NATIONAL RADIO NEWS

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COMPETITION ADDS SPICE TO THE GAME

WHEN a competitor opens a shop in your neighborhood, your first reactions are probably the same as those of most people—you feel that he is "cutting in" on your trade and that, by fair or foul means, he may run you out of business. However, there is another view to take of this problem.

First, forget your fears! A mind frozen by mistrust and hate is incapable of reasoning; it will lead you to the very downfall you fear. Face the facts; someone else is in the same business, so you must make your services so much *better* than his that you get your share of the work. Welcome the competition as a spur—something to force you to your best efforts. Realize that you must stay on your toes and you will automatically become more careful, more efficient, more alert. You will find that hard, honest competition adds enjoyment to your work just as competition increases the pleasure of any game.

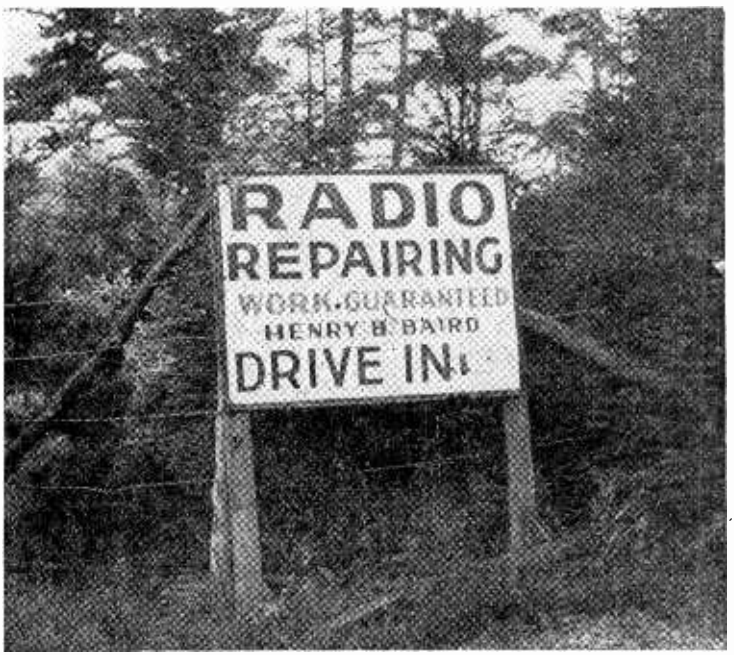
And, another thing, force your competitor to rise to *your* level to survive—don't stoop to his. Do your best work and you'll find that your fears were unjustified—there is plenty of business for the man who can deliver the goods!

E. R. Haas,
Executive Vice President.

THE RURAL RADIOMAN

A Story of How Radio Receivers in Remote Communities are Kept Playing

By S. R. WINTERS



Signboard, 24 x 32 inches, located six miles north of Asheville, N. C.

This interesting story regarding a National Radio Institute graduate originally appeared in Radio News and is reproduced here with permission of the Editor of that publication.

THE mountaineer had plodded four miles across the hills from his home in a cove of the Great Smokies of the Blue Ridge Mountains. Slung across his shoulders was a poke (sack), formerly containing flour but now holding a battery-operated radio receiving set. Panting from the exhausting trek across the mountains, the man approached a stranger and exlaimed, "Mister, I hooked a car battery to my portable radio and burnt every gut out of it."

The above language was too inelegant for a pink tea but fully descriptive of the ill-fated experience of the man of the hills. However, he wasn't wandering aimlessly in search of help because, paralleling the antiquity of the mountains from

which had come this man's strength, signs have always pointed the way out of difficulties. This time the signboard, (size 24 by 32 inches) located six miles north of Asheville, North Carolina, on U. S. Highway 70 from New York to Florida, read, "Radio Repairing, Work Guaranteed, Henry B. Baird, Drive In." A revised but truthful version could be substituted reading "The Radio Man of the Mountains," inasmuch as Henry Baird has been servicing radio receivers in three mountain counties of west North Carolina since 1938.

The signpost, staked hard by this main north-to-south thoroughfare, flanks one side of a gravelly lane leading up to Henry's house, one room of which is a radio repair shop. This 200-yard roadway is lined with stately, giant pines, man-planted and grouped in threes, and whose fifty years of weathering the elements have produced no noticeable adverse effects, except erosion has exposed some of the big tree roots. At the trail's end is a 50-year-old rambling frame house, the nucleus of the 175-acre Baird estate, (now farmed by shareholders). It borders upon the acres of the immortal O. Henry, and Mrs. Sydney Porter (O. Henry's widow) is a neighbor of Henry Baird. The home of "the radio man of the mountains" is situated on a commanding hill and from this vantage the observer can scan enchanting beauty in the seemingly limitless horizons beyond—vistas that always merge in the blue haze of the Great Smokies, from which is derived the descriptive term "Blue Ridge Mountains."

The legend about the mountain going to Mohammed for convenience's sake may parallel the mountaineer's visit to Henry Baird, with his "gutless" radio receiver, but more often than not, Henry goes to the mountains with his radio repair kit. As evidence of this, parked alongside his home in the early forenoon may be seen one of two automobiles—he keeps a touring car and also a jalope—in readiness for any service call. For true missionary of the mountains that he is, Henry's trips into the coves and hills beyond are limited only by gasoline rationing. His telephone may ring day or night—a summons to bring along his simple testing equipment, consisting of a tube checker, weighing about five pounds, and a volt-ohmmilliammeter, weighing approximately two pounds.

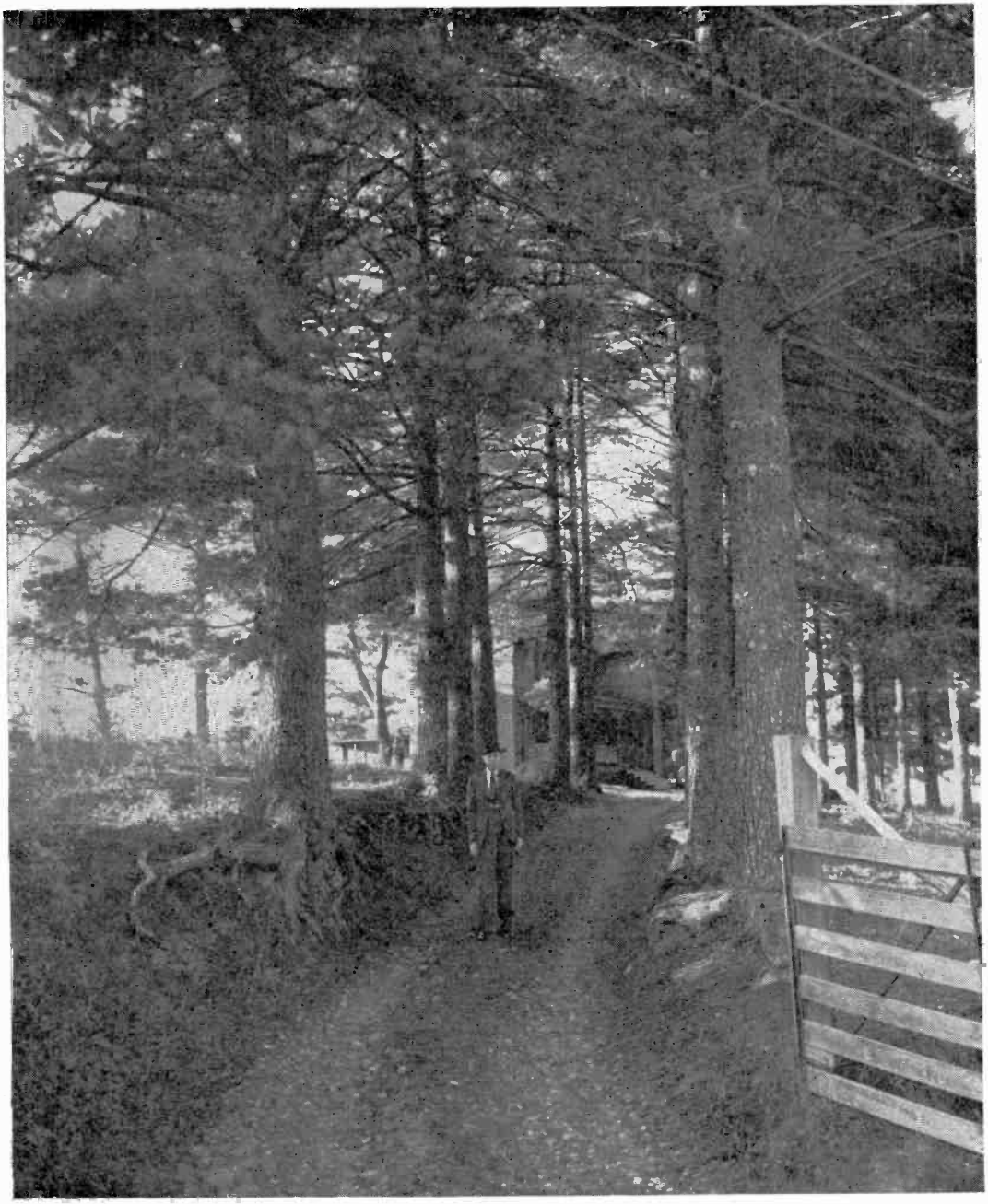
Before the war severely restricted the use of gasoline, Henry covered three mountain counties —servicing thousands of radio sets. Now, with even necessary travel looked upon askance by gasoline rationing boards, "the radio man of the mountains" encourages his patrons to bring apparatus in need of repair to the shop located in his home.

Twenty years in the radio business, starting as a salesman after graduating from the National Radio Institute of Washington, D. C., and continuing to sell sets until 1938, when he began servicing sets as an exclusive business—such pioneering over two decades has spread with favorable disposition the name of Henry Baird. This word-of-mouth advertising and low repair rates to meet the pocketbooks of a mountain folk "ill-fed, ill-clothed and ill-housed," makes Henry's 200-yard roadway lead, figuratively, far into the hills—and of late families as far away as the neighboring state of Tennessee have been pooling their temporarily unworkable radio receivers and having one neighbor's automobile transport a half a dozen or even more sets to this central repair shop. Having been repaired, they are returned to the remote neighborhood by designating some one neighbor's car as a pickup in accordance with the pooling arrangement.

To gather a faint idea of what a boon radio is to these mountain folk it is necessary to sketch a word picture of their homes, living conditions, and remoteness of their lives to cities and what we call civilization. Their lowly cabins—some of them situated deep in the recesses of a cove, others in the path of a wind-swept mountain top —may still be lighted by a vile-smelling oil lamp, a 50-year-old rifle stacked in the corner of the one room, with no rug on the floor except where the backwoodsman has pushed back the frontiers of civilization, as it were, and acquired a rag carpet for the floor. Not unlike her pioneer ancestors of a century ago, the wife of the mountaineer churns her butter in a homemade cedar churn, and without the spurt of development of the mountain handicrafts the housewife would not sit on a sheepskin cushion in a hickory-split chair as she maneuvers the dasher of the churn up and down. These churns of antiquity are bound with brass hoops.

The mountaineer's family does not sleep on a store-bought mattress, but instead seeks a night's repose on a bed tick stuffed with corn husks or wheat straw. The broom that sweeps the cabin —of dirt that may be considered clean by the mountain folk if it is native soil—may be fashioned from broomsedge which grows riotous in the nearby hills—or the broom may take the form of the end of a hickory pole split back into many thin thongs, and a handle inserted.

Alvin F. Harlow, in his treatise of "The Frontier People of the Appalachians," in *Travel*, describes the true mountaineer's home as a crude product of his own handicraft—or that of his neighbors. In the construction of a log house, beginning with the felling of the trees, only five tools are necessary—axe, saw, hammer, mallet, and an edged tool called a frow. With rough-hewn logs, unplaned poles, large shingles hand-split from blocks of oak, the mountaineer may build his own "castle" or construct it through the pooled efforts of neighbors in an old-fashioned house-raising bee. The chimney takes shape through the use of odd flakes and chunks of stone held together with clay.

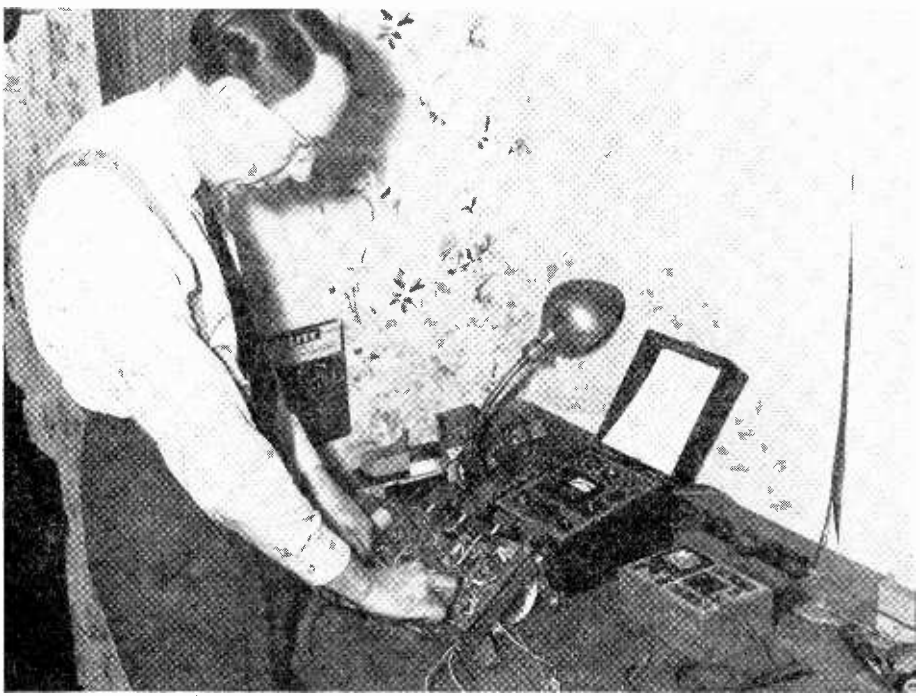


The 200-yard driveway, lined with stately, giant pines, leads to the 50-year-old rambling frame house of Henry Baird, "The Radio Man of the Mountains."

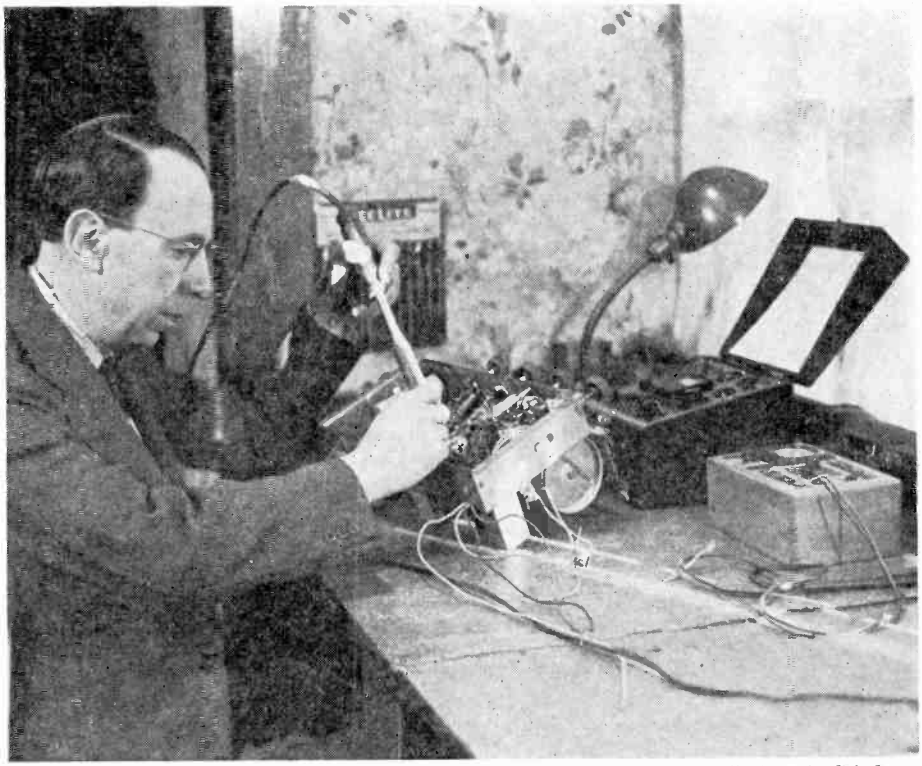
The "Close-Up of a Hillbilly Family," as set down by T. Ham in *The American Mercury*, is pictured as follows: "The cabin is about 10 x 20 feet. Its two windows, little square holes, have never known glass. Both are boarded up in winter against the cold. The single room would be Stygian dark but for the blazing logs in the huge open hearth. Over the fireplace a long, rough scantling serves as a mantel, repository for several small bags of herbs, a seldom used kerosene lantern, and family pictures. Nailed to the walls, not too near the fire, are several bush hides of coon, fox, and groundhog. From pegs here and there hang overalls, a cap, a rifle, a coal-oil can. On one side of the hearth a stack of firewood, on the other a grotesque old talking machine. (perhaps playing "On The Wall," a melancholy dirge). At the far end of the cabin are the beds—four wide, wooden things of incalculable age, jammed headboard to footboard, two to a side. On these sleep all the family, together with such of their kin as may trek over the ridge for a visit. A reckless pullet from the flock of 30-odd outside, stalks solemnly across the floor in quest of a stray grain of corn."

"We allus lived hyar—my pappy an' his pappy afore him, I reckon"—is a stock phrase suggesting the status quo of the mountain folk before the advent of radio. Whole communities have remained unchanged for fifty years—and at least one community, Ox Creek, Buncombe County, is practically the same as it was 150 years ago. There are no mules or horses—not an automobile in nine square miles—and oxen are used exclusively as work stock and as a mode of transportation. The invisible radio waves, however, are the leavening process likely to transform these mountainous areas into modern counterparts of progress. News and entertainment by radio are infiltrating the coves and isolated outposts—where formerly there were no available newspapers. Sermons vie with hillbilly music for popularity, and many mountain music-makers have climbed the pinnacle of fame and riches via the ether route. An outstanding example is Roy Acuff, a mountain boy of Tennessee, whose singing of heart-songs on radio programs, in motion pictures, and by making personal appearances is grossing him a revenue in excess of $100,000 per year.

Henry Baird maintains that what radio means to these isolated folks can only be appraised



Before gasoline rationing, Henry Baird covered three mountain counties, servicing thousands of Radio sets. Now he encourages patrons to bring receivers in need of repair to the shop located in his home.



All photos by Bob Brown

"The Radio Man of the Mountains" shown at his work of servicing a radio at his home repair shop.

properly by personal contact. He relates the instance of his most vivid experience of twenty years as a radioman. It was just before Christmas of 1944. He had received word of an elderly woman living alone in a remote spot of the hills —her only contact with the world beyond her own very restricted vista—sound or sight—was a radio receiver that had fallen into disrepair. An expensive repair bill, with which she was unable to cope, loomed whenever she consulted servicemen. Henry offered to fix the set without charge. It was put into working order, returned to her promptly, and when told it was o.k. she smiled that gracious smile of appreciation, with the remark, "I will have a happy Christmas after all." Money then seemed indeed but as "filthy lucre" when Henry told us that he refused any remuneration even for his time, adding that, "I was repaid tenfold when I saw how much this little radio meant to her."

The experiences of Henry Baird in fixing radios run the gamut from the simple procedure of adjusting a set in which the broadcast band has simply been switched to a short-wave band and the complex operation of checking and almost rebuilding a noisy receiver. About ready to despair, he disconnected the "magic eye" and the trouble vanished before his eyes. When trouble-shooting and finding something out-of-the-ordinary wrong, he jots down the nature of the difficulty and how he solved it—as a sort of reference guide should he encounter similar trouble. But here is one experience that Henry hopes will not be duplicated. He reports, "I went out on a job one day where I was met at the door by five dogs and four cats. I had to wade knee-deep through this menagerie to reach the radio. I have never been kissed by so many animals before. You may think this job was the cat's meow, but believe you me, when I had finished I was doggon' tired."

That reflects the lighter, the humorous side of this unique "radio man of the mountains." I like to think of Henry Baird as a many-sided personality—a practicing philosopher, a missionary to the mountain folk with the zeal of a spiritual missionary to a foreign field, and even as a phil-

anthropist (for he is well-to-do in the rights of his own bank account and estate) in discounting rather than counting the dollars in repairing radio sets whose owners are not rich in worldly goods. Furthermore, he is a radio pioneer, having been inoculated with the "bug" in 1922 when he walked two miles to the home of a friend to listen to his first broadcast. The set was produced by that "grand old man" and "father of radio"—Dr. Lee de Forest. Making use of head telephones and plugged-in tuning coils, Henry recalls that this early receiver took on the appearance of a telephone switchboard, rather than that of a radio receiver.

The first station tuned in that eventful evening 23 years ago was that pioneering station KDKA; the musical number being played was "Sleepy Hollow," by Richard Koontz; and the announcer was Glenn Riggs. One night Henry was listening to a program when a sudden mountain thunderstorm developed, virtually stunning him, and causing him to throw the headphones to the floor, breaking them to smithereens. "Well, after that," muses the philosophical Henry, "I bought a radio of my own and really turned into a night owl. I would sit until the last station had signed off." Incidentally, and as a valuable pointer to other servicemen, he reserves his best radio set for use by customers when they would otherwise be deprived of radio during the period required for fixing their own sets.

Henry Baird, in stature at least, has the appearance of the mountain folk to whom he is a benefactor. Towering more than six feet, slightly stooped—a posture due to bending over an estimated 10,000 radio sets in twenty years, he reflects the kindliness and staunch friendliness of the hill country. He is a Beau Brummel, and goes to church on Sunday. Aside from one diversion, radio—both his vocation and avocation—his one hobby is that of approaching, in a serious vein, and asking a drug clerk for a particular drug in pharmaceutical terms—for instance, scorning the simple term aspirin and requesting the purchase of acetylsalicyclic.

Henry Baird, modest, unassuming man that he is, would not lay the slightest claim to being, even in disguise, an inventor or a radio manufacturer, but he, too, has a blueprint for tomorrow's radio receiver—at least how to simplify it. He captions his 9-point proposal as "Some Changes I Believe Every Serviceman Would Be Glad to See in the Postwar Radio," and this writer believes thousands of radio servicemen will rally to the cause of his agenda. It follows:

(1) Each radio should have the model number die-stamped on the chassis. It has been the practice of most manufacturers to print the number on a piece of paper and paste it on the inside of the cabinet or on the chassis. In many cases the glue dries out and the paper comes off and is lost.

(2) The capacity and working voltage should be plainly marked on each by-pass and filter condenser.

(3) The frequency of all i.f. transformers should be indicated on the can.

(4) The resistance of the field should be on every speaker.

(5) One standard color code should be used for all resistors.

(6) Portable radios should have an efficient loop built in the back cover instead of the mess of wires running all through the cabinet.

(7) Tube sockets should be marked with the type of tube used instead of printed on a diagram and pasted on the chassis.

(8) A simple dial mechanism should be worked out to replace some of the present complicated wheels and pulleys, which require a contortionist to string one of the blamed things.

(9) The types of tubes used should be reduced from the present six or seven hundred to not more than fifty. If this had been done several years ago the present tube shortage would not exist.

———*n r i*———

FM Music to Relax Patients

Miss Violet Kmety, speaking at Kimball Hall in Chicago at a recent meeting of the National Music Week Conference, outlined the results of several years cooperation between WWZR, the Zenith Radio Corporation's Frequency Modulation station, and the local dentists and surgeons who use FM music to relax patients while subjecting them to tedious and painful operations under local anesthesia. Miss Kmety is the program director of WWZR.

Miss Kmety said that music is in constant use at the Chicago Blood Bank to quiet the nerves and ease the minds of the 2,700 donors who weekly visit the blood bank. She also indicated that the use of music for special medical purposes is comparatively new, but that the effect of music on people has been appreciated for a long time. Music is now employed in many government hospitals to speed the recovery of patients by improving morale and modern factories use it to reduce worker fatigue and to speed production. Radio and public address play important roles in providing music for the public, both for entertainment and other benefits.

How to Choose and Install Replacement Parts

By R. H. SCHAAF
N.R.I. Consultant

WHILE the final steps in making a repair—removing the defective part and obtaining and installing a replacement—are purely mechanical, it is possible to waste a great deal of time in taking these steps unless you know what to buy, where to buy it, and how to install it. We will give you some of this important information in this article, along with a number of hints on testing parts. Let's start by learning something about the kinds of radio parts which are usually available.

Kinds of Replacement Parts. Replacement parts fall into three groups: exact duplicate replacements; universal replacements; and general replacement parts.

Exact Duplicate Parts. These parts are exact duplicates of the originals, both physically and electrically.

Universal Parts. There are a number of universal radio parts so designed that, with minor physical or electrical alterations, they can be used as replacements for a wide variety of radio parts. For example, volume controls come with extra-long shafts. Once you have chosen a control of the proper electrical characteristics, you can make it fit the receiver by cutting off the shaft to the required length. Thus, the same control can be used in any receiver which its electrical characteristics will fit.

As another example, output transformers come with tapped secondaries; by choosing the proper taps, you can match practically any loudspeaker to almost any output tube (or tubes).

General Replacement Parts. Finally, we have parts, such as tubes, resistors, and condensers, which can be used in any receiver as long as the proper electrical characteristics are chosen and as long as there is sufficient room for the parts.

We include, among these, parts not designed for the particular radio, but which can be used by making some slight change in the original circuit to "fit" the new part characteristics. Changes of this kind are rare, as the widespread distribution of exact duplicate and universal replacement parts generally makes it possible to make a direct replacement.

Stocking Radio Parts

You can start a radio service business with a surprisingly small stock of parts. However, you will want to build up your stock gradually, both so you can cut down the number of trips or orders to the parts suppliers and so you can render the fastest possible radio service.

When you start in business, you will need a kit of resistors, a small number of electrolytic, paper, and mica condensers, a stock of tubes, an assortment of pilot lights, and a certain amount of hook-up wire and hardware. With this small stock as a beginning, you can increase gradually the amount and variety of these parts. Also, you can add items like universal output transformers, a volume control kit, i.f. transformers, tube sockets, dial cords and belts, and an assortment of knobs.

Some servicemen make the mistake of acquiring too large a stock. It is not wise to invest much money in slow-moving parts. Increase the quantity and variety of your stock only as your ser-

vice experience indicates the need for such expansion. At the beginning, ask your local distributor to help you choose parts which, according to his sales records, move rapidly in your area. This is particularly important in the case of tubes. There are about a thousand different types of radio tubes, yet perhaps in your district only seventy-five to one hundred types are widely used.

Where To Buy Radio Parts

There are many sources of supply available to the serviceman. Perhaps the best known are the large mail-order radio parts suppliers, who carry very complete stocks of parts and who can usually obtain any special parts you may need. In large cities there are also radio parts supply houses and distributors who carry a wide selection of radio parts.

In addition, there are distributors scattered throughout the country who handle various popular makes of radio receivers. Exact duplicate parts for these receivers can be obtained through these distributors. Where there are no distributors, parts can sometimes be obtained directly from the factory. Also, many *parts* manufacturers (condenser and resistor manufacturers, etc.) deal directly with servicemen, although in recent years, mail-order and local parts supply houses have acted as distributors for these lines.

Collecting Service Data. All servicemen collect wholesale parts catalogs, both to locate sources of supply and to obtain information on the electrical and physical characteristics of different parts. Be sure to collect all the volume control guide booklets, vibrator replacement guides, transformer replacement guides, tube charts, and other service data which are available from your local distributors or supply house. Many of these are free, while others are sold for just a few cents.

While we are on the subject of collecting information—try to get all possible information on radio receivers themselves. You will find that your parts distributor will help you obtain service manuals.

Many set manufacturers publish their own manuals, which are kept up-to-date by supplements or come out in yearly editions. You may find it desirable to get those covering any particular brands of receivers which predominate in your locality.

Let us turn now to certain specific radio parts and learn more about the problems of obtaining the proper replacement and installing it quickly.

Replacing Condensers

You may have to replace all kinds of condensers —even tuning condenser gangs. However, you will usually carry only an assortment of paper and electrolytic types, and perhaps a few fixed mica condensers in stock. Let's take up condenser replacements according to type.

Paper Condensers

The most important ratings for any condenser are the capacity and the working voltage. The rating of the original part usually can be found from the schematic diagram or from the condenser label, but an exact duplicate replacement is seldom needed for a defective paper condenser. A wide variation in capacity is usually permissible.

If you don't know the original capacity, use .01 mfd. to .1 mfd. for r.f. and i.f. by-passing, .25

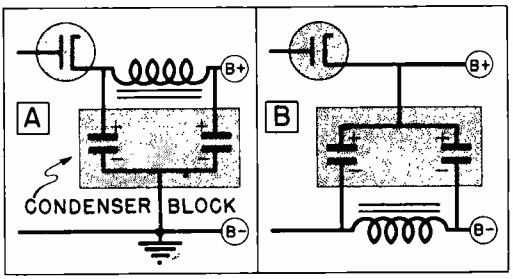


FIG. 1. Two styles of filter condenser blocks. These are NOT interchangeable, so be sure you get the proper replacement.

mfd. to 1 mfd. for a.f. by-passing, .00025 mfd. for grid leak detectors, .006 mfd. to .05 mfd. for a.f. coupling condensers, and .001 mfd. to .05 mfd. for buffer condensers. This gives a clue to the sizes you should stock. A few each of the .01, .05, .1, .25, and .5-mfd. sizes will be adequate for practically all by-pass and audio coupling purposes.

A more important factor is the condenser working voltage rating, *which should always be greater than the voltage across the terminals to which the condenser is connected.* Many servicemen never use a paper condenser with less than a 600-volt rating (space permitting) even if the condenser is to be used in a low-voltage circuit. It costs only a few cents more and is excellent insurance against a call back. Buffer condensers in vibrator power supplies should be rated at 1600 volts or more. Filter condensers of the paper type (very rare today) should have a 600-volt to 1000-volt rating.

Sometimes one end of a tubular paper condenser will have a black ring on it and be marked "outside foil" or "ground." The foil connected to the lead at this end of the condenser is the final outside layer and surrounds the rest of the condenser. If a condenser goes either directly or

through a low-impedance path to ground, this ground connection should be made to the outside foil end of the condenser—the outside foil then acts as a grounded shield and prevents undesirable coupling between the condenser and other circuits. In most well-designed receivers, however, it won't make any difference which end of a paper condenser is grounded. If the condenser is used for coupling (neither end grounded), ignore the outside foil marking.

Electrolytic Condensers

Electrolytic condensers often prove puzzling to newcomers in the service business. When replacements are to be made, many questions about capacity, working voltage, and types come up.

Let's consider capacity first. A replacement should not be much below the capacity of the original, but can be much higher. For example, a 10-mfd. *output* filter condenser should not be replaced by one smaller than 8 mfd., but a much larger condenser can be used and will give better filtering. However, do not replace an *input* filter condenser with one of more than twice the capacity of the original, for the peak current through the rectifier tube may increase to the point where the tube will be damaged. This is particularly true of a.c.-d.c. sets.

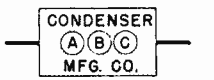
In replacing electrolytic by-pass condensers, never use a capacity lower than the original; a larger capacity will give better results. In replacing condensers used across the filament strings of three-way receivers, stick to the original capacity if possible.

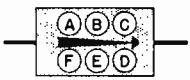
Here is a good rule to remember about working voltage. *The working voltage of the replacement must be at least as high as the original;* if it is higher there will be less chance that the new condenser will break down. If you are in doubt about the voltage applied to the condenser, check it with a d.c. voltmeter. When the set is first turned on, the voltage may be considerably higher than when the tubes start drawing current. It is this initial high voltage that the condenser must withstand. A working voltage of 150 volts is standard for filter condensers in a.c.-d.c. sets (voltage doublers use 250 volts), while 450 volts is standard for a.c. receivers. C bias by-pass condensers are usually rated at 25 or 50 volts.

Dry electrolytics usually—but not always—can be substituted for wet electrolytics. Remember the fundamental difference between the two. The dielectric of wet electrolytics can be broken down by an overload, but when the overload is reduced the dielectric film will reform. If dry electrolytics are overloaded for any length of time, their dielectric film breaks down *permanently* and the condenser must be discarded. In some sets using wet electrolytics, the initial starting surge breaks down the dielectric film each time the set is turned on. If you want to substitute drys, be sure to check this starting voltage. If it exceeds the working voltage of the condensers, either install wet electrolytics, or try a 50,000-ohm, 5- or 10-watt bleeder resistor across the output filter condenser. The resistor will draw current as soon as the rectifier tube starts passing current and usually will reduce the starting voltage to a safe level. Be sure to measure the voltage again after installing the bleeder, however, to be certain it does not lower operating voltages too much.

The type of can or container used for electrolytic condensers has nothing to do with replacements.

RMA COLOR CODE FOR MICA CONDENSERS





COLOR A is first figure of capacitance.
COLOR B is second figure.
COLOR C is number of zeros after second figure.

COLOR A is first figure of capacitance.
COLOR B is second figure.
COLOR C is third figure.
COLOR D is number of zeros after third figure.
COLOR E is tolerance.
COLOR F is working voltage.

Capacitance in MMFD for condensers smaller than .01 mfd, capacitance in MFD for larger condensers.
Arrow or lettering usually shows right direction for reading dots.

COLOR	FIGURE	TOLERANCE	WORKING VOLTAGE
BLACK	0	—	—
BROWN	1	1%	100 V.
RED	2	2%	200 V.
ORANGE	3	3%	300 V.
YELLOW	4	4%	400 V.
GREEN	5	5%	500 V.
BLUE	6	6%	600 V.
VIOLET	7	7%	700 V.
GRAY	8	8%	800 V.
WHITE	9	9%	900 V.
GOLD	—	5%	1000 V.
SILVER	—	10%	2000 V.
NONE	same as case color	20%	500 V.

FIG. 2. The RMA color code for mica condensers.

For example, a condenser in an aluminum can may be replaced by a tubular paper type electrolytic with similar ratings.

If there are a number of condensers in a case and only one is bad, you can connect a single-section replacement unit outside the case in the place of the defective section. However, it is best to replace them all, since the others will not last as long as the new one. Not only must the replacement contain the correct number of condensers, but also their leads must be ar-

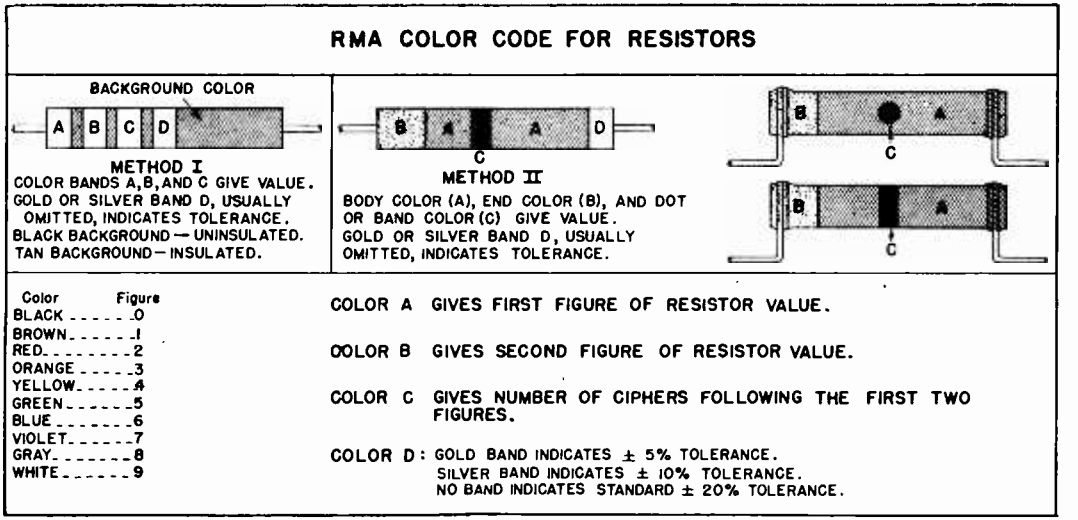


FIG. 3. The RMA color code for resistors.

ranged so that they can be properly wired into the circuit. As an example, look at Fig. *1A* and Fig. *1B*. Each condenser block contains the same condensers and each has three leads. Yet the blocks could not be interchanged—the block in Fig. *1A* has a common negative lead for both condensers, while the block in Fig. *1B* has a *common positive* lead for both condensers. If any of the leads in a block are common to two or more condensers, say so when you order a replacement. Two separate condensers, or two condensers in a block with separate positive and negative leads, could be used to replace the condensers in Fig. *1A* and Fig. *1B*.

Mica Condensers

Mica condensers rarely go bad; when one does, it is best to use a replacement of the same capacity. Because different color codes are often used on micas, it is usually easiest to identify the proper size from the wiring diagram. If you have no service information, examine the original. You may find the capacity value is stamped on the condenser, or it may be marked according to the standard color code (*see* Fig. *2*). Remember, *private* color codes are sometimes used, so if you come out to some unreasonable capacity value, the marking is probably *not* the standard code.

Gang Tuning Condensers

In modern receivers the tuning condenser gang seldom becomes so defective it cannot be repaired. Even badly bent plates usually can be straightened with a thin putty knife. However, if they are beyond repair, the shaft is bent, or the bearings are damaged, a new gang—an exact duplicate—should be installed. Unless you order from the set manufacturer, remove the old gang and send it with your order to make certain you get the correct replacement. Be sure to give the make and model number of the receiver.

The plates of older condensers were often set in white metal castings. This metal may warp, throwing the condenser out of line and causing the rotor and stator plates to scrape against each other. Don't try to bend the plates, unless no replacement is available, as the casting will continue to warp and the trouble will reappear in a short time.

Replacing Resistors

Resistors fall into several classifications: fixed, semi-variable, and variable types. They may have carbon, a metallic deposit, or resistance wire as the resistive element. Let's take up each type in turn.

Fixed Resistors

You're usually safe in suspecting excess current as the reason for a metallized or carbon fixed resistor going bad, particularly if the resistor has a burned or charred appearance. (Wire-wound resistors rarely burn out — electrolysis at the junction of the terminal lug and the resistance wire is the usual trouble.) Look carefully for the cause of this excess current before installing a new resistor. A check from the low potential end of the resistor to the chassis with an ohmmeter will show whether a broken-down condenser or some other short burned out the resistor. If the resistor is not

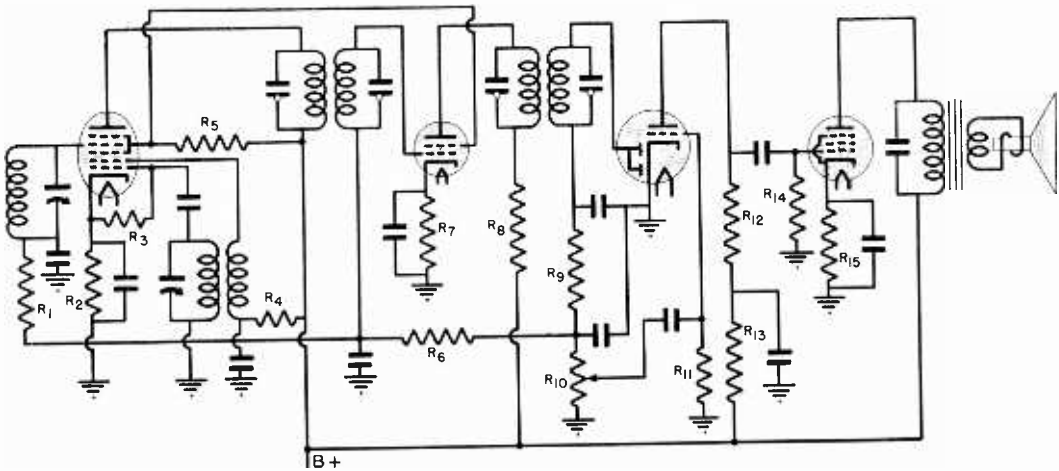


FIG. 4. This circuit shows the locations of most of the resistors used in modern radic receivers. (The diagram is incomplete otherwise.) Here are typical values used:

R_1 —a.v.c. decoupler—50,000 to 250,000ω (100,000 most common)
R_2 —1st det. bias resistor—200 to 300ω
R_3 —osc. grid resistor—50,000ω for a.c., 100,000-200,000ω for battery tubes
R_4 —osc. plate resistor—20,000ω
R_5 —screen dropping res.—50,000ω if no bleeder
R_6 —a.v.c. decoupler—500,000ω to 2 megs. (1 meg. most common)
R_7 —i.f. bias—200-600ω (usually 300ω)
R_8 —i.f. plate decoupler—1,000 to 10,000ω (usually 2000 or 5000ω)
R_9 —i.f. filter—50,000ω
R_{10}—diode load—50,000 to 500,000ω (100,000ω most common)
R_{11}—1st a.f. grid—500,000 if biased; 10 to 20 megs. if convection biased
R_{12}—R-C plate res.—50,000 to 250,000 (100,000 most common)
R_{13}—plate decoupler—5000 to 50,000 (10,000 or 20,000 most common)
R_{14}—R-C grid res.—100,000 to 500,000 (250,000 most common)
R_{15}—power tube bias—150 to 600ω (depends on tube, and whether bias is for single or push-pull tubes)

changed in appearance and no short can be found, the element is probably cracked.

After you've repaired the short (or made sure there is none), determine the proper size for the replacement.

Resistance values are not critical and a variation of 20% is of little importance. You can find the value of the original resistor from the schematic diagram, or from the color code markings (if it follows the standard code). The color code for resistors is shown in Fig. *3*.

The circuit in Fig. *4* shows some typical resistor value ranges. If you can't determine the resistance of the burned-out resistor, install one that is shown by this figure to be appropriate for the circuit involved. If the set works satisfactorily and the voltages seem to be normal, leave the resistor in—otherwise, experiment with different values until you get the results you want.

Always use a replacement resistor with a wattage rating equal to or higher than that of the original —*never lower*. Otherwise, the replacement will burn out. You can use the physical size of the resistor as a guide if the replacement is the same type (carbon, metallized, or wire-wound) as the original. The replacement should be the same physical size, or larger.

If carbon resistors used as bleeders or voltage dividers are defective, replace them with 10- or 20-watt wire-wound types.

When sections of a candohm unit fail, it is generally best to replace the entire unit with a duplicate or with individual wire-wound units. Don't use the lugs on the candohm as anchor points for individual resistors, because the defective unit may "come alive."

Your stock of resistors should include a kit of carbon or metallized resistors in the ½-, 1-, and 2-watt sizes. You will usually find that values of

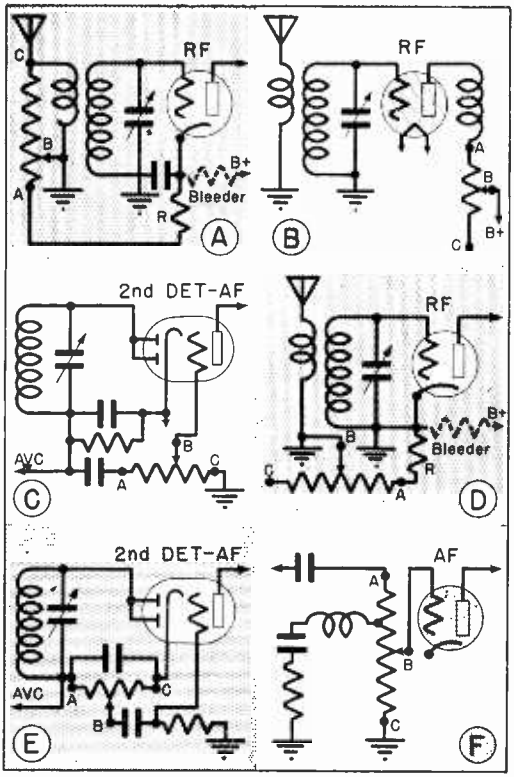


FIG. 5. Typical volume control connections.

200, 300, 1,000 5,000 20,000, 50,000, 100,000, 250,000, and 500,000 ohms are used most. Then, you can add a kit of wire-wound 10- and 20-watt types. The most used sizes of these depend on the kinds of radios you service most, and they can be learned best from experience.

Most wire-wound voltage dividers have fixed, predetermined values. If a duplicate divider cannot be obtained and the section values cannot be determined from the service data, install a 25,000- to 50,000-ohm, 50-watt semi-variable unit and adjust it to give the proper voltages. Then, measure the sections and use fixed resistors as replacements for them.

Some of the new molded resistors look like the small mica condensers. These resistors are ordinarily black, marked with three colored dots. Read these dots in the same order as you would those on a three-dot condenser; they then have the same meaning as the body, end, and dot colors respectively, on regular carbon resistors.

There are also condensers shaped like resistors. The condenser values are indicated by bands of color. Two groups of bands may be used, with the bands in each group being the same width, and the groups of bands being different in width. The bands of greater width indicate the significant figures of the capacity, while the bands of smaller size indicate the number of ciphers, the tolerance, and the voltage rating respectively.

Variable Resistors

Volume and tone controls are the most important variable resistors. Exact duplicate controls are available and are the simplest to install. Some special dual control units can be replaced only by exact duplicates. However, a kit of universal sizes will permit replacement of most controls; sooner or later you will probably stock such a kit.

The physical size of a volume or tone control will not matter as long as it is not too large for the space provided. However, there are several types of shafts, and if the wrong one is used the knob may not fit. Most shafts which are not exact duplicates are considerably longer than necessary and must be cut to the right length with a hacksaw.

The original control may have been equipped with an ON-OFF switch. If so, a switch can be attached to the back of a universal control by following the manufacturer's instructions. Consult a control guide book if the original switch is a special type, such as may be found in battery sets; you may have to use a duplicate control.

The electrical size of a volume control depends on the circuit in which it is used. Some representative circuits are shown in Fig. 5. (Volume control guides show many more.) These guides will also prove helpful if you can't determine resistance values from the schematic diagram or the original control. Actually, the resistance value is seldom critical.

Of the three types of connections commonly used today, the combination antenna-C bias control (Fig. 5A) may have any value between 10,000 and 100,000 ohms; the a.f. grid control (Fig. 5C) may be between 250,000 ohms and 2 megohms; and the diode load type (Fig. 5E) may be from 50,000 to 1,000,000 ohms.

More important than the resistance value is the control taper—the manner in which the resistance varies with the shaft rotation. You don't have to worry about this, however; just name or sketch the circuit in which the control is used and your supplier can furnish the proper replacement. (Your kit of universal types will have a guide book showing the proper types.)

Some controls have taps for automatic bass com-

pensation circuits. Be sure the replacement has similar taps.

Tone controls are ordered and replaced the same as volume controls. Again, a guide book will prove helpful.

Before removing an old control, always draw a connection diagram so you'll have no trouble wiring up the new control. When the old control is removed, measure the distance from the end of the shaft to the threads on the bushing. If necessary, cut the new control shaft to the same length with a hacksaw. Hold the end of the shaft in a vise while cutting it.

When one terminal of a control must be connected to the set chassis, you will sometimes find that the connection was made internally in the original control. An *exact duplicate* replacement will have a similar connection, but a *universal* replacement will not. In this last case, you have to run a wire from the proper terminal lug to the chassis, in addition to making the other connections.

———*n r i*———

A Pocket Notebook

Many of the greatest men of our country had the habit of making notes on scraps of paper or in a small notebook because they felt they could not rely on memory alone. Often, in our everyday work, we may forget things that are important to us. By making notes at the time we have the thoughts we can frequently do much to advance our work. Students who are studying radio and even professional radio servicemen who are established and "have arrived" will find that note-taking will be valuable to them.

So 'elp me guard, I ain't doin' no strip-tease. Dere's somebody crooked in dis place!

From Author of Story—See Page 3

"Very sincere congratulations to you and your loyal employees upon reaching the thirty-first anniversary of the National Radio Institute.

"The influence of your school has reached into the farthermost recesses of this country—its lessons having been learned in the busy sections of our cities and into the mountain coves of the remote regions of America. To illustrate the penetrating reach of your radio correspondence institution into the mountains of Western North Carolina; by chance I ran into an alumnus of the National Radio Institute, who might be regarded as a philanthropist in repairing radio sets on the mountaintops and coves in several counties around Asheville, North Carolina. He is wealthy in his own rights, but his unflagging interest is that of a radio repair man who gets his greatest joy from fixing sets of a people who former President Roosevelt described as 'ill fed, ill housed, and ill clothed.'

"This man, Henry B. Baird, of Asheville R. F. D., never turns aside a set because the owner is without means, and if unable to pay the work is done without charge; often vegetables and fruits are accepted in lieu of cash.

"In journeying southward through several states, with Florida as my objective, I ran across this unusual type of philanthropist in a by-way off the main highway, but a radio repair signboard identified his mission in life.

"I am enclosing some pictures of Mr. Baird, thinking you will be greatly impressed that the tenets of your school have reached so far afield, and that an institution, as well as an individual, is best known by its work.

"With best wishes, I am,"

S. R. Winters, Killarney, Fla.

———*n r i*———

From Graduate Referred to on Page 3

Dear Mr. Smith:—

"I appreciated very much your nice letter of recent date. Had it not been for your untiring efforts to convince me that I should take the N.R.I. course I might still be hoeing corn. I really started from scratch and have worked very hard to build up my business, but today I have more work than I can possibly take care of. During the past twelve months I have put in an average of fifteen hours a day, six days a week.

"I had a card from Mr. Winters recently. He is a swell person. I do hope he will return to Weaverville this summer. If you ever visit Asheville do look me up. I am located six miles north of Asheville on the Weaverville highway."

Henry B. Baird, Asheville, N. C.

Electronics in Industry and Railroading

By LEO M. CONNER
W3GUP
N.R.I. Consultant

THE widespread application of electron tubes to industrial control, protective, and measurement functions has opened up a new field to the radio serviceman. The difference between servicing an electronic control device and a radio receiver is not as great as most servicemen think it is because various combinations of resistance, capacity, inductance and different kinds of electron tubes are used in both types of equipment. While the physical size of the various components may be quite different, their fundamental characteristics are the same.

The serviceman doing electronic control maintenance work must first learn how to read electronic circuit diagrams for some of the symbols are not the same as those used in radio diagrams. For instance, contrast the diagram of the General Electric Company's model CR7505K108 photoelectric relay as drawn with industrial symbols (Fig. 1) with the same circuit drawn according to radio diagram practice as given in Fig. 2. As you can see, there is a noticeable difference.

To help you read industrial electronic circuit diagrams, some conventional radio and industrial symbols are compared in Table I.

The serviceman who intends to install and maintain industrial electronic equipment will also find it necessary to familiarize himself with a number of new terms. In the industrial field, the "choke" coil familiar to every radio man is known as a "reactor." And, incidentally, many of these reactors are of the saturable type, so be on the lookout for "chokes" having two or more windings and different operating characteristics. Another term is the use of the word "capacitor" for the more familiar "condenser." And as may be expected, the names of many new types of electron tubes must be added to the serviceman's vocabulary. Here are a few of the more outstanding ones.

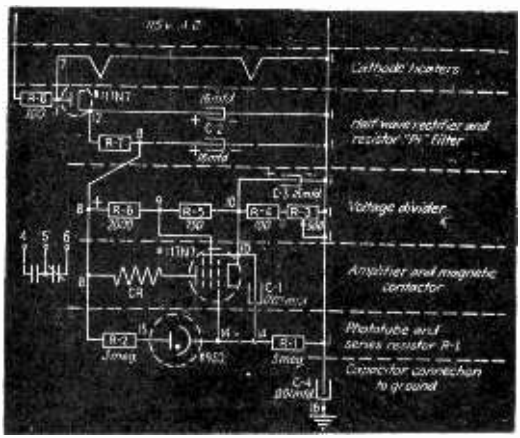


FIG. 1. General Electric model CR7505K108 photoelectric relay, drawn with industrial symbols.

Thyratron is a word coined by General Electric Co. engineers to describe a particular type of triode and screen-grid tubes which have a special gas in them instead of the usual high vacuum. Westinghouse engineers often call the same type of tube a "grow-glow" tube.

An *Ignitron* is a somewhat similar tube except that its power rating is much higher, it does not have the control grid elements, and its cathode is a pool of mercury. All but the smallest of these are water-cooled. They are used a great deal as rectifiers in resistance welding units where high currents at comparatively low voltages are required.

High power rectifier tubes of the high vacuum type are known as *Kenotrons*, another trade name. High power rectifiers of the mercury vapor type are known as *Phanotrons*.

In industrial service, high power triodes, screen grid and pentode tubes are often called *Pliotrons* and are used as oscillator and amplifier tubes for high frequency induction heating service.

The next step is to learn how the various resistors, capacitors, reactors, relay and tubes are used to achieve the desired effects. The serviceman is already familiar with conventional half and full-wave rectifier circuits, audio and radio frequency amplifiers and oscillators so all he need do is to get used to seeing water-cooled tubes, r.f. inductances made of copper tubing, a variety of relays and resistors and condensers very much larger than those used in a radio receiver. He will also find that industrial rectifiers are often three or six-phase bridge circuits and that the load may be used as its own filter.

A type of amplifier which may be new to many servicemen is the d.c. amplifier. Where the voltage to be amplified is a mere pulse, or where it is desired to amplify a d.c. voltage or current, coupling from one tube to another by means of a transformer, or condenser and resistor, will not work. The pulse, current or voltage will not build up a sufficient voltage across a coupling transformer or condenser to affect the grid of the following tube so direct coupling is used. Service men who have worked on Loften-White amplifiers used in some of the older public address systems and a few radio receivers are already familiar with one type of d.c. amplifier. The circuit of a typical d.c. amplifier is given in Fig. 3.

Industrial electronic servicemen must also be thoroughly familiar with timing circuits. Fortunately for the radio man, many of these timing circuits are simply a variation of the standard series or parallel resistor-condenser circuit. Anyone who has worked on a receiver a.v.c. system knows what a resistance does to the time element required to charge or discharge the a.v.c. filter condenser. A very simple circuit, using an ordinary receiving type tube, is shown in Fig. 4.

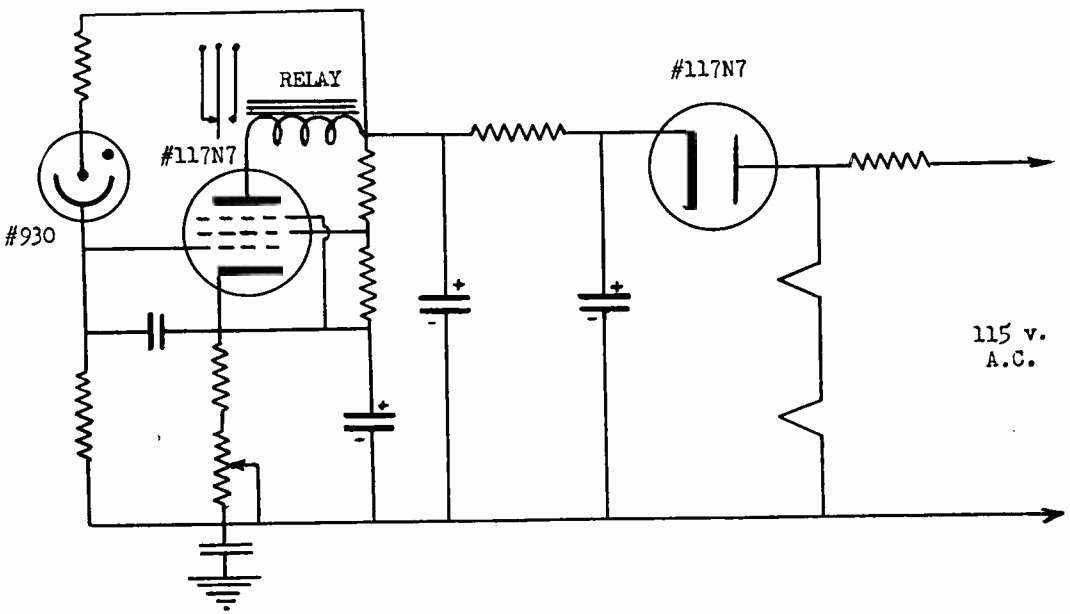
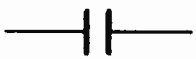
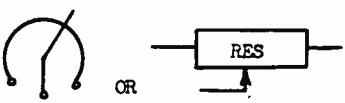
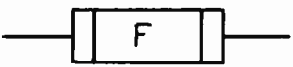
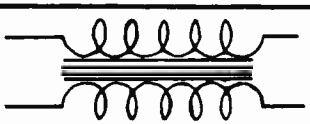
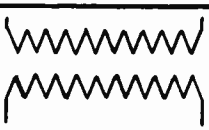
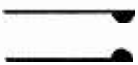
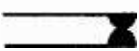


FIG. 2. This is how Fig. 1 might appear if drawn according to radio diagram practice. The circuits are identical except for the differences in the symbols representing the various parts.

TABLE I

PART REPRESENTED	COMMONLY USED CIRCUIT DIAGRAM SYMBOLS	
	RADIO DIAGRAM SYMBOL	INDUSTRIAL DIAGRAM SYMBOL
CONDENSER (fixed)		
RESISTOR (fixed)		
POTENTIOMETER		
FUSE		
IRON CORE CHOKE		
IRON CORE TRANSFORMER		
RELAY CONTACTS (open)		
RELAY CONTACTS (closed)		

Another integral part of many industrial electronic devices is a voltage regulator. This may consist merely of a tapped primary on the power transformer to be manually adjusted for a particular line voltage value, or it may be completely automatic and electronically operated as is the one shown in Fig. 5.

The basic test instruments used in servicing industrial electronic equipment are, of course, the

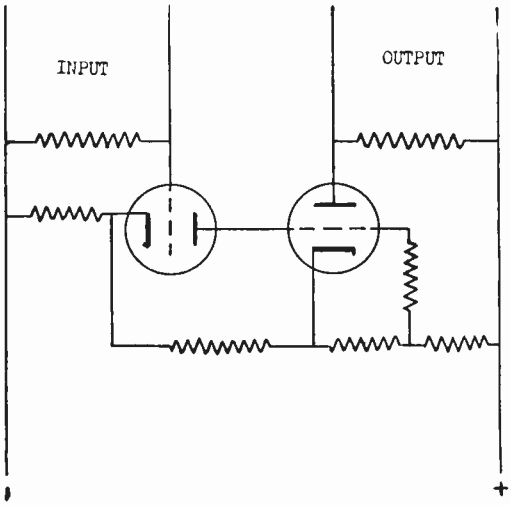


FIG. 3. A typical direct current amplifier.

voltmeter and ohmmeter. As a rule, voltmeter ranges are higher than those used in radio. Voltmeter sensitivity may be of the order of 5,000-ohms-per-volt. Ohmmeters of both the conventional and electronic types are used. Special low-range ohmmeters are used to check contact resistance and various forms of the Wheatstone bridge find application in precise determination of resistance values. Other instruments, used for special tests, include cathode-ray oscilloscopes, recording ammeters, distortion meters, wave analyzers, frequency meters and audio and radio frequency signal generators.

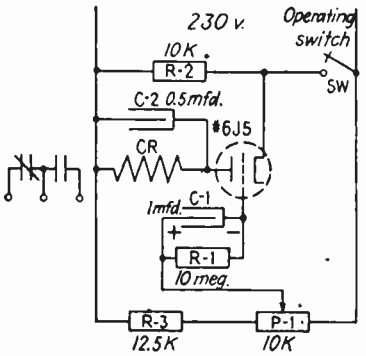


FIG. 4. The GE model CR7504A1A timer.

So you see, servicing electronic equipment is not so different from radio servicing after all. The component parts are larger, but they are still resistors, condensers, transformers and electron tubes. The service man who is thoroughly familiar with basic radio and electric theory, and who will not let himself become frightened simply because the parts are different in appearance and represented by different symbols on a circuit diagram, should experience little difficulty fitting into this new field.

Industrial electronics, however, is not the only new field opening up to qualified technicians. Recent developments in low-frequency carrier current, and ultra-high-frequency transmission

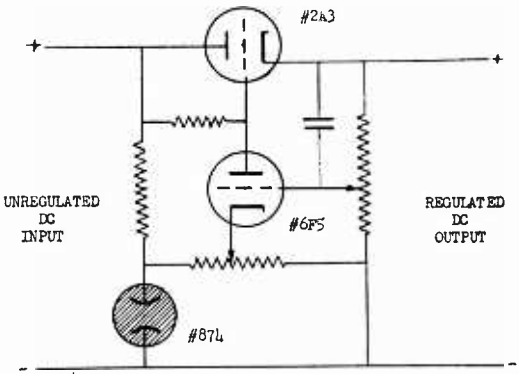


FIG. 5. Typical voltage regulator of the degenerative type.

systems have made it possible for the railroads to use these means of communication to speed up work in freight classification yards and promote safety along the mainlines.

Radio communication problems seem to fall into three distinct classifications.

1. End to end train communication.
2. Fixed-point to train communication.
3. Emergency Service.

Two types of radio have been found suitable for these services.

In fixed-point to train communication, such as between the yardmaster and switch engines in a freight classification yard, or between the dispatcher and the trains in his particular block of mainline track, direct radiating systems operating on frequencies in the ultra-high-frequency or micro-wave region have proven quite successful. On the other hand, for end to end train communication (from the conductor at one end to the engine crew at the other end), the low frequency, low radiation carrier current system using the rails as a transmission medium is particularly suitable. Both the direct radiating and carrier current systems lend themselves to emergency service which may involve communication from one train to another on the same track, or between trains on different tracks. It may even be used as a link to replace existing telephone and dispatching circuits which may be disrupted by storms.

Such a communication link was actually set up to handle traffic as a result of damage to regular channels by a freak snowstorm along a portion of the Rock Island's lines between Kansas and Nebraska recently. Furthermore, it is entirely possible that two-way radio might have prevented the disastrous wreck of the Tamiami East Coast Champion on the night of December 16, 1943.

Since to radio men there is nothing unusual about

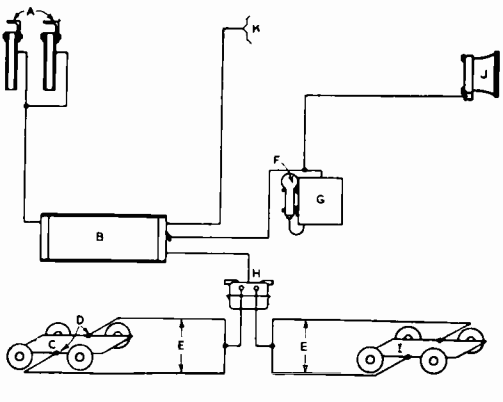


FIG. 6. Block diagram of a two-way radio installation in a caboose. Legend to identifying letters as follows: (A) Receiving coils; (B) Equipment box containing transmitter, receiver and dynamotor; (C) Caboose rear truck which is insulated from the caboose frame; (D) Connections bolted to truck frame; (E) One-inch copper pipe; (F) Hand microphone or handset; (G) Control panel; (H) Output transformer unit; (I) Caboose front truck, also insulated from the caboose frame; (J) Loudspeaker; and (K) 32 volts d.c. from caboose battery.

the high-frequency transmitting equipment, no details are given here. Both amplitude and frequency modulation have been used with good success. The carrier-current system, however, although familiar to telephone and power company men, will no doubt be new to most radio servicemen.

A block diagram of two-way equipment installed in a caboose is shown in Fig. 6, while the current

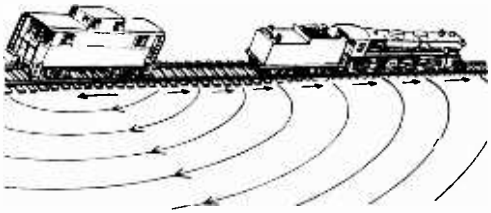


FIG. 7. Signal current flow from caboose to locomotive. Note that the earth forms the return circuit.

flow from caboose to the locomotive appears in Fig. 7. Note that the rails form the outgoing circuit while the earth provides the return circuit. Experiments have shown that while as much as 80% of the power in the output circuit of the transmitter may be transferred to the rails, almost 90% of the transferred power is lost due to the mis-match between the short section of the rails underneath the caboose (considered as the source) and the rest of the track and earth return circuit. Track signal currents as low as one-half microampere have been measured.

The signal currents are picked up by two coils inductively coupled to the rails. The signal is then amplified and demodulated in the conventional way. A typical installation is shown schematically Fig. 8.

It is interesting to note that the carrier frequency of such systems approximates 6,000 *cycles*, well within the audio spectrum; and that the voice frequency range is limited to a band of only 1,800 *cycles*. High fidelity fans will shudder at this but it has been entirely adequate for voice work.

The results of exhaustive tests made by many railroads and equipment manufacturers all point toward increased use of these communication means once the F. C. C. has allocated a suitable group of frequencies for this work.

Right now, of course, it is impossible to say just when or where opportunities will open up in this field. It is safe to say, however, that the chap

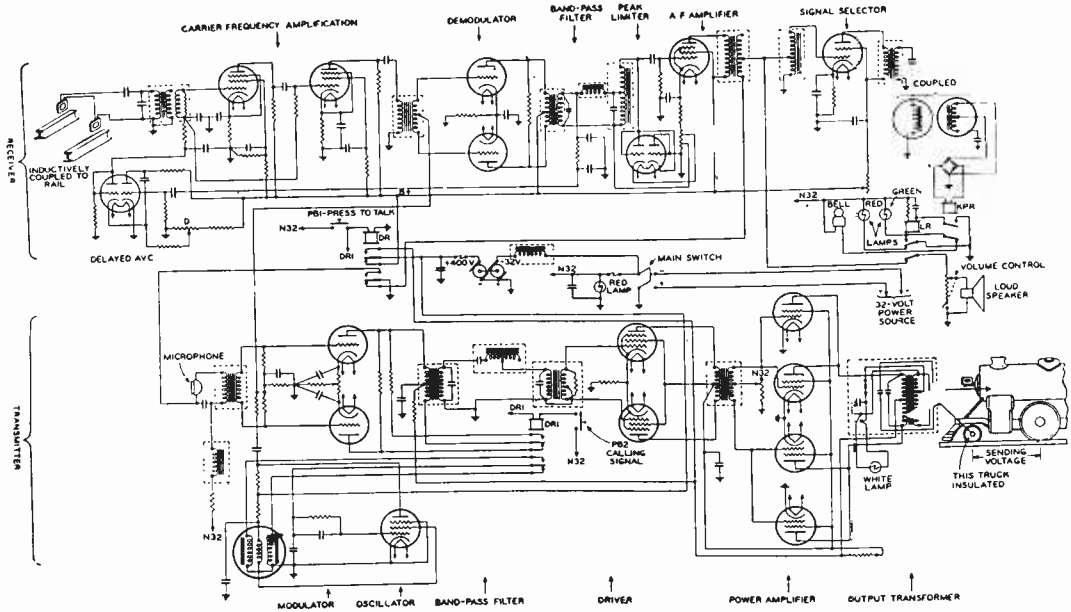


FIG. 8. Schematic diagram of a complete two-way unit showing both the transmitting and receiving equipments and the calling signals.

who really knows radio, and who possesses the skill required to shoot trouble accurately and in a hurry (on transmitting as well as receiving equipment) will stand the best chance of getting into this sort of work. If you'd like to read some of the recent technical papers published on this subject, we suggest the following magazines:

1. Electrical Engineering, July 1943
2. Electronic Industries, April 1944
3. Electronics, April 1944 (2 articles)
4. Radio News, July 1944 (The Radio-Electronic edition has 2 articles)

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Our Cover

With us always we have the skeptics who view every new development with cynicism, but that Television will hold interest for many in the postwar Electronic Era is a foregone conclusion. Witness the rapt attention of these comely lassies as they view the screen of the General Electric Television receiver. Imagine the thrill of *seeing* in addition to *hearing* your favorite radio or movie star with Television!

———*n r i*———

Fair Enough!

"Why did you beat up this man?"
"Well, judge, I comes home and catches this guy in the parlor with my wife on his lap. He monkeyed with my radio and busted it. No guy is gonna bust up my radio and get away with it!"

Keep Your Customers Good Will

A story going the rounds is this. A shop foreman told a mechanic he had just engaged, "Now, there are just two things to remember. If a customer wants us to do some work on his car, we can't take it. If we've got the car in the shop —it ain't ready."
Exaggerated, of course, but it sends home the point. A lot of business men will learn, in time, that the customer's memory will last longer than the war.

———*n r i*———

Hold Her Newt!

"Does that mule ever kick you?" The young officer asked a mule-driver.
"No, suh," was the reply, "he ain't yet, but he frequently kicks de place whar I recently was."
—*Reader's Digest.*

Radio-Electronics in Oil Prospecting

By WILLARD MOODY
N.R.I. Consultant

EVER SINCE MAN has made use of the earth's mineral products, the thought has been in his mind that it should be possible to predict the location of mineral deposits hidden from view and located beneath the surface of the earth. Today, modern research methods, using radio-electronic principles, aid in the search for "black gold"—oil.

Discoveries of new oil-producing areas in recent years have not been equal to the yearly consumption of oil. Each year the discovery of new deposits of oil becomes more difficult. Consequently, there has been a great demand for improved prospecting methods, resulting during the last ten or fifteen years in the development of the art of seismic prospecting.* The method makes use of sound wave reflection and timing in determining the characteristics of the earth's depths.

Seismic exploration does not locate oil directly but locates and defines the underground structures and materials known to be associated with oil deposits. The work of locating the oil must be closely associated with geology and scientific personnel cooperate with the radio-electronic experts.

America's oil industry spends about $20,000,000 yearly in seismic prospecting and probably more money will be spent in the future, as the supply of oil dwindles and finding new oil becomes even more difficult.

The average successful oil well's entire life yield is used up on the Atlantic Seaboard in a day or two. New wells must be drilled every day while fresh reserves for the future are being located.

The modern search for oil is based on the anticlinal theory which states that if oil, gas, and water occur in bedded sands or sandstones and the formation is uplifted into a closed upfold or anticline, as shown in Fig *1*, the oil, gas, and water will accumulate in distinct layers as shown in the drawing. This will result in a condition that makes it possible to recover the oil on a commercial basis.

The search for formations of this type was first carried on by geologists on the basis of surface indications alone. It soon was discovered, however, that such formations could and did exist below the broad, flat plains of the Gulf Coast region and the use of methods that would give information on conditions below the earth's surface became necessary. Seismic methods were developed.

The word *seismic* means "pertaining to earthquakes." A small earthquake or ground vibration which is in reality a series of low frequency sound waves traveling through the ground, can be produced by exploding a one-half to 10 lb. charge of dynamite at the bottom of a 4 to 6-inch hole drilled 50 to 750 feet below the surface of the ground.

In Fig. *2* a typical layout used in this work is shown. The dynamite at *A* is exploded electrically and at the same instant that the charge is exploded an electrical signal is sent out over the transmission line from the shooting truck to the recording truck where a time record is made. When the dynamite explodes, sound waves are produced. These waves travel from the dynamite down to the reflecting layers and then up to the geophones. Some waves may travel di-

*Seismic is pronounced "seez-mick"

rectly to the geophones, principally the first, high intensity waves. In Fig. 3, a typical geophone or seismometer is shown, and we'll return to it in a moment.

The direct waves are received quickly, while the reflected waves require time to travel down to the reflecting layer, be reflected and then travel back upwards to the geophones. If the reflecting layer is located a considerable distance down into the earth's depths, more time will be required for the waves to make their journey. This fact enables the geologists and radio-electronic experts to explore the earth's depths and to map them. Photographic records called seismograms are made. At the instant that the explosion occurs, a time record signal can be transmitted from the shooting truck over the telephone transmission line to the recording truck, if the distances between the trucks is not too great, perhaps no more than 1,000 feet. If greater distances are used, a radio transmitter in the shooting truck can be used to send a radio signal through the air to the recording truck.

The sound waves that are picked up by the geophones are converted into electrical signals which are fed into suitable amplifying equipment. The basic circuit is shown in Fig. 2 and the seismometer or geophone is illustrated in Fig. 3. These signals, too, may be transmitted over a wire line or by radio to the recording truck.

This is a reluctance type geophone, somewhat similar in its action to a dynamic microphone.

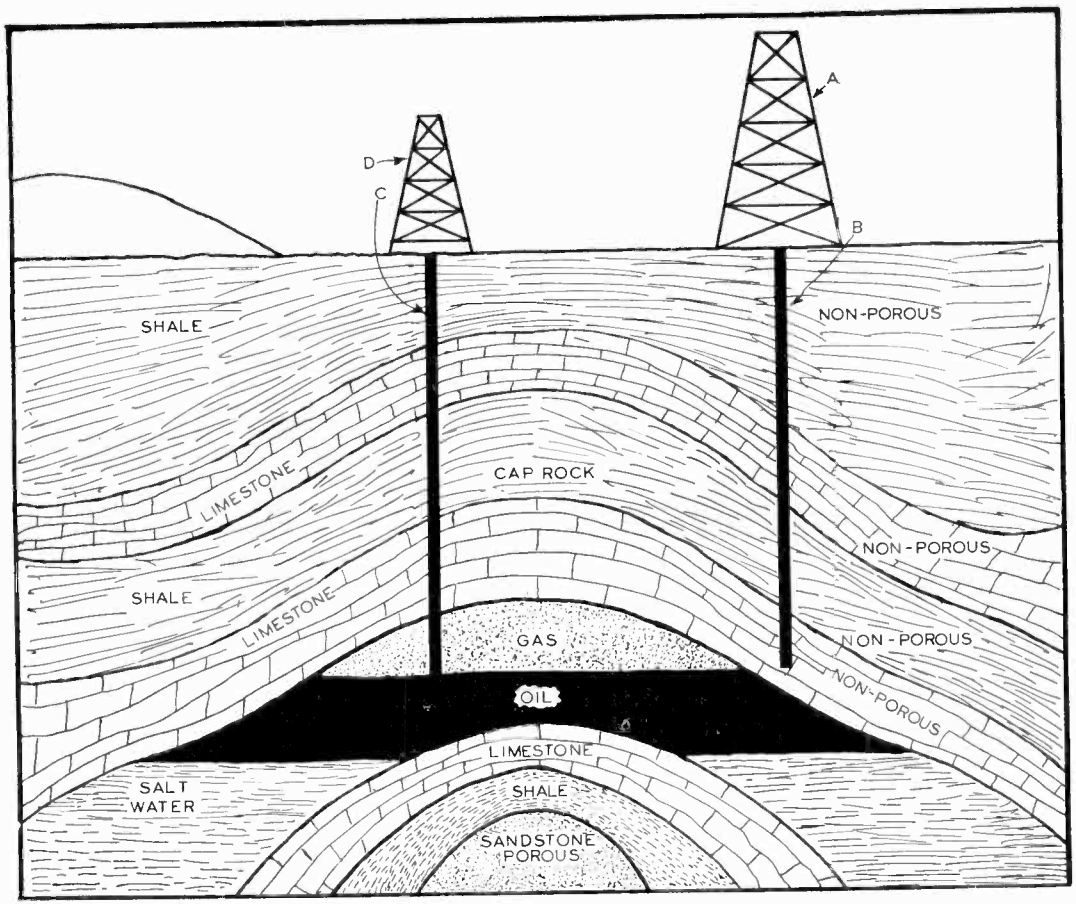

FIG. 1.—The geological layers below ground are shown. How easy it is to "miss oil" is shown by the well at "A". If the well is too far to the right or left, the oil will be "missed." To avoid drilling errors, seismic or radio-electronic prospecting is employed.

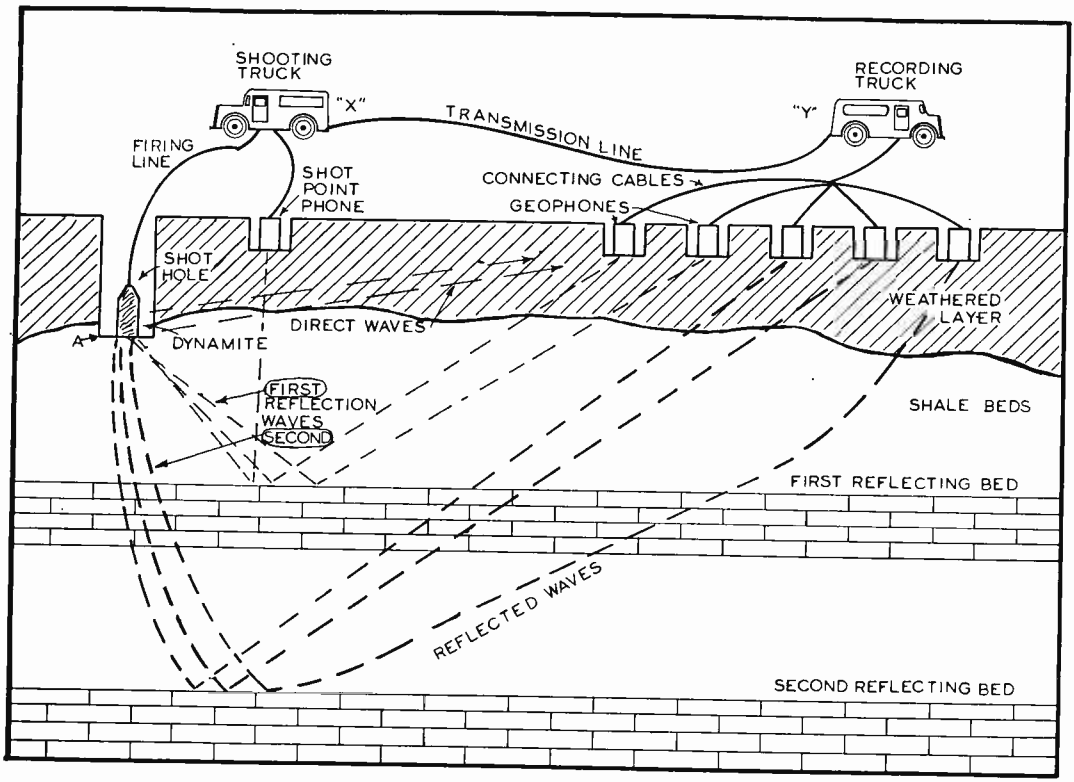

FIG. 2.—A typical radio-electronic prospecting set-up. Audio amplifier and recorder apparatus is located in truck "Y". Sound waves (earth vibrations) generated by the dynamite explosion travel down to the reflecting layers and back up to the geophones which are really special dynamic mikes. From the geophones, electrical signals travel to the amplifiers and recording equipment.

When a vibration is picked up, the armature carrying the coil is set in motion and the coil cuts lines of force (magnetic flux) in the magnetic field. The result is an induction of signal voltage in the coil. The voltage can now be fed into the input of a pre-amplifier, as shown in Fig. 4, which in turn works into the main amplifier. The main amplifier supplies signal voltage to a recording oscillograph.

High sensitivity recorders do not require much power and therefore amplifiers are not required to be high power types. Also, the frequency range is not wide but may extend only from 20 to 150 cycles.

Individual geophones are connected to each pre-amplifier channel. Using two or more geophones, the depth of the reflecting layer can be determined and also the angle of the layer. Making a number of tests over a wide area, the underground structures can be "mapped" and expen-

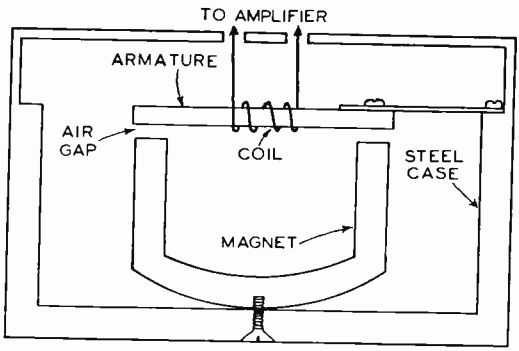

FIG. 3.—This is a geophone or seismometer, used for picking up sound vibrations and converting them into electrical signal vibrations. The sound waves cause the coil to move in the magnetic field, and a voltage is induced in the coil.

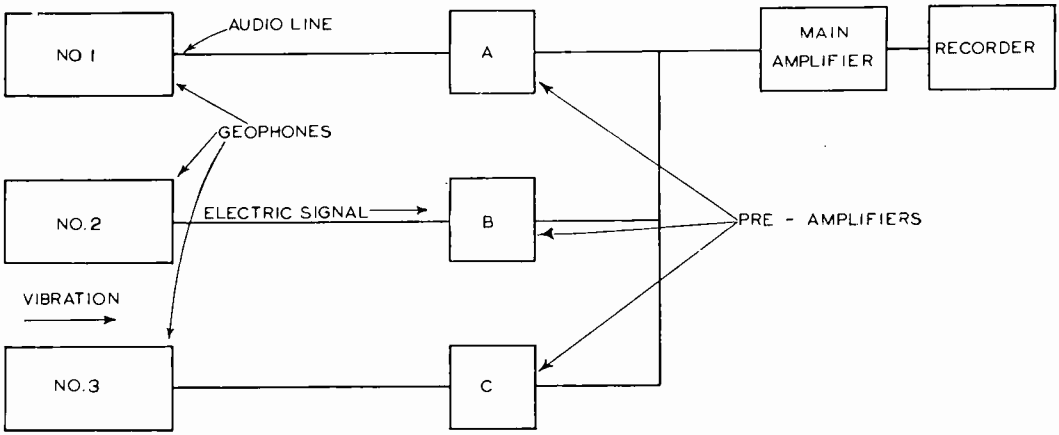

FIG. 4.—The geophones are connected by wire lines to audio pre-amplifiers which in turn work into the main a.f. amplifier. The recorder receives signal power from the main amplifier.

sive drilling can be avoided in cases where there is no justification for drilling operations.

The amplifiers are resistance-capacitance or transformer coupled. Filters are used to restrict the range of frequencies handled to approximately 20 to 150 cycles.

The exact time of explosion must be determined very accurately so that the travel time can be measured. One method is to wrap the dynamite with a small copper wire through which a current is passed. This current is cut off by breaking of the wire at the instant of explosion, and the record shows this time. Another method involves recording the instant at which a small metal fuse breaks in the cap that explodes the dynamite. In this case, the current from a blaster is passed through the fuse and its heating causes the dynamite charge to explode.

The greatest care must always be exercised to prevent the accidental explosion of blasting caps or dynamite and the design of the shooting apparatus must incorporate safety features. Two safety buttons are used—both of which must be pressed by the shooter. In addition, a shooting switch must be closed before the dynamite can be electrically exploded. If the shooter cannot see the casing where the dynamite is to be exploded—for instance when operating a shooting apparatus mounted in a truck—a second pair of safety buttons is mounted in such a way that an assistant can view the shot-hole when closing the circuit. This reduces the possible danger to personnel near the explosion point, and, as a final precaution, all cap wires are kept shorted and grounded until a short time before the charge is to be exploded.

Thunderstorms have been known to explode blasting caps when long wire lines are used. An electrical thunderstorm discharge of electricity may result in the induction of a high voltage in the wires, causing current flow and unscheduled explosions that are very dangerous. This trouble has often been experienced when the wire lines are located near wire fences which may attract lightning. When a storm is in progress, it is best to discontinue operations temporarily.

A further precaution must be taken with radio apparatus mounted in trucks. The capacitance of the truck to ground may be fairly small so that the cap wire line extending from the truck to the dynamite may pick up r.f. signal energy from the radio transmitter in the truck, causing an explosion of the dynamite due to the induced r.f. voltage in the firing wire. By using low powered radio transmitters and keeping the wire as distant as possible from the transmitter antenna, the danger of the effect can be minimized.

Each dynamite cap wire, further, may be bypassed to the chassis of the truck, with a suitable condenser.

The price of safety, however, is constant vigilance by all concerned with the handling of explosives. Mechanical safety devices must never be considered to be absolutely foolproof.

The explosion, when it does occur, according to schedule, may result in a signal voltage of 1 volt to 5 microvolts across a 250,000 ohm resistor in the grid circuit of the first audio amplifier tube. The power output of the last tube must remain fairly constant and the amplifier output power,

for efficient recording action, should not vary more than plus or minus 6 decibels. The gain of the amplifier immediately after the explosion must be low. Then, the gain must gradually rise in value as time goes on, so that the weaker sound waves that travel down into the earth's depths and are reflected by the sub-surface layers before coming up to the geophones to cause the development of signal voltages, will be efficiently built up in signal strength by the amplifying equipment.

The power range may be as great as 60 to 80 decibels. The power of the waves may decay from a maximum at starting of the sound waves to a minimum value of power, at a rate of decay which is roughly 20 to 40 db per second.

Special types of automatic gain control circuits may be used in the amplifiers in which a part of the audio output is rectified, filtered and applied as a bias to control the gain of the tubes. Although similar to A.V.C. systems in radio receivers, the problem is here complicated by the fact that it is desired to change the amplifier gain appreciably in a few cycles. The result is that unusual difficulties are encountered with a tendency for the amplifier to oscillate and create distorted waveforms.

Because of limited available space in the trucks, the amplifiers must be of compact construction. The weight and power consumption must be kept at a minimum. Extensive precautions are taken in shielding tubes and transformers. Reducing microphonic noise in tubes receives considerable attention in designing the amplifiers. Decoupling filters to avoid interaction and oscillation due to coupling in a common power supply impedance are used. The effect of humidity and leakage on the operating efficiency is carefully taken into account in building the special amplifiers and only the finest grade parts are used.

The power supply for the entire exploration unit is obtained from a storage battery or from a combination of A and B batteries. The plate supply, in some cases, may be obtained from a vibrator type power pack, motor-generator, or from dry cell B batteries. The equipment is designed, usually, for minimum power consumption in the field.

The apparatus is highly specialized and much of the radio-electronic training required of men responsible for its operation is given by experienced and expert engineers of the companies to newcomers who may enter the field. The circuits are often so complex and involved that they resemble telephone switching layouts, but with a basic knowledge of radio there is no reason why an intelligent technician could not gradually learn not only how to operate the equipment but also how to maintain it in good operating order.

High School Boy, N.R.I. Graduate, Passes Eddy Test

It was especially gratifying to learn that Student Robert Kassebaum of Arlington, Va., had successfully passed the Navy's "Eddy" Test for admission to the Navy Radio School. When Bob enrolled in 1943, he was just completing his freshman year in high school. Since then he has carried both his N.R.I. course and regular high school work with better than average results. His opinion of N.R.I. training is best expressed in a letter he addressed to Mr. Smith just before he left for the Great Lakes Naval Training Station, Great Lakes, Ill.

"This is to inform you that I have successfully passed the "Eddy" Radio aptitude test for admission to the Navy Radio School which will ultimately lead to a rating of Petty Officer—Radio or Radar Technician.

"As I am 17 years of age and a junior in high school, this would not have been possible without the training I received through N.R.I., and I wish to express my thanks and appreciation for the help which I have received through this course."

Incidentally, Bob's dad tells us that he has been informed that Bob is the only Washington area boy who, with only two years of high school has passed the Eddy test. Hats off to you, Bob.

The best wishes of everyone here at National Radio Institute go with you, Bob, and all our other boys in service, as you put into practice the basic principles and advanced techniques of the radio art you have chosen for your tour of duty.

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25th Anniversary of Commercial Broadcasting

The National Broadcasters' Association has joined in an appeal to the Post Office Department for a stamp to mark the 25th anniversary of commercial broadcasting this year. Those interested in Radio who approve the petition are invited to communicate with Third Assistant Postmaster General Joseph J. Lawler, Washington, D. C.

Simply say that you would like to see a postage stamp commemorating the 25th anniversary of commercial Radio broadcasting. Radio, which plays such a big part in our lives, deserves this recognition.

R.I. ALUMNI NEWS

How To Get Along With Others

Dr. James F. Bender, Director

The National Institute for Human Relations

PEOPLE who get stirred up about little things don't live and work well with others. They make us feel uncomfortable. You never know when they're going to fly off the handle next. On the other hand, those whose human relations are the right sort, check the impulse to let their tempers run wild. They learn to count ten and take a deep breath and resolve to try again when things don't go just right. As a result, life becomes easier and happier. Blood pressure goes down, and "good luck" bobs up all over the place.

This problem of getting wrought up about little things brings up the question, "What are the marks of emotional maturity?" First we might place the habit of using the head instead of the solar plexus in our dealings with people. Have you ever seen someone just miss the bus and cuss and fume about it, getting his whole day spoilt right at its beginning? It's invariably the fault of somebody else, but you and I know that the commonest reason why we miss buses is that we don't get up in time to meet them. So, the first mark of emotional maturity is using your head to solve the little everyday problems on the job and at home. Once we make this a habit, the big problems take care of themselves.

Second, the emotionally mature person is one who can keep a secret. Have you ever had an unpleasant experience because someone wasn't old enough emotionally to repress the urge to break a confidence? Information is of three kinds—that to be shared with everybody, that to be shared with nobody, and that to be shared discreetly. The second and third types test emotional maturity. For unless we can control the impulse to break a confidence—unless we can keep a secret—we are not grown up emotionally.

Someone has called *blame* and *fame* "those twin imposters." Now, the emotionally mature person isn't thrown off balance by words of undue praise or unfair censure. He knows that such words are uttered with little regard for facts. While attempting to correct the situation, he keeps on plodding his resolute way and holds to his accustomed course. This then, is our third mark of emotional maturity.

There are many other characteristics of emotional maturity, but the three we mention here are among the most highly valued in the world at large. To cultivate them, making them habits, is a noble and rewarding pursuit. By using our heads instead of our solar plexus, by keeping confidences, and by being impervious to "those twin imposters," we not only get along well with others, but we rise in self-estimation as well. GROWING UP EMOTIONALLY IS A LOT OF FUN THAT ALL OF US CAN INDULGE IN.

New York Chapter

Vice Chairman Peterson built a very nice radio for the benefit of our members. He explained each step as he went along using the blackboard for additional details. At this particular meeting fifty of our members were present; also five new members joined at this meeting. All in all this was one of our best meetings in quite some time.

Mr. Eugene L. Williams continued with his short talk on Mathematics. His discussions on this subject have been well received, showing that our members are interested in Math. even though the subject may be dry. Much of the interest is due to the splendid manner Mr. Williams uses in presenting the matter.

Of course we always hold our regular Forum under the leadership of Pete Peterson. Another feature of our meetings conducted by Mr. Peterson is the answering of radio questions which are dropped in our question box. Any member may ask any question he wishes. This is a good stunt and is very helpful.

Another of our members, Mr. Louis Capano, has come to the front as a capable speaker. He spoke on the Resistor Color Coding. Still another, Mr. Morris Friedman, likewise did a good job in discussing servicing problems which he encountered in his work. In these discussions he was assisted by Angel Merced. Mr. Merced, by the way, has donated a tube tester to the chapter. When they named him "Angel" they didn't miss.

At our next meeting with fifty-one members present and three others joining the chapter that evening, we voted to take a larger hall in the same building. We feel the growth of our chapter is due in a large measure to the planning of our Executive Committee.

We are very sorry to announce that our good and loyal member, Adolph Schlette lost his son in action in the Philippines. Mr. Schlette, by the way, has loaned us his P. A. system, to be used by our chapter until such time as the chapter can purchase one of their own. A big vote of thanks is voted to Mr. Schlette for his fine cooperation.

Three new members have been added to our Executive Committee. They are William Fox, Hans Bockelman and James Newbeck. They are men with ideas and are expected to contribute much to the welfare of our chapter.

Meetings are held right through the summer months on the first and third Thursdays of the month at St. Marks Community Center, 12 St. Marks Place, between Second and Third Avenues, New York City.

LOUIS J. KUNERT, *Secretary.*

Chicago Chapter

Chicago Chapter will resume meetings in October after vacationing during the summer months. If you live in the Chicago area and are not on the mailing list to receive notices regarding meetings, we suggest you send a postcard to either Charles Kadlub, Chairman, 2026 West James Street, Chicago 9, Ill., or Lloyd Immel, Secretary, 2306 West 51st St., Chicago, Ill.

———*n r i*———

The officers and some of the members of Chicago Chapter.

Phila-Camden Chapter

First of all we want our members to know that we will continue to hold our meetings right through the summer months as is our custom.

Our Chapter is growing so rapidly we have decided to put into operation a plan whereby the members are identified so that we may all become better acquainted without a great deal of formality. Therefore, immediately after meetings are called to order, each member in turn arises and announces his full name.

New members since last report are as follows: John McAleese, Fred Grisick, John Riddle, Paul Lennon, Walter Wysoczanski, Joseph P. McGovern, and Julius C. Shubert.

Jimmy Sunday gave a very interesting lecture on the uses of "Line Cord Resistors" when the necessary ballast tubes are unobtainable. Jimmy Sunday, by the way, is doing remarkably well. He has a helper, Miss Joan, who makes daily rounds to the supply houses for the necessary parts.

At another meeting, Harvey Morris gave a very splendid talk on the Rectification of A.C. using the R.C.A. demonstrator to point out the parts through which the juice travels, to iron out the ripples, to become D.C. Those of us who did not grasp all of this from our N.R.I. lessons now have

a better understanding of the action that takes place.

Before the close of the meeting the group posed for some pictures which were taken by Norman Kraft. These pictures should soon appear in the NEWS if Norm can get them developed. (Editor's note.—Ha! Ha! Kraft says that it is impossible to take inside pictures with outside films. Photos did not print—he says.)

Chairman Laverne Kulp deserves a word of praise for the good programs we have had, thus accounting for the good attendance.

HARRY J. SCHNEIDER, *Secretary.*

———*n r i*———

Chairman Harold E. Chase of Detroit Chapter at work in his shop at 15731 Grand River Ave. Mr. Chase and his partner are doing a thriving business. We are trying to get Mr. Chase to write a complete story regarding this efficient shop.

———*n r i*———

Detroit Chapter

Earl Oliver did an excellent job conducting our Service Forum after which he spoke on AVC Circuits. This was a splendid talk of real interest to even some of the old-timers who had forgotten some of the whys and wherefores of AVC.

A special meeting was called for the purpose of being addressed by our own member, Lt. R. L. Mains, of the Army Air Forces, who was home on a furlough. It was a great meeting and it was well attended. Mr. Henry Rissi delivered a fine talk on Voltages in Servicing.

The next event is our big party to bring our season to a close. This will be for the benefit of our members and their families . And judging from reservations the attendance will be the biggest in years. More details will be given in our next report.

HARRY R. STEPHENS, *Secretary.*

Baltimore Chapter

Baltimore Chapter will meet, as usual, during the summer months at Redmen's Hall, 745 West Baltimore St. Meeting nights on the second and fourth Tuesday of the month.

All N.R.I. students and graduates in the Baltimore area are cordially invited to attend our meetings. They will receive a warm welcome by Chairman E. W. Gosnell and all officers and members of our chapter.

P. E. MARSH, *Secretary.*

———*n r i*———

Sergeant Frank S. Palmer, N.R.I. Graduate, Invents Machine To Test Radio Dynamotors

Working as a radio repairman with a signal company in a 15th Air Force Service Command, Air Service Group, in Italy, N.R.I. Graduate, Sergeant Frank C. Palmer did all of the P-38 Lightning Fighters dynamotor repair work for his unit. He found in the course of his work that standard equipment allowed an occasional bug to slip through unnoticed. Working with several different test sets, Palmer developed his own circuit diagram, hooked up the equipment and soon was in a position to guarantee every dynamotor repair job that he handled.

As Palmer says, "These dynamotors are as vital to the airplane as the radio itself, for the dynamotor supplies power to the radio equipment. I figure it's mighty important they don't go bad over enemy territory, just when the pilot is most dependent on his equipment."

The accompanying photo shows Sgt. Palmer near his dynamotor test unit. The photo also shows some mighty interesting looking pinups, but—let's keep our minds on our work. It was the development of the dynamotor test unit that earned his promotion from Corporal to Sergeant.

Sgt. Palmer mentions that, "There have been several times I was thankful to have some of my N.R.I. books to refer to."

Here And There Among Alumni Members

Listen here! It's a boy at the home of Harry Stephens, that dandy Secretary of Detroit Chapter. As we wrote Harry, if young Warren Roger Stephens is half the man his daddy is and one-tenth as nice as his mother is, he will do all right.

———n r i———

Had a nice letter from Aram Ishkanian of Heliopolis, Egypt. He graduated in 1935. Has a good Radio Shop and is looking forward to a very prosperous business, now that there is every reason to expect war restrictions to be lifted.

———n r i———

Alexander Kish, Jr., of Carteret, N. J., made about $1,200 in his spare time last year, servicing Radios and having a lot of fun doing it.

———n r i———

William W. Jordan worked for the War Department for two years—attended some government schools. Met quite a few N.R.I. men among the students and instructors. Now Bill Jordan is nicely established in his own business, the Jordan Radio Shop, Lexington, Miss.

———n r i———

L. McNiel of Rockdale, Texas, is working in a good Radio shop in his home town—a one-man shop through which Mr. McNiel averages $400.00 a month.

———n r i———

T. L. Kidd is back in the United States. In 1941 he taught Radio to aircraft mechanics. Then he went to India with Hindustan Aircraft, Ltd. Put in some mighty hard licks. Had a grand experience but mighty glad to return to his beloved homeland.

———n r i———

Speaking of experiences, there is Earl Merryman, our Secretary, who spent three years in the Pacific fighting Japs. Earl is Chief Petty Officer. Set up Radio equipment on some of the toughest island spots. Had plenty of close calls. The Japs couldn't get him but Nature did! At this writing Earl is at Bethesda Medical Center, Bethesda, Md., undergoing treatment. J. E. Smith and L. L. Menne have been out to see him. His good wife is with him almost constantly. Earl is going to be all right. The medicos have cut him up a bit but nothing serious—getting him ready for discharge. He has done his job—and how!

———n r i———

T. E. Hooper is doing splendidly as Radio Operator at WNOX, Knoxville, Tenn. Making good money and has good prospects for advancement.

———n r i———

Had a letter from Sgt. Harold L. Young, formerly of Miles City, Montana, who is somewhere with Uncle Sam's boys. A Christmas remembrance we sent reached him May 4—so you know he is way in deep somewhere.

———n r i———

Edward R. Mashburn, Ensign, U. S. M. S., of Goldsboro, N. C., is now on a new C-2 freighter of about ten ton. Has good Radio equipment.

———n r i———

Alumni President Charles J. Fehn wrote us, "Norman Kraft is sending you some pictures of our chapter for the News." We waited a week and then Kraft wrote, "Sorry, no go! The blame thing didn't print again. Had the boys posing so pretty too—about 25 of them." No fooling, Kraft is a mighty good Radio man—but as a photographer—phooey!

———n r i———

Ted Warden of Laurel Bloomery, Tenn., is another N.R.I. man who has a fine business. He is located in a tri-state area, his work covering three counties in Virginia, North Carolina and Tennessee.

———n r i———

Edward M. Schminke of Irvington, N. J., is all ready for whatever the postwar era will bring. Has a fine shop in the main part of town—expects much from F. M. and Television.

———n r i———

Got some beautiful photographs from Raymond Ess, Jr., Mt. Morris, N. Y., showing him at work in his shop. Mr. Ess had to call in a commercial photographer from Rochester, N. Y., some thirty miles away, to take the pictures—which gives you an idea of the kind of cooperation he gives.

———n r i———

Remember Clyde D. Kiebach, who has been candidate for Secretary and who has been in Italy for several years! Now that the censorship is lifted he tells us he is quartered in Caserta, Italy, in the very building where the Italians signed the unconditional surrender document. Kiebach's job has been communication Chief in charge of teletype—connected with a large air force.

———n r i———

We are saddened to learn of the death of Arthur Wieland of Elizabeth, N. J. Mr. Wieland was a charter member of the N.R.I. Alumni Association. He attended the convention in November, 1929, at which time the charter members of the Alumni presented Mr. J. E. Smith with a handsome loving cup. Mr. Wieland's name is one of 72 engraved on that cup. Our sympathies to Mrs. C. Wieland, mother; Albert, brother, and Jeanette, sister.

———n r i———

Paul Howell, who had a swell Radio job in Williamsport, Tenn., quit his job to volunteer in the Maritime Service. He is stationed at Hoffman Island, S. I., New York. Mrs. Howell is also tremendously interested in Radio and is just about ready to begin the N.R.I. Course.

NEWS OF THE RADIO WORLD

BY Willard R. Moody

Colored photographs can now be sent and received at any distance. The patent covering transmission of color by facsimile is held by Finch Telecommunications.

The Veterans Wireless Operators Association recently celebrated its 20th anniversary in New York.

After the war, a single operator in a control room may be able to control with remote equipment a full battery of lathes, punch presses or other machines through television, according to L. M. Clement, Vice President in charge of research and engineering at the Crosley Corporation.

Thirty-six million families now populate the United States. A recent survey shows that over 83% have home radios, totaling approximately fifty million sets. When the war is over, the number of families will increase at the rate of approximately a million a year for the following five or six years. Accordingly, a great demand for radio receivers will result. A total of about one hundred million radios, including automobile sets, may eventually represent the number of radios in service in America.

Recently a sub-committee of the Senate Committee on Interstate Commerce has been conducting hearings on international communications to determine global applications, frequency assignments and means of operation and control. News services are interested in securing licenses for radio transmitters which permit efficient transmission of news from all parts of the globe to home offices in the United States.

Western Union is interested in radio transmission for communication purposes. Recently the Western Union Company made an application for an experimental license for the operation of a transmitter in the 2,000 to 11,372 megacycle range! A short time ago, such very high frequencies would have seemed fantastic. Due to the war, the acceleration of research has resulted in exploitation of the very high frequencies.

Nearly 50% of U. S. radio stations today are operating on low power, according to recent data prepared by the Federal Communications Commission.

Sylvania Electric Products Company, Emporium, Pennsylvania, in its laboratory now measures tube characteristics using a new procedure based on photographing oscillographic traces.

The Aireon Manufacturing Corporation has developed a new f.m. carrier current system that makes use of way-side wires in railroad communications.

We will be hearing more about plastic insulation for wires in civilian radio equipment after the war.

Fire Departments serving over 150,000 people are now being licensed by the Federal Communications Commission to operate their own radio stations.

The descriptive Office of War Information slogan, "patch it up; wear it out; make it do; go without," has served as the basic engineering program of all of our broadcasting stations since December 7, 1941, after Pearl Harbor.

The Raytheon Manufacturing Company is planning a microwave relay communications system to be installed on mountain peaks on the West Coast. The system will be used for automatic operation of relay stations every thirty to forty-five miles between terminal points. The mountain peaks range in height from 3,000 to 15,000 feet. Frequencies as high as 26,000 megacycles will be used.

After the war, Radar may be used to trace the migration flights of birds, according to Professor Maurice Brooks of West Virginia University. The idea occurred to Professor Brooks after hearing of a Naval officer's experience in the Pacific. Radar on the officer's ship often detected the presence of large birds 5,000 yards away when the birds themselves were invisible.

New equipment for lifeboats provides both radio-telegraph and radio-telephone service at sea. Power is supplied by a hand generator. The equipment is entirely waterproof and balloon and kite antennas are included which make possible a range of as great as 1,000 miles. A cylinder of helium gas, packed with the equipment, is used to inflate the balloon. Operation on the 500 kc. distress frequency is possible or on short-wave.

N.R.I. Graduate Wins Second Citation

15TH AAF IN ITALY—S/Sgt. Charles W. Hoffman, 1941 2nd St., Washington, D. C., a member of the 484th Bombardment Group with the Fifteenth Air Force in Italy, has been authorized to wear an Oak Leaf Cluster to the Distinguished Unit Badge as a member of a heavy bombardment group which was twice cited by the War

S/Sgt. Charles W. Hoffman, maintenance man with a veteran B-24 Liberator group, checks a generator.

Department for "outstanding performance of duty in armed conflict with the enemy."

The group received the second citation for the successful destruction of railroad yards at Innsbruck, Austria, after fighting it's way to the target through strong fighter opposition. The 484th received its first citation for the destruction of underground oil storage installations at Vienna last August.

Sergeant Hoffman arrived overseas with the group in March of last year and helped set up its base. He entered the service in March, 1943, and attended schools at Scott Field, Ill., and Truax Field, Wis., prior to being assigned to his present unit. He is a graduate of the National Radio Institute and was formerly employed in Washington.

His mother, Mrs. Agnes S. Hoffman, resides at the above address.

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