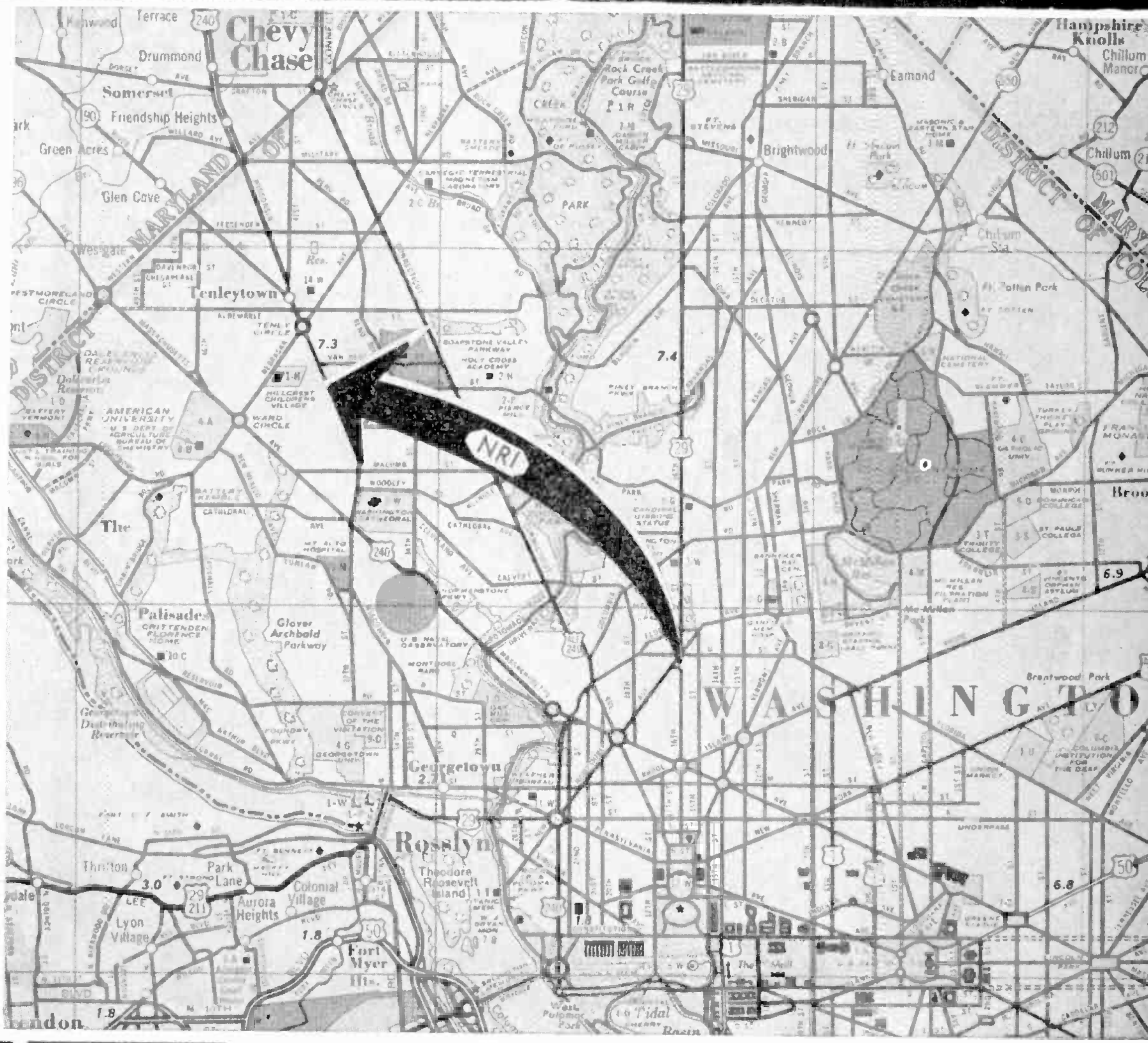
National RADIO-TV NEWS



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Jun.-Jul. 1957

VOL. 17 No. 9

NRI HAS MOVED

Here Is Our New Home At

3939 WISCONSIN AVENUE
WASHINGTON 16, D. C.

It was a real red letter day when NRI moved into its new building early in May. We are mighty proud of our handsome new home.

The building is of the most modern construction and was designed specifically to fulfill our requirements as a home study school. It was so planned that the most efficient use can be made of its working areas and facilities. From the first rough sketch to the completed building we kept this one thought uppermost in mind: its purpose is to enable the folks here at NRI to serve our students and graduates efficiently.

But NRI's new home is more than an assembly of brick and stone and steel and glass—more than just a building. It is also a monument to the founder of NRI—to the man who originated home study training for the Radio industry—J. E. Smith. It is no less a monument to the thousands of men in the United States, Canada, and throughout the world whom J. E. Smith has trained or is training for a career in the Radio-TV industry.

Our new address, next door to a Branch Post Office, will speed incoming and outgoing mail. We have arranged to have all mail delivered to us promptly whether it is addressed to our former location—16th and U Street, N.W., Washington 9, D. C.—or to our new address, 3939 Wisconsin Ave., Washington 16, D. C. In fact, mail addressed simply "National Radio Institute, Washington, D. C." will be delivered just as promptly. NRI is one of the largest private users of the mails in Washington; we are very well known to all departments of the Washington, D. C. Post Office.

So by all means continue to use envelopes, lesson answer sheets, stationery, order blanks, etc., showing our old address. Indeed, you will probably receive a good many printed items from us with our old address for some time to come, since we plan to use up all printed matter on hand.

We take this opportunity to renew our standing invitation to all students and graduates, whenever you are in Washington, to drop in and visit with us. You are heartily welcome. Our office hours are 8:15 A.M. to 5:00 P.M. every day except Saturdays, Sundays and holidays. We'd like to "show off" our new home to you.

NATIONAL RADIO-TV NEWS

Theodore E. Rose, *Editor*
J. F. Thompson, *Associate Editor*
J. B. Straughn, *Technical Editor*
L. L. Menne, *Editor Emeritus*

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TV Antenna Installation Problems

By JOE SCHEK

NRI Consultant

Joseph Schek

The service technician frequently is called upon to install or improve television antenna systems. He knows that the best Television set in the world will provide poor pictures if signal quality from the antenna system is not adequate. He should, therefore, become thoroughly familiar with the technique for obtaining the maximum effectiveness from a suitable antenna installation. The following article has been prepared from performance data of various types of antenna installations.

In strong signal (primary) areas a common problem is multiple signal paths, from the Television station antenna to the receiver location, causing ghosting. A VHF or UHF signal can strike and be reflected on man-made structures, such as building walls, towers, bridges, or other metallic surfaces. Likewise it can be reflected from natural objects such as a side of a hill or mountain and become a secondary signal source to reach the receiving antenna. The receiving antenna also picks up the signal in a direct path from the station.

The reflected signal may strike the receiving antenna only one micro-second (one millionth of a second) after the direct wave. But that minute time delay is sufficient for a dual image (ghost) to appear on the screen. If several reflections reach the antenna for any one channel, more than one ghost can appear on the Television screen. How this is caused is shown in Fig. 1.

The reflecting s. ces may not be close enough to the antenna cause an actual ghost. However, the ghosting will be present in the form of

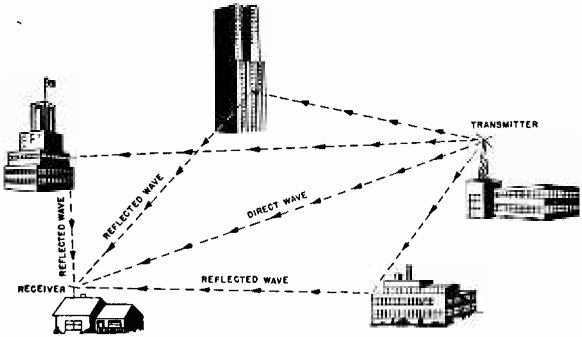

FIG. I. How reflected signals can cause multi-path reception, which may produce ghosts.

picture smears or other picture transients. This type of reflection often occurs in mis-matched transmission lines when the total antenna signal is not absorbed by the load (receiver antenna circuit) and moves back up the transmission line and down again to enter the receiver later than the original signal.

The reflecting surfaces can be behind the receiving antenna with respect to the station location as shown in Fig. 2. In this case the direct wave passes the antenna and strikes the building. The reflected signal bounces from the biulding at the proper angle to reach the receiving antenna a short time after the direct wave arrives at the antenna. The more distant the reflecting surface is from the receiving antenna, the greater will be the displacement of the ghost from the directly received signal as indicated on the picture tube screen. Roughly, a reflecting surface about 1000 feet from the receiving antenna will show the ghosts approximately one-quarter of an inch to the right of the picture produced by direct wave signal. This effect, as illustrated in Fig. 3, makes Tele-viewing considerably less than enjoyable.

The task of reducing these multiple images is the specialized task of the Television service technician. The nature of this service problem is such, that a good deal of time and effort may be expended in trying to eliminate ghosting effects without achieving complete success. A considerable amount of experimental work may be necessary to obtain the best possible picture quality for a given set of receiving conditions.

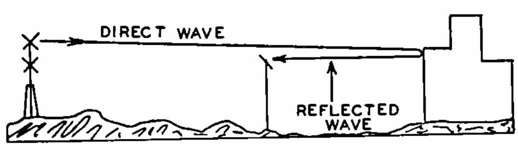

FIG. 2. Rear signal path causing ghosting.

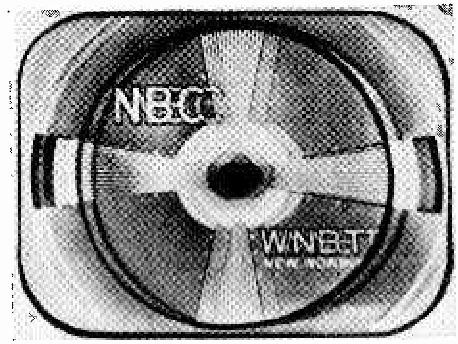

FIG. 3. Effect of ghosts on picture.

Generally, the three most important factors that determine the success of ghost reduction are the type of antenna, installation position and orientation. The proper antenna array does much to minimize the pickup of reflected signals. In general the sharper the antenna pattern the more the direct wave component will dominate the reflected component. A desirable antenna pattern for minimum ghost pickup is illustrated in Fig. 4. You will see the major pickup area is restricted as compared to the pattern shown in Fig. 5. The pickup pattern of an antenna array will be largely determined by the number of director elements mounted in front of the driven element. A Yagi-type antenna is illustrated in Fig. 6, exhibiting a sharp, Uni-directional receiving pattern.

A popular array for non-critical installation conditions with a broad pickup pattern is shown in Fig. 7. The directional properties of a Yagi-type antenna increases its gain which would be valuable in a fringe area installation. However, the receiving pattern is likewise successful in minimizing ghost pickup. Since reflected signals reach the antenna from the side as well as from the rear, the side pickup from the antenna should be weak as possible.

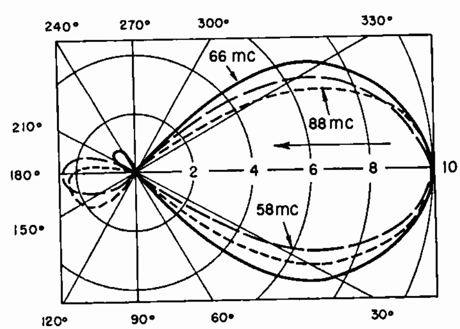

FIG. 4. A desirable antenna radiation pattern for reduced ghost pickup.

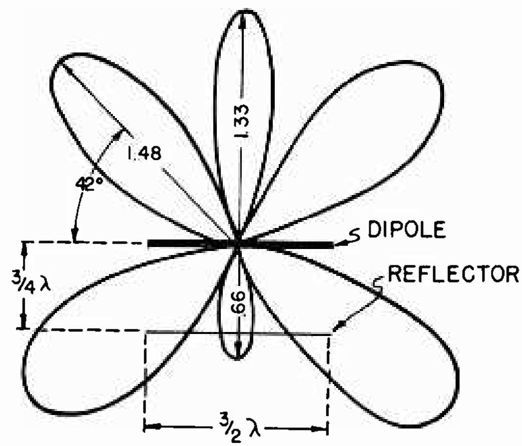

FIG. 5. An antenna radiation pattern good for a ghost-free area.

In some cases, reducing the number of elements will be effective in eliminating ghosts. For example, ghosts have been reduced by removing elements from an antenna so as to prevent less area for reflections to strike. Trial and error seems to be the rule after the routine steps have been taken to eliminate ghosting. The very small, strong signal area VHF antennas now being marketed seem to be much less subject to reflections than the larger style. Thus, not only an antenna with a good pattern is less subject to reflection pickup, but one with a smaller band and simpler construction also is less susceptible.

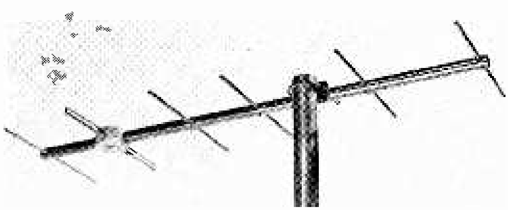

FIG. 6. A high-gain, highly directional antenna of the Yagi type.

The high gain all band type of antenna is often not effective in eliminating reflections. It has a greater mass, side pickup is not uniformly weak from channel to channel and the effectiveness of its pattern is often influenced by nearby objects and other Television antennas close by.

The technician should realize that clear cut rules for eliminating reflections do not exist. Perseverance in experimenting with the maximum number of possible antenna arrays will provide the most practicable results.

Careful antenna orientation often does much to minimize reflection. Some ghosts are reduced by aiming the antenna precisely at the desired station, so as to obtain the strongest, desired signal. At other times it is best to orient the antenna away from the station when ample signal permits a slight sacrifice to gain in another way. This would be to present the less sensitive side of the antenna to the angle of the undesired reflection component.

The height of the mounting position is also important in minimizing reflection. In the presence of a reflection, moving the antenna a few feet, can sometimes reduce the ghosts substantially. In general, however, best results are obtained in a ghost-ridden area by mounting the antenna high and as free of surrounding obstacles as possible. There are exceptions to this rule and on occasion a low mounting position is the one that is free of reflections. These considerations again demonstrate just how much of an experimental procedure the elimination of reflections can be.

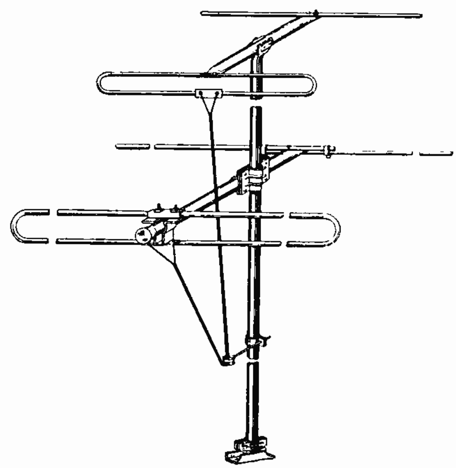

FIG. 7. A popular antenna array for ghost-free areas.

"Problem" antenna installations have been improved by mounting the antenna so an obstacle such as the apex of a roof or other similar mass blocks the path of the reflected signal. Some typical solutions are shown in Fig. 8. It is difficult to make a completely satisfactory installation in situations where station signals arrive from differing directions and reflections are prevalent. In a strong signal area the simplest antenna and a systematic orientation also helps. In such a location simple orientation every 15 to 25 degrees are recommended. At each position the quality of the picture is observed and noted until the best possible orientation angle is located.

The use of an electrically powered antenna rotator allows the set owner to obtain the best possible antenna orientation by pin-point aiming of the antenna array. An antenna rotator is a low speed reversible motor mechanically coupled to the mast, with a control box at the receiver. An added advantage of using the antenna rotator is that tele-viewers who thrill in receiving far away stations can go distant station hunting with a rotator and sharp beam antenna.

Normally the additional rotator equipment substantially increases the cost of the antenna installation. This is primarily due to the necessarily heavy duty construction of the motor mechanism built for outdoor use under all weather conditions. However, to offset this cost and still provide remote control of antenna

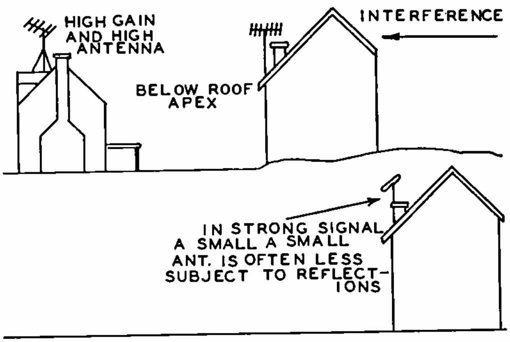

FIG. 8. Ghost reduction methods.

orientation, a model is marketed intended for attic installation. With the motor equipment shielded from the weather elements, a lighter duty rotator mechanism can be used that costs considerably less.

If the orientation method does not solve the difficulty, then the use of separate antennas for the more difficult stations is preferred. This type of antenna installation will take advantage of the sharply tuned single channel antenna arrays now available. Unfortunately, narrow antenna receiving patterns go hand and hand with high gain. Frequently the greater signal level, in a metropolitan area, will overload the receiver causing horizontal tearing. This excess of signal, however, is easily compensated by the addition of an attenuator resistor network at the set terminals. This pad (attenuator) may have a fixed value, but it is more desirable to use a variable type since the amount of attenuation required will vary with the location. One type of signal attenuator helps maintain a nearly 300 ohm load on the antenna lead-in to minimize ghosts caused by mismatch of antenna lead to receiver. The use of an attenuator pad or control will also help to reduce ghosts by decreasing the level of the reflected signal down to a non-visible value. When installing the 300 ohm lead-in, avoid unnecessary horizontal length in order to reduce spurious signal pickup. Likewise, reduce or eliminate any slack or excess lead-in that may coil up behind the receiver. Ghosts elimination is truly a combination of logic, trial and error.

Adjacent Channel Interference

In many areas adjacent channel interference has become a problem with the increase of station powers, improved set sensitivity and the desire of a customer to receive all channels, fringe and local. Two forms of adjacent channel interference can be interference from the sound carrier of the next lowest channel. For example, a strong channel 3 sound carrier can cause interference on channel 4 picture. Another type of adjacent channel interference can be caused by the picture carrier of the next highest channel. Likewise, a strong channel 6 picture can cause interference on a channel 5 picture.

The reduction of adjacent channel interference is also a function of choice of antenna type positions. Generally adjacent channel interference is severe when trying to receive a weak fringe station in the presence of an adjacent channel local station. The local station remains rather uniform in signal strength, the fringe area signal fluctuates from hour to hour, day to day, and season to season. First the severity of the adjacent channel interference depends on the strength of the fringe area signal. When the fringe area signal is very strong, the adjacent channel interference is absent or becomes less annoying.

The best solution to the adjacent channel interference problem is first to make certain that the adjacent channel traps in the receiver have been adjusted precisely. Next the use of a separate well-isolated antenna and transmission line for the fringe area station being interfered with is recommended. This antenna should have a high gain single pickup pattern with peak sensitivity toward the desired station. The sensitivity of the antenna in the direction of the undesired station should be extremely low. In fact, it is often helpful to orient the antenna so as to pickup minimum signal from the adjacent channel causing the interference. This might mean that the antenna is slightly off the beam of the desired station but the resultant improvement in the ratio between the desired station and undesired adjacent channel interference is very much improved, resulting in a better picture. Again some good starting logic and then cut and try seems to be the only method of circumventing the tough ones.

A separate transmission line should run to the

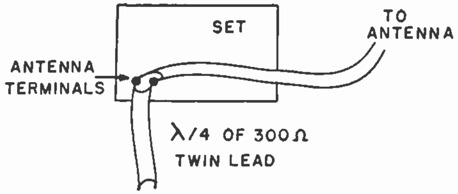

FIG. 9. How a stub is connected to the input terminals of a TV set.

receiver from the fringe area antenna picking up the signal that is being interfered with. This line should be kept away from the antenna line system carrying the local channel as much as possible. A low capacity slider or knife type switch should be used at the receiver to permit switching between antenna systems. A stub or tunable trap should be connected in the transmission line of the fringe antenna and tuned for maximum rejection of the adjacent channel signal. This can be connected conveniently at the receiver between the change over switch and the fringe antenna incoming transmission line. Fig. 9 shows how a stub is connected to the input terminals of television receiver. To determine a quarter wave length at the desired frequency, use the formula for determining the length in inches or half wave length of 300 ohm transmission line (5905 over F times .82 equals length), and divide the result by 2 to get the length of a quarter wave open circuit.

Stubs are frequently used to eliminate interference from nearby FM stations as well as any interfering signal in the VHF or UHF range. The FM broadcast stations operate in the band frequencies from 88 to 108 megacycles. Since the lowest signal will have the longest wave length, cut the stub for 88 megacycles to start and then adjust it to the correct length later. Using the formula, you will see that the length of the stub at 88 megacycles is approximately 27 inches.

The next step is to adjust the stub to the correct length. You can start by cutting off about one inch from the open end of the stub. Continue this procedure until you notice some effect on the interference. Fig. 10 illustrates the interference from a nearby FM set. As soon as the interference has started to decrease, you should cut off small bits of the stub until you have either completely eliminated the interference or have reduced it as much as possible.

Even a sliding piece of tin-foil 8 to 10 inches long wrapped around the transmission line can do much to establish a more favorable desired to undesired signal ratio. Where it has been determined that the antenna lead-in is picking up the signal from the interfering adjacent channel station, use of shielded 300 ohm twin lead transmission line would minimize this pickup.

Co-Channel Interference

Still another type of interference that the technician is called upon to minimize in co-channel interference. This is usually a fringe area problem where the desired signal is being picked up over a considerable range (in excess of 40 miles) and is being interfered with by a still further distant station on the same channel. Co-channel interference produces the "venetian blind" effect often seen on fringe area pictures, as shown in Fig. 11.

It is best overcome with the use of an antenna having the most favorable pattern in terms of sensitivity toward the desired station and as weak a sensitivity in the direction of the interfering channel as possible. Trial and error off-beam orientation is often helpful. The influence of antenna pattern on the signal intensity ratio should be kept in mind. Recall that with the antenna beam exactly on the desired station there can also be present a substantial sensitivity in the direction of the undesired station.

A slight off-beam orientation might rotate the pattern so that a deep dip between two lobes of the minor pickup patterns of the antenna is in the direction of the undesired station. The desired pickup pattern of the antenna in the direction of the station to be received need at times be shifted only slightly off true direction.

It must be stressed again that the severity of the co-channel interference is also a function of natural transmission variables. If the atmospheric bending in the troposphere is such that reception from the undesired direction is favorable there will be an increase in the amount of

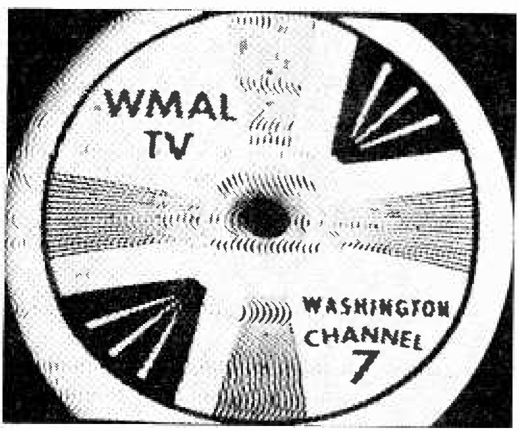

FIG. 10. Interference of this sort can be produced by the local oscillator of a nearby TV or FM set.

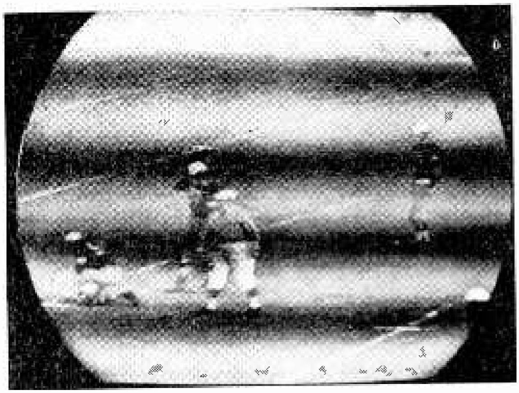

FIG. 11. Co-channel interference.

co-channel interference. But in summer time and in evening hours when long distance reception is quite favorable there is often a general increase in the amount of Co-channel interference. Summer interference often arises from stations from three to five times further away than the desired station.

UHF Antenna Installation Difficulties

Ghosts problems on the UHF band are not nearly so prevalent as in VHF reception. There are some reflection problems but by far the most difficult propagation condition in the UHF band is the much reduced range over which satisfactory reception can be obtained.

Fortunately the size of the antenna is very much reduced and consequently high gain antennas such as corner reflectors and Yagi-types can be employed. A typical array is illustrated in Fig. 12 Mounting positions can be changed with ease to obtain the most favorable location for the antenna.

We mentioned previously that very rarely is the only signal arriving at the receiving location the direct wave. The secondary signals can be earth-reflected, obstacle-reflected, or additional signals refracted from the troposphere. Strong secondary signals add or subtract from the direct wave and have an appreciable influence on the net signal strength. Hence antenna positioning is quite important and experimental checks to find a location where the UHF signal is strongest do much to give the customer the very best picture in a difficult signal area.

It is equally important to try different horizontal positions in the vicinity of the desired mounting site as well as different vertical positions for the antenna. These experimental procedures should be followed in particular in dead spot areas and in UHF fringe locations. Weather conditions and other propagation variables do not have as pronounced an influence on UHF signal strength as in the VHF band. Some sporadic conditions do arise but they are less frequent.

FM Antenna Installation Considerations

FM reception problems are not as numerous because of the narrow band-width of a typical FM system and the very much improved sensitivity of an FM tuner or receiver as compared to the wide band input restrictions of a Television receiver. In a local or metropolitan area where the FM signals are strong the usual built-in antenna or simple dipole are quite adequate for FM reception.

However, it must be stressed that in most areas full quieting (best signal-to-noise ratio) is not obtained on each receivable station because of the inadequacy of too simple an antenna system. The high fidelity enthusiasts because of his desire to have noise free reception and full dynamic range without background noise is usually aware of this condition. This type of person is interested in a better type of FM antenna system. Thus there are markets for a higher gain FM antenna even up to Yagi types to obtain improved or longer range FM receptions.

In many areas a good FM antenna would permit the customer to receive signals from more dis-

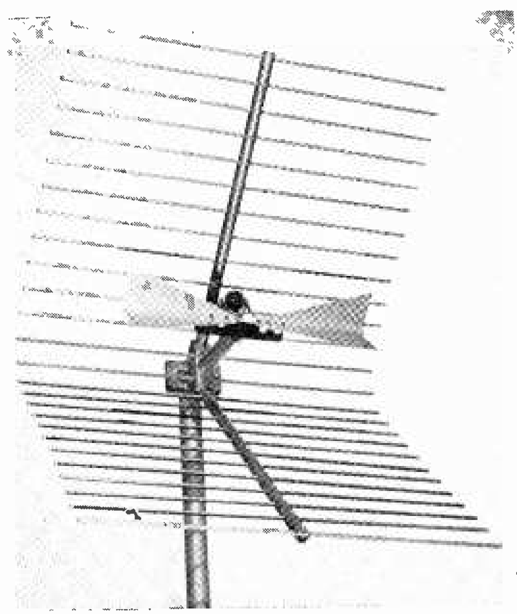

FIG. 12. A UHF antenna using a corner reflector and bow-tie design.

tant metropolitan areas (over 70-80 miles) where live FM shows might originate and good high fidelity reproduction could be obtained. There are on occasion adjacent channel interference problems on the FM band. These arise in a locality where there are local FM stations and the customer desires to receive a particular long distance FM station that is carrying some of the programs he would like to receive.

Most of the live high fidelity music programs originate in the large metropolitan areas and therefore the high fidelity fans in the outlying districts are interested or could be made interested in receiving this type of program material. If interference from a local station interferes with the reception of a long distance station a wise choice of antenna and mounting position often overcomes this problem.

The use of a high gain sharply directional antenna for receiving the distant signal is the solution. Again the technique of orienting this antenna so that it has minimum pickup of the undesired station can be useful in establishing the best signal-to-noise ratio so that the fringe station is able to cause more complete suppression of the local interference in the FM receiver discriminator and limiter circuits. In a difficult case the use of separate antenna and separate transmission lines with a change-over switch is preferred.

———*n r i*———

OPEN WIDE!

The nation's largest dental college is using closed-circuit television as a new teaching medium to speed instruction and to keep abreast of the changing profession.

New York University's College of Dentistry hopes to broaden subject courses within the currently-heavy curriculum. Thus, students will be informed of rapidly-changing dental practices without need for additional courses.

Demonstrations are televised from a central studio at the College and "piped" into several lecture halls on various floors of the building. Two GE TV cameras are used in the studio; one equipped with a wide-angle lens for overall viewing; and the other with a Perkin-Elmer variable focal length lens for closeup viewing.

The lecturer usually leads demonstrations by microphone and two-way amplifying system so that students may ask questions thru portable microphones available in the lecture halls.

The College recently demonstrated a new clinical treatment to some 400 students via closed-circuit TV. Under ordinary classroom conditions, this would have been impossible.

Listen Americans!

by Dr. George S. Benson
Director, National Education Program

The American economic system gives natural laws freedom to work in their natural way. The motive power in the system is supplied by man's natural desire for rewards—or profits—in all his undertakings. This is a fundamental human desire. When it is multiplied by the number of people in America it is a powerful force, producing great volumes of goods and services. By permitting this profit motive a great degree of freedom, the American system is tapping the brain-power and the energy-power of all its people.

A 12-year-old boy doesn't like to mow the lawn at home—for free. But let the next door neighbor offer $2.50 for a lawn-mowing job, and the 12-year-old suddenly finds joy in mowing that lawn. Given enough lawns to mow, at $2.50 each, he will spend the entire summer working without complaint. And the money he earns comes from somebody else's exercise of the profit motive. The man next door may be a carpenter, a manufacturer, or a lathe operator in the local woodworking plant; whatever his occupation, his brain-power and energy-power are driven by the human desire for rewards, where he is earning so much he can't afford to mow his own lawn.

The people who are determined to change the American system fundamentally, center their subtle and direct attacks on corporation or business profits—trying to make people believe they are unreasonable and that, therefore, the system is not good.

In the last year for which we have the official Commerce Department statistics, the national income was approximately 300-billion dollars. The net profit of all the corporations in America amounted to 5.9 per cent of this total income. Three and three-tenths, or $9.9 billion, was paid directly to the stockholders—more than 12,000,000 people, most of them small town residents earning less than $7500 a year. The other 2.9 per cent of the profit was ploughed back into the businesses—to buy new machines, to pay for research, to develop new production methods and new products, to expand plants, to help build new plants, and to make new and better jobs.

In the last year for which we have official figures, the annual corporation sales in America

(Page 13, please)

The Decibel

By E. H. BODEN

Advanced Application Engineer
Sylvania Electric Products, Inc.

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Introduction

The increasing use of the decibel makes it more and more important that radio and television servicemen and radio amateurs become acquainted with this unit of measurement and know how to properly use it. Catalogs and technical literature are making use of the decibel to describe the performance of amplifiers, antennas and filter networks. Radio amateurs have for some time used decibels in giving signal strength reports.

The use of decibels provides a convenient shorthand notation for power ratios and simplifies overall communication system analysis.

Basic Definition of the Decibel

At one time or another we have all probably read or heard it said that the human ear is nonlinear in response to changes in power or energy levels. For example, let's assume we have an audio amplifier that is delivering a pure tone and has an actual power output of 10 watts. Now, research has shown that for the ear to sense that the output has been doubled the actual power output of our amplifier must be increased by 10 times, 100 watts. For the ear to sense an increase of four times, the output of the amplifier must be increased by 1000 times, 10,000 watts, etc. Thus it can be seen that the ear becomes less sensitive to changes in power as the delivered power is increased.

The decibel is simply a relative unit of measurement used to express changes in power based on the ability of the human ear to recognize these changes. As previously stated, application of the decibel as a unit of measurement is not limited to the audio frequency band and/or audio amplifiers. The ease with which the decibel enables us to express power gain and/or power loss, through elimination of the necessity of handling large numbers, has resulted in wide-spread usage.

For those who are mathematically inclined, the decibel is defined by the equation:

$$\text{db} = 10 \log_{10} \frac{P_L}{P_s} \qquad (1)$$

where P_L is always the larger power, in watts. P_s is always the smaller power, in watts.

The log function comes from the fact that the response of the ear to changes in power is actually logarithmic. Although equation (1) may be written in a few slightly different forms, the decibel is never anything more or less than equation (1).

Using a Decibel Table

To find db we can use equation (1) or, for those who prefer to eliminate as much math as possible, we can refer to a Decibel table, Table I. The use of this table is best explained with a few examples. Let's assume we have a gain of 3 decibels. Referring to Table I we find that the corresponding power ratio for a gain of 3 db is 1.99 to 1. In other words, the power output is 1.99 or approximately 2 times the power input. Referring again to Table I, we see that for a power output which is 5 times the power input the gain is 7 db, thus we can work from either direction.

Now, let's see how to handle a power gain of 26 db. First, we look opposite 6 db and find that the corresponding power ratio is 4. In the same manner we find that 20 db represents a power ratio of 100. The power gain, therefore, corresponding to 26 db is 4 × 100 or 400 times.

DB Gain

To generalize, in Fig. 1 we have a "black box." P1 is the power, in watts, that is going in or the input power. P2 is the power, in watts, that we are getting out or the output power. If our box is an amplifier with gain, then P2 will be greater than P1. Let's say by experiment it was found that when a power of 10 milliwatts was put into the amplifier we got 2000 milliwatts (2 watts) out. Let's now find the gain in db. The power gain of the amplifier is found by dividing the power output by the power input:

$$\frac{2000 \text{ mw}}{10 \text{ mw}} = 200$$

Since a power gain of 200 (power ratio of 200 to 1) cannot be read directly in db from Table I it must be broken down into 2 × 100. Referring to Table I we find that a power gain of 2 is 3 db and a power gain of 100 is 20 db. The db gain of the amplifier is simply the sum of 3 db and 20 db or 23 db.

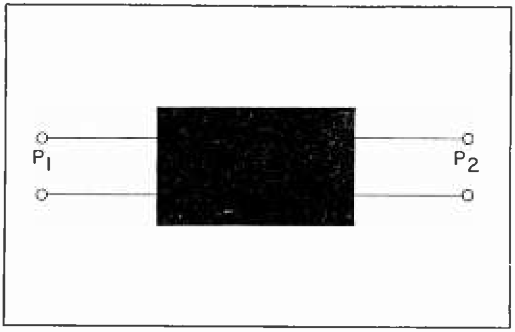

FIG. 1. Amplifier or network having an input of P_1 and output of P_2.

DB Loss

Many times we find a minus sign in front of a decibel figure. This simply means that there is more power going in than coming out. Now let's say that our "black box," Fig. 1, is a filter network which reduces the undesired signal. In other words, P2 is less than P1. Let's say then, that P1 = 10 mw and P2 = 2 mw. Referring to Table 1 we find that for a power ratio $\frac{(P_L)}{(P_S)}$ of 10/2 = 5. A figure of 7 db is obtained. Since the power input is greater than the power output we say the circuit has a loss of 7 db or a —7 db gain.

Relationship to Noise Figure

Here again we are talking about a power ratio. The ratio is the noise power of the circuit in question as compared to the noise power of an ideal circuit. Ten times the logarithm of this ratio gives us the noise figure in decibels.

TABLE I

TABLE OF DECIBELS FOR POWER AND VOLTAGE RATIOS

DB	POWER RATIO	VOLTAGE* RATIO	DB	POWER RATIO	VOLTAGE* RATIO
1.0	1.26	1.12	6.0	3.98	1.99
1.2	1.32	1.15	6.2	4.17	2.04
1.4	1.38	1.17	6.4	4.36	2.09
1.6	1.44	1.20	6.6	4.57	2.14
1.8	1.51	1.23	6.8	4.79	2.19
2.0	1.58	1.26	7.0	5.01	2.24
2.2	1.66	1.29	7.2	5.25	2.29
2.4	1.74	1.32	7.4	5.50	2.34
2.6	1.82	1.35	7.6	5.75	2.40
2.8	1.91	1.38	7.8	6.03	2.46
3.0	1.99	1.41	8.0	6.31	2.51
3.2	2.09	1.44	8.2	6.61	2.57
3.4	2.19	1.48	8.4	6.92	2.63
3.6	2.29	1.51	8.6	7.24	2.69
3.8	2.40	1.55	8.8	7.59	2.75
4.0	2.51	1.58	9.0	7.94	2.81
4.2	2.63	1.62	9.2	8.32	2.88
4.4	2.75	1.66	9.4	8.71	2.95
4.6	2.88	1.70	9.6	9.12	3.02
4.8	3.02	1.74	9.8	9.55	3.09
5.0	3.16	1.78	10.0	10.00	3.16
5.2	3.31	1.82	20.0	100.00	10.00
5.4	3.47	1.86	30.0	1,000.00	31.60
5.6	3.63	1.91	40.0	10,000.00	100.00
5.8	3.80	1.95	50.0	100,000.00	316.00

*May be used only when input and output impedances are equal.

Transmission Lines and Boosters

Since the advent of directional television antennas we have become accustomed to seeing antennas listed with 5, 6 or 9 db gain. This seems to imply that we are getting some free power in the antenna some place. What is really happening is we are making an antenna more sensitive in one direction at the expense of sensitivity in other directions. In most cases the gain is relative to a half wave dipole while at times it is relative to a point source (antenna with equal response in all directions). A half wave dipole has a gain of 2 db over that of a point source.

A transmission line may be reduced to a simple network. For a given length, frequency and type of line, there will be a power loss. By taking ten times the logarithm of the sending end power to the receiving end power we will have the db loss of the transmission line, or this can be figured by using Table I.

Before going on, let us see how we can use what we have learned so far. Let us suppose that we have an antenna, amplifiers and lengths of transmission line in order to bring the signal from a remotely located antenna to the receiver. Let us also assume that a satisfactory signal can be obtained at the antenna with a simple folded dipole. When using ordinary flat twin lead there is a transmission line loss of 40 db for the particular length involved. To make up for this 40 db loss, two 20 db boosters may be used. If an antenna of 10 db gain and possibly a tubular twin lead with 10 db less loss is employed only 20 db booster would be needed. What we are saying is that in this case the db gains must add up to equal the db losses. In this way we can be certain of a good picture.

Voltage and Current Relationships

It is said earlier that equation (1) could be rewritten in a few slightly different forms. These new forms are derived by substituting the latter two fundamental power relationships in equation (1):

$$P = I \times E$$
$$P = E^2 \div R \qquad (2)$$
$$P = I^2 \times R$$

Skipping the mathematics involved our new equations are:

$$db = 20 \log \frac{E_L}{E_S} \qquad (3)$$

Here the E_L is the larger voltage while E_s is the smaller voltage.

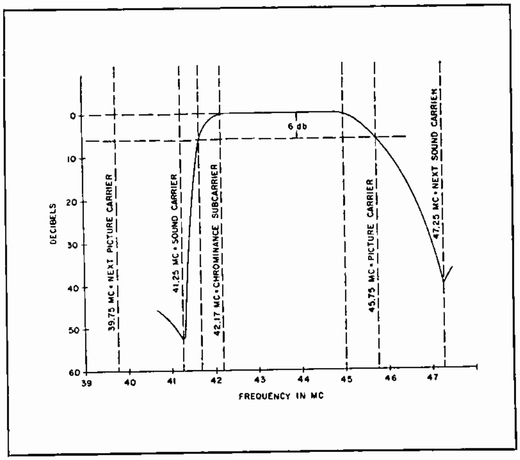

FIG. 2. Gain characteristic of color receiver IF Amplifier.

and

$$db = 20 \log \frac{I_L}{I_S} \qquad (4)$$

I_L is the larger current while I_S is the smaller current.

These two relationships, however, hold true only if the input and output resistances of the circuit with which we are working are equal.

Although the application of equation (3) is limited by the fact that input and output resistances must be equal it is still very handy. For example, if we have a booster with a 300 ohm input and output, the gain of the amplifier in db is simply 20 times the log of the input to output voltage ratio. Table I also includes voltage ratios for various db levels, thus eliminating the necessity of handling logarithms.

Response Curves

Fig. 2 shows the gain characteristics of a typical i-f amplifier of a color receiver. Note that the picture brightness carrier is —6 db. This means that the picture carrier power is one-fourth the maximum response of the amplifier. The chroma carrier is at zero db, that is, it is amplified fully, while the sound carrier is down 52 db (1/160,000 the power or 1/400 the voltage level).

The above method of describing the i-f response curve is also used to describe the characteristics of a video amplifier, a hi-fi amplifier or even a vacuum tube voltmeter.

Amateur Radio

At this point it is interesting to go back and think about some of the signal reports given out in amateur radio. "Your signal here Joe, is 10 db over S-9." This tells Joe that he may decrease his power a factor of 10. Since Joe is running 1 kw to the final, the signal report tells him that he may reduce his power to 100 watts and still have an S-9 (satisfactory) signal with a much reduced electric bill.

DBM

Occasionally one finds the use of dbm. This means decibel relative to one milliwatt power. Plus 30 dbm would then equal one watt of power while —3 dbm equals 0.5 milliwatt.

Microphone db ratings have not been standardized. For some, the zero db reference level is one volt at a sound pressure of one dyne per square centimeter while others use one milliwatt at 0.0002 dyne per square centimeter (threshold of hearing).

Conclusion

With practice and frequent use one will find the decibel a very convenient tool, i.e., it saves the handling of large numbers (50 db is 100,000 times), and many times, lengthy descriptions. Where a number of amplifiers and transmission lines are involved the overall performance is obtained by a simple algebraic addition.

LOGARITHMS

Editor's Note: For those who wish to go further into the basic equation for decibels, Mr. Boden has prepared the following review of logarithms.

Some people think that logarithm is a word, like calculus, used by teachers to scare little mathematicians. Fortunately, this is not so. Truly, logarithms are as simple as they are powerful. They were invented by a famous Scottish astronomer, Lord John Napier in 1614 and have been considered the greatest contribution to mathematics and mathematical sciences since the invention of the very numbers we use.

To explain logs, let us first observe that if we write 10^2 we mean 100 and that 10^3 is 1000 and so on. Also $10^1 = 10$. Now let us look at $10^2 \times 10^2$. By expanding the two squares and then performing the multiplication we have $10^2 \times 10^2 = 100 \times 100 = 10{,}000$. But, 10,000 is also 10^4. Now notice that John Napier noticed that by adding the exponents of the first two 10's we get the exponent of another 10 which is the answer. For example, $2 + 2 = 4$ or $10^2 \times 10^2 = 10^4$. In the same way

$$\begin{aligned} 10^1 \times 10^2 &= 10^3 \\ 10^1 \times 10^3 &= 10^4 \\ 10^2 \times 10^3 &= 10^5 \end{aligned} \qquad (1)$$

The point is that we performed multiplcation by doing addition. If we knew to what power to which we may raise 10 to get other numbers such as 2 and 4 then we could do any kind of multiplication we wanted by simple addition. Table II is a table of just such numbers. Table II is a table of powers to which 10 may be raised in order to give a certain number.

TABLE II

A SHORT TABLE OF LOGARITHMS

N	l	N	l	N	l
1.0	.0000	4.1	.6128	7.2	.8573
1.1	.0414	4.2	.6232	7.3	.8633
1.2	.0792	4.3	.6335	7.4	.8692
1.3	.1139	4.4	.6435	7.5	.8751
1.4	.1461	4.5	.6532	7.6	.8808
1.5	.1761	4.6	.6628	7.7	.8865
1.6	.2041	4.7	.6721	7.8	.8921
1.7	.2304	4.8	.6812	7.9	.8976
1.8	.2553	4.9	.6902	8.0	.9031
1.9	.2788	5.0	.6990	8.1	.9085
2.0	.3010	5.1	.7076	8.2	.9138
2.1	.3222	5.2	.7160	8.3	.9191
2.2	.3424	5.3	.7243	8.4	.9243
2.3	.3617	5.4	.7324	8.5	.9294
2.4	.3802	5.5	.7404	8.6	.9345
2.5	.3979	5.6	.7482	8.7	.9395
2.6	.4150	5.7	.7559	8.8	.9445
2.7	.4314	5.8	.7634	8.9	.9494
2.8	.4472	5.9	.7709	9.0	.9542
2.9	.4624	6.0	.7782	9.1	.9590
3.0	.4771	6.1	.7853	9.2	.9638
3.1	.4914	6.2	.7924	9.3	.9685
3.2	.5051	6.3	.7993	9.4	.9731
3.3	.5185	6.4	.8062	9.5	.9777
3.4	.5315	6.5	.8129	9.6	.9823
3.5	.5441	6.6	.8195	9.7	.9868
3.6	.5563	6.7	.8261	9.8	.9912
3.7	.5682	6.8	.8325	9.9	.9956
3.8	.5798	6.9	.8388	10.0	1.0000
3.9	.5911	7.0	.8451		
4.0	.6021	7.1	.8513		

For example, the log 2 = .3010. This then says that if ten is raised to the .3010 power it would equal 2. Now let us use logarithms to solve 2×4.

Referring to Table II and looking opposite 2 we see that its log is .3010. In the same way the log of 4 is found to be .6021. Since these two numbers are exponents we add them

$$\begin{array}{r} \text{Log } 2 = .3010 \\ \text{Log } 4 = .6021 \\ \hline .9031 \end{array} \qquad (2)$$

The sum is the logarithm of the number which is our answer or 8. Saying it another way, the antilog of .9031 = 8.

Let us now look at another example. Our problem now is 12×150. This time we have numbers for which we apparently do not have a logarithm. But, if you notice, we can rewrite both of these numbers

$$12 = 10^1 \times 1.2$$
$$150 = 10^2 \times 1.5$$

Also the log of 10 = 1 and the log $10^2 = 2$ so that from Table II

$\log 12 = \log 10 + \log 1.2 = 1 + .0792 = 1.0792$
$\log 150 = \log 10^2 + \log 1.5 = 2 + .1761 = 2.1761$
Adding we find that $1.0792 + 2.1761 = 3.2553$

Also from Table II we see that the log of 1.8 is .2553 and because our answer has a three in front of the decimal point we multiply 1.8 by 10^3 to obtain the answer of 1800.

Should it be desired to multiply several numbers together, one finds the log of each number, adds the logs of the numbers and then looks up the antilog of the total for the answer.

By the use of logs, division is also simplified. Briefly, to divide 12 by 2 one subtracts the log of 2 from the log of 12.

$$\begin{array}{r} \log 12 = 1.0792 \\ \log 2 = -.3010 \\ \hline .7782 \\ \text{Antilog } .7782 = 6.0 \end{array}$$

In the above we have used 10 as our number to be raised by certain powers. When we do this our system is termed "to the base 10" and is written $\log_{10}$. When used with decibels the base is always 10. When it is understood to be to the base 10 the 10 may be omitted.

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HELP WANTED

Mike & Jerry TV, Inc., 3114 E Princess Anne Road, Norfolk 12, Virginia, wants a fairly good TV benchman. They would like to fill this position as soon as possible so if interested write to or contact in person the Secretary-Treasurer, Mr. Mike Koerin at the above address.

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Listen Americans!

(Continued from page 9)

totalled $508 billion. In spite of the belief of some people (and the propaganda) that profits run 12, 15, 25 and 50 per cent—the fact is that the profit on this $508 billion in sales amounted to 3.3 per cent.

The alternative to the profit system is Socialism—with its loss of freedom and drastically lower living standard. We should all understand these and other facts about our profit system—and be strongly for it.

J. G. Dodgson

How to Build An Intercom

By J. G. DODGSON
NRI Consultant

Intercom systems provide a convenient means of communication between two (or more) rooms in the home, office or short distances out-of-doors—a sort of "private telephone."

Although it is advisable for a serviceman to use commercial type intercoms for any professional installations, he may wish to build one for his own use. An intercom can be very handy in TV antenna installations to provide "roof-to-receiver communications" or it can be used between the front counter and bench in a service shop.

Besides the familiar inter-office use where they provide efficient and inexpensive service, intercoms can be employed in various ways in the home.

Probably their most familiar use in the home is to furnish a convenient means of communication between the workshop, garage or "ham shack," and the kitchen, or some other central point of the home. Another application is to place the remote station outside the front door and to have the master station at some central location in the home. There is probably no better way of discouraging a "high pressure salesman"!

Intercoms can also be used advantageously as "electronic nurses" by placing a remote station over the baby's crib or in the nursery and the master station in the main bedroom.

A wired intercom system is a comparatively simple device. It consists of one master station and one or more remote stations. The master station contains a loudspeaker, which is also used as the microphone, an audio amplifier, and a special switching system. The switching system provides for the amplification of either the incoming signal from the remote station or the outgoing signal of the master station—depending on who is talking and who is listening.

The remote station is comprised of only a loudspeaker connected to the master station with a two conductor transmission line.

"Build It Yourself"

First of all, let us consider the disadvantages of building your own intercom. The primary disadvantage is that it is probably going to cost more money to build your own intercom than it would to purchase a factory-built unit of the same type or an intercom kit. It is generally impossible to save any money building your own electronic equipment unless a kit is purchased. The tremendous purchasing power of

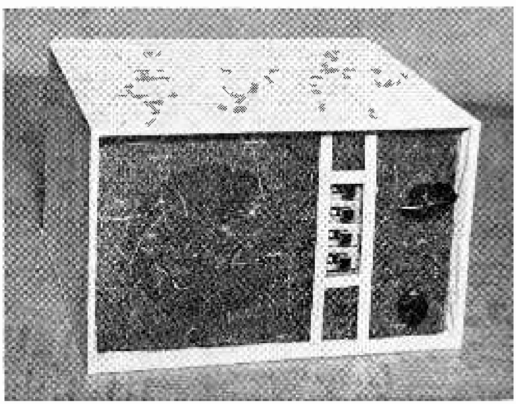

Fig. 1. Completed intercom.

large kit manufacturers permits these companies to purchase components at an unbelievably low price as compared to standard wholesale cost. Thus, the manufacturers can offer kits (and even factory-built units) cheaper than most people could buy the parts for them. Usually, the only time any money is saved in building your own equipment is when you happen to have a considerable number of "junk box" components that can be used in the equipment.

There are, of course, some advantages to building your own electronic equipment. The chief advantage, perhaps, is the personal satisfaction which cannot be measured in dollars and cents. Another definite advantage is that the equipment can be designed to suit one's own purpose. Not only can the exterior be customized to fit the personal taste of the owner but the electronic operation can also be altered (to a degree) to what the owner considers most convenient and desirable. Furthermore, there can be some advantage in ease of maintenance and repair gained by building your own. By actually as-

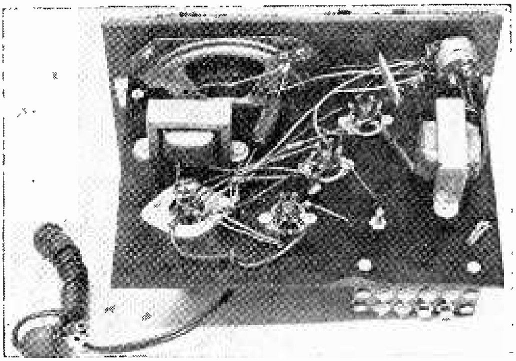

Fig. 2. Bottom view of chassis.

sembling each stage of the equipment, little trouble is wasted in trying to figure out which part is which when it breaks down—and all equipment, no matter how carefully built, will eventually become defective!

Fig. 4 shows the master station of a simple ac-dc type intercom. Notice that it consists of a two stage RC coupled amplifier and the switching system provides for four remote stations. The main "listen-talk" switch is shown in the listen position—the normal position since it is spring loaded. The switches to the remote stations which are labeled S2 through S5 are all shown in the closed position which indicates that all remote stations are being "monitored." This actually is not the normal situation since all of the remote stations would seldom need to be monitored at the same time. For example, should a speaker be placed outside the front door, it

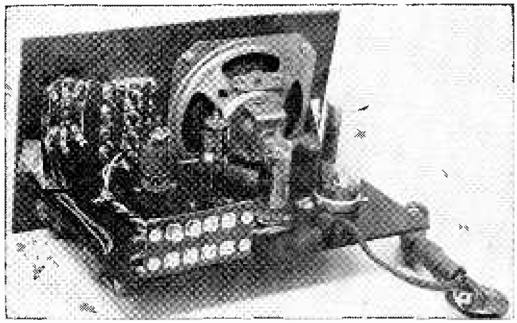

Fig. 3. Top view of chassis.

would not usually be put in operation until someone actually knocked on the door or rang the bell. Similarly, there would be little need to monitor a speaker in, say, the recreation room when no one would be in there.

Normally, as mentioned above, the listen-talk switch of the master station is kept in the listen position and the switches S2 through S5 are closed according to the remote speakers that are desired to be monitored. Then, should anyone speak into one of the remote station speakers, the speaker would act as the microphone and generate an electrical signal which would be fed through the two conductor transmission line to the master station. This signal would pass through its corresponding switch (S2 through S5), through the bottom portion (S1B) of the listen-talk switch and to the primary of the input transformer T1. The signal would then be transferred to the secondary winding by transformer action causing a signal current to flow through this winding. The voltage drop across the winding becomes the grid signal voltage for the 12BA6 tube. An amplified version of this signal from the tube appears across the plate load resistor in the printed circuit (couplate) and is passed through the coupling condenser which is also in the couplate and consequently through the volume control R1 to ground. The voltage between the center tap or slider of the volume control R1 and ground becomes a signal voltage for the 50C5 tube. The amplified version of this signal from the 50C5 appears across the primary of the output transformer T2 and consequently across the secondary winding.

With the listen-talk switch in its normal listen position the signal appearing across the secondary of transformer T2 is fed, by the top section of the switch (S1A) to the loudspeaker in the master station and is thus converted to audible sound.

With the listen-talk switch in the talk position, the loudspeaker in the master station becomes the source of signal which is fed to the amplifier stages. The output signal from transformer T2 is, however, fed to the remote stations instead of to the loudspeaker in the master station. Of course, the position of switches S2 through R5 determines which remote stations receive the signal. Should all the switches be closed then, naturally, all the remote stations will "hear" the master station.

Since B— in the unit connects directly to one side of the power line it is important to isolate the switching system, and thereby the transmission line from B—. Otherwise, with the power cord plug in the outlet "the wrong way," the transmission lines to the remote stations would be shock and fire hazards. This isolation is accomplished by connecting all of the normally grounded points in the switching system together and connecting this common junction to B— through a condenser (C4 in Fig. 4). As can be seen in the schematic the normally grounded points are one lead each of the input transformer, output transformer, and loudspeaker as well as one terminal of each of the remote station output terminal strips.

Notice that the amplifier and its power supply are simple straightforward stages except, perhaps, for the printed circuit type couplate. The use of this couplate reduces the cost of the unit and simplifies the wiring. These units also seem to stand up better than individual components. The small size of the couplate is not important since there is no great need to miniaturize the master station.

The printed circuit couplate does have some minor disadvantages, however. First of all, it reduces the maximum gain that could have been obtained with the 12BA6 stage if individual parts were chosen. However, even with this reduction the voltage gain is still somewhat over 50 and is more than enough. The over-all voltage gain of the amplifier, by the way, is about one thousand. Another disadvantage of the couplate is that it was designed for battery type tubes and the built-in grid resistor (for the output stage) is very high, which would in normal circumstances cause grid current in the output stage. However, this high grid resistor can be ignored since it is connected in parallel with the volume control thereby lowering the over-all resistance and eliminating any possibility of grid current.

The power supply is of the ac-dc receiver variety employing a 35W4 half-wave rectifier tube. The small 22-ohm, ½-watt resistor connected between the center tap of the 35W4 heater and plate acts as a protection against surges. The filament voltage dropping resistor R2, of course, reduces the filament voltage for the tubes. Notice that the on-off switch is located in the B+ line and opening it (turning the unit off) merely prevents B+ from being applied to the tubes. The tube heaters remain lighted as long as the unit is plugged in. This method eliminates the annoyance of waiting for the tubes to heat up after the unit is turned on (since it would probably be turned off at night, when no one is home, etc.). In addition, tubes tend to last longer this way, since it is the surges of current through the heater wires that weaken them. The on-off switch is, of course, the regular ac switch on the volume control.

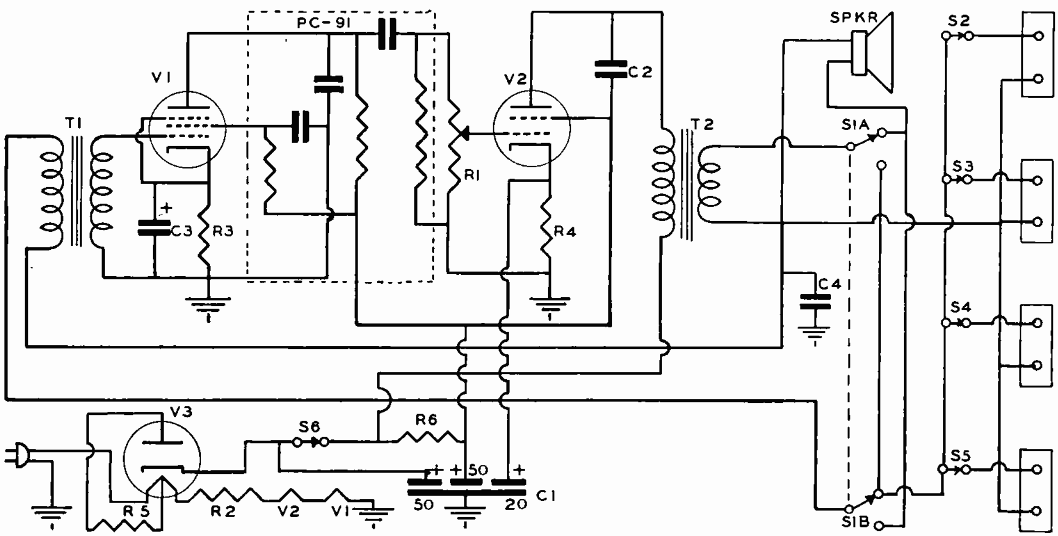

Fig. 4. Schematic of Master Station.

The two 50-mfd (150-volt) sections of the three section filter condenser (C1) are used to provide filtering while the 20-mfd (25-volt) section is used as a cathode bypass condenser for the 50C5 output stage. The 2200-ohm, ½-watt resistor R6 along with the filter condensers provide sufficient filtering. Notice that the plate supply for the 50C5 tube is connected to the input of the filter while the plate supply for the 12BA6 tube is connected to the output in the filter. Even though the ripple voltage at the input filter is applied to the plate circuit of the 50C5 tube, hum is not objectionable because pentodes have little change in plate current due to plate voltage variation and since the low frequency response of the unit is seriously limited by the output transformer T2 and the 4-inch loudspeaker. Keep in mind that an intercom, like a telephone, is required only to pass "voice frequencies" which fall approximately between 500 and 3500 cycles. This intercom, incidentally, actually does have a much better response than a telephone enabling it to sound more natural.

Construction of the Master Station

Although most electronic devices like intercoms are built on aluminum chassis, the author chose a bakelite chassis for this unit for several reasons. First of all, bakelite can be easily worked with few tools eliminating, for example, such tools as expensive chassis punches that are normally used to cut tube socket holes. The tools used by the author consisted of a small keyhole saw, a hand drill, a few small drill bits, and a reamer. The only large holes in the bakelite chassis are for the tube sockets and the electrolytic condenser—these were first drilled and then enlarged with the reamer.

The loudspeaker hole and remote station switch holes on the front panel of the master station were cut with the keyhole saw. The panel is made from ⅛-inch masonite. All of the other small screw holes in the masonite panel and the bakelite chassis were cut with the drill bits.

Although bakelite is very easy to "work" with hand tools—an electric drill should not be used. The heat caused by the high speed tends to melt the bakelite and "gum up" the drill bits. Incidentally, the drill sizes needed are: No. 28 for the 6-32 screws; No. 33 for the 4-40 screws; and for the particular reamer used, a ¼-inch drill was necessary for the "starting" hole. Although 4-40 screws are usually needed for miniature tube sockets, any size can be used for the transformers, speaker, etc.

The bakelite chassis is attached to the masonite panel with two small angle braces made from very thin aluminum. Wood blocks or any handy material would serve just as well. The chassis itself is self-supporting by virtue of the fact that both the input and output transformers were placed on the bottom to act as legs.

Figs. 2 and 3 show the general construction of the master station and indicate the layout of the main components.

The wiring is not at all critical providing the usual precautions are taken, such as keeping grid and plate leads apart to prevent oscillation, keeping grid and filament leads apart to prevent hum, etc. Due to the high gain in the first stage and the relatively low signal input, it is best to keep it a reasonable distance from the power supply components. It is also well to keep the input transformer away from the output transformer for this same reason.

As the experienced electronic experimenter well knows, it isn't difficult to build such equipment as this intercom from magazine articles. There are, of course, some "tricks of the trade" which, as usual, are generally learned the hard way. The layout indicated in the author's unit should not be considered as the only or best and of course would probably need to be changed according to the types and size chassis chosen by the builder. However, if the chassis size or shape is changed it is well to plan the layout before any work is actually done. This can be easily done by using a piece of paper, the same size as the chassis, and placing the components on the paper. The various parts can then be moved around to the seemingly best possible positions keeping in mind the above mentioned "usual precautions." The position of the parts can then be roughly marked on the paper and the mounting holes for tube sockets, transformers, terminals strips and other such parts can be indicated by using the parts themselves, as templates. The positions of the interconnecting wires (B+, filament, etc.) can also be sketched. The final "paper plan" can then be taped to the chassis for the drilling and cutting. It should, of course, be removed before the parts are attached to the chassis.

Even this "dry run" method is not foolproof. You will almost always find, during the actual construction, that a slightly different arrangement would have been better so far as ease of construction is concerned.

By the way, one sure way of looking for trouble when building equipment is to use a chassis that has previously been planned for some other equipment, such as an old radio chassis. Although the already cut holes do eliminate some work and save the cost of a chassis, the holes predetermine a layout which cannot be the best and may even be disastrous. It is sometimes possible to choose a scrap chassis that will work out, but experience has shown that it is well worth purchasing a new one and starting fresh. Chassis bases for such home construction are available from most radio jobbers at very reasonable prices. For example, a 1½ x 8 x 4½ aluminum open-end chassis (ICA No. 29000) suitable for this intercom would cost less than one dollar. Most wholesalers and mail order houses carry a great deal of materials and tools for the do-it-yourself fans.

Notice that the filament voltage dropping resistor is shown on top of the chassis. A wire-wound resistor of the type having a hollow center was chosen and a large bolt put right through the center of it holding it to the chassis in an upright position. By doing this, any heat dissipated by the resistor is on top of the chassis away from the small components where it might cause damage.

One other advantage of the bakelite chassis in an ac-dc type unit is that the chassis itself is not "hot" since it is an insulator rather than a conductor. However, since the chassis cannot be used as a ground point, separate leads must be run for grounds. To prevent any hum which might be caused by ground loops, there are only two actual ground points in the entire chassis. The main ground point is at the electrolytic condenser negative terminals and the other ground point is the grounded side of the volume control. Furthermore, a heavy piece of No. 10 bus bar interconnects these points to eliminate any possibility of ground loops. All of the ground connections in each stage should be connected to either one of the ground points.

The cabinet for the unit is constructed of ⅛-inch masonite and is glued together with the aid of some wooden blocks. The wooden blocks are so placed that the front panel and chassis (which are attached together) can be slid into the front of the cabinet up to the wooden blocks. Since it is a very snug fit, no other method of attaching the chassis (and front panel) to the cabinet was needed.

The cabinet itself is covered with a plastic material called "Contact" which is available at some radio wholesalers, department stores, and even in some grocery stores. The front panel of the master station is covered with plastic grille cloth which is available from radio wholesalers or mail order houses. This grille cloth was stapled to a piece of cardboard which was in turn glued to the masonite.

Of course, the cabinet, front panel, and chassis could be constructed of almost any material. If the chassis is constructed of metal, keep in mind that the chassis itself should not be used as B— for safety's sake due to the ac-dc circuitry. If a wooden cabinet is chosen it could be varnished or painted just as easily (well, not quite!) as being covered with "Contact." One advantage of the plastic material is that the cabinet need not be so carefully built and finished. Both this plastic material and the heavy plastic grille cloth have proven quite a boon to technicians that find themselves much handier with a soldering iron than with a saw. It has been known that some wives unfairly make unkind remarks about their husbands' electronic marvels just because of some sloppy wood-work, bare chassis, gleaming tubes, etc.!

Checking and Troubleshooting

It is usually necessary to enlist someone to check the unit after it is built. The master station must be in a different room than any remote stations or audible feedback will cause howling. This can also occur in adjacent rooms when the volume control is set up too high. If, for some unforeseeable accident, the device does not work after it is built, troubleshooting is not difficult. Just keep in mind that the master station is only a simple two-stage RC coupled amplifier with a special switching system. Circuit disturbance, signal injection, etc., and other such methods are readily adaptable to track down any trouble. Due to the high gain of the unit, hum is particularly troublesome and can usually be traced to defective filter condensers, cathode-to-heater leakage in the tubes, and wiring that is not particularly neat.

Needless to say, wiring errors can cause considerable difficulty. It is not particularly difficult to wire the switches incorrectly which can cause all sorts of weird troubles or to completely reverse the connections on the input transformer which drops the gain to about nothing. A defective component is not too hard to obtain at a wholesaler's and a poor ground connection can cause unbelievably loud hum.

The operating voltages shown on the diagram of Fig. 4 will vary somewhat according to the parts tolerances, line voltage, and tester accuracy. Due to the high resistor values in the plate and screen circuits of the 12BA6 stage, you'll notice the voltage values are quite low. Even lower values will be obtained if a VOM is used instead of a VTVM.

Who knows, you may find that it works the first time; or on the other hand, you may join the great majority of us and find, after some difficulty, a wiring error, poorly soldered connection, defective components, or any of the other reasons for gray hair!

As previously pointed out, all of the components used in the article are available from your local radio wholesaler or a mail order house; they are not available from NRI.

The loudspeaker is not included in the parts list on the following page. Any four or five inch with a 4 ohm voice coil is suitable. Incidentally, all resistors except R2 are ½ watt.

Parts List

V1	12BA6
V2	50C5
V3	35W4
T1	Input transf. 4 Ω to grid Stancor A-4744
T2	Output transf. 2500 Ω to 4 Ω
PC-91	Centralab couplate
S1	DP-DT listen-talk Centralab 1464 (see text)
S2-S5	SP-ST station selector
C1	Electrolytic filter capacitor 50-50-20/150-150-25 Mallory FP 311
R1	500K volume control with switch (S6)
R2	150 Ω, 10-watt
R3	6.8K
R4	150 Ω
R5	22 Ω
R6	2.2K
C2	.002 mfd
C3	10-mfd, 25-volt elect.
C4	.05-mfd, 200-volt

OPERATING VOLTAGES (SEE TEXT)

	12BA6	50C5
Plate	27	100
Screen Grid	5	106
Cathode	.8	7

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"REPROCESSED TUBES"

The December-January, 1955-1956, issue of the National Radio-TV News reprinted an article from Electronic Technician magazine entitled "The Reprocessed Tube Racket".

Since this practice was exposed, a grand jury in New York returned 18 indictments against 13 individuals for fraud in bilking the public and tube manufacturers. The defendants are alleged to have re-branded faulty receiving tubes with in-warranty codes and returned them to the manufacturers for new tube replacement.

One tube manufacturer reports that he lost $1 million dollars in one year this way. It would be interesting to find out just how many dollars Radio and TV Technicians lose by purchasing thirty-nine cent "bargain" tubes when they think they are getting new tubes.

All Radio-TV Servicemen should be on their guard to avoid being defrauded in this manner, thereby discouraging the practice itself.

Civil Service Announces Examinations for Electronic Technicians and Radio Broadcast Technicians

Electronic Technicians: Positions are for duty with the Civil Aeronautics Administration in Alaska. The starting salaries are $4,080 and $4,525 a year plus 25% cost-of-living differential. No written test is required but applicants must have had appropriate experience or a combination of education and experience. Full information regarding the requirements is contained in the announcement. If interested, write to the U. S. Civil Service Commission, Washington 25, D. C. and request Announcement No. 11-101-2(57) issued April 9, 1957.

Radio Broadcast Technicians: Positions are with the International Broadcasting Service (Voice of America)), U. S. Information Agency, Washington, D. C. Starting salary is $5,915 a year. To qualify, applicants must have had appropriate experience and pass a written examination. No maximum age limit. For additional information, write the U. S. Civil Service Commission. Specify Announcement No. 98B issued January 29, 1957.

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Answers to Technical Ramblings Quiz

(a)
$P = EI$
$P = 50 \times .002$
$P = 0.1$ watts

(b)
$P = E^2/R$
$P = 50 \times 50/22{,}000$
$P = 0.113$ watts or 0.11 watts

(c)
$P = I^2R$
$P = .002 \times .002 \times 22{,}000$
$P = .088$ watts or .09 watts

This inaccuracy in this computation occurs because the resistance is inexact in terms of the assumed voltage and current.

In each case, however, the power works out to be about 0.1 watts. The closest commercially available wattage rating is ½ watt.

The screen bleeder problem:

$P = E^2R$
$P = 175 \times 175/25{,}000$
$P = 30{,}625/25{,}000$
$P = 1.2+$ watts

The closest, higher commercially available wattage rating is 2 watts, but a 3-watt resistor would be better.

—— n r i ——

He who thinks he can live without others is mistaken. He who thinks others cannot live without him is even more mistaken.

Technical Ramblings

By B. VAN SUTPHIN

NRI Consultant

Subject: Ohm's Law

Electronics, Radio, and Television, no less than all the sciences, has its basis in mathematics. This doesn't mean that every person working with electronic equipment must have college training in mathematics, two slide rules and an electric calculator. But it does mean that an understanding of electrical laws and computation using those laws will be helpful.

Now don't start screaming, "But I don't like math," and throw the magazine in the corner. This discussion is going to be almost painless.

Fig. 1 shows Ohm's Law in a convenient, easy-to-handle, easy-to-remember form. Standard symbols—E for voltage, R for resistance, and I for current—are used. To prevent confusion, it is best to keep the units in their basic quantities —*volts, ohms,* and *amperes.*

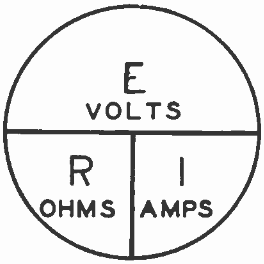


FIG. 1

Suppose you know the ohmic value of a resistor and the current through it, and want to know the voltage drop across the resistor. On Fig. 1 cover the voltage symbol, E, with your finger. Read the two remaining terms, RI. This shows you that the voltage, in *volts,* equals the resistance, in *ohms,* times the current in *amperes.* E = RI.

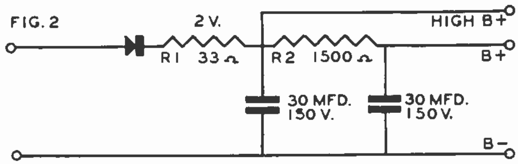
Suppose you know the voltage and the resistance, and need to know the current. On Fig. 1, cover the current symbol, I, with your finger. Read the two remaining terms, E/R. This shows you that the current, in *amperes,* equals the voltage, in *volts,* divided by the resistance, in *ohms.* I = E/R.

When the voltage and current are known and the resistance must be determined, cover the resistance symbol, R, with your finger. The two remaining symbols show you that the resistance, in *ohms,* equals the voltage, in *volts,* divided by the current, in *amperes.* R = E/I.

By now, you are probably muttering to yourself, "All this is fine, but what does it mean to me in servicing sets?" I am coming to that.

Suppose you want to know the current through resistor R1 in Fig. 2. You know the resistance value, 33 ohms, and the voltage across the resistor, 2 volts. Using Ohm's Law, you find the current to be 0.061 amperes. Moving the decimal point three places to the right converts the reading into milliamperes, 61 milliamperes. This is about the normal current drain from the power supply circuit of an ac-dc receiver.

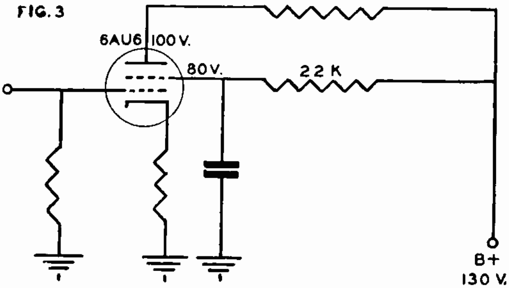
FIG. 2



Now consider Fig. 3. Suppose you want to know what value screen resistor to use in the circuit. You know that the voltage drop across the resistor must be 50 volts, 130 volts —80 volts. From the tube manual you know that the normal screen current is 2 milliamperes. (Moving the decimal point three places to the *left* gives you the current in amperes, .002 amperes.) Using Ohm's Law, you find that the screen resistor must be 22,500 ohms. This checks with the value given in the schematic, 22,000 ohms.

Now you can point out that such computation is unnecessary since the part value is marked on the schematic. You are right. But consider that knowing Ohm's Law you can quickly determine what effect an increase, or a decrease, in screen current would have assuming that the resistor value remains constant. An increase in current would mean increased voltage drop across the resistor and decreased voltage at the screen grid. Conversely, a decrease in screen current would

FIG. 3



mean decreased voltage drop across the resistor and increased voltage at the screen grid.

Now let's look at a formula that you will use for actual computation much more often, the formula for computing power. Through the ohmic value of resistors is generally given on schematics, the wattage ratings often are not given.

The Power Law formula given in Fig. 4 works just like the Ohm's Law formula given earlier. Cover the term that you need to know with your finger, and read the other two. For example, P=EI, E=P/I and I=P/E. Also, notice that the additional terms are given so that the power can be determined when only the resistance and the current are known, or when only the voltage and the resistance are known. It is not necessary to go through the additional computation of computing the unknown term and then computing the power.

Consider that you need to know the required power rating for resistor R1 in Fig. 2. You know the resistance and you know the voltage drop across the resistor. On Fig. 4, cover the power symbol, P, with your finger. Read those parts of the rule that give the power in terms of the voltage and resistance. You find that P = E x E/R. In other words, P = E^2R. Applying this to the resistor, gives you 2 x 2, which equals 4, divided by 33. Therefore, the actual power dissipated in the resistor will be 0.12 watts. The actual resistor could be a one-half watt unit, or a one-third watt unit depending on which was most readily available.

Computing from the voltage drop across the resistor and the current flow through the resistor, you arrive at exactly the same value. Also, you could arrive at the same value by computing from the resistance value and the current.

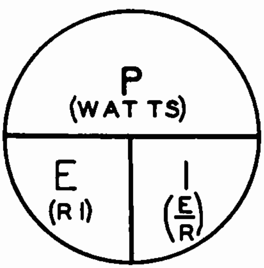


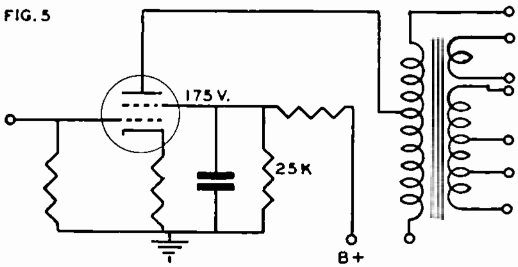
FIG. 4

When replacing resistors, you should always allow a safety factor in the wattage rating. Generally a 50% safety factor is sufficient. If your computations indicate that the actual power dissipated is 1 watt, use a 2-watt resistor.

Armed with this information, compute the power dissipated in the screen resistor for the 6AU6 stage shown in Fig. 3. What commercially available wattage rating resistor would you use in this circuit? The answer, worked out a number of different ways, is given on Page 19.

Another one: Consider a screen bleeder-resistor connected as shown in Fig. 5. The screen voltage—existing across the bleeder-resistor—is 175 volts and the resistor value is 25,000 ohms. What is the current through the resistor? How much power is dissipated in the resistor? What commercially available wattage rating should be used? Answers on Page 19. Don't peek!

FIG. 5



Now this little discussion wasn't so painful, was it? If you like this type of discussion, complete with questions and answers, write in and tell us.

Though we normally try to "steer clear of" question-and-answer columns in *National Radio-TV News,* we feel that you, our readers might enjoy these chances to "sharpen your wits" with practical problems.

A final point: Some resistor manufacturers sell Ohm's Law Calculators that servicemen often find handy. Your local wholesaler, or mail order supply house, will probably be able to supply them. I keep one in my desk and use it often.

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Color Continues

According to NBC, there are now 257 stations equipped to transmit color programs. 136 of these are said to be tied into the network and able to serve about 96% of the total number of TV homes in the country. This number of network stations is a 30% boost over one year ago and is expected to increase to about 153 by the first part of 1958.

SWEEP GENERATORS

By B. VAN SUTPHIN

NRI Consultant

B. van Sutphin

Since the TV receiver has become as much a part of the average American home as the kitchen stove and the living room sofa, a whole new line of test equipment has become necessary in the service shop. Much of this "new" test equipment has been directly transplanted from the experimental laboratory where it has been used for a number of years. Typical examples are the oscilloscope and the sweep generator.

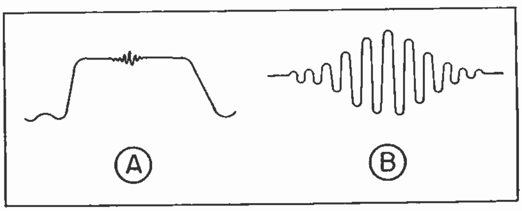
By now, the oscilloscope is rather common and the purpose of the instrument is generally understood. The sweep generator, however, is a little less common and there is still some confusion regarding what it is, what it does, why it is necessary, and why other equipment must be used with it. Let's explore this topic.

What is a sweep generator? It is a signal generator whose output is swept back and forth over a range of frequencies on each side of a tunable operating or center frequency. The range of frequencies over which the oscillator is swept can be varied, and the center frequency can also be varied by adjusting the controls on the instrument.

When this sweep signal is fed to the receiver rf or i-f stages, an oscilloscope is connected to the detector load, and the electron beam in the scope is moved back and forth at the same rate as the sweep in the generator, the curve traced on the screen of the scope will be a representation of the receiver response. Any humps or dips in the receiver response will show up as humps or dips in the curve traced on the scope.

Why is a sweep generator necessary? A sweep generator is necessary in television alignment because the video i-f circuit of a TV receiver must have response at a wide range of frequencies—not just a single frequency—and with an oscilloscope, you can see the video i-f response curve, or the over-all rf and i-f response curve of the receiver. Then you can compare the response curve actually obtained with the curve shown in the manufacturer's information and quickly detect any irregularities in the response. Without a sweep generator, it would be necessary to plot the curve on graph paper.

What features must the sweep generator have? First, it must cover the frequency range used in the i-f and rf circuits of TV receivers—with the exception that it need not cover the UHF range. (Because of design limitations, circuit response at the higher frequencies is extremely broad, and any defect that would upset the response would first show up as some other defect.) Second, it must have sufficient output to give a trace of reasonable size on the scope. Third, it must have constant output over the swept range. And fourth, it must be easy to



adjust and use. All these points are of about equal importance.

Why must a marker generator be used with the sweep generator? The response at certain individual frequencies, in addition to the over-all shape of the response curve, is important. To accurately determine these points on the curve, a precisely calibrated marker generator must be used. By mixing the marker signal with the sweep signal, a "pip" appears on the response curve indicating the marked frequency. By noting the position of the "pip" on the response, you can easily determine the circuit response at that particular frequency.

Fig. 1A shows the appearance of the marker "pip" on the response curve. If a wide band oscilloscope is used in alignment work, the "pip" may appear as shown in Fig. 1B. To sharpen the marker "pip," reduce the scope band width by connecting a .005-mfd condenser across the scope input terminals. Using a shielded direct probe—or even better, a resistor isolated probe—with this scope will also sharpen the "pip." In each case, the probe acts as a low-pass filter, taking out the higher beat products and thereby making the "pip" narrower.

Now, the subject of inter-connecting the instruments used in sweep alignment. Proper "bonding" is extremely important. Without it, the curve obtained may not be a true representation of the response. At the higher frequencies used in TV receivers, even a length of wire has appreciable reactance and for that reason, straps of metal braid, rather than lengths of wire, should be used to inter-connect the instrument and the receiver.

In the early days of television, benches with grounded metal tops were recommended so that setting the individual units on the bench would inter-connect them. With so many transformerless sets having the power line connected directly to the TV receiver in use now, however, this is no longer recommended and would in fact be dangerous.

The test equipment manufacturers have come up with an easy solution to the problem of bonding the sweep generator and the marker generator together. Mount both instruments in the same cabinet, and build them on the same chassis. There are commercial instruments available that are constructed in this manner.

For the serviceman who already has a good rf signal generator with accurate calibration, however, it is generally best to purchase a separate sweep generator without the marker generator built in. For example, those persons who already have the Model 89 Professional Signal Generator might want to use that instrument as the marker, and purchase a separate sweep generator. If separate instruments are used for the sweep and marker functions, be very careful to bond them together, and bond them to both the TV chassis and the oscilloscope securely.

Who needs a sweep generator? At one time or another, every TV serviceman encounters a problem where he could use a sweep generator to advantage. This does not mean, however, that the beginning TV serviceman must have a sweep generator before he checks the first set. It does mean that he should keep the instrument in mind with the idea of buying it in the future.

When should the TV serviceman buy a sweep generator? Only after he has the basic stock of instruments—for both radio and TV servicing, this would include vtvm, signal generator, tube tester and scope. Even then, he must remember that the instrument cannot, and will not, pay for itself until the serviceman has gained skill and experience in sweep alignment.

What is the *most important* single point about sweep alignment? It is using care in inter-connecting the equipment? No. Is it taking care not to overload the circuit under test thereby giving inaccurate response curves? No. Those points are important, but the most important single point about sweep alignment is: Study the instruction manual carefully—every page—and practice using the instrument until you are so familiar with the controls and their functions that setting them is almost as natural as reading a watch, or tying your shoestring.

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DUMONT HAS AUTOMATIC "DIAL-DIRECT" MOBILE RADIOTELEPHONE SYSTEM

The first completely automatic "dial-direct" mobile two-way radiotelephone system has been made available by DuMont.

The unique system allows phone calls to-and-from vehicles to be relayed, completely unattended, through local telephone systems.

Reduced costs to the user, because of the automatic features, greatly expand the potential application of such equipment. Unlike other radiotelephone systems, it operates on a tweny-four hour basis and no manual operators are required.

Calls are made from a vehicle by simply dialing a number within a local telephone system; also, anyone within that system can call the vehicle in the same manner as when making a house-to-house call. Only when placing a toll call must the long distance operator be contacted.

N.R.I. ALUMNI NEWS

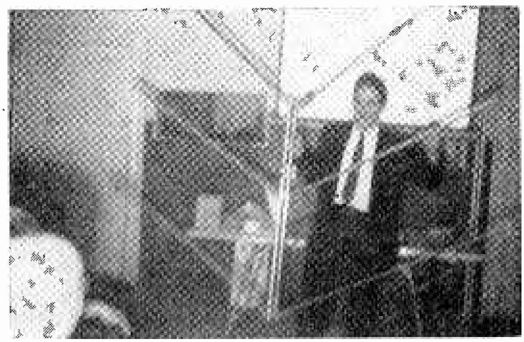
Elmer E. Shue .... President
F. Earl Oliver .... Vice Pres.
John Babcock .... Vice Pres.
William Fox .... Vice Pres.
Joseph Stocker .... Vice Pres.
Theodore E. Rose .... Executive Secretary

Chapter Chatter

Philadelphia-Camden Chapter has notified National Hedquarters of five new members, to whom we extend a hearty welcome: Henry Piotrowski, Graduate, Philadelphia; Marion N. Nelson, Student, Philadelphia; William Blum, Student, Fort Washington; David Williams, Associate Member; Robert Wright, Associate Member; and John Ross, Jr., Graduate of the Servicing Appliance Course.

Maintaining its usual full-steam-ahead program of activities, the Chapter reports a number of guest speakers since the last report published in the April-May issue. Among these were Richard Deutsch, Sales Engineer of Channel Master Corporation; Harry Fallon, Sales Manager of Radio Electric Service Company of Pennsylvania, sole distributors of Channel Master Antenna for Philadelphia; Sy Gershwer, District Sales Manager for Radio Electric Service Company. Mr. Fallon gave an excellent talk on the Channel Master Antenna, presented the Chapter with a seven-element TW Channel Master Antenna and donated two Showman indoor antennas as door prizes. In addition Mr. Fallon has put all members of the Chapter on his mailing list to receive announcements of new items or specials offered by the Radio Electric Service Company. He expressed his satisfaction with attendance at the meeting and with the willingness of the members to learn all they could about Radio and Television.

Floyd Myers, Service Manager of the Stuart Lockheim Corporation, holding a Zenith "Space Command" chassis, on which he delivered a talk at a recent meeting of the Philadelphia-Camden Chapter.



Dick Deutsch holding a three-element TW Channel Master Antenna.

Present at another meeting were Mr. Ernie Stuchell of E. D. Lowery, Inc., distributor of Win-Tronix Electronic Instruments manufactured by the Winston Electric Company. With Mr. Stuchell was Mr. Pete Pettie, Sales Manager of Winston Electronics; Mr. Ed Stepler, Sales Manager of Almo Radio Company, Philadelphia distributors for Win-Tronix; and Mr. Jim Daly, who is in charge of sales and service for Almo. Mr. Daly delivered the main talk of the evening. There was a Muntz TV receiver on display and he went through all the instruments he had with him, explaining how each one was used to the best advantage. He also had a Color Bar and Dot Generator which he showed how to use and he applied it to the black and white set. The Win-Tronix representatives gave each member a high voltage condenser that they make and the Almo representatives gave each member a memo pad with a sort of wallet combination encased in leather or plastic. The membership was very appreciative of the talks and demonstrations and the gifts.

Along with one or two other chapters, the Philadelphia-Camden Chapter is going to undertake the construction of a TV Demonstration Panel. But at the moment they are handicapped with the lack of space for storing it. A committee is going after this problem with the usual energy of the Philadelphia-Camden Chapter and will undoubtedly find a solution to this problem.

Left to right: Harry Fallon, Dick Deutsch, and Sy Gershwer.

The Chapter is also laying plans for its annual June Party, which is quite an event and one that no member should miss if he can possibly help it.

The Chapter will welcome visits from NRI students and graduates who are not now members. Get in touch with secretary Jules Cohen, 7124 Souder St., Philadelphia, Pa. Meetings are held on the second and fourth Monday of each month at the Knights of Columbus Hall, Tulip and Tyson St., Philadelphia.

Flint (Saginaw Valley) Chapter reports that it is growing considerably through the graduation of students who become members of the Alumni Association and of the Flint Chapter. At the present the Chapter has a potential membership of 90 members but since the Chapter embraces cities and towns within a radius of sixty miles, considerably fewer than that number are present at any one meeting.

However, those that have been attending meetings regularly have benefited by a diversified educational program put together by the officers. Oscilloscope and sweep generator and marker demonstrations have been the chief topic of interest and have met with enthusiastic response. Dog TV sets have been brought in periodically to the meetings and almost very one goes to work on them to restore them to playing performance.

The Chapter has adopted annual membership dues of only $1.50. This money is used for the express purpose of defraying costs of meeting notices, literature, etc. Such activities as family picnics and stag parties are financed through an equal assessment on each member wishing to attend. This policy has been well received by the membership.

Officers of the Chapter for the current year are: Warren Williamson, Chairman, 1201 Allen St., Flint; George Mitru, Vice-Chairman, 1061 E. Alma St., Flint; David Nagel, Secretary, 3135 E. Mt. Morris Rd., Mt. Morris; William Neumann, Treasurer, 1613 S. Kiesel St., Bay City.

NRI students and graduates in the area who are not now members of the chapter are urged to attend a meeting either as a guest or as a potential member. Meetings are held on the second Saturday of each month at the Buick Local Union Hall, Flint, Mich.

Baltimore Chapter was delighted to receive a visit from H. J. Rathbun who together with Mrs. Rathbun has been in St. Petersburg, Fla., for several months on account of his wife's health. The change in climate appears to have helped his wife's illness, so he has decided to live there permanently. It was pleasant to have him present at one more meeting before he leaves for Florida for good.

President of the NRI Alumni Association Elmer Shue provided the highlight of this meeting by bringing in an electronic light organ which he constructed from an article appearing in a 1936 issue of a science magazine. Naturally, out came the blackboard and a detailed discussion about the construction and functioning of the apparatus. Mr. Shue informed the Chapter that he planned to devote considerable time to the construction of an electronic banjo. It was logical, therefore, to assume that the next meeting would include a musical recital as a part of the scientific lecture.

National NRIAA President Elmer Shue (right center) answering a question asked by Mr. Thompson (standing) prior to beginning the TV Clinic portion of a meeting of the Baltimore Chapter.

A HI-FI show was held in Baltimore which was attended by quite a few of the Chapter members. Secretary John Woolschlager gave a brief report of his impressions of the exhibit and brought back some of the descriptive literature for distribution to the members.

As a passing note of interest, Chairman Dolivka sent National Headquarters a photograph of a Baltimore Chapter Meeting taken more than twenty years ago. We are sorry that space does not permit us to reproduce the photograph in these pages but we oldtimers here at NRI are glad to have it.

The Chapter meets on the second Tuesday of each month at 100 North Paca St., Baltimore. The Chairman is Joseph Dolivka, 717 N. Montford Avenue; the Secretary is John Woolschlager, 1106 South Lakewood Avenue, Baltimore. NRI students and graduates, whether or not they are members of the Chapter, are cordially invited to attend the meetings.

Detroit Chapter is going ahead with its plans for the construction of a TV Demonstration Panel and has been in touch with the Springfield Chapter concerning the details of the panel. The Springfield Chapter has promised to furnish the necessary information as soon as the plans of construction are completed.

Chairman Nagy has been presenting a series of films on the theory and practice of Radio and TV servicing. Another film was titled "There Will Be Three—Preface To Physics," sound waves and their source, speed of light. The Chapter reports that it has been enjoying the best attendance for sometime and that a number of visitors have indicated their intention to join the chapter. A hearty welcome to these new members.

The Chapter has made arrangements for its customary Spring Social. It will be held on June 28 at the Chry-Moto Club, in Windsor, Canada. Students and graduates in the Detroit area who would like to enjoy an evening of fun, good fellowship, and a delicious supper should wangle an invitation to this social. Contact Chairman John Nagy, 1406 Euclid, Lincoln Park, or Secretary James Kelley, 1140 Livernois Ave., Detroit, Mich.

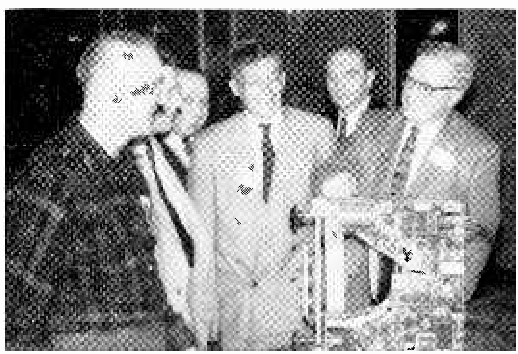
The Chapter meets at 8 PM on the Second and Fourth Friday of each month at St. Andrews Hall, 431 E. Congress St., Detroit, Mich.

New York City Chapter Secretary Emil Paul at last report was still at home recuperating from injuries he suffered in an accident last December but was improving and expected to return to work soon. This was good news to Emil's fellow-members and friends.

While Emil has been at home convalescing, First Vice-Chairman Frank Zimmer has been pinch-hitting for him as Secretary and has done a very good job of it.

The Chapter had an unusual and pleasant surprise in the form of a visit by Howard Smith, Chairman, and Lyman Brown, Technical Advisor, of the Springfield, Mass., Chapter. These visitors were given a warm welcome by the Chapter and later on in the evening Mr. Smith and Mr. Brown expressed their appreciation of the hospitality shown them.

Speakers at recent meetings were: Alex Jemmoth, who gave a short but interesting talk on variations in horizontal output systems.



Tom Hull (extreme right), Executive Chairman of NYC Chapter, "pointing up" a tuner to (left to right) Ed McAdams, Chairman of NYC Chapter; visitor Howard Smith, Chairman of Springfield Chapter; William Fox, member of NYC Chapter Executive Committee and National NRIAA Vice-President; visitor Lyman Brown, Technical Advisor to the Springfield Chapter; Frank Zimmer, First Vice-Chairman of NYC Chapter.

Tom Hull explained very clearly the functions of sync separators in a Television set. Frank Zimmer read a release by the Sonotone Corporation explaining the successful development of the smallest electronic device—a self-**contained transistorized hearing aid without ex-**ternal attachment or wires. Frank also gave the membership an account of his experience with his own Scott 210A Hi-Fi amplifier, which had a defect in the bass control circuit. The members joined in a lively discussion in analyzing this circuit.

Chairman McAdams brought in a Television receiver that had an exceptionally high voltage reading, on which trouble-shooting was jointly carried out by Tom Hull and Willie Fox.

Jim Eaddy made an informative talk on how transistor Radios are checked before sale to the public and on the methods used to locate defects quickly. Tom Hull, continuing his TV series, explained and demonstrated on the oscilloscope the formation of the sawtooth wave shape for sweep systems. Phil Spampinato spoke on customer relations and contacts with regard to Hi-Fi servicing

Two of the important speakers assigned for forthcoming meetings were Jim Eaddy on the picture tube tester and Tom Hull, continuing his discussion on vertical sweep systems. More time is being allowed for "Tip-Time," a valuable feature of the Chapter's programs.

Students and graduates interested in attending the meetings of the Chapter should contact Chairman Edward McAdams, 135 West 90th Street, New York 24, or Secretary Emil Paul, 6 Gateway, Bethpage, Long Island. The Chapter meets at St. Marks Community Center, 12 St. Marks Pl., New York City on the first and third Thursday of each month.

Milwaukee Chapter was visited by the NRI Alumni Association Executive Secretary, Ted Rose. This is a belated report of that visit. In consequence, it seems rather odd in view of the present weather to speak of the weather conditions at that time, because in making this visit Ted Rose landed in Milwaukee during a blizzard, which continued throughout the night and the next day. Of course, the Milwaukee Chapter members accused him of having brought this blizzard with him from Washington.

In spite of the bad weather there was a surprisingly good attendance and Ted Rose was very pleased with the cordiality shown him.

In meetings held since then, plans have been made to undertake the block diagram method of learning Television; a Hales Corners serviceman gave a talk on TV customer relations, and most of this meeting developed into a discussion by the members of the status of the TV serviceman in the community.

One of the members repeated his offer to lend the Chapter his camera and services at meetings for sorely needed pictures of the meetings. It is hoped that the Chapter will take advantage of this offer and furnish National Headquarters photographs of its meetings for publication in National Radio-TV News when space permits.

Chairman Kapheim gave an enlightening talk on "Legal Rackets." He warned the members to beware of being led into paths unwarily by selfish interests which seek to use him as a tool for their own ends. The last twenty minutes of this meeting were devoted to the Television Discussion Period, which consists of a discussion of the problems the members encounter in connection with Radio-TV servicing.

Plans are being made to organize new Sectional TV analysis groups.

The Chapter meetings, to which all NRI men in the Milwaukee area are invited, are held on the third Monday of each month at the Radio-TV Store and Shop of S. J. Petrich, 5901 West Vliet St., Milwaukee. The Chairman is Erwin Kapheim, 3525 N. Fourth St.; the Secretary is Robert Krauss, 2467 N. 29th St., Milwaukee.

Hagerstown (Cumberland Valley) Chapter has begun a series of demonstrations and a course in which each member present will take part. It will feature the use of basic equipment in TV servicing.

President John Pearl, part-owner of the successful Electronic Service Company, is the instructor for this important series of demonstrations. Many members will remember his very interesting demonstrations of the oscilloscope. Working in pairs, each member will measure and compare voltages on a vtvm, tracings on an oscilloscope, etc., with those of the diagram of the set. At times the set may be goofed and the members will try to find the bad part from their readings and observations.

In addition, the Chapter's color course, started in January, is getting to the most interesting part—color TV circuits and their servicing.

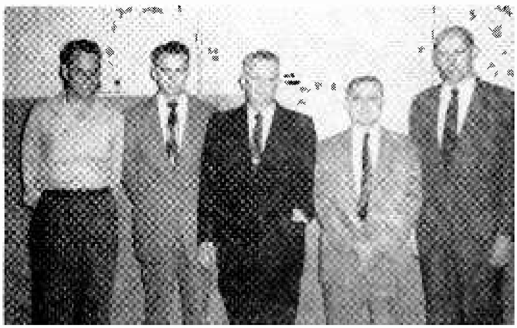
Students and graduates in the Cumberland Valley should by all means avail themselves of this opportunity to add to their knowledge of Radio and Television Servicing. Even if you are not a member you will be welcomed as a guest or a potential member. Get in touch with Chairman John Pearl, 702 Potomac Ave., Hagerstown, or Secretary Edwin Kemp, 618 Sunset Avenue, Hagerstown. **The meetings are held** on the second Thursday of each month, 8:00 P.M., at the YMCA, Hagerstown.

New Orleans Chapter welcomed a visit by Mr. Eldridge Helwick of the Shuler Supply Company of New Orleans. This company is going to open a supply house in Pass Christian, Miss., of which Mr. Helwick will be in charge.

Mr. Helwick, now an Electronics Engineer, is a real NRI old-timer. He enrolled for NRI training as a boy way back in 1929 and was graduated in September, 1930. He made a talk on Electronics from its inception to present-day color Television, then conducted an open forum on the various aspects of Radio and Television theory and servicing. His talk was a real treat to the members present.

Scheduled for a future meeting is a lecture by Bell Telephone representatives on transistors and the solar battery.

The Chapter meets at the home of Louis Grossman, 2229 Napoleon, New Orleans, La. The Chairman is Patrick Boudreaux, 1015 Race Street; the Secretary is Oscar Hilding, 6225 St. Anthony Street, New Orleans. The Chapter extends a cordial invitation to all NRI students and graduates in the area to attend its meetings.



Officers of the New Orleans Chapter and Ted Rose, Executive Secretary of the NRIAA. Left to right: Benny Collins, Vice-Chairman; Pat Boudreaux, Chairman; Ted Rose; O. Jumonville, Treasurer; Oscar Hilding, Secretary.

Minneapolis-St. Paul Chapter outdid itself with a sumptuous banquet held on April 11 at the Venetian Inn on the outskirts of St. Paul. This was the Chapter's annual banquet but it was distinctive in that it was the first social at which the members' wives were present. Due largely to this fact the banquet was an unqualified success.

The NRI Executive Secretary, Ted Rose—on his annual visit to the Chapter—and J. B. Straughn, Chief of NRI Consultation Service, were guests of honor at the dinner and were obviously impressed with the hospitality extended to them.

Following the excellent steak dinner (and what steaks!) Ted Rose delivered an informal talk, consisting mostly of humorous stories, as his contribution to the enjoyment of the evening. J. B. Straughn spoke on the development and features of the NRI VTVM Kit.

Ted Rose then conducted a short ceremony in which he swore in the officers for the next twelve months, as follows:

John Babcock, Chairman
Paul Donatell, Secretary
George Dickson, Treasurer
Walter Berbee, Sergeant at Arms
M. C. Lundgren, Librarian.

Treasurer George Dixon was chiefly responsible for the arrangements for this banquet and was given a well-deserved vote of thanks for his highly successful efforts.

The Chapter has discontinued meeting at its former meeting-place, the YMCA, and will hereafter meet at various members' homes where they will have the opportunity to work out problems, with equipment to be furnished by the members at whose homes the meetings are held. This is a decided improvement: more time and effort can be devoted to the solution of practical problems encountered in everyday Radio-TV servicing work.

NRI students and graduates in the Minneapolis-St. Paul area should take advantage of the Chapter's invitation to attend its meetings, which are held at 8:00 P.M. on the second Thursday of each month. Contact Chairman John Babcock, 3157 32nd Avenue South, Minneapolis, or Secretary Paul Donatell, 933 Burr St., St. Paul.

Springfield, Mass. Chapter Chairman Howard Smith and Technical Advisor Lyman Brown, on the same trip on which they visited the New York City Chapter, flew down to Washington for a visit at the National Radio Institute. This was a pleasant surprise for us here at NRI.

At the Institute they renewed acquaintance with the folks of NRI, then were guests of the Executive Secretary of the NRI Alumni Association, Ted Rose, for luncheon at the Statler Hotel. This was followed with a visit to NRI's new home. Howard and Lyman were very interested in the details of construction and much impressed with the building, of which they took several shots with a movie camera. Upon return to NRI, they had an enjoyable talk-fest with Bill Dunn, Director of Education, and J. B. Straughn, Chief of Consultation Service, mostly about the Springfield Chapter's TV Demonstration Panel.

The Springfield Chapter is one of those Chapters that are hard to keep up with. They have so many interesting things going on all the time that it is difficult to keep track of them. Recently the Chapter ran a film on the transistor, showing the progress made by the transistor in different phases of instruments and the great advantages it has already displayed in respect to cost, compactness and durability. Another film "Of Many Voices" dealt with the progress of the telephone from its early stages to the present day. It was remarkable to see the progress made by the telephone company in such a short time, with the end of possibilities not yet in sight.

Howard Smith and Lyman Brown reported on their visits to the New York City Chapter and to National Headquarters, and spoke particularly of NRI's beautiful new building.

Hugo Walpurgis and Lyman Brown working on Springfield Chapter's TV Demonstration Panel. Interested spectator is Hugo Walpurgis' son Donald.

Along with all its other projects, the Chapter has started on a plan to train speakers among its own members. In this connection, one of its comparatively new members, Mr. Orin Hayden, delivered a talk on "The Art of Speaking" in which he gave many pointers and suggestions for public speaking. This was an excellent talk, contained much valuable help. Under Mr. Hayden's guidance, the chapter should develop a number of able speakers.

Lyman Brown is continuing with his customarily fine job of developing and explaining TV circuitry on the Chapter's TV Demonstration Panel.

Not only is the Chapter a lively and high-spirited group, but it is also notable for the good fellowship and commradeship that exists among members. It is such a treat and so heart-warming an experience to be present at one of its meetings, that it is difficult to see how any NRI student or graduate in the area can fail to take advantage of the Chapter's invitation to attend as a guest. All NRI students and graduates in the vicinity interested in attending one of the meetings should write or telephone Chairman Howard Smith, 53 Bangor Street, Springfield, or Secretary Marcellus Reed, 41 Westland St., Hartford, Connecticut.

Members of the Springfield Chapter were unquestionably interested in what the speaker was saying at this meeting on April 5.

The Chapter meets at 7:00 P.M. on the first and third Friday of each month at the U.S. Army Headquarters Building, 50 East Street, Springfield, Mass.

Chicago Chapter was host to Mr. H. J. Wolfson, Chairman of the Associated Radio and Television Servicemen of Illinois; Ted Rose, Executive Secretary of the NRI Alumni Association; and J. B. Straughn, Chief of NRI Consultation Service.

Mr. Wolfson made a timely talk on licensing in general and on the proposed Illinois licensing law in particular. He had an attentative and appreciative audience, for the members present were indeed glad to have the opportunity to get the down-to-earth facts that Mr. Wolfson gave in his talk.

Ted Rose then addressed the meeting briefly, wherepon J. B. Straughn made the main address of the evening in outlining the background, development and the superior advantages of the NRI VTVM Kit.

Regular business had been dispensed with at this meeting in order to allow these speakers adequate time for their talks. Nevertheless the meeting broke up rather late but the members agreed that it had been an interesting and rewarding meeting.

At a previous meeting Librarian Schick came prepared with a key and vibrator unit so that, under the direction of Chairman Nicely, the members enjoyed what was for the most of them their first experience with Morse Code.

The Chapter cordially invites all NRI students and graduates in the Chicago area to attend its meetings as guests or potential members. The Chapter meets on the second and fourth Wednesday of each month at 666 Lakeshore Dr., West Entrance, 33rd floor. The Chairman is Walter Nicely, 6441 South Campbell Avenue, Chicago; the Secretary is Charles Mead, 666 Lakeshore Dr., Room 228, Chicago.

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Radio-TV Technician Wanted

Mr. R. L. Hines of South Hill, Virginia who owns and operates R. L. Hines Electric Store, would like to hire a good Radio-TV technician. Mr. Hines tells us this is a good opportunity and chance for increased income. If interested, write to him at the store in South Hill.

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How Times Have Changed!

As we were packing in preparation for moving into our new building, a member of the NRI Instruction Department came across an interesting article in a 1938 issue of a popular engineering magazine, *Electronics*.

The purpose of the article was simply stated in the heading: "To give engineers information on a topic entirely new and different from anything they had encountered in the past—a deflection system for an all-electronic TV receiver."

The article explained the problems of obtaining deflection, the methods of controlling it, and the advantages of a relatively new idea—interlaced scanning.

How times have changed! Today an article like this would appear in a Radio-TV servicing magazine, not an engineering journal. The student of Television learns about all this in his introduction to sweep circuits. A clear indication of the rising technical level of servicemen.

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At Least We've Improved—Percentagewise

In 1895 there were four automobiles registered in the whole of the United States. In that same year two of these met head-on and the driver of one was killed!

Some Suggestions Regarding Long Distance Telephone Calls To NRI

Occasionally we receive a long distance telephone call from an NRI student or graduate—for something that he needs in a hurry, or to discuss an urgent problem.

Because such calls cost the student or graduate quite a bit, we feel that they should be made only when absolutely necessary. And—particularly where a consultation problem is involved, our reply by letter will be more complete, and therefore more satisfactory than an answer given in a hurry over the phone. That's why we suggest that it may be better to write us Air Mail rather than telephone, except where an immediate reply is required.

If you do find it is necessary to call, we shall of course, be glad to help you in any way we can. In that case, please keep in mind the following because it will enable us to handle your call most efficiently and save you money on the cost:

1. Tell *our* switchboard operator—the one who answers "National Radio Institute"—your name, address, student number, and that you are calling long distance. The way the Telephone Company handles calls nowadays, she won't *know* that it is long distance unless you tell her.

2. Explain the purpose of your call. The operator won't be able to give you the information or handle your problem herself, but she must know its nature so as to refer you to the proper individual or department.

3. Remember that the Institute is open from 8:15 AM to 5:00 PM, Monday through Friday —closed completely Saturday and Sunday. Outside of these office hours, the switchboard is also closed, and there will not be anyone here to handle your call.

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Cover

Our cover for this issue shows the main arteries of downtown Washington, D. C., and will give our readers a general idea of NRI's new location. We are proud of our new home and extend a cordial invitation to Students and Graduates to stop in for a visit whenever they are in or around Washington. Visitors are always most welcome. (More information about our move on Page 2)

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A wise man's prayer: May I never be caught talking when I should be listening.

Admiral Corp Designs Sun-Powered Radio

A sun-powered portable radio-phonograph has been developed by the Admiral Corp.

The experimental unit operates on a 48-cell solar battery. On sunless days the cells can be activated by incandescent light or six rechargeable flashlight-size standby batteries. The standby cells can power the radio for 10 hours and the phonograph for two hours.

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Quite a Show

The IRE 1957 National Convention & Radio Engineering Show held in New York, March 18-23, attracted some 50,000 electronic specialists. The 800 exhibits displayed 17,000 different pieces of apparatus, worth about $10 million. The 2.5 miles of booths required a megawatt of power to keep it going.

INDEX

Here and There Among Alumni Members

Graduate Robert Ragin of Lansing, Michigan, tells us that he has two good part-time jobs. In addition to his Radio-TV service shop, he is also a school crossing guard. The school children tell their parents about his Radio-TV business and this "free" advertising really pays off.

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NRI training has paid off for Rex Martin, Greenville, Tennessee. He was formerly a theatre projectionist and is now Assistant Manager for three theatres.

———*n r i*———

Graduate Lee R. Hewitt, Carlsbad, New Mexico, does the service work on 150 radios in two hospitals. This sounds like a good, steady, spare-time job, Lee.

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We wish lots of success to Leonard J. Wampler, who has recently opened the Wise Radio-TV Servicing Shop in Norton, Virginia.

———*n r i*———

Graduate Amos A. Sharpe, Kutztown, Pennsylvania, is a physical science instructor at State Teachers College there. Says he had lots of radio theory before taking his NRI course but the course gave him the practical experience he needed.

Congratulations to Donald L. Monge of Winona, Minnesota, who writes that he now has his first-class license and is assistant chief engineer with Station KWNO. He is also a full-time staff announcer there. Says NRI was the key to his success.

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Graduate Roy C. Johnston, Pasadena, California, has gone into partnership and is engaged in the manufacture of test equipment and electronic devices. Reports that his company is doing their own development, manufacture and research as well as research for other firms.

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Thanks to Takaji J. Tanabe, instrument technician with Hughes Aircraft, who writes: "I was pleasantly surprised to learn that technical knowledge gained from NRI was as great if not greater than my fellow employees who have attended resident technical schools."

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Graduate Gordon T. Chambers is now a technical writer at the Glenn L. Martin Co., Baltimore, Maryland. He was recently promoted to Group Engineer.

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Eugene E. Lang has an interesting job as foreman in charge of electrical and mechanical work at the Eau Gallie Yacht Basin, Florida. Among his many duties, he services Photo-Electric Automatic Pilots, Depth Finders, radios and other equipment found aboard luxury yachts.

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