simple and easy job. On sets where there are a number of different troubles, it is only fair to reduce those charges which are high for the particular job. Of course, I was also concerned with just how much this customer could afford to pay, and was quite surprised to find him handing out the $9 without a murmur of protest.

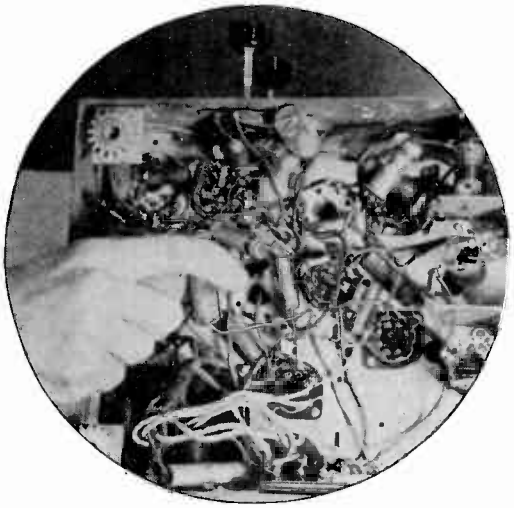


FIG. 3. An open by-pass condenser can be located without brain-work by shunting a good condenser temporarily across each paper condenser in the set in turn while the set is operating, as shown here. Any size will do; a .1-mfd. 600-volt unit is one possibility.

►Forgetfulness can be costly in radio servicing, but fortunately it wasn't on Job 122. Forgot to take along the chart for my tube tester. Didn't discover this until I was in the customer's home, ready to test tubes. Decided to bluff it out without letting the customer know, and turned the set around. Lo and behold, there was a rectifier tube with the prettiest purple glow I ever did see—a 5Y3G which is definitely a vacuum tube and should not show color. Had a new tube in the kit right beside me, so just swapped tubes, collected $3.50 for the job, and walked out in ten minutes with a deep sigh of relief. Had it been any other tube, I really don't know what I would have done. Probably would have had to pull out the chassis and take it to the shop, then explain to the customer later why I did that for just one bad tube.

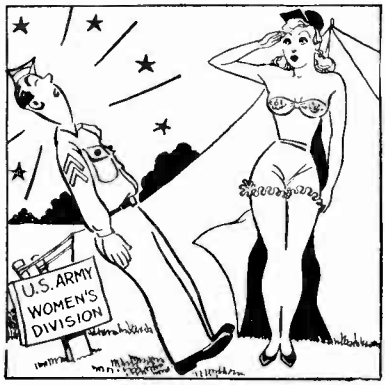
►A man stopped the other day while I was putting a chassis into the trunk of the car, asked if I was a serviceman, and proceeded to write a note to his mother instructing her to hand me the chassis and loudspeaker of his radio set, in an apartment a few blocks away. It proved to be a $6 job, involving replacement of a large paper by-pass condenser.

Must admit I found this open condenser by the simple procedure of shunting each condenser in turn with a good condenser, as shown in Fig. 3. A simple method like this gives the brain a rest from effect-to-cause reasoning and isolation procedures, takes only about five minutes, and works surprisingly often.

The customer was quite convinced that the charge was too high, and was equally convinced that I knew it was too high, but paid anyway and assured me he would not use my services again. People are like that, and I have become resigned to the fact that a certain percentage of the jobs will end up in such a way regardless of what you do or how much you charge.

The thing to do is to charge a fair amount at all times for your services, stick to your charges, and just don't let these forever-complaining customers get you down. As a matter of fact, many of them will complain regardless of what you charge, and you might as well collect full prices while listening to their gripes and accusations as to collect less. Such are the things which make spare-time servicing an interesting and at the same time profitable relaxation from the regular day-time job.

Hip! Hip! Hooray!



But Corporal, you said, "All out and make it snappy!"

Playback Of Recordings

By CLINTON B. DE SOTO

Executive Editor, QST

The Editor is very grateful to QST, the publication devoted to Amateur Radio, for permission to reprint this interesting article which originally appeared in QST, October, 1942.

THE best record ever made is just so much plastic and metal unless there is some way to re-convert into audible sound waves the message it imprisons.

And so we come to the topic of playback. That topic largely reduces itself to a consideration of pickups and their associated components. Good performance in the remaining elements of the reproducer system—the turntable and motor drive—is based in the main on the same considerations as those for good recording.

Types of Pickups

The pickup is a device for translating into electrical voltage the mechanical motion of a finely-pointed stylus or needle riding in the record groove. There are two basic kinds of pickups—magnetic and crystal. Both are widely used, but the crystal type is now by long odds the most popular. This is chiefly because it is simpler—and therefore cheaper—to manufacture.

First to be considered is the magnetic pickup. There are two basic categories: (a) moving armature, and (b) moving coil. These are broad classifications, there being several special varieties which go by other names. For purposes of analysis, however, it is convenient to consider any reproducer whose electrical output is generated in a coil in a fixed magnetic field as a "magnetic" pickup.

The armature type in some instances is made with the winding on the armature proper and in others with a diaphragm-type armature and the winding on the poles. Other variations include the manner of suspending the coil or armature; i. e., full-rotating center-pivoted coil or armature with U-fields, or the half-rocker type with end suspension.

A typical magnetic pickup for lateral reproduction is shown in Fig. 1-A. With the movement of the armature, as it is vibrated by the needle in its groove, through the steady flux provided by the permanent magnet, a flux flows through the armature which induces a voltage in the coil. This voltage is purely a magnetic product and is independent of frequency so long as the velocity of the armature is independent of frequency. Thus a constant-velocity characteristic is reproduced. In practical designs the damping is made such that the needle swing is progressively limited for the high-amplitude constant-velocity low-frequency swings, and therefore the response below 1000 cycles or so becomes modified constant-velocity as in the magnetic cutter.

Because of the necessary mass of the armature and the high damping required, a pickup of this type exerts considerable pressure upon the record groove. A more satisfactory type in this respect is that of Fig. 1-B. Here the armature is a clamped reed, actuated by a mechanical "step-down" transformer. Because of the great reduction in both mass and stiffness, as seen by the record, the effective pressure on the groove is substantially reduced.

Another commercially-popular development in this direction is the "relayed-flux" type, in which the reproducer stylus is made integral with a tiny vibrating reed. As in the example of Fig. 1-B, the air-gap is very small, requiring only about 0.00015-inch displacement for the highest amplitudes. The combination of small mass and slight displacement results in low needle "impedance" from the standpoint of the record.

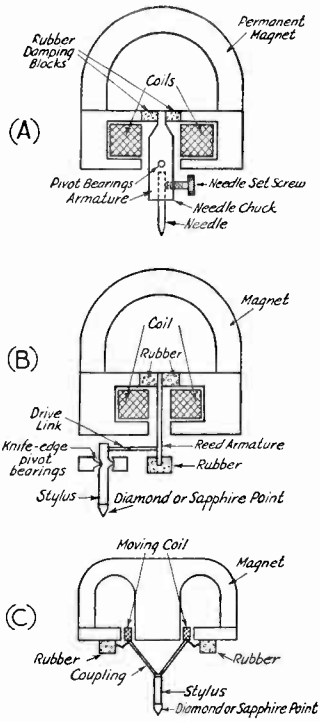


Fig. 1—Typical magnetic pickups.

(A) Conventional moving-armature pickup as used in phonographs and home-recording playback systems, with replaceable steel or alloy needle. When the balanced armature is stationary in a central position, there is no flux through it. When deflected by lateral motion of the needle, a flux flows which induces a voltage in the coil. The armature works against the resistance of the rubber damping blocks.

(B) Transcription-type reproducer with reduced mass and stiffness, resulting in lowered needle pressure. The armature is a thin leaf of magnetic material clamped tightly at the top between non-magnetic spacers, actuated by the permanent jewel stylus through a pivoted linkage having a high leverage ratio. The light aluminum-alloy pivot arm is held in laterally-rigid knife-edge bearings, spring-mounted to accommodate vertical displacements. The rubber blocks provide damping.

(C) Dynamic (moving-coil) pickup for vertical reproduction. Motion imparted to the coil by the needle induces in it an alternating flux corresponding to the groove modulation. The moving coil is held in rubber-mounted flexible suspension springs.

The moving-coil or dynamic pickup of Fig. 1-C is a magnetic pickup similar to a permanent-magnet dynamic speaker, wherein the output results from the motion of the coil in a steady magnetic field. This type is used chiefly in vertical reproducers, as in the example illustrated. Generally speaking, the smaller and lighter the coil and the fewer its turns (with resulting smaller mass) and the less the stiffness of the suspension system, the lower the needle impedance. On the other hand, reducing the number of turns means either reduced output or increased displacement.

The coils in magnetic pickups are wound to have impedances of from a fraction of an ohm to as high as 18,000 ohms or more. Typical moving coil units have about one ohm impedance, while standard armature-type pickups range from 8 to 10,000 ohms, with at least one special type of 18,000 ohms. Generally speaking, low impedance means reduced mass and inertia but also reduced output. By proper design, a coil of almost any impedance can be made to function satisfactorily.

Crystal pickups differ from their magnetic counterparts much as does the crystal cutter from the magnetic cutter. The needle, driven from the record by a suitable coupling, applies pressure to one end of the crystal, the other being securely clamped. The resulting displacement produces a voltage in the crystal by piezo-electric effect.

The amplitude of this voltage is proportional to the displacement—in contrast to the magnetic type, where it is proportional to the velocity. Thus the amplitude is greater at low frequencies than at high. That's from the mechanical standpoint. From the electrical standpoint, the crystal may be considered a voltage source in series with a low resistance and a capacitance equal to that of the crystal. Thus it is equivalent to a coupling capacitance, and the transfer efficiency at various frequencies can be closely regulated by varying the load resistance. Lowering the load resistance reduces the low-frequency response—the opposite of the mechanical effect. By balancing the electrical and mechanical characteristics of the crystal pickup, therefore, a flat over-all constant-amplitude characteristic may be achieved.

The nominal impedance (not the rated load resistance) of typical crystal pickup elements ranges from 80,000 to 200,000 ohms. The internal capacity of the element varies widely with the type of construction and with temperature, but normally lies within the range 0.001-0.005 mfd.

Typical examples of crystal pickup construction are shown in Fig. 2. The inexpensive unit at (A) has a minimum of parts and is designed to be simple of construction. The needle chuck,

holding a replaceable steel or alloy needle, is attached to the free end of the crystal element by a suitable coupling shaft suspended in trunnion bearings. At the point of coupling to the crystal pads of rubber or other mechanical resistance material are inserted to provide the necessary damping.

At the other end of the scale is the professional type of pickup shown at (B). Here the mass and stiffness of the relatively bulky assembly described above are eliminated by using a tiny sapphire permanent stylus mounted in a short length of nickel tubing, attached to a torsional drive wire. The beryllium-copper drive wire twists in metal bearings held in rubber bearing supports. Slightly yielding pads connect to the crystal cartridge. The crystal element itself is well damped, being mounted on pads having a high damping coefficient and surrounded by oil having a high viscosity.

The output voltage from the pickup necessarily varies with its quality. High fidelity—extended frequency range and low harmonic distortion—means low amplitude and high damping, and therefore low output. The cheaper and therefore less precise the construction, on the other hand, the greater the amplitude and therefore the output voltage. Typical medium-priced crystal pickups deliver about 1.5 volts peak with a standard maximum groove amplitude of 0.002 inch. Some, particularly the cheaper units, give as much as 2.5 to 3 volts, while transcription-quality pickups deliver from 0.25 to 1 volt or more.

The output of high-impedance magnetic pickups is at the same general level—1 to 1.5 volts for those from 5000 ohms up, proportionately less for lower impedance units. Since low-impedance pickups are designed to work into a step-up transformer, the effective signal at the first amplifier-tube grid is also of about the same order—a volt or so for peak modulation swing.

Frequency Response

As with the cutting head, the frequency response characteristic of a pickup is usually made to correspond as closely as possible with either a constant-amplitude curve (for crystal types) or modified constant-velocity (for magnetic types). The permissible deviation from a true curve varies with the service to be performed. For high-quality professional work it must be held to less than 2 db, while in home record players a 5 db variation is usually not objectionable. Gradual slopes are not as troublesome as sharp peaks; these are to be avoided at all costs, since they result in "rattling" and a particularly unpleasant species of distortion.

Broadly speaking, the cost of a pickup is an index to the maximum frequency range it will reproduce. Units listing for under five dollars seldom reproduce more than a 70 to 4500-cycle band; they do a fair job on shellac pressings and the "home-recorder" type of instantaneous recordings. In those costing between five and ten dollars, the high-frequency response is usually extended to about 7000 cycles, which is adequate for most non-professional work. For high-quality transcription work, however, the cost of a good pickup runs from fifteen to seventy-five dollars, with a 50-8000 cycle range at the lower end of that price scale and 30-10,000 or even 15,000 cycles for the most expensive types.

The response characteristics of any magnetic pickup, whether of the armature or moving-coil

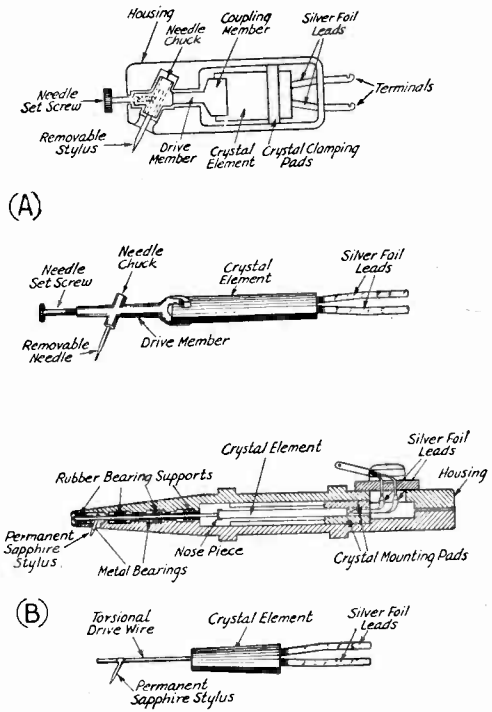


Fig. 2—Crystal pickups.

(A) Typical inexpensive type of pickup now used in 80 percent of all record players. The pickup head as a whole is shown in cross-section at top, the removable crystal cartridge, coupling shaft and needle chuck below.

(B) Transcription-type low-needle-pressure crystal pickup capable of high fidelity, wide frequency range and low harmonic distortion. Needle and chuck are replaced by a small permanent jewel stylus, coupling shaft by a thin torsional drive wire an inch long and 0.024 inch in diameter.

type, resembles that of the magnetic cutting heads described previously in this series. The bass response drops off below 1000 cycles or so at a rate of about 6 db per octave, which must be compensated for in the amplifier. This is because the output is proportional to the velocity of the moving armature or coil. If modified constant-velocity recordings are being played the rate of equalization must be doubled, to compensate both for the record and the pickup.

Usually two small bumps will be observed in the response curve of a magnetic pickup, one at the low-frequency end and the other at the high. The low-frequency peak is due to the mechanical resonance of the total mass of the pickup and arm, constituting inductance, with the capacity represented by the compliances of the suspension and damping elements. The pickup is designed to take advantage of this resonant condition to extend the low-frequency limit. Similarly, electrical resonance is often introduced to extend the high-frequency range, making use of the inductance of the coil. In properly designed pickups the amplitudes of these peaks is small, and the response drops off sharply at either end.

The response curve of an unloaded crystal pickup is more or less the inverse of the magnetic type, as has been stated. However, the desired flat constant-amplitude characteristics can be obtained simply by shunting the element with an appropriate load resistance. Commercial crystal pickups are usually designed to give flat response with a load of 0.25 to 0.5 megohms. (The correct value of load resistance is not the same as the rated impedance of the crystal, in contrast to magnetic types. It is usually made at least two or three times as high, not only to give correct compensation but also to reduce the effect of impedance variations resulting from changes in the internal element capacity due to temperature effects.) In this connection, the following rule should be remembered: Increasing the load resistance increases the low-frequency response, decreasing the resistance lowers it.

As with the magnetic pickup, two resonance peaks are usually observed in the response curve, one at very low frequencies resulting from resonance of the mounting and one at a high frequency produced by the natural resonant period of the crystal element itself. In designing the pickup the latter is usually placed to coincide with the limit of the high-frequency range, being followed by a sharp cut-off. In the less expensive types this may be 7000 cycles (as low as 4500 cycles for the very cheap models), while in the costly professional types it may be placed as high as 20,000 cycles to extend the useful playing range out to 15,000 cycles or so.

Needle Force

One of the most important characteristics of the pickup is the needle pressure or, more correctly, needle force. This represents the effective weight of the pickup as it rests upon the record. In old-style magnetic pickups this may be as much as 5 or 6 ounces, and even in modern light weight units of the less expensive variety it averages 2½ to 3 ounces. This may not seem much until it is realized that, because the actual area of contact between needle point and record is very small, the final pressure for even a 3-ounce pickup against the groove may exceed 10 tons per square inch!

Recent design has been directed strongly toward reducing this pressure, until now good pickups with a needle force of 2 ounces or less are available at reasonable cost and transcription-type pickups are made that exert a force of only 15 grams (half an ounce).

There are practical limits to the reduction in stylus force, however. A pickup with too little pressure may wear the record even more than a heavier one, particularly if it has appreciable tracking error and horizontal inertia (both of which will be discussed in detail later). The needle then tends to climb or "skate" the wall of the groove, resulting in poor tracking, rattling and distortion. Low-pressure pickups may also have high vibratory momentum due to the high velocity of the moving mass. Fluctuation in output resulting from these defects may raise the surface noise level several db, in addition to increased harmonic distortion and record wear. Recent studies indicate that a minimum force of about 12 grams is required to prevent skating with the 0.002-inch maximum amplitude and 90° groove now accepted as standard practice. Actually, the record groove is capable of absorbing a surprising amount of pressure if the needle point is correctly shaped and carefully polished to reduce friction and tearing. The coating of instantaneous records has an elastic property which enables it to recover from the deformation of the groove caused by the stylus pressure as it moves along much like a piece of sponge rubber across which a stick is dragged. Of course, if the force is sufficient to break the surface, particularly if the point is sharp, permanent damage will be done. However, with a properly-ground needle and a good record coating a needle force up to 2 ounces may be used for several hundred playings. Shellac pressings will stand even more, while the softer nitrate and vinylite coatings may begin to wear after a few playings with 1-ounce pressure. NAB recommended standard practice for broadcast transcription work is to limit the maximum vertical force to 1½ ounces.

As to the preferred type in this respect, both magnetic and crystal pickups have been designed

to give low needle force. It is somewhat more difficult to build a magnetic pickup with light needle pressure than a crystal pickup of the same performance. During the reproduction of high frequencies, the vibratory system of a pickup is enertia controlled, and the forces required to move the stylus point depend upon the moment of inertia of the vibratory system. In a magnetic pickup the stylus has to move either a small armature or a coil to generate a voltage. The cystal element, on the other hand, generates a voltage depending upon the pressure exerted on the crystal element, requiring relatively little motion. By properly designing a crystal pickup only the stylus point itself and its mounting represent the inertia of a vibratory system, while in a magnetic pickup other parts must also be moved. Only by employing a mechanical "impedance stepdown" transformer (as in Fig. 1-B) can the greater mass and inertia of these larger parts be handled effectively.

"Needle" or "Stylus"?

The terms "needle" and "stylus" have been used more or less interchangeably in this discussion, as they are throughout the literature and in conversations on the subject. There is no accepted distinction, but commonly a "needle" is a replaceable point, usually of steel or alloy (or, less desirably, of fibre, thorn or cactus), while a "stylus" is a "permanent" jewel point assembled integral with the pickup.

In either case the use of a playback point that is correctly designed and manufactured is often the difference between good and indifferent results. This is particularly true in reproducing instantaneous recordings.

The common phonograph-type steel needle is virtually useless for that purpose. The point of such a needle is merely sharpened—not ground to a tip corresponding to the groove conformation, as is essential. Usually the tip is rough and jagged, scoring the grooves and even tearing through to the base material. Even if smooth, a sharply-pointed tip will not track properly, resulting in "groove-skating." Such needles are useful only in playing commercial pressings which, because of their high abrasive content, grind the point to the proper shape before it wears the record—and then only if high-frequency response is sharply restricted by a scratch filter, because the grinding process results in high surface noise.

Carefully-made highly-polished steel needles with "shadowgraphed" or "microspected" ground points are found reasonably satisfactory when frequently changed. Even better are some of the special alloys, which not only wear longer, and can be ground more accurately, but also have a lower initial coefficient of friction and therefore lower surface noise or hiss.

Most "permanent" needles use jewel tips—diamond or sapphire, or synthetic equivalents thereof. The term "permanent" is placed in quotes because they are not really that; if used to play abrasive-type records they will wear after a few hundred playings, and in any event they are subject to chipping, breakage and even over-heating. The cleavage characteristics due to the crystalline structure of the material occasionally results in microscopic fissures which wear the groove. Once the scratch level with a particular permanent stylus begins to increase, it should immediately be replaced or reground.

Composition needles of the type described as "quiet" when used with commercial pressings should never be used on instantaneous recordings. The reason they are "quiet" is because they are not worn in the same manner by the abrasive action. They cannot be given a high polish, how-

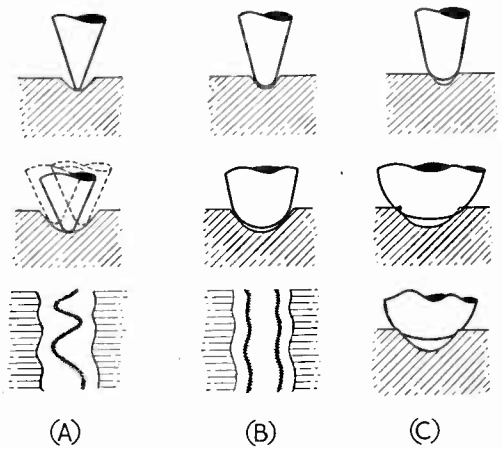


Fig. 3—Importance of playback needle tip shape.

(A) Sharp-pointed needle does not track well in groove, resulting in "groove skating" (riding of the sidewalls), which causes distortion and rapid and irregular wear of the groove.

(B) Correctly-shaped needle rests on sidewalls of groove, with sufficient pressure compressing coating slightly to make groove conform exactly with tip radius. Maximum area of needle and groove should be in contact for good tracking and minimum distortion.

(C) Blunt needle with too-large tip radius rides top of groove, compressing lips and resulting in poor tracking and tendency to jump groove. Repeated playings wear either groove or needle (bottom), depending on abrasive content of record material. Either way friction results, increasing distortion.

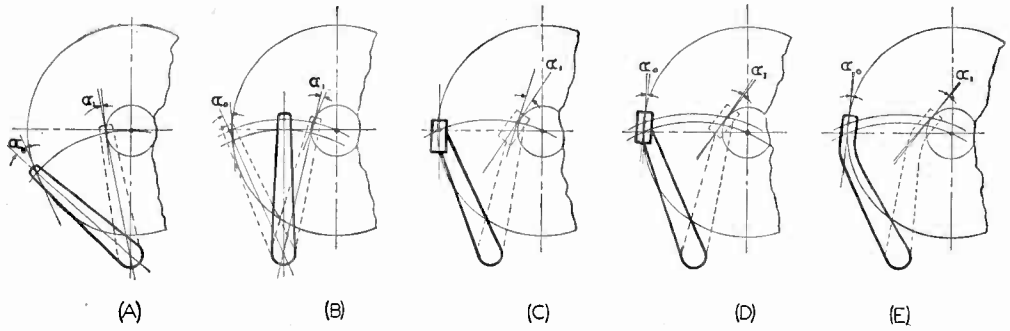


Fig. 4—Tracking Area with various types of pickup arms.

(A) Straight arm aligned with record spindle. As arm moves across record tracking angle of needle (tangent to groove at needle point) increases. At outside of playing area, it is worse than at inside but at no point is it zero.

(B) Moving the arm so needle is correctly aligned at one-half record diameter improves things, but appreciable error still exists at outside and inside. Only near center does zero tracking error occur.

(C) Offsetting pickup on arm so zero error occurs at outside helps, but there is still appreciable error at inside.

(D) Extending radius of arm helps still more, making overall tracking error negligible for ordinary work. Zero error now occurs at two points on record.

(E)) Slight further improvement is achieved by using curved arm instead of offset head. Either (D) or (E) is suitable for highest transcription-quality work with extended frequency range.

ever, and the consequent increase in friction not only raises the noise level on instantaneous recordings but wears the groove.

Pickup Arm

Hardly less complex than the mechanical design of the pickup head itself is that of the arm which supports it. This arm—often misnamed the "tone arm" from its original function in the days of the old mechanical phonograph—must be designed so that it supports the pickup without adding pressure on the groove. Its vertical inertia must be low so that it can follow an uneven (warped or bumpy) record surface. Its horizontal inertia must be sufficiently low to minimize pressure on the groove sidewall and avoid groove jumping, but not so low as to allow low-frequency vibrations to be set up.

Typical pickup arms are provided with two pivoting points. In the horizontal plane the arm rotates on a smooth frictionless bearing—cone-type ball bearings, in the better units—and in the vertical plane it is hinged either at the mounting or near the head. In the latter case the arm itself is made heavy, to provide the required horizontal damping, while the hinged portion is counterbalanced either with a weight or a spring. A spring counterbalance is considered to have less undesirable vertical inertia than a weighted arm.

One of the most important requirements of the arm is that it causes the needle to "track" or meet the oncoming groove tangent to its radius. Since the pickup traverses the record not in a straight line but on a radius, an appreciable variation in the angle between the tangent of the groove radius and the plane in which the needle vibrates may occur. If the angle is appreciable, the needle tends to push against the wall of the groove, resulting in distortion and increased groove wear.

Figure 4 illustrates how this error arises, and also how it may be minimized, first by properly placing the arm and further by using an offset head or curved arm. The proportional angle for various types of arms is shown in Fig. 4, which also shows the improvement to be had by using a long arm radius. Another method of reducing the tracking error is the use of an inclined needle, the vertical angle of which changes as it progresses across the record.

Translation Loss

Another important but until recently little-appreciated factor of reproducer performance is that of translation loss. This is the loss in upper-register response caused by the inability of the needle to traverse the sharply-radiused grooves which occur at high frequencies and small record diameters.

The translation loss varies with pickup inertia, needle shape and mass and record material, as well as with playing diameter. A soft (more elastic) coating will allow the groove walls to compress, allowing the needle to shortcut and thus reducing the amplitude. On the other hand, at very large playing diameters the vibratory system of the pickup and the record material may resonate, accentuating the high-frequency response. Thus in a typical case of a 78 r.p.m. recording using a wide-range pickup, the response at 10,000 cycles for a 14-inch playing diameter was 5 db above the average middle-frequency level, while at 4½ inches it was 5 db below. The softer the coating, the lower and more pronounced is this peak. In the typical case mentioned, the 10,000-cycle response was greater than that at 1000 cycles at all diameters above 6 inches.

With ordinary pickups, the translation loss—which is primarily the limiting factor for high-frequency response—limits the useful upper-frequency range for various standard record sizes as follows: 6-inch—4500 cycles; 8-inch—7000 cycles; 10-inch—9000 cycles; 12-inch—10,000 cycles.

———*n r i*———

Cash and Carry

Drawn by Graduate Art Miller

"But why should I bring the whole radio when it's only the speaker that won't play?"

Cover Photograph

Through the courtesy of General Electric Co., we show this month an intimate close-up of the correct technique for holding a microphone while making a home recording. The microphone is connected to a G-E home recording radio-phonograph combination.

———*n r i*———

SAVE
AND
HELP
WIN
THE
WAR

Every Pay Day
BUY BONDS

———*n r i*———

Electron Microscope Can Measure Millionth of an Inch

Particles as small as one millionth of an inch—one thousandth of the diameter of a human hair—can be measured accurately with a new electron microscope developed by General Electric engineers.

With the new G-E electron microscope, small cubical shaped smoke particles only one millionth of an inch, for example, can be clearly seen.

In the new instrument, a specimen can be enlarged 10,000 times. Further enlargement of the picture can be made photographically, up to 100,000 times the size of the original specimen, or better.

The measure of a microscope lies in how small an object can be seen, rather than how much an image can be magnified, for magnification alone does not make a picture clearer.

If a human hair, about 1/100 of an inch across, were split lengthwise into 100 slivers, and 99 of these pieces were thrown away and the one remaining piece was split again into 100 similar pieces, each of these filaments only 1/1,000,000 of an inch across would stand out clearly in the G-E electron microscope.

Novel Radio Items

-BY L.J. MARKUS-

A sound truck and a marine emptied a snooty Louisiana night club recently. A Marine Sergeant encountered a sign outside the club saying "FOR OFFICERS AND CIVILIANS ONLY." He went away mad, came back with a sound truck, played the Marine Corps hymn 55 times with full output power, made a recruiting speech, played the hymn 55 times more, read the Constitution and the Bill of Rights. This emptied the night club.

n r i

WATTS (Women's Auxiliary Television Technicians) are handling production and engineering at W9XBK, Chicago television station.

n r i

A rat called the police in Worcester, Mass. by pushing a box of caramels off a shelf. The falling box interrupted an A.D.T. Invisible Ray burglar alarm, thereby sending a signal to American District Telegraph headquarters. The rat is now searching for a new home.

n r i

A bug-killer is an important tool at one police radio station. Here's the story, in the operator's own words: "Every once in a while we notice something goes wrong with the rig while we're operating it from the station a few blocks away. So we dash down there to discover various spiders and bugs have crawled in the condensers. Not beneficial to health, but that doesn't worry us as much as the fact that the condenser spacing is reduced, causing arc-overs. So after cleaning out the condensers, we grab a spray gun and kill all the other bugs in the transmitter."

n r i

A "scratchless" phonograph needle, claimed to make unnecessary the closing of the top of a phonograph during playing of a record, is now being marketed by Jensen Industries, Chicago. The new needle has a point made from an alloy of precious metals.

n r i

Thickness of ice on bomber wings is measured by a new electronic device which also turns on de-icing equipment automatically at the exact moment of maximum effectiveness for breaking up the ice. It has been developed for Allied bombing planes by Doctor Waldo Kliever of Minneapolis-Honeywell Regulator Company. A metal disc set flush in the wing is connected to an amplifier inside the wing, and this in turn is connected to a power supply unit which does the actual work of turning on the de-icing apparatus. At the same time, it provides the pilot with data on the thickness and rate of accumulation of ice on exposed surfaces of the plane. The entire electronic de-icing control unit, called an "Ice Indicator," weighs less than 5 lbs.

n r i

Lightning strikes 50 times a year on each 50 miles of power line, according to thunderbolt-probability curves recently plotted by engineers.

n r i

Baseball speed can now be measured electronically. Two "curtains" of light beams, spaced about 4 feet apart, are focused on two rows of photoelectric cells. The equipment is mounted in a trailer, and so arranged that a ball which enters the window of the trailer passes first through one curtain of light and then through the other. Interruption of the first curtain by the ball causes a separate beam of light to start moving down a large scale which is visible from the outside. Interruption of the second curtain of light stops this light beam at the point which indicates the speed of the pitched ball. Weighted, hinged mirrors and quick-acting thyratron tube circuits supplement the electric eye and conventional circuits in this unique system.

n r i

Photoelectric cells in one large New York truck garage provide continuous indication to the entrance watchman as to which spaces on the upper floor are already occupied by trucks. This facilitates dispatching trucks to empty parking spaces in the building.

n r i

Automatic painting of murals on walls by means of photoelectric equipment is the subject of a recent experiment. An original of the picture to be reproduced is projected in enlarged final size on the wall. Scanning equipment mounted on a carriage in front of the wall scans this image and converts its tone values into corresponding electrical impulses which actuate an air brush on the same moving carriage. This air brush sprays paint on the wall in exact proportion to the intensity of the projected image, thus duplicating it. When colored paintings are desired, the picture is projected in color, and scanned by different electric eyes fed through a prism which separates the image into three primary colors. Three air brushes, each having one primary color, are then used.

An American

DEDICATED TO THE MILLIONS OF MOTHERS AND FATHERS WHO HAVE SONS IN THE SERVICE.—L. L. MENNE, *Editor.*

"YES SIR, my boy John always was a funny sort. He was slow to begin, but once he set his mind to a thing, all get-out couldn't get him to change it.

"Ma always wanted him to get a job in the bank. But John wasn't cut out for that. He liked to tinker. He was always hooking something together to see what would happen. Sometimes there would be sparks, too, but I could see he was learning. Experimenting, he called it.

"He liked Radio. So it was only natural that he should enroll for a Course. Say, that boy could hook together a couple of gadgets and get an opera out of a soapbox. He was good, all right!

"Then came Pearl Harbor and the war. We didn't want to lose John. He is all we have now and Ma and I need him at home. But I could see John had other ideas. He talked a lot about the Signal Corps. And sure enough, when his number came up they put him in the Signal Corps. I guess they were glad to get him, too, because Radio men — good ones, you understand, like John, just aren't made overnight.

"Well sir, it wasn't very long before he wrote us that he had been promoted. He is in the Army school now learning about those new Army fandangles, and after that John will be ready to do his job for our country.

"It's been rather hard on Ma and me, too, what with John away. But Ma tries to be brave, and says 'we'll get along somehow.' And so we will, by gad, until all the boys come home and the world will again be a decent place to live in.

Father Speaks

"I'm too old to do any fighting, but I tell you what I am doing. I'm buying bonds for all I'm worth. The Government needs the money. I am not giving it to them, you understand. All they want me to do is lend it to them—and they pay me a darn good interest, too. Listen: If we don't win the war, everything I've got won't be worth two whoops and a holler, so I am giving. If we all give so that our boys can have the tools to fight with, we'll lick the pants off of these dictators.

"I am writing John tonight—What's that you say! You're going to buy twice as many bonds this year? That's great! I'll tell John and he'll tell his buddies. You know, after all, we are only lending our boys to those who haven't sons of their own. We want them back. So John can open that Radio shop he always dreamed about. So that we can all be together again—all of us Americans. When it is all over, they ain't nobody going to be able to point a finger at you, and say you didn't do your part. You won't have to feel you are a bob-tailed American.

"As for Ma and me, we'd rather die than feel that we let our great country down when it needed us. We gave John—and we'll give all that we can spare. Yes sir, we're Americans.

"Every time our boys shove the Stars and Stripes forward another mile or so, I get a big kick out of it. Because I know without my help—and yours—and millions of others, they simply couldn't do it no matter how brave they are. Yes sir, neighbor, the winning of this war depends on us at home — on every dollar we can spare for planes, guns and tanks.

"You know, it's strange that some people still don't fully realize we're at war. Yes sir, it's mighty strange—mighty strange."

THE FIRST FIVE MINUTES IN A RADIO CUSTOMER'S HOME

BY JOSEPH KAUFMAN,

N.R.I. Director of Education

WHEN you as a Radiotrician are called to service a radio receiver which has been in use for several months, it is reasonable to assume that some defects have developed in that receiver. The customer's complaint will be based upon a definite change in the performance of the receiver, and his description of this change in performance can be an important clue to the actual technical defect.

In rare cases, you may be called to service a receiver which has been in use only a few days. Here it is entirely possible that the customer is expecting too much of that particular set. Your job then involves explaining the limitations of various types of receivers. If the customer insists upon better performance, you should recommend that he secure a higher-quality receiver.

One thing a Radiotrician must recognize right from the start is that no radio receiver is perfect. Modern receivers are the result of an engineering compromise between desirable technical characteristics, cost and sales-getting features. Thus, good selectivity and exceptionally high fidelity cannot both be obtained at the same time. A communication receiver has good selectivity at a sacrifice in fidelity; a high-fidelity broadcast-band receiver has poor selectivity; the average home radio has a compromise between the two; the large, high-priced home radio may have a special circuit and an extra control which permits changing the selectivity and fidelity characteristics at will.

A radio engineer or a well-trained musician might object to a receiver having harmonic distortion greater than 5%, yet the average customer would not ordinarily notice a gradual rise in harmonic distortion to 10%. It is only when a circuit defect occurs which garbles speech and music or makes reproduction raspy or unintelligible that the average customer calls a serviceman to eliminate the distortion.

Poor sensitivity is a typical example of a complaint which is sometimes unjustified. A particular receiver may be entirely satisfactory to a person desiring only reception from nearby powerful stations, yet this same set might be inadequate for a rural listener who must depend upon distant stations for his programs. Your job as a Radiotrician is to restore the original performance of the receiver, not to change or improve the factory design.

By checking the performance of each receiver which passes through your hands, you will quickly acquire the ability to predict the type of performance each receiver can be expected to give, and will have no difficulty in determining whether or not a customer's complaint is justified.

Let the Customer Talk

Ordinarily, about all you will know after a customer phones is that his receiver is not working satisfactorily and that he would like you to fix it. You can often secure additional helpful information from the customer, however, either over the phone or at his home.

First of all, let the customer describe in detail exactly what he is complaining about in the way of receiver performance. The customer may have several complaints, so be sure to let him tell you about all of them. You must remember that people's tastes differ greatly as to what is and is not good in radio reception, and you cannot do a satisfactory repair job unless you know exactly what the customer expects.

Don't ask the customer outright, "What's wrong with the set?" Use questions like these: "How is

the set acting now? When did the trouble first start? Did it come suddenly or gradually? Did you notice any other trouble before this really serious one started?"

After securing this information from the customer, turn on the set and check its performance yourself to verify the customer's complaint and to see if there are other clues to the location of the trouble.

If the receiver is dead when you first try it, always check for removed tubes, a disconnected power cord plug, a disconnected antenna or other disconnected leads. Oftentimes people will disconnect wires or remove tubes as soon as trouble develops, in the hope of preventing further damage to the receiver.

Defects like howling, noise, hum or severe distortion are easy to recognize, but they may mask other troubles which existed previously. Furthermore, defects like occasional noise, inability to pick up certain stations, fading, blasting or intermittent troubles are not so obvious and sometimes would not even be noticed by a Radiotrician during an initial check of performance. Considerable time can be saved by allowing the customer to tell how his receiver is misbehaving, hence listening to the customer is an important part of every professional servicing technique. You'll find that most people are willing and anxious to talk, if only you give them a chance and listen respectfully to what they say.

Types of Complaints

No matter how a customer describes the complaints, you can usually recognize them instantly and place them in one or more of the following groups for purposes of analysis:

1. Dead receiver.
2. Noisy reception.
3. Annoying hum.
4. Squealing or howling.
5. Distortion.
6. Low volume.
7. Poor sensitivity.
8. Poor selectivity.
9. Station interference.
10. Intermittent reception.

We will now take up in turn each of these major complaints, and learn what clues to look for in each case in order to recognize and verify the customer's complaint while checking receiver performance. In many instances, we will also take up effect-to-cause reasoning techniques for localizing the trouble in a general way. It should be pointed out, however, that this article is just a preview of the entire field of professional servicing. Your N.R.I. lessons will give you more detailed instructions.

1. *Dead Receiver.* The customer may simply say that the set does not play, but even in a dead receiver there may be clues indicating the nature of the trouble. If the pilot lamps light up, you know that the set is receiving power from its source. See if all the tubes light up or get warm. Listen for the low-level hum and weak rushing sounds which are heard on almost any receiver when no stations are tuned in. Hearing these means that the power supply and loudspeaker are very likely good. Also listen for the normal rushing sound usually heard when the volume is turned up with no station tuned in (proof that the stages between the volume control and loudspeaker are good). A popping or clicking sound should be heard from the loudspeaker when the ON-OFF switch is turned on and off quickly after the receiver has been operating for a few minutes; failure to get it can mean a loudspeaker defect, power pack defect, or an a.f. output stage defect.

In the case of an all-wave receiver, try to tune in stations on two or more of the ranges, to see if the defect can be localized to the preselector and oscillator sections of a particular range.

Even simple listening tests like this can yield valuable information from a dead receiver. For example, a low-level hum heard all the time the set is on, associated with a popping sound when the power switch is manipulated, means that the main power pack is functioning. Absence of all of these symptoms is an indication that the power pack is dead, the last a.f. stage is dead, or the loudspeaker is defective.

Other combinations of symptoms will give other conclusions as to the source of trouble, once you have learned to analyze the customer's complaint and verify it by checking the performance of the receiver yourself. Truly, a thorough check of receiver performance is an important part of professional servicing techniques.

2. *Noisy Reception.* A certain amount of noise is always present both in amplitude and frequency-modulated receivers, in phonograph amplifiers and in public address amplifiers, even when the units are operating properly. The same phenomenon of noise is present in television receivers, though here it appears as white spots on the screen rather than as sound. The constant quest of design engineers for a high signal-to-noise ratio is evidence that noise is a real problem in any system of radio reception or sound amplification.

If it were not for noise, distant broadcast band reception would be limited only by the gain of the receiver, and it would be unnecessary to have high-power transmitters.

Noise is a Radiotrician's problem only when it becomes greater than is normal for the particular system in question. Here again, considerable judgment is required to determine whether or

not the amount of noise is normal. By checking performance of good receivers whenever you have an opportunity, you will quickly learn how much noise to expect from various types of sets with various types of antenna systems.

Noise which is due to something entirely outside of the receiver is called *external noise*, to distinguish it from *internal noise* which is due to a receiver defect or to limitations in receiver design.

External Noise. Spark-producing devices, like motors, generators, vibrators, diathermy apparatus, household electrical appliances with moving contacts, electromedical devices, ignition systems in automobiles, and oil burner electrical systems all produce a type of interfering noise which is often called *man-made static.* Manufacturers of electrical equipment are today turning out units which produce a minimum of noise interference. Special noise filters are available for apparatus which is producing excessive noise interference, and their installation is covered in lessons of the N.R.I. Course.

Noise-reducing antennas on receivers will reduce the effects of external noise signals, so whenever the source of noise is something beyond your control (street car motors, elevator motors in buildings, and power stations are examples), you should consider noise-reducing antenna systems.

In addition to man-made interference, we also have nature's source of noise, consisting of electrical disturbances produced by local or distant electrical storms and by lightning discharges. Natural noise is known as atmospheric disturbance or static. In a broadcasting system employing amplitude modulation, little can be done to reduce the effects of atmospheric disturbances. With a good frequency modulation receiver, however, radio reception can usually be enjoyed right through the strongest local electrical storms.

Internal Noise. Noise originating inside a radio receiver can be due either to an actual circuit defect or to certain unavoidable and natural characteristics of radio tubes and circuits.

A poor connection in a receiver can produce a crackling noise which interferes with reception and is hence a justifiable customer complaint. Jarring of the receiver or tapping on certain parts will usually increase the intensity of this noise. Your job as a Radiotrician is to locate and correct the faulty connections or locate the faulty part which is the cause of this type of internal noise.

Circuit noise exists because of the erratic motions of free electrons in conductors. These movements increase with temperature, hence the effect is called *thermal agitation.* The electron movements produce small voltages in conductors. When these voltages are in the input stage of a receiver, they are amplified thousands of times by the high-gain tubes in modern receivers, and the result is a characteristic rushing noise.

In addition, we have in every radio tube another type of noise which is known as the "shot effect." It is due to the irregular movement of electrons from the cathode to the plate inside a vacuum tube, a movement which is often compared to the falling of sand or raindrops on a tin roof.

Tube and circuit noises together produce a noise signal which is only a few microvolts at the most, except possibly in the frequency converter tube where it is much higher. This internal noise is a sort of hissing sound. It is most evident when the set is tuned off a station and the volume control advanced for maximum loudness, for the a.v.c. system is then set for maximum r.f. gain, and the a.f. system is getting the entire output of preceding stages.

To make sure that signals will over-ride noise originating in the frequency converter tube, receiver design engineers place an r.f. amplifier stage ahead of the converter whenever cost and design considerations permit. This extra stage makes distant reception more enjoyable. Without an r.f. stage in a super, the noise in the frequency converter would be the chief factor limiting distant reception.

When confronted with a customer's complaint of noisy reception, determine first whether you have an internal or external noise problem.

3. *Annoying Hum.* If you listen intently, you will ordinarily be able to hear hum from the loudspeaker of any receiver operating from an a.c. power line, from a vibrator-type power supply, or from a motor-generator set. Keeping this normal hum below the level at which it becomes objectionable is an important design problem.

In high-fidelity receivers which reproduce sounds as low as 30 cycles, considerably more hum reduction is required than in midget or table model receivers which do not reproduce much below 150 cycles. In any receiver, the hum should be only barely audible, and listeners in the same room should not be conscious of its presence during a program.

There are a number of receiver defects which can cause the amount of hum to increase considerably. Thus, the hum level may increase gradually as the electrolytic filter condensers in the power pack dry out, or when one-half of the rectifier tube has considerably lower emission than the other half. On the other hand, the hum level may rise suddenly due to failure of a

filter or by-pass condenser, or development of cathode leakage in a tube. Hum may become so intense that it over-rides broadcast programs, or may be annoying only when tuning between stations.

Hum is one trouble which definitely irritates the listener. The longer he listens, the more offensive the hum becomes and the more critical he becomes of hum.

4. *Squealing or Howling.* In the days of regenerative receivers, it was normal for a set to squeal and to cause squeals in nearby receivers during tuning. This type of set is fortunately almost extinct now, but modern receivers may still squeal or howl when certain types of defects occur in circuits or parts.

Squealing due to external sources is rather rare today. There is little chance that the carrier signals of two broadcast stations will beat with each other to produce a squeal, because all stations are assigned frequencies not likely to produce interference and are required to maintain operation on assigned frequencies with a high degree of accuracy.

Occasionally, an experimental regenerative receiver or the oscillator circuit of a superheterodyne will radiate a signal and produce an audible squeal in nearby receivers. You can recognize this external squeal source by its intermittent nature and by the fact that its frequency varies as the offending set is tuned.

Internal sources of squealing are more numerous. You may encounter squeals due to troubles inherent in the process of frequency conversion in a superheterodyne receiver. As a general rule, the number of tuned circuits in a receiver, its basic design and its i.f. value determine just how much of this trouble will occur. Also, squealing may be due to oscillation caused by an open by-pass condenser or misplaced connecting lead. The defect may be in the r.f., i.f. or a.f. system of the receiver, or can even be due to an open output filter condenser in the power pack.

Defects in the supply circuit filters of an a.f. amplifier, or defective by-pass condensers which are common to two or more screen grids of r.f. or i.f. tubes, can cause a put-put noise which is commonly called *motorboating*.

Loose or flexible elements in tubes or other radio parts, or even a thin, flexible chassis itself can give rise to a variable-pitched howl under the influence of powerful sound waves from the loudspeaker, giving an effect called *microphonics*.

The ability to recognize, localize and remove the cause of squeals, howls, motorboating and microphonics is an important part of the Radiotrician's work if he is engaged in radio servicing.

5. *Distortion.* When a customer complains that voice or music is muffled, harsh, raspy or unintelligible, you have a definite and justifiable complaint of distortion due to an internal receiver defect.

Equally important cases of distortion, however, are those situations where the customer's complaint is rather indefinite. He may say, "*It just doesn't sound right.*" Careful questioning in cases like this will probably reveal that the customer quickly gets tired of listening to the receiver, or reveals that listening for an hour or so gives him a headache or makes him so irritable that he gets up and turns off the set in disgust. Certain amounts of distortion are not noticeable as such by the average person, but an hour or more of listening to distorted reproduction produces a definite though unconscious reaction.

In the case of distortion, it is important to find out whether it occurs on local or distant stations or both, whether it occurs on all bands of an all-wave receiver, and whether it occurs only at high or low settings of the volume control or at all settings. Combining a thorough check of receiver performance with this additional analysis of the customer's complaint is an important feature of radio service work, because it helps to isolate the probable location of the defect.

There will be cases of distortion in which there is nothing you can correct. Thus, selective attenuation of the side-bands from sky-wave signals, or phase cancellation of signals at a location near the skip distance limits can give distortion.

Distortion can be due to improper alignment, and this in turn may be either the result of normal aging of parts or due to a breakdown in some part. Distortion may exist in the loudspeaker due to a weak field, to complete absence of field excitation, to a broken spider, to a rubbing voice coil, or to a damaged or old cone. It is your job as a radio serviceman to recognize and correct abnormal distortion. In fact, it would be rare indeed, except perhaps in the case of a trained musician, that you would be called at all for distortion which was not definitely abnormal.

6. *Low Volume.* The average radio receiver is so designed that reception of a fairly powerful local station with the volume control fully advanced and with an antenna of average effectiveness will overload the loudspeaker and perhaps produce rattling. Fortunately, however, the a.v.c. system in a receiver levels out variations in signal strength sufficiently to prevent excessive overloading of the loudspeaker or other stages at normal volume control settings. The average listener rarely advances his volume control fully; he is satisfied to know that the set has sufficient reserve "power" to blast out if he does advance the control.

With the possible exception of certain inexpensive midget sets, modern receivers will give more than sufficient volume for the average room in a home, even for weak local stations and for not-too-distant stations. It takes a little experience to be able to tell whether or not a receiver is delivering a normal amount of volume, but you probably know already what the acceptable volume is for ordinary types of sets.

When the volume is definitely lower than normal both for local and distant stations, but the tuning indicator reacts normally during tuning of stations or you can still tune in the distant stations, you can be quite sure that a defect exists in the audio system. It may be a low-emission tube, low electrode voltages on a.f. tubes, or weak field excitation for the loudspeaker.

When low volume is associated with poor sensitivity (the next complaint to be discussed), so that distant stations cannot be tuned in and the tuning indicator (if present) just barely works when stations are tuned in, look for a defect in the r.f. system.

When local stations come in with adequate volume but both volume and sensitivity are poor for distant stations, you can suspect a poor antenna system. It is easy enough to recognize the defect of low volume, but in applying professional servicing techniques you must go further and investigate every symptom which may help you to isolate the probable causes of the trouble.

7. *Poor Sensitivity.* A customer would probably describe the condition of poor sensitivity as inability to pick up his favorite distant station. Your first step is to determine whether the trouble is actually poor sensitivity, or whether it is a natural condition.

Ask if the customer has picked up that distant station regularly before, both summer and winter, with that *same receiver* and *same antenna system* in exactly that *same location.* For example, a New Yorker moving to Washington may complain of inability to get New York stations, yet his set was never capable of giving good distant-station reception.

If questioning indicates the possibility that the receiver is defective, check its pick-up performance by trying to tune in one or more distant stations on the receiver. Judge the sensitivity according to the manner in which the stations come in, making due allowance for the time of day and season of the year. Memorize the frequencies of several near-distant stations which can be picked up regularly in your locality with a good receiver, so you can tune them in quickly when checking the sensitivity of a receiver.

If a receiver fails to give adequate volume on distant stations when used with an antenna known to be in good condition, then poor sensitivity is definitely the complaint, and is probably due to a circuit defect. It should be noted that the customer will generally complain of poor volume rather than poor sensitivity, although both troubles are present when the defect is in the r.f. system.

Complaints of poor sensitivity are often not justified. For example, a customer may complain that a station 500 or more miles away came in clear and loud one day, but the next day was weak or could not be heard at all. This may be an entirely normal condition which is not the fault of the receiver; the trouble can be due to variations in conditions up in the stratosphere.

Complaints of poor sensitivity may also be due to normal variations in radio reception with changes in season. Reception is generally far better in winter than in summer, and better at night than during the day for broadcast band stations. This is a situation which most people recognize, but you will still encounter customers who will welcome an explanation of these peculiarities of radio.

You thus see that a radio serviceman is more than a trouble shooter and repair man. He must have a broad general knowledge of radio, covering the broadcasting system as a whole and covering basic design features. He should know, for instance, that a receiver with limited r.f. gain but high audio gain produces extremely loud signals on local and semi-local stations, but does not bring in distant stations.

8. *Poor Selectivity.* When the customer complains that a powerful local station prevents him from receiving a distant station on a nearby frequency, you have the condition of poor selectivity. It may be a condition inherent in receiver design, or it may be due to a circuit defect.

A leaky tuning condenser, a damp coil, conductive dirt on tube sockets, or dirt elsewhere in r.f. circuits can definitely produce poor selectivity. These defects lower the Q factors of resonant circuits, thereby lowering the sensitivity and selectivity of the receiver. In extreme cases, the symptom of low volume may also be present.

On the other hand, poor selectivity may be due to the natural characteristics of the superheterodyne circuit employed, coupled with some local receiving condition. It may be the result of several stations operating on nearly the same frequency, with atmospheric conditions particularly favorable for reception of the more distant of the two stations, so that both come in at the same time.

Whenever a customer's complaint of poor selectivity is found to be due to atmospheric conditions, an explanation in non-technical language will satisfy and please the customer in most cases.

It is obvious that in this brief presentation of the complaints of low volume, low sensitivity and poor selectivity, we can merely mention only a few of the causes. Remember that all these troubles are taken up in greater detail in your Course. They are mentioned here only to stress the need for more than casual recognition of the customer's complaint. The value of a thorough check of receiver performance cannot be stressed too highly in this study of professional servicing techniques.

9. *Station Interference.* There may be as many as 40 or 50 low-power stations operating on some frequencies. Under certain favorable atmospheric conditions, some are bound to interfere with each other, so that two stations having the same frequency are heard at the same time. This type of interference usually occurs at the high-frequency end of the broadcast band, because most of the low-power stations are crowded together here. You can recognize troubles of this sort by the fact that they occur only for a few stations, not for all signals received. Nothing can be done about it.

When interference is due to a code station operating at or near the i.f. value of the receiver, or is due to image interference or to harmonics of the oscillator beating with a high-frequency station, a wave trap which is tuned to the frequency of the interfering station will give a solution. Many sets have built-in wave-trap circuits.

10. *Intermittent Reception.* When a complaint exists for a short period of time and then corrects itself, you have the trouble known as *intermittent reception.* As one example, a tube filament can break in such a way that it opens after being heated for a short period of time, causing a dead receiver, but makes contact after the filament has cooled off. Reception is thus alternately good and bad, with the cycle repeating itself at regular intervals. The customer might complain that the set plays for a while and then stops.

A break in a connecting wire inside or outside a part can cause intermittent reception. Thus, the internal connection between the pigtail leads and the metal foil of a paper condenser may break due to a strain during assembly of the condenser or during wiring of the receiver. The break may be such that any vibration or heat in the chassis will cause a temporary open circuit. A loud portion of a program from the loudspeaker may break the connection, and jarring of the cabinet may restore the connection. Heat may likewise intermittently make and break such a defective contact.

In addition to being intermittently dead, the set may intermittently have any of the other receiver complaints, depending upon the location of the defect. Thus, if the condenser in question happens to be a screen grid by-pass condenser, the break will normally cause intermittent *oscillation.* If the condenser is a plate-grid coupling condenser in an audio amplifier, the complaint could be intermittent *weak reception* or *dead reception* during those intervals when the condenser is open.

Just imagine how many open connections you could have in the various coils, condensers, resistors, transformers, loudspeakers and tubes in a radio receiver. Imagine further the number of possible shorts, partial shorts and leaks which could occur. Combine these with the condition whereby the defect lasts only for a short period of time, perhaps vanishing as soon as you touch the set, and you have intermittent reception—a type of complaint which taxes the ingenuity of radio servicemen to the utmost.

In the customer's home, it should suffice to confirm the customer's complaint that an intermittent exists, and secure as detailed a description as possible of the exact nature of the trouble during the duration of the intermittent defect. It is well to do this, because the intermittent defect may not appear immediately when you turn on the receiver and check its performance. Find out whether the trouble is intermittent dead reception, intermittent hum, intermittent oscillation, etc. Knowing which one it is, you can localize your search to those defects which will produce the type of complaint observed.

Another valuable clue to an intermittent defect is the rate at which the set becomes intermittent and the regularity of the trouble, so be sure to ask the customer how often the trouble occurs. Intermittent troubles which recur at a more or less regular rate are due to heat, whereas troubles which occur at irregular intervals are due to vibration.

In general, if an intermittent trouble does not reveal itself in ten or fifteen minutes while you are in the customer's home, it is best to check over the antenna, ground and power cord systems to clear them of suspicion, then remove the chassis and take it to your shop for further observation.

One Way or Another

Judge: "Come now, you really don't think he meant to put your eye out?"
Pat: "No, I don't but I do believe he tried to put it further in."

Sample Questions and Answers for Radio Operator License Examinations

By WM. FRANKLIN COOK
N. R. I. Technical Consultant

THIS is another installment of the questions taken from the "Study Guide and Reference Material for Commercial Radio Operator Examinations," together with typical answers. The questions give a general idea of the scope of the commercial radio operator examinations.

The basic theory for these questions has been covered elsewhere in your Course, but is being repeated here as answers to these questions. Remember, the following answers are far more detailed than would be required for an operator's license examination. The questions are theoretical, so the answers go more thoroughly into the basic theory, in order to permit similar questions to be answered.

Some of the material is advanced technical data, of course, which can be properly understood only by the advanced student or graduate. However, you will find this information valuable, whether or not you intend to take the operator's license examination.

ELEMENT II
Basic Theory and Practice

(2-92) Draw a simple schematic diagram showing a tuned-grid Armstrong-type triode oscillator, with series-fed plate. Indicate power supply polarity.

Ans. Refer to Fig. *2-92*. Also see the answer to Question 2-88. The only difference between this circuit and Fig. *2-88* is the fact that we now have a series-fed plate circuit instead of a shunt-fed circuit.

Note that both a.c. and d.c. plate currents flow through coil *L2*. Since the two currents flow through the same part, this is a series-fed plate circuit.

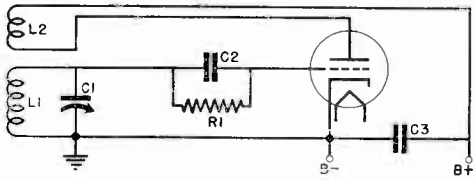


Fig. 2-92

The tuned circuit consists of coil *L1* and condenser *C1*, while the grid bias is furnished by the grid leak-condenser combination. *C2-R1*. Condenser *C3* is a plate supply by-pass condenser. Be sure all necessary by-pass condensers are shown in any drawings you may make for an examination.

(2-93) Draw a simple schematic diagram of an electron-coupled oscillator, indicating power supply polarities where necessary.

Ans. An electron-coupled oscillator is primarily an oscillating circuit using the electron stream within a multi-element tube for coupling to the load.

In the ordinary oscillator, the load is usually coupled to the oscillator by bringing a pick-up coil close to the tuned circuit, or through the use of capacity coupling to the same tuned circuit. Either of these methods results in undesirable changes in the frequency if the load happens to vary.

In the electron-coupled oscillator, this defect is cleared up to a great extent. In

Fig. 2-93 is shown a Hartley-type oscillator, although any other suitable type could be used. The upper section of coil *L1* is in the grid circuit by being between the grid and cathode. The lower section is in the plate circuit, since it is between the cathode and the B power supply. Note that this circuit is somewhat different from the one shown in Fig. 2-87.

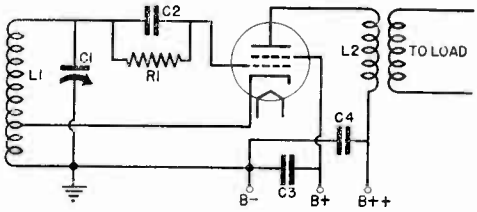


Fig. 2-93

The screen grid of the tube is by-passed to ground through condenser *C3* and is acting as the plate of the oscillator. In other words, the cathode, control grid and screen grid act as the cathode, control grid and plate, respectively, of the oscillator circuit.

As a result of this action, the circuit produces a varying electron current. This means that the current flowing to the real plate of the tube will be varied at the oscillator rate.

By coupling the load to the plate of the tube, it will be possible to take power from the plate circuit. If the load happens to vary, this will not greatly affect the oscillator as the only coupling between the oscillator and the external load is through the electron stream within the tube. The circuit characteristics are adjusted so that the electron stream is relatively independent of any changes occurring in the plate circuit of this tube.

(2-94) Draw a simple schematic diagram of a pentode-type tube used as a crystal-controlled oscillator, indicating power supply polarities.

Ans. Refer to Fig. 2-94. As a pentode tube is desired, be sure three grids are shown.

The crystal is connected in a manner similar to that of Fig. 2-90. Resistor *R1* is again the grid resistor for developing an automatic bias. Condensers *C2* and *C3* by-pass the screen grid and plate supplies, respectively. Tuned circuit *L1-C1* is adjusted for oscillation.

As this circuit depends on feed-back from the plate to the control grid circuit to maintain oscillation, there may not be enough feed-back due to the action of the screen and suppressor grids. Hence, condenser *C4*, shown connected with dotted lines, may be

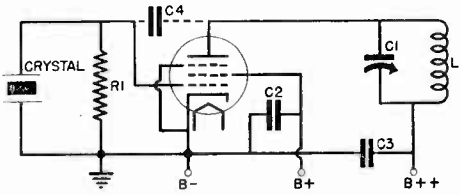


Fig. 2-94

necessary to make this circuit oscillate reliably.

(2-95) Draw a simple schematic circuit showing a method of coupling a high-impedance loudspeaker to an audio frequency amplifier tube without flow of tube plate current through the speaker windings, and without the use of a transformer.

Ans. Refer to Fig. 2-95.

A high-impedance loudspeaker is specified, which means that it can operate directly from the plate of the tube without a transformer. One of the older type magnetic speakers could be operated this way.

However, the question states that d.c. plate current must not flow through the loudspeaker and we are not to use a transformer.

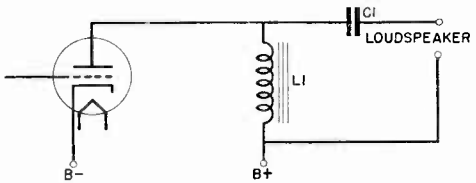


Fig. 2-95

Therefore, blocking condenser *C1* prevents plate current from flowing through the speaker. Choke coil *L1* provides a complete path for the d.c. plate current. In other words, this is a shunt-fed circuit. Of course, the impedance of choke coil *L1* is very high, so alternating current will take the path through the speaker.

(2-96) Draw a simple schematic diagram of a triode vacuum tube audio frequency

amplifier inductively coupled to a loudspeaker.

Ans. Refer to Fig. *2-96*. This time we are to use inductive coupling (a transformer) to couple to the loudspeaker.

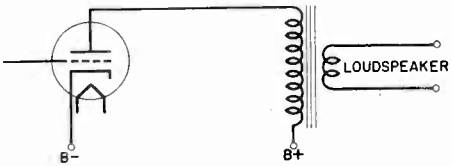


Fig. 2-96

(2-97) Draw a simple schematic circuit showing a method of resistance coupling between two triode vacuum tubes in an audio frequency amplifier.

Ans. Refer to Fig. *2-97*.

Resistor *R1* is the plate load resistor for the first tube. The signal developed across *R1* is passed through condenser *C1* and is developed across resistor *R2*. As *R2* is in the grid circuit of the succeeding stage, the signal is thus passed on from stage to stage.

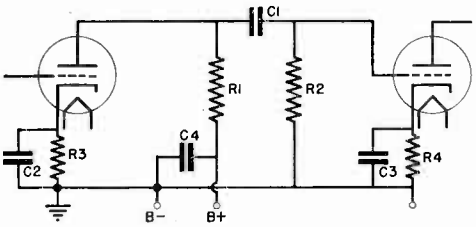


Fig. 2-97

Resistors *R3* and *R4* are grid bias resistors. Condensers *C2* and *C3* by-pass these resistors. Condenser *C4* is the plate by-pass condenser.

(2-98) Draw a simple schematic diagram showing a method of transformer coupling between two triode vacuum tubes in an audio frequency amplifier.

Ans. Refer to Fig. *2-98*.

The transformer is used to couple the two triode circuits. Condenser *C1* is a plate by-pass condenser. Resistors *R1* and *R2* furnish the grid bias for the two tubes, while condensers *C2* and *C3* by-pass these bias resistors.

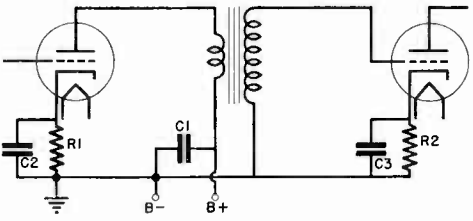


Fig. 2-98

(2-99) Draw a simple schematic diagram of the method of impedance coupling between two vacuum tubes in an audio frequency amplifier.

Ans. Refer to Fig. *2-99*.

An impedance-coupled amplifier is basically similar to a resistance-coupled amplifier except that choke coils are used in place of the resistors. Due to the cost of a choke coil, however, only one is usually used. The choke coil is usually used in place of the plate load resistor in such a case. The reason for using the choke in the plate circuit is that there is a smaller d.c. voltage drop across the choke coil than there is in a resistor, due to the lower d.c. resistance of the

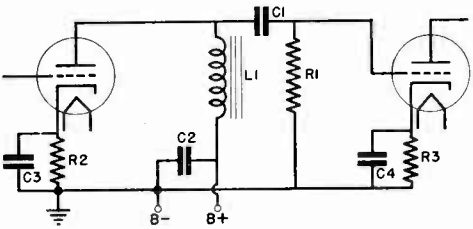


Fig. 2-99

choke. When the supply voltages are not high, therefore, impedance coupling offers some advantages over resistance coupling. The frequency range is usually best with resistance coupling, cost factors being taken into consideration.

In Fig. *2-99*, choke coil *L1* is the plate load impedance. Condenser *C1* passes the signal to resistor *R1* and thus to the following stage. The other parts have the same purposes as similar ones used in Fig. *2-97* and Fig. *2-98*.

N.R.I. ALUMNI NEWS

Earl Oliver of Detroit Is Elected Alumni President

MR. F. EARL OLIVER has been elected President of the National Radio Institute Alumni Association for the year of 1943. Always a vital figure in the affairs of the Alumni it was only natural that Earl should some day be chosen to serve us as President.

Allen McCluskey, of Birmingham, who opposed Earl Oliver in this friendly contest, has always been an Oliver booster and he warmly congratulates our members on their choice. McCluskey did not seek the office—at least, not this year—although he greatly appreciates the compliment extended to him by our members in selecting him as part of the Presidential ticket.

Both McCluskey and Oliver, by the way, formerly served as Vice-Presidents. Oliver also was one of the organizers of Detroit Chapter, served it as Chairman and for the past several years, as Secretary. He attends meetings regularly, is very conscientious in his records and reports, and is an experienced organizer. He is an expert Radio man and an accomplished speaker. Earl Oliver is an ideal man for President of our Alumni Association.

In the field of Vice-Presidents, Mr. Louis J. Kunert of Middle Village, L. I., New York; Mr. Peter J. Dunn of Baltimore, and Mr. Charles J. Fehn of Philadelphia were reelected. Mr. Earl Bennett of Evanston, Illinois, was elected to complete our roster of four Vice-Presidents. All of these men are influential Chapter members.

Lou Kunert for many years has been Secretary of New York Chapter. Pete Dunn has held all of the offices in Baltimore Chapter. Charley Fehn likewise has gone through all the chairs in Philadelphia-Camden Chapter, and Earl Bennett has served several terms as Chairman and in other capacities in Chicago Chapter. In addition, both Pete Dunn and Earl Bennett are past National Presidents of our Alumni Association.

As was expected both Earl Merryman as Secretary and L. L. Menne as Executive Secretary were reelected. Mr. Merryman is a Charter Member of the N.R.I. Alumni Association. He was elected Secretary at the time our Alumni was organized in 1929, and has held the office ever since. He is very popular with our members and is always strongly supported.

Mr. Menne also is well known to our members. He directs the affairs of the Alumni Association at headquarters and in this capacity has had opportunities to develop many real friends. He is ever ready to extend a helping hand to any Alumni Member and is genuinely delighted when he can be of service. Mr. Menne is also Editor of NATIONAL RADIO NEWS.

It is, of course, unfortunate that all candidates cannot be elected. In an organization such as ours these offices are purely honorary. Sometimes the vote is so close the result is not decided until the last day permitted for balloting. The fact that some candidates are better known because of Chapter connections or for other reasons is certainly no reflection on those over whom they were elected. Often candidates who miss being elected in one year come back stronger than ever in following years. They are all grand fellows who have no personal ambitions but merely a desire to serve their fellow members in any capacity for which they may be called.

Now for a busy year! The members of our Alumni Association have contributed much to the war effort. Let's double that in 1943 and get the job of winning the war over with so that we can return to our peaceful pursuits in the great field of Radio which promises even greater opportunities because of many new developments.

Chicago Chapter

Our annual election was held and the following officers were elected for 1943:

Chairman—Harry Andresen
Corresponding Secretary—Clark Adamson
Financial Secretary—Emory Snavely
Sergeant-at-Arms—Stanley Lukes

We have been holding meetings regularly on the second Wednesday of each month at Kaplans Hall, 3900 W. 26th Street. Chairman Andresen, however, is working on a plan to alternate the meetings on the north, west and south sides of the city which he believes will greatly increase our attendance.

New members of the Chapter are Martin Smith and Sgt. Fred Pechacek. An honor roll for members in the Service was suggested and approved. The Secretary will attend to this.

Speakers at recent meetings were Mr. Frank Smith of Westinghouse, who spoke on "Electrical Devices," and Mr. H. Freund of Sylvania Electrical Products Corporation, whose subject was "Tubes for Domestic Use." These were very interesting talks and a vote of thanks was given to each of the speakers.

At all meetings, we hold open forum. Any member may ask for information on a radio problem and get the benefit of a discussion by experts.

The highlight of our activities, since our last report, was our party held at 2955 W. Belmont Avenue. This was a typical Chicago affair which means plenty of good wholesome fun for all.

N.R.I. students and graduates in this area are invited to attend our meetings. Information may be had through Chairman H. Andresen, 3317 N. Albany Avenue, phone Juniper 2857.

CLARK ADAMSON, *Secretary.*

n r i

Detroit Chapter

John Stanish has been reelected chairman of our chapter. A complete roster of our 1943 officers will be announced in our next report.

The experiment of meeting at the homes and shops of members has proved very satisfactory except that we are sometimes crowded for space. It is an interesting change but occassionally we find it necessary to return to the shop of Chairman Stanish, who has all the facilities for meetings such as ours.

Information regarding meetings is contained in notices mailed by Mr. F. Earl Oliver, 3999 Bedford, Detroit. If you live in Detroit we advise you to get on the mailing list.

HAROLD CHASE, *Vice Chairman.*

New York Chapter

A particularly interesting meeting was one at which our Mr. Ralph Baer presented "Demonstration of Home Recording and Public Address Systems.'" All the equipment used was built by Ralph Baer and Robert Golas. The attendance was good and the talk and demonstration was very well received.

At our last two meetings we went back to the good old service forum. We like variety and that is why we reserve some of our meetings for speakers but for real beneficial information it is hard to beat our service forum. Our members all have a chance to take part.

Election of officers will be announced in our next report. Meetings are held at our headquarters, Damanzek's Manor, 12 St. Marks Place, (between 2nd and 3rd Avenues), New York City, at 8:15 P.M., every first and third Thursday of the month.

L. J. KUNERT, *Secretary.*

n r i

Baltimore Chapter

The following officers have been elected:

Chairman—E. W. Gosnell
Vice Chairman—H. J. Rathbun
Financial Secretary—B. J. Ulrich
Recording Secretary—P. E. Marsh
Editor—L. Arthur

In spite of handicaps such as long hours, gasoline rationing and precious rubber in tires, our attendance has been remarkably good which speaks well for the spirit of our members.

Chairman Gosnell, who is now serving his third consecutive term, is always on the job and gives us real worth-while meetings. In this he is ably assisted by all the officers and Pete Dunn, our National Vice President.

Our meetings are held, without interruption, on the second and fourth Tuesday of each month at Redmen's Hall, 745 West Baltimore Street. Drop in on us sometime.

P. E. MARSH, *Secretary.*

n r i

Phila.-Camden Chapter

Because of fine leadership by our chairman, Harvey Morris and the whole-hearted support of National Vice President Charles J. Fehn, our attendance has been good and our meetings have been very fruitful.

We continue to meet at Freas Shop, northeast corner of Atlantic and Emerald Sts. (near Tioga Elevated Station) on first and third Thursday of the month.

HAROLD STRAWN, *Secretary.*

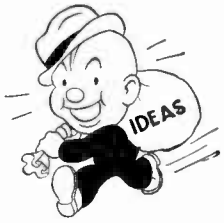
Chicago Chapter has one of its popular parties for the ladies. Apparently everyone was having a grand time. The party took place at the headquarters of the Veterans of Foreign Wars, rented for the occasion, which explains the large and impressive emblem in the center of the picture.

1942 Chairman James Cada is second from right edge of picture. Newly elected Chairman, Harry Andresen with Mrs. Andresen, are standing in back row, on left. Executive Secretary Menne is in the right center of the group, cigar in hand. Past President Sorg is second from right, back row. Past Chairman Schultz is swooning in the arms of Mrs. Bennett at left. Southeast of him, snuggling to Mrs. Cada, is past Vice President Cecil Morehead, while Mrs. Lackner and Mrs. Schultz are well in hand in the lower center of the picture. To the left, in foreground, is Sam Juricek, former Secretary.

Past Chairman Stan Lukes is at extreme right and winsome Mrs. Lukes is the first lady at extreme right. The other good looking ladies and gentlemen are too numerous to identify. Past President Earl Bennett took the picture. Mr. Bennett, by the way, has just been again elected as a National Vice President.

Two merrymakers put on a Bumpsa-daisy while Eleanor and Isabelle Rys add words to the music. Ed Sorg, at right, is more interested in refreshments at the moment. The ship is merely a background painting.

Here And There Among The Alumni Members



Hoyt Moore, a charter member of the N.R.I. Alumni Association and former Vice President, was elected state senator to represent Marion county in the Indiana legislature. Mr. Moore is the man who made the presentation speech, at the 1929 convention, when the Alumni Association gave Mr. J. E. Smith a beautiful loving cup which still adorns our reception room.

n r i

We are informed that J. F. Meline has joined the Engineering Dept. of the National Broadcasting Co. at Radio station WRC here in Washington, D. C. WRC is a 5000 watt station and one of the best in the country.

n r i

Staff Sergeant John R. Davis is an aerial radio operator with the Air Control Branch A.A.F., American Intelligence Command. Due for another promotion soon.

n r i

Earl Bennett, who has built a very successful Radio business, the North Shore Radio Co., Evanston, Ill., has taken on another store in beautiful Wilmette, Ill. We have seen it. It is strictly up-to-date and in the best location in town.

n r i

Lieutenant Richard W. Anderson, Signal Corps, is now on the west coast. Andy has made good use of his N.R.I. training as is attested by the promotions he has received.

n r i

For all the Christmas cards, for all the good wishes received during the holiday season, we extend our thanks. It is very gratifying to us to be remembered by so many truly sincere friends.

n r i

A. I. Maltby, Civil Service Radio Technician, who is class instructor for a group of Radio Electricians, was one of several men who took part in a demonstration of Army Signal Equipment, for the benefit of advanced ROTC cadets, ROTC officers, Army Air Officers, Naval communications trainees and the WAVES. The demonstration took place at Madison, Wis.

n r i

William A. Lieds, Jr., is Radio Instructor, A.A.F. Technical Training Command.

n r i

John B. Patrizi, who operates the National Radio Service in Newark, N. J., has a tire cover on his spare which features his slogan "Radio Life Saver." Is making $65.00 to $80.00 a week.

n r i

Another member uses "I Make Radios Talk" as his slogan. Catchy phrases such as these have much advertising value.

n r i

Remember Benny McGehee "Chief Fixer-Upper of Your Radio" who had a nice Radio business in Arcadia, Florida and who got quite a write-up in the NEWS some time ago? Well, Benny is a Corporal in the Army now and itching to do his best to get the job over with.

n r i

Executive Secretary Menne presents a handsome medallion to retiring President Sorg (left) in appreciation of his work during 1942.

Jimmy Cada, the popular former chairman of Chicago Chapter has an essential war job. The Saturday night of the Chicago party Jimmy worked until midnight, then ducked home to dress and hurried to the party, with his charming wife, in time to get in on the fun which is always at its greatest height just before "home, sweet, home" is played. There's fraternal spirit for you.

n r i

Fergus Fuselier is Chief Officer on a steam tug on the Texas coast. In his spare time he does Radio servicing and is doing splendidly. Very proud of his N.R.I. Alumni connection, too.

n r i

Snorri P. B. Arnar is foreman of a committee to pass on the qualifications of all men who wish to work as Radio servicemen in Iceland. Mr. Arnar is making good use of his N.R.I. training.

n r i

While in Chicago we visited the Rys Radio Lab. operated by Walter Rys of Chicago Chapter. He has a very fine layout and is destined to go places.

n r i

L. E. Wilcox, on duty at an Air Base in So. Dakota, has as his buddy, N.R.I. student Henry Goodyke.

n r i

Our good friend and graduate, Julius C. Vessels, Chief Engineer, Radio Station WDOD, sent us a very attractive souvenir card of his station.

Likes Sample Questions For Operators

Although I take two other radio magazines, I look forward to receiving each issue of the NEWS and read every page. The articles on the FCC examinations and circuit analysis are very interesting.

F. L. PALMITER,
Beloit, Wisconsin.

n r i

Thanks For These Kind Words

I do believe that the NATIONAL RADIO NEWS has more real "meat" in it than many magazines much larger. It seems to get at the heart of radio circuits, whereas many merely touch the surface. Wishing you the best of everything.

HAROLD R. POTTER,
Indianapolis, Indiana.

n r i

Cash and Carry Plan

Congratulations on NATIONAL RADIO NEWS! I have had the Cash and Carry plan in operation for about six months and find that it works out lots better than expected. In fact, I can hardly tell the difference in the volume at all.

HAROLD J. BURTON,
Fayetteville, Tenn.

n r i

Welcomed by Detroit Chapter

I enjoy each issue of NATIONAL RADIO NEWS and learn much from them. I was glad to learn of the Detroit Chapter of the Alumni Association. I went over and was made very welcome by John Stanish, F. E. Oliver, H. Stephens and the others.

At a recent meeting we were given a demonstration on signal tracing which gave me a lot of hints. The chapter here is full of life and I look forward to many more such meetings.

FLOYD A. BEUHLER,
Detroit, Michigan.

Proud to Become Alumni Member

The membership certificate of the N.R.I. Alumni Association arrived this morning.

I must say that I consider it a great privilege to become a member of so fine an organization. The NATIONAL RADIO NEWS is, in my opinion, a source of much useful information.

JAMES J. NEWHECK,
New York City.

n r i

Learns Much From N. R. News

I have learned so much from your little NATIONAL RADIO NEWS, that I prize each issue as much as I do my text books! So please keep up the good work.

JOHN LAGO,
New York, N. Y.

n r i

Photo On Cover of April-May Issue

All of the thanks you sent me in regard to the use of the photograph of my shop, in NATIONAL RADIO NEWS, should come from this end of the line. The NATIONAL RADIO NEWS is a great little magazine and you are doing a swell job. I know that I will appreciate the NEWS even more now that a photo of my shop has appeared in it. I thank you for your kindness in bestowing this honor on me.

DEWITT SAWYER,
Fitchburg, Mass.

n r i

How Many More Want Service Forum

In the last few issues of NATIONAL RADIO NEWS I notice you have been omitting the Service Forum. I hope you have not discontinued this as it was really a great help and I used to look forward to reading it.

ERNEST SMITH,
Winnipeg, Man., Canada.

A Long Stretch

Lady Visitor: "How long are you in for, my poor man?"
Prisoner: "From now on, lady, from now on."

———— *n r i* ————

A lady overheard her maid make a rather short reply at the telephone and then hang up. She called to her:
"Mandy, who was that on the phone."
"Tain't nobody, ma'am. Just a lady sayin' 'It's a long distance from New York,' and I said, 'Yes'm, it sure is.'"

———— *n r i* ————

"Did you take the car out last night Jim?"
"Why, yes, Dad, I took some of the boys to visit a friend at the hospital."
"Well, tell the boys I found one of their little lace handkerchiefs in the front seat."

———— *n r i* ————

A school teacher tells about a little boy whose coat was so difficult to fasten that she went to his assistance. As she tugged at the hook, she asked: "Did your mother hook this coat for you?"
"No," was the astounding reply, "she bought it."

———— *n r i* ————

Teacher looked at the corners of Johnny's mouth.
"You had eggs for breakfast this morning, didn't you, Johnny?"
"You're wrong, teacher," replied Johnny, "We had eggs for breakfast yesterday morning."

———— *n r i* ————

"When you jump," said the officer to the parachutist about to make his first leap, "count to 10 and pull the rip cord. If nothing happens, count 10 more and pull the second rip cord. When you get down, a truck will be waiting to take you back to camp."
The rookie jumped out of the plane, counted to 10, pulled the first cord. Nothing happened. He counted to 10 once more, pulled the second cord. Again nothing happened. Said he, in disgust: "Phooey. I'll bet that truck won't be there either and I'll have to walk back to camp."

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L. J. MARKUS, TECHNICAL EDITOR

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