MAY 1946

# RADIO MAINTENANCE

PA SYSTEMS

TEST PANEL FOR THE MODERN BENCH

RINGING THE BELL

A BOLAND AND BOYCE PUBLICATION

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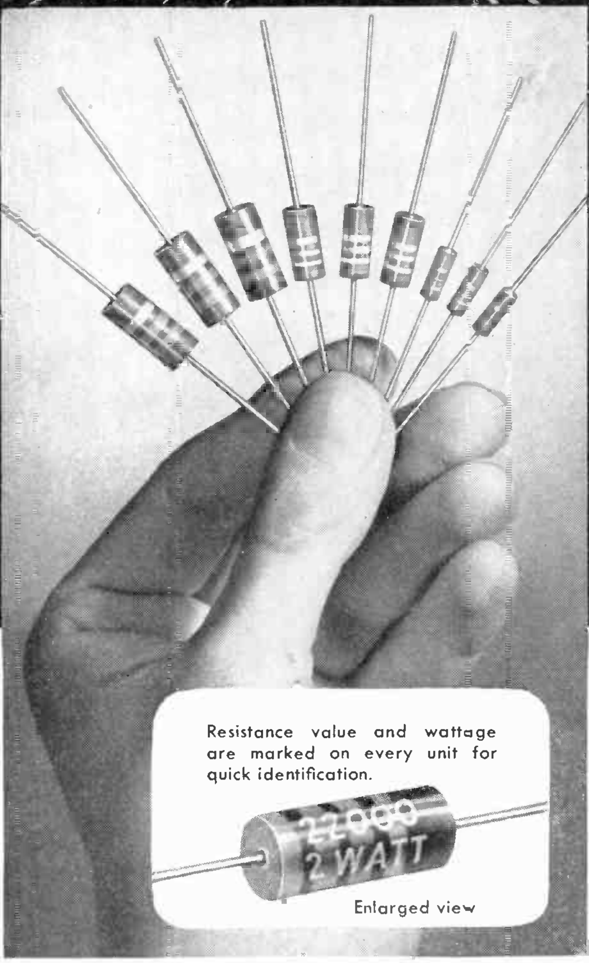


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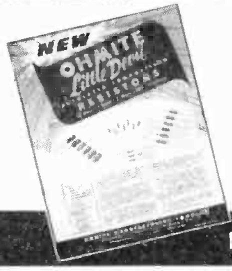


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Volume 2 MAY 1946 Number 5

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# PA Systems

by C. G. McProud

**This is the second article on public address systems. It covers the layout of equipment for indoor installations. Four common types of installations are discussed.**

ONE OF THE FIRST THOUGHTS that occurs in the mind of the radio service man who is considering the addition of public address system activities to his already varied lines of endeavor is, "How do I go about selecting the right type of system for a client's installation?" While we discussed the general features of PA systems in the first article in this series, the details of the individual installations were purposely avoided. These details are sufficiently important to warrant further treatment, which is the purpose of this article.

Let us assume that a client arrives at your shop one bright Monday morning, with a desire to have you make a PA installation for him. He will probably ask you "What kind of a system do I need, and how much will it cost?" At this point, the question is about as easy to answer as "how long is a piece of string?" You will have to know what use is to be made of the system, how large a room is to be covered, how many people will be in it, what is the average noise level in the room, and the nature of the entertainment—instrumental, vocal, or just speech—that is to be amplified. You will need to know all these conditions in order to determine the number of inputs, whether microphones, phonographs, or remote lines from a centrally-operated music distribution system; the type and size of amplifier required; the number, type and size of speakers required; and the extent and type of wiring necessary. It is necessary to know all these things before you can offer an equitable bid on the cost of the job, otherwise you will not remain in the PA business for long.

After you have all of this information, you will want to prepare your bid in a suitable fashion, giving complete specifications for the installation, outlining both the characteristics of the system and your responsibilities with regards to its performance, together with your price for the complete installation.

In this article, we propose to show the steps involved in making these determinations, and to outline the information that should be incorporated in the specification and bid. We will therefore take a "case history" of each of several installations, discussing them from the first time we see them until we have settled upon the equipment to be used for each.

### The First Problem

The first installation that we are to make is a fairly simple one. It is a small lecture hall, 40 x 50 feet, commonly seating about 150 people, as in Fig. 1. The method of planning comprises four steps — determining the microphone and speaker placement, determining the amplifier gain necessary, and then deciding upon the amplifier and its placement. After that, planning the best method of making connections between the various components.

An inspection shows us that the walls of this hall are hard, and there are no acoustically-treated surfaces to reduce reverberation. Therefore, to avoid feedback trouble, we select a microphone of the unidirectional type, which is effectively "dead" from the back. This will eliminate the possibility of feedback from the sides and back of the hall, and we will only have to be sure that there is not too much reverberation from the front end of the hall, that is, from behind the performer. Figure 2 shows the directivity pattern of the microphone, as located on the stage.

With regard to the speakers, we must again remember that they must be so mounted that the sound from them reaches the listeners at the same time as that from the performer. Another good point to remember is that the people in the front rows

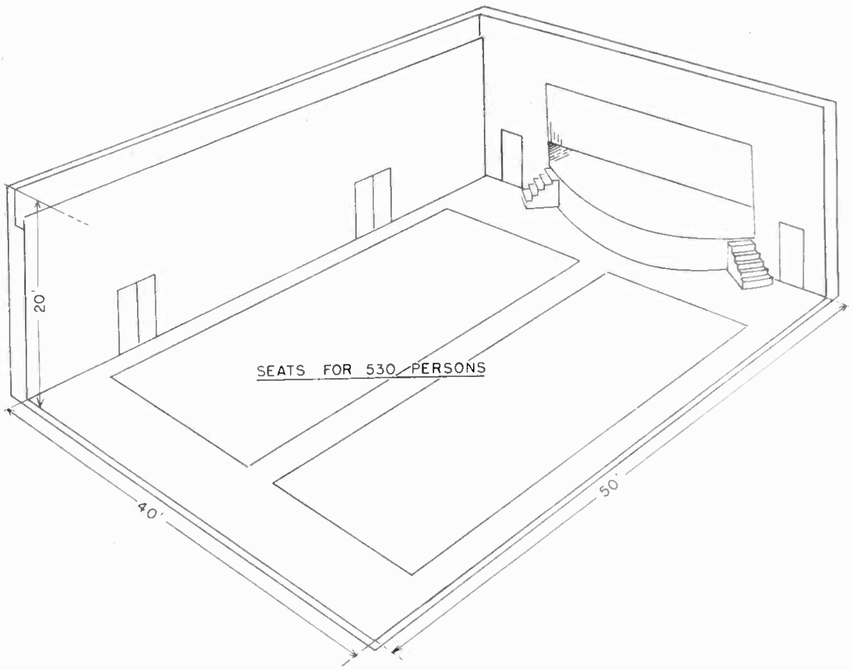


**Fig. 1. Dimensions and arrangements of lecture hall.**

will have no trouble in hearing the performer without sound reinforcement. Therefore, it is a good plan to place the speakers fairly high up. As this hall is nearly square, it is desirable to place one a little to each side of the center. An effective arrangement is shown in Fig. 3.

In order to determine the gain required in the amplifier, we must first decide upon the amount of power required to furnish sufficient reinforcement for this particular application. Using Fig. 4 we can arrive at the power required for a room of any size, as measured in cubic feet of volume. This particular room has a ceiling height of 20 feet, and therefore has a volume of 40,000 cubic feet. From the curve of Fig 4, we see that this installation will require just under ten watts of power when used with efficient speakers. To be sure of being on the safe side, and because most medium-sized amplifiers are rated at fifteen watts, we will select one of that output. To be sure of sufficient gain, we must determine the level corresponding to fifteen watts of output power; then we must ascertain the output level of the microphones to be used. With this information, we can immediately calculate the total gain required to bring the signal at the output of the microphone up to the level necessary for the speakers. Table I shows the levels corresponding to various power outputs commonly encountered in PA amplifiers.

TABLE I

VU/Watts Relationship

(Approximate)

| Power Watts | Level VU | Power Watts | Level VU |
|---|---|---|---|
| 5 | +37 | 30 | +45 |
| 10 | +40 | 60 | +48 |
| 15 | +42 | 100 | +50 |
| 20 | +43 | 150 | +52 |

From this table, we see that the level required from this system is 42 vu. (Vu, meaning volume units, indicates a specified number of db above or below a reference power of 1 milliwatt, which corresponds to 0 vu. It also indicates that the measurement was made with a meter of specified characteristics, and on program material, rather than on a steady tone.)

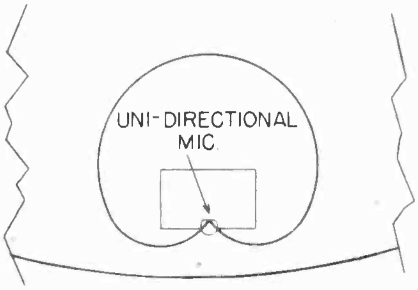


**Fig. 2. Directivity pattern of microphone selected for lecture hall installation.**

Next we must check the microphone sensitivity. All manufacturers do not rate their products in the same manner, so that when you read in a catalog that the output of a microphone is —55 vu, for example, you must read further. Ratings are given in db

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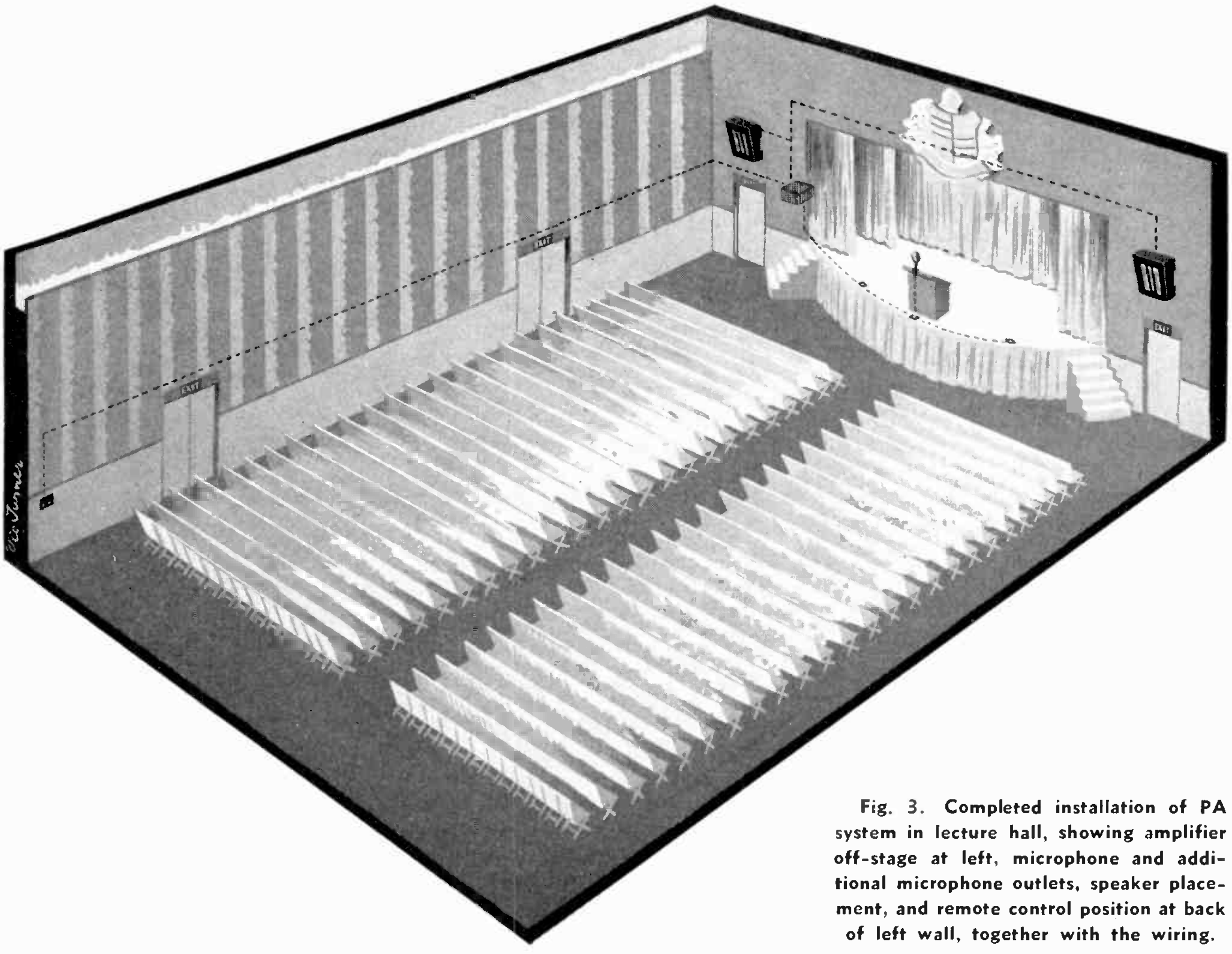

**Fig. 3. Completed installation of PA system in lecture hall, showing amplifier off-stage at left, microphone and additional microphone outlets, speaker placement, and remote control position at back of left wall, together with the wiring.**

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below one milliwatt for 10 bar signals, db below one volt per bar, db below one volt for a 10-bar signal, and in numerous other ways.

To compare these methods of rating microphone sensitivity, it is necessary to know the average power in various sounds. Sound pressure is measured in dynes per square centimeter, and a pressure of one dyne per square centimeter is commonly called one *barye* (from the Greek word meaning "heavy"), abbreviated *bar*. Air pressure due to speech ranges from 0.003 to 3.0 bars, with an average of 0.4 bars. For music, the pressure ranges from 0.5 bars to 1250 bars. Therefore, a rating of a certain sensitivity "per bar" gives a fairly safe average for speech, but a pressure of 10 bars is somewhat above that encountered in speech. It must also be remembered that a specified output for a pressure of 10 bars differs by 20 db from a specified output of the same microphone for a pressure of 1 bar. Therefore, we may make the following tabulation:

TABLE II

Comparison of Microphone Ratings

| *Sensitivity Given* | *Correction Factor* |
|---|---|
| db below 1 mw/1 bar | 0 db |
| db below 1 mw/10 bars | —20 db |
| db below 1 volt/bar | 2 db |
| db below 1 volt/10 bars | —18 db |

With this information we can rate a microphone in values that mean something to us. To return to the installation we were discussing, we had determined that the output level was + 42 and from catalogs, we find that the level from the microphone we selected is 55 db below 1 volt per bar, which is 53 db below zero level for speech power. (Note that we *added* the correction factor of 2 db to the negative value of 55 db, to arrive at the negative value of 53 db. 55 db below 1 volt means that the level is —55 db with respect to 1 volt.)

Therefore, we need an amplifier with a minimum gain of 95 db, although for safety, it would be advisable to have a gain of at least 105 db. This, we note from the catalog, is readily obtainable.

We now must consider the placement of the amplifier. In a hall of this type, it is advisable that the control operator be seated at a point where he can hear the effect of the reinforcement. For this reason, the amplifier, or at least its controls, should be located at the back of the hall. Inasmuch as this entails a lot of microphone cable, which must be shielded, and which is relatively expensive, this is a good time to consider an amplifier that is equipped for remote control by electronic means. There are many of this type of amplifier on the market, and the use of one would eliminate the necessity of running a lot of microphone cable, and at least the same amount of speaker cable, from the stage to the back of the hall. By using an amplifier with remote control, it is possible to make the installation with a three-wire unshielded cable, which simplifies the installation somewhat. This wiring, as well as the amplifier location, is shown in Fig. 3. This is the type of installation in which it is sometimes advisable to provide a lapel microphone for speakers who insist on walking back and forth across the stage while they are talking. This type of microphone hangs around the neck of the speaker on a strap or attaches to his coat lapel and "follows" him wherever he goes.

We have completed the layout for this type of system, and have arrived at the following list of material.

| COMPONENT | TYPE AND CHARACTERISTICS | PLACEMENT |
|---|---|---|
| 1 Microphone | Uni-directional, —55 db | Stand on platform |
| 1 Microphone | Lapel Type, —62 db | Performer's person |
| 1 Stand | Heavy base, for stand mike | On platform |
| 2 Speakers | 12-inch PM dynamic, 10-watt type | Above and slightly to either side of center of platform |
| 2 Housings | For above speakers | As above |
| 1 Amplifier | 15-watt, 105 db gain, equipped for electronic remote control, two microphone inputs | Offstage where convenient, but close to stage |
| Cable | Single-wire, shielded, for mikes, #14 rubber covered, for speakers 3-wire, for remote control | |

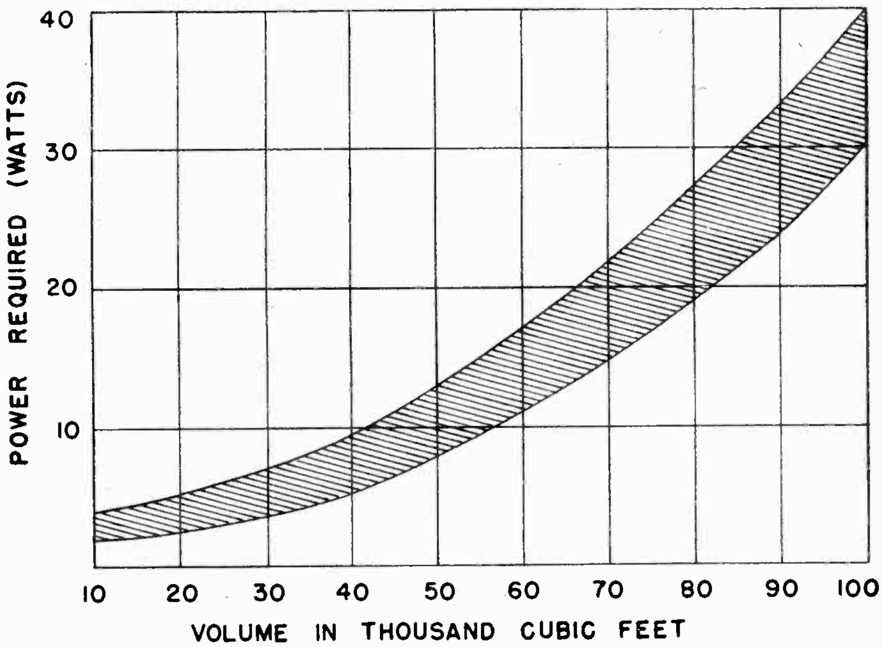


**Fig. 4. Curve showing approximate power required for adequate coverage of rooms of various cubical contents. Upper limits of shaded area should be used for locations with high noise level, or where maximum fidelity of music reproduction is desired.**

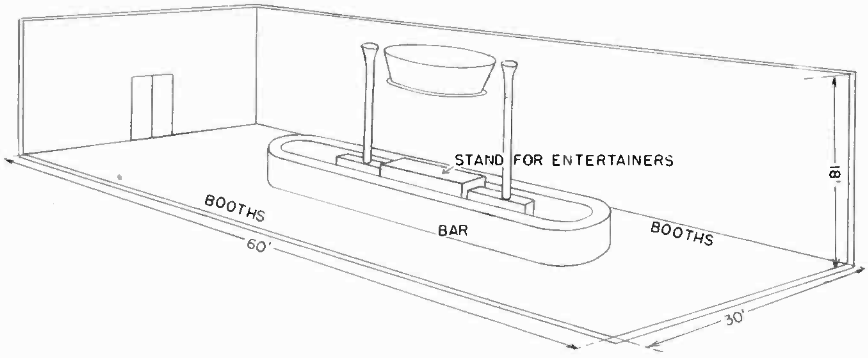


**Fig. 5. Dimensions and layout of bar with stage for entertainers in center of room.**

## Stage in Center of Room

Our next installation is a little more difficult. It is for a tavern which has an oval bar of which the owner is justly proud. In the center of this bar is a platform on which an instrumental trio performs, with occasional vocal numbers by the pianist of the group. The other two instruments are a guitar and a saxophone. Figure 5 pictures this location, before we have installed the equipment.

This type of installation is a little unusual for PA systems, for it requires that the distribution of sound be in an angle of 360 degrees, with the speakers sensibly located at the same point as the source of sound.

This statement needs some amplification. Whenever a sound is heard coming from two or more sources at different distances from the listener, the difference in the time it takes the sound to reach the listener's ears causes it to have the characteristics of an echo, and the intelligibility is lost. It may be stated as an axiom for PA work that speakers should be so placed in relation to each other, and to the original source of the sound, if that is also within the range of the listener so that no listener will hear the sound from more than one source unless he is equidistant from those he hears.

Getting back to the oval bar, we are practically forced to place the speakers directly above the performers, or, under the worst conditions, in a circle centered over the performers' platform. If the ceiling is sufficiently high, or if there is an attic over the room, it is possible to use a speaker which is designed for just such an application. This type of speaker, known as "radial" is composed, essentially of two concentric horns with different curvature, with the sound coming out between the two and being distributed equally in all directions. Another possibility is to construct a false ceiling suspended about three feet below the ceiling of the room, directly over the performers, and to mount the speakers above this false ceiling. This is the least expensive of the possible solutions, and in addition, presents decorative possibilities. For these reasons, we will use this type of speaker assembly, as shown in Fig. 6. which shows the completed installation.

Having made this decision, we now come to the choice of types of micro-

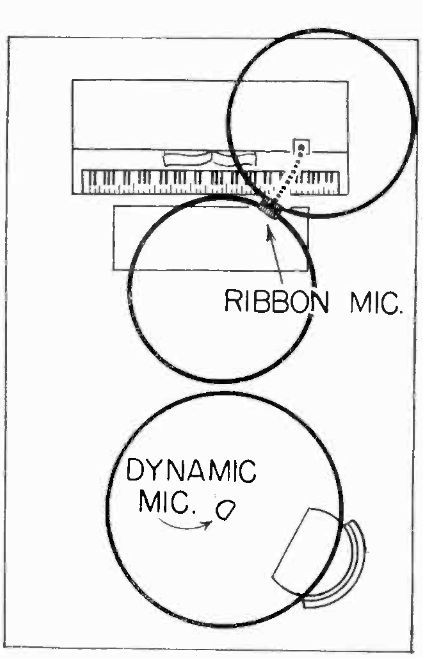


**Fig. 7. Directivity pattern of microphones used on entertainers' platform.**

phones, and the placement of them. Since the pianist is also the vocalist of the group, it is a good idea to provide him with a microphone above the keyboard, so positioned that he can sing into it while playing. For the other two instruments, another microphone must be furnished. Due to the high volume from the speakers directly above the performers, the use of a microphone with some directional characteristics is advisable for the vocal position because this microphone will generally be operated with greater amplification than the other one due to the lower level from the piano and voice. The ribbon microphone has directional characteristics

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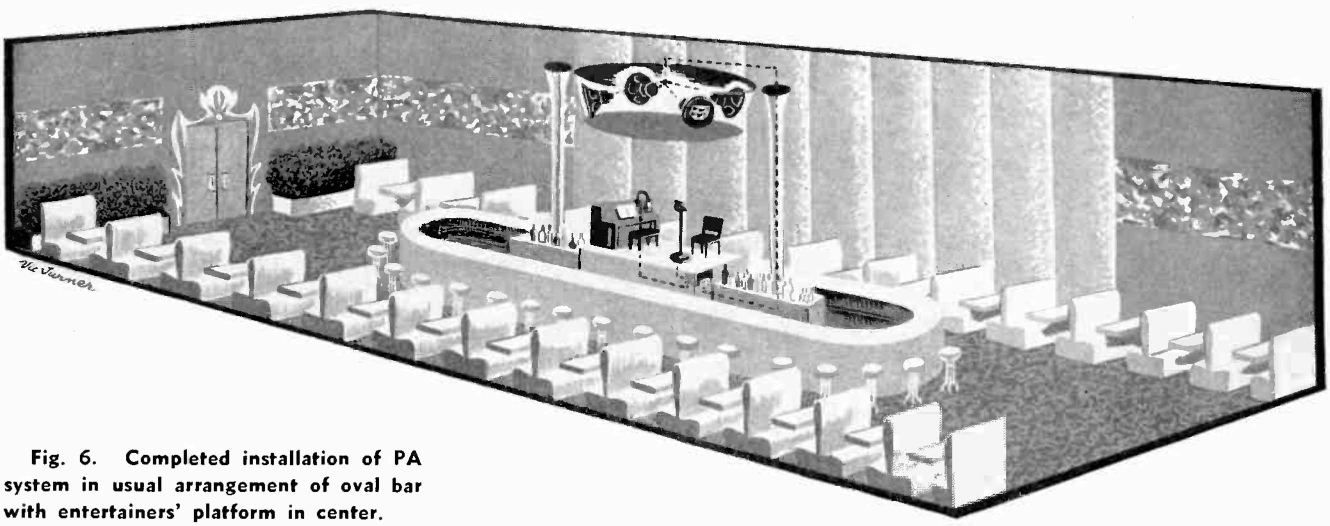

**Fig. 6. Completed installation of PA system in usual arrangement of oval bar with entertainers' platform in center.**

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which are adaptable to the singer's use, as the pattern will resemble two spheres side by side with the microphone located at their point of contact. For the other microphone, we shall use a crystal unit, non-directional, since crystals are of naturally high impedance, and they may be connected directly to grid circuits without the use of transformers. This will help in keeping the cost down. Figure 7 is a plan view of the elevated stage with the directional pattern of the microphones. It will be noted that this pattern effectively places the speakers in a "dead" area, thus reducing possible feedback problems.

Analyzing the requirements of this installation, we decide upon a 20-watt amplifier. The calculations for arriving at the required gain from the amplifier are made in the same fashion as in the previous installation, and for that matter, for all installations.

As to its placement, the client desires that the amplifier be located under the performers' platform so that one of the bartenders can operate the controls. Figure 6 shows the amplifier adjacent to the cash register, together with the locations of the microphone cables, which make very short runs from the mike stands. In order to keep the cables to the speakers as much out of sight as possible, and far away from all microphone cabling, these output leads are run along the back bar and up a column thence across the ceiling in a false wooden beam, as shown in the drawing.

## MATERIAL LIST—BAR INSTALLATION

| COMPONENT | TYPE AND CHARACTERISTICS | PLACEMENT |
|---|---|---|
| I Microphone | Ribbon —60 db | Gooseneck stand over piano keyboard |
| 1 Microphone | Crystal —55 db | Floor stand |
| 1 Stand | Gooseneck, attachable to piano for ribbon microphone | |
| 1 Stand | Floor type, for crystal microphone | |
| 4 Speakers | High quality, PM dynamic | In structure over platform. |
| 1 Amplifier | 20-watt, 112 db gain, with inputs for at least two microphones | Below platform, adjacent to cash register |
| Cabling | Shielded, for microphones # 14 Rubber-covered for speakers | |

### Two-Room Installation

Our next problem involves a 25 by 50 foot dance floor, and a refreshment room 30 x 30 feet adjacent to the dance floor, connected together by a door, as pictured in Fig. 8. The orchestra plays from a platform at one end of the dance floor, and it is required that the sound equipment be capable of reinforcing the orchestra and singers to the dancers, and that it shall reproduce the program in the refreshment room. This type of installation presents no particular problems, and the analysis of the requirements is performed in the same manner as for the previous installations. The orchestra is composed of ten musicians, and features "sweet" music, having for its main feature a trio of violins. The usual soloist sings the vocal choruses. The amplifier is to be placed so that the pianist can operate the controls. Adjustment of the volume from the speakers in the refreshment room is to be handled by an attendant at the bar.

With this type of orchestra, it is necessary to provide three mikes, especially when the best overall effect is to be had. One should be placed in such a position that it can pick up the entire group, one should be placed to pick up the string section separately, and a floor mike should be available for the use of the vocalist. For these various uses the choice of types and their location should be approximately as follows: For the overall pickup, a uni-directional microphone, mounted about eight feet above the floor of the orchestra platform, so oriented that its directivity pattern encompasses the entire orchestra, its placement favoring the strings slightly; for the vocalist, a dynamic microphone on a heavily-weighted floor stand at the center of the front of the platform is recommended; and for the string section, best results

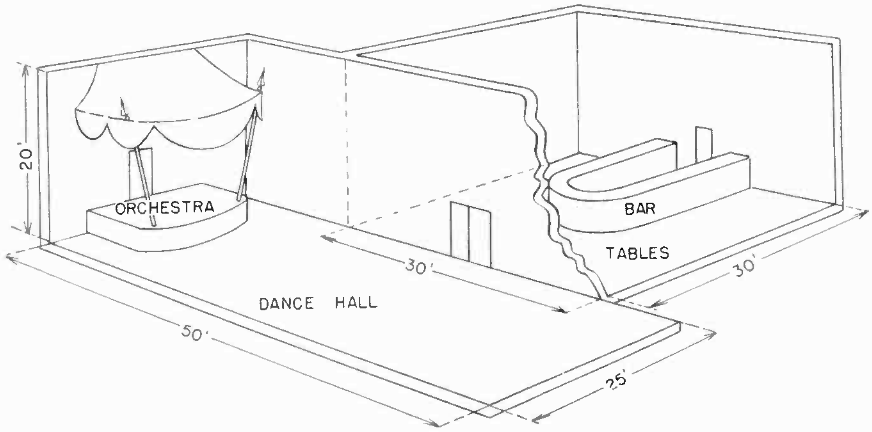


Fig. 8. Dimensions and layout of dance floor and refreshments room.

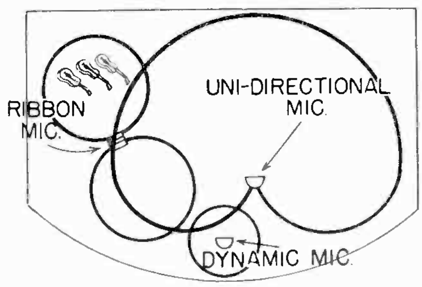


Fig. 9. Directivity patterns of microphones used for stage or dance floor. Ribbon microphone is suspended above violin section, with maximum pickup from strings.

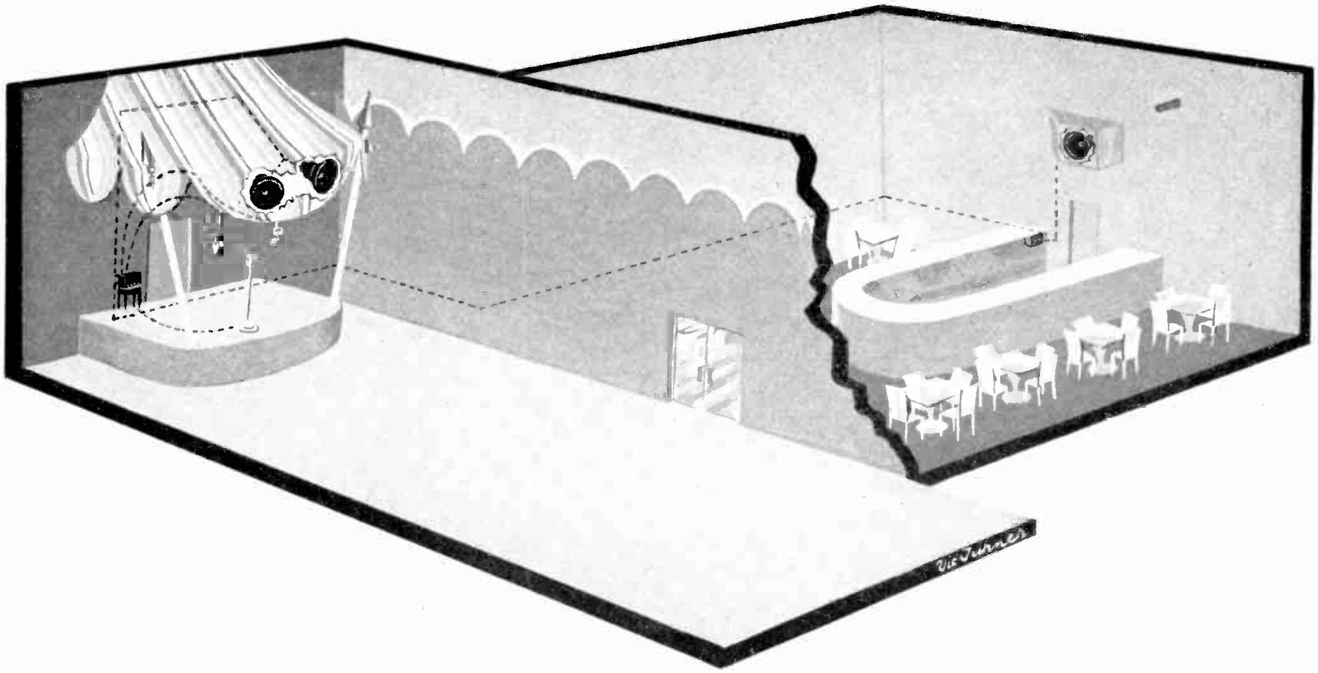

**Fig. 10. Completed installation of PA system in dance and refreshment rooms, showing location of components, wiring, and volume control for refreshment room speaker.**

are generally obtained by use of a standard ribbon microphone, which by the way, seems most suitable for "sub-tone" close-up clarinet playing. The location of all of these mikes and their directivity patterns is pictured in Fig. 9.

The speakers for the dance floor should be well up against the ceiling, and directed so that the center line of the speakers cuts the floor level at the back wall. Again, the speakers should be directly above the orchestra, and none should be anywhere else in the room. In order to keep down the sound level from the speakers in the area immediately in front of the orchestra, the speakers should be mounted in some form of directional baffle, preferably made of wood. Figure 10 shows the optimum placement of these speakers, as well as for the speakers in the refreshment room. The location in this latter room was chosen so that the delay between sounds from the two sources —the orchestra and speakers above it, and the speaker in the refreshment room—is reduced to a minimum at the entrance, which is the only place where both speakers would be heard at the same time. Speakers of good locations, the recommended type being the newer concentric speakers like the Altec-Lansing "Duplex", the Stephens "Tru-Senic", or the Jensen speaker of similar design.

Figure 10 also shows the placement of the amplifier, alongside the

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## DANCE HALL MATERIAL LIST

| Component | Type and Characteristics | Placement |
|---|---|---|
| 1 Microphone | Uni-directional, -55 db | Supported from ceiling about 8 ft. from floor |
| 1 Microphone | Ribbon, -62 db | Supported from ceiling close to string section |
| 1 Microphone | Dynamic - 50 db | Floor stand, for singer |
| 1 Stand | Heavy base, for dynamic make | Front of orchestra platform |
| 3 Speakers | High-quality, PM dynamic | 2 over orchestra, 1 in refreshment room |
| 2 Housings | Directional baffles for above speakers | Over orchestra platform |
| 1 Housing | Well-mounting cabinet, for speaker | One wall in refreshment room |
| 1 Amplifier | 30-watt, 112-db gain, with inputs for at least three microphones | One solid table by pianist |
| 1 Table | Heavy construction, for amplifier | On platform, near pianist |
| 1 T-pad | 15 ohm, 10-watt, constant impedance, for speaker control | Under bar in refreshment room |
| Cabling | Shielded, for microphone; No. 14 rubber covered, for speaker lines | |

# Ringing the Bell

by Peter Markantes

**Some important pointers to help you sell your service on those outside jobs.**

THE SERVICEMAN who calls at a customer's home must be a salesman in every sense of the word. He must observe, at all times, every one of the dozens of written and unwritten laws of successful salesmanship if he is to create the type of customer satisfaction which constitutes the most profitable type of advertising—personal recommendation by pleased customers.

Almost invariably, the most prosperous radio man in any community is the man who practices business psychology and applies the principles of consumer-tradesman relationships.

To the oldtimer, these practices are second nature—he has followed them for so many years that their application is effortless. To the newcomer, there is a danger that they may appear hackneyed—so commonsense and simple that they may be dismissed with only a casual thought. No worse mistake could be made.

The ability to gain a customer's confidence and respect is of primary importance, even greater than technical knowledge and skill. There will be some who may argue with this statement, but it has been the author's personal experience that a radio man, who is not at the same time a good businessman, can never hope to survive in a highly competitive craft such as radio servicing.

On the other hand, a man whose technical knowledge may be somewhat limited, judged by the standards of topnotch technicians, can nevertheless become highly successful if he is an accomplished salesman.

This is not to say that business "know-how" can replace technical skill or that the serviceman can afford not to make an effort to increase his familiarity with developments in the field, but rather to point up the importance of good business practice.

Emerson may have been correct when he propounded his much-repeated theory concerning the manufacture of better mouse traps, but when a dozen competitors build "mouse traps" as good as yours, then something extra is required if the

world is to "beat a path to your door."

Before the war this something extra in all too many instances took the form of "free service calls," "any radio fixed for $1.00," "charges made only for parts." Numerous other artifices gave the servicing profession an unsavory notoriety.

To some, this something extra may be a trade organization that will suppress these ruinous practices. I believe that if and when a national organization is formed, it will benefit most those whose theories of business practice are in agreement with the simple doctrines I shall illustrate.

Rest assured that no organization, however powerful or restrictive, will force John Q. Citizen to admit into his home a slovenly, unkempt boob who doesn't know enough to remove his hat or wipe his muddy shoes on the front doormat.

To me, radio servicing is a profession, and if its members are to appear before the public as professional men, they must look and act the part. In this connection, perhaps the most important requirement is that of a neat, well groomed appearance. The outside serviceman should not find it necessary to carry a tool bag with the legend "radio service" emblazoned in bold characters in order to enable the housewife to distinguish him from the garbage collector. Neither should he go to the extreme of patent leather shoes and manicured fingernails.

It should suffice merely to make sure of a decently clean suit, shined shoes and an occasional visit to the barber.

Many men — particularly those whose time is divided between outside calls and bench work or auto radio servicing — will find this difficult. It is not an unreasonable objective, however. To the man who says he can't afford to wear his best clothes on the job, the only answer is, "You can't afford *not* to wear your best." Another requirement is that an outside man be able to converse intelligently with a customer and be able to sell himself and his services in a dignified, restrained, yet forceful manner. This doesn't require linguistic ability to the extent that every utterance is a polysyllabic ponderosity, but if you are the "dees" and "dose" type, you might better find some other field of endeavor.

The "do's" and "don'ts" of dealing with the customer on outside jobs are many. Rather than indulge in a pedantic recital of them, I shall endeavor to trace, from start to finish, two hypothetical case histories which will serve to illustrate some of the guiding principles.

First, let us consider the case of Joe MacJerk.

It is Saturday afternoon and Joe is deeply involved in an "intermittent." Surrounding the radio are a 'scope, signal generator, V.T.V.M. and multi-tester. Emerging from the chassis, in a manner reminiscent of a Dali painting, is a fantastic array of clip leads, probes, and test cords.

We find Joe standing in the foreground of this interesting tableau, his brow furrowed in concentration. With practiced hands, he throws switches and turns dials. Suddenly, a gleam of triumph lights his eyes as the 'scope shows the picture he has been awaiting. At that precise instant the phone rings.

In disgust and aggravation, Joe throws the pliers on the bench, walks to the stand, and removes the phone from its cradle. With the smooth, dulcet tones of a pure-bred bull who is about to sink a horn into the midsection of an annoying matador, Joe says,

"Yeah?"

There is a moment of silence at the other end and then, hesitantly, a feminine voice asks,

"Is this MacJerk's Radio and Television Service?"

"Yup."

Again hesitantly, "My radio has stopped playing. Would you be able to come to my home and fix it?"

By this time, Joe realizes that he is talking to a prospective customer. Adopting a confident tone, he replies,

"Yes sir" and, as an afterthought,

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# RINGING THE BELL

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"Whatcher name and address?" (Note Joe's ability to obtain the pertinent information with a minimum of fuss and gab.)

"This is Mrs. John Walsh, 1316 Washington Avenue."

This information results in a frenzied search for pencil and paper, but Joe's efforts are fruitless. Loath to trust his memory, he saves the day by asking, "Would ya hold the line a minute, lady? I can't find my pencil. Dat lousy helper of mine musta walked off with it. You know how help is nowadays. Ha, Ha, Ha!" (Observe clever introduction of humorous note to relieve an awkward situation.)

Some minutes later, Joe crawls from under the bench with a pencil.

"Okay, Mrs. Welch. What's the address again?"

"1613 Washington Avenue, and the name is Walsh: W-A-L-S-H"—this in a chilly tone affected chiefly by those fortunate souls who do not suffer with names like Zybyschowicz.

"Oh, sure, Mrs. Walsh. Whatsa matter with the set, lady?"

Despite the directness of the query, the subject is one that is close to Mrs. Walsh's heart and she begins a lengthy discourse on a host of symptoms that have to do with strange noises emanating from her instrument when a light switch in an adjacent room is turned on, or when someone stamps across the living room floor.

With a gentle sigh and a heavenward glance of eyes as if to seek patience with the opposite sex's tendency for loquacity, Joe listens stoically. When Mrs. Walsh has reached a point where a pause for breath is a necessity, Joe seizes his opportunity and interjects. "That's okay, Mrs. Walsh, I'll fix it. Don't worry. I'll be there about 7:00 P.M. Goodby and thanks for the business." (Note business-like setting of time for call at hour when family is most apt to be sitting down to dinner. This technique may not win friends but it always influences people.)

The remainder of the afternoon passes uneventfully. Joe fixes three more sets before the clock says 6:45. Although he is aware that 1613 Washington Avenue is a good 30 minute drive, Joe is in no hurry since he has always reasoned that punctuality may give the impression that he is hungry for business.

As he is about to pack his service kit, he suddenly realizes that he forgot to ask Mrs. Walsh what make of radio she owns. Since his kit will not hold more than a dozen tubes, this poses a problem, but Joe solves it by optimistically concluding that tube trouble was not likely. Packing a few condensers into the kit, and making a mental note to clean that bag out one of these days, he leaves.

Joe makes all the red lights and gets stuck in two traffic jams so it is 7:40 by the time he arrives at Mrs. Walsh's. He is surprised to find that it is in a very fashionable section. Although Joe is the type who may be placed in the category labeled "mental midgets," he is not so far gone that he can't realize his baggy pants, dirty shoes, and greasy pullover sweater are slightly out of place in an environment like this.

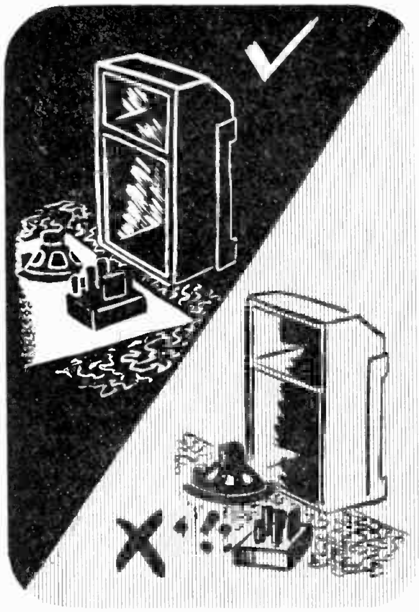
With publicity-created nonchalance, he pauses at the front door to light a cigarette, then rings the bell.

As Mrs. Walsh opens the door, her smile of welcome quickly changes into a glance of consternation. He removes his cap, and in a very crisp, business-like manner, he announces, "MacJerk's Radio and Television Service."

Recovering, Mrs. Walsh says, "Oh yes. Won't you please come in?"

To a more sensitive ear, the tone of the invitation would have given the impression she was hoping for an answer in the negative.

"Sure," graciously accepts Joe, struggling with a momentous problem: He has two bags, one cap, one cigarette and only two hands.



What to do?

With his customary lack of indecision, he places the cigarette back in his mouth, the cap on his head, and picks up the bags.

Mrs. Walsh ushers him into the living room and nervously introduces him to the man of the house who is at the moment seated behind the evening newspaper. It would not require the services of a physiognomist to deduce that Mr. Walsh is slightly displeased because his dinner has been delayed pending the arrival of the radio man.

In answer to Joe's "How d'ya do?" Mr. Walsh grunts a very non-committal "harumph" and gives his spouse a look which asks, better than words, "Where did you find this character?"

Joe walks over to the radio and turns it on. By this time, the ash on his cigarette is about an inch long, so he stops to cross the room and snub the butt on a clean ash tray. (Note his concern for Mrs. Walsh's rug.)

Returning, he picks up a vase from the top of the console and carefully places it on the mantel. A white lace doily is more of a problem, but Joe solves it by picking it up with one hand so that there will be only one set of greasy fingerprints on it. The coast clear, he swings the cabinet out from the wall and goes to work.

A vigorous tapping on the tubes produces results—a '55 when tapped, starts the set playing for an instant.

Being methodical, he decides to remove the chassis and make certain that everything underneath is in order.

He opens his tool kit and after a bit of digging around, during which a few ends of wire and an empty tube carton fall to the floor, he finds his set of socket wrenches and proceeds to remove the chassis. Some minutes later, having left his fingerprints on the white window sill and the drapes when he disconnected the aerial lead-in, Joe has the set and speaker on the rug.

He plugs the radio in, but when he attempts to plug in his soldering iron, it is necessary to remove the plug that is occupying the other half of the outlet, removing the illumination from Mr. Walsh's newspaper.

Ignoring the ominous rustling of the paper, and a black look, Joe performs his checks at the conclusion of which he announces,

"It'll cost you $5.50 to fix this set."

"Really? Just what seems to be wrong?"

"Well, I gotta replace two tubes and one by-pass condenser," says Joe.

"Do you think it would be better if I traded this set in for a new one?"

"I don't know—it'll be pretty good when I get through," confidently replies Joe.

"Well, all right then. Go ahead," acceded Mr. Walsh, anxious to get this over with, and get to his dinner.

Some ten minutes later when the contents of his service kit have been spread over the floor, Joe comes to the dismaying conclusion that his kit does not include a '55 or 2A5.

"Mister Walsh, I'm sorry, but I don't seem to have the tube replacements with me—guess I'll have to buzz back to the shop and pick them up."

This is the last straw. Joe soon finds himself on the front porch, his ears still burning from Mr. Walsh's impressions of a clumsy stumblebum who messes up people's homes and does not know his trade well enough to come out on a service call with adequate equipment.

"Whew! I'm glad we got rid of that stupe. I wouldn't trust him with Junior's scooter," ejaculated Mr. Walsh as his wife ran the vacuum cleaner over the rug where neat, symmetrical, designs of dust betrayed the location of the speaker and the tallest components of the chassis.

"Frank Benson was telling me what an excellent job he had done on his set the other day. Think I'll give him a ring after dinner and get the name of the man who did his work."

Thus it was that early Monday morning, Fred Williams' phone rang. Fred turned from his bench. Picking up the phone he answers,

"Good morning. Williams' Radio Service, Fred Williams speaking."

"Good morning. This is Mrs. Walsh, 1613 Washington Avenue. My radio is giving trouble. Could you take care of it?"

"Certainly, Mrs. Walsh. What would be a convenient time for me to call?" asked Fred as he entered the name and address in his call book.

"Any time in the early afternoon, say about 2:00?" Replies Mrs. Walsh pleasantly surprised to learn that not all radio men are unconcerned about inconveniencing their customers.

Glancing at his call book to confirm that this hour was free, Fred replies, "That's fine. You may expect me at 2:00. Now Mrs. Walsh, if I may take a minute of your time, you can help me to give you more efficient service by telling me just what trouble you are having with your radio—that is, has it stopped playing altogether, is it weak, or noisy?"

"It doesn't play at all."

"I see. Does the dial light up when you turn it on?"

"Yes."

"Thank you. Now one thing more —would you happen to know the name of the manufacturer and the age of the radio?"

"Yes. It is a———; as for its age, I really don't know for sure. We bought it in 1937."

"That's fine, Mrs. Walsh. I am very much obliged to you. You may expect me at 2:00."

Since radios of 1937 manufacture employed 6A7's, 75's, 77's, 78's, 42's and 80's, Fred made sure his kit contained at least one of each. On the chance that the set may have been on the dealer's floor for some time, Fred also packed some 2A7's, 55's, 57's, 58's, 2A5's and 80's, as this was the lineup of most of the 1936 sets.

Since the set lit up, power transformer trouble was not to be suspected. A 15-henry choke, thru 8mfd 600v electrolytics, and a 30,000-ohm, 25-watt resistor with adjustable taps took care of possible power pack troubles. If coil or speaker trouble requiring replacement was encountered, Fred reckoned on removing the set to the shop, so no attempt was made to carry along these items. A standard assortment of paper and mica condensers, resistors, and "pots" took care of most eventualities in this department.

In addition to replacement parts, he checked his kit for such items as "carbon tet" and speaker cement. He made sure of an ample supply of colored, insulated staples, 30 ft. each of white, black, and brown parallel cord, base-board mounting current tap, and antenna kit. (Observe in-

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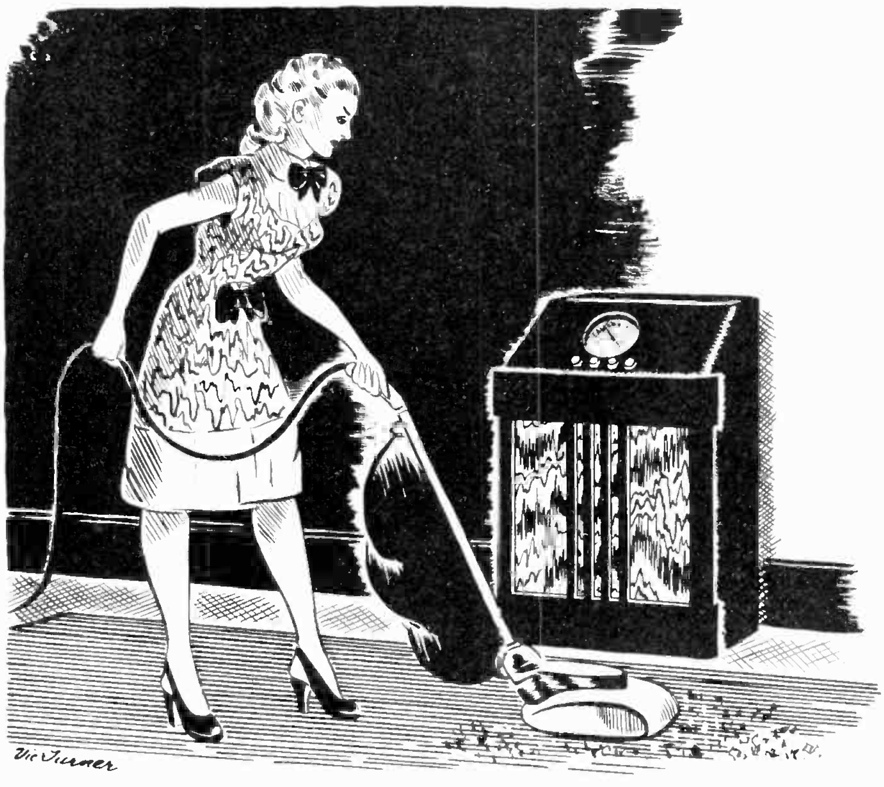

# Test Panel for the Modern Bench

**The February issue carried an article on a modern service bench. This article describes a test panel for use on that bench. It can, however, be used to advantage on most service benches.**

The Modern Radio Service Bench which was proposed in the February issue was received with great interest on the part of readers of Radio Maintenance magazine. This article was to be published in the following issue but due to the fact that new material and test equipment became available in the interval between issues we felt it necessary to conduct further experimentation with a view toward improving the bench.

This article is devoted to the test panel. Future articles will cover other auxiliary equipment, such as power supplies, test speaker, etc. The instrument pictured in the first design was a multimeter of the push-button type, which is a very useful instrument. But with the advent of television and F-M servicing in the near future, it has been decided that a vacuum-tube volt-ohmmeter would prove more useful as the fixed instrument. The instrument panel includes five of the important features of the bench, as follows:

1. A *complete* analyzer, capable of making all measurements in one instrument (VTVM Type).
2. Complete power control for the entire bench.
3. Complete antenna and ground circuits.
4. Rapid aurally-indicating continuity tester.
5. Soldering iron control.
6. Lighting control.

A *complete* analyzer that fills the requirement of (1) should contain facilities for measuring A-C and D-C volts with negligible circuit loading up into the R-F ranges, and it should be able to measure resistance and direct current. The remainder of the other features of the instrument panel comprise switches for controlling all power supplied to the bench, with separate switches for controlling the soldering iron, the lights under the instrument panel, and the outlets to the instruments on the upper shelf. Pilot lights indicate when power is supplied to the bench wiring, and the condition of heating of the soldering iron. For greatest convenience in servicing operations, it is thought that antenna leads should be available on the bench, and the instrument panel is a convenient place for them. One other innovation that is of great value to the user when he becomes familiar with its possibilities is the addition of a continuity tester of the buzzer type. While an ohm-meter will measure D-C resistance down to less than one ohm, it is often desirable to determine, for example, which side of a filament circuit is grounded. The ohm-meter will indicate a resistance of less than 0.1 ohm from either side of the filament to ground, and unless the power can be turned on and the voltage measured, little further information can be gained. The suggested continuity tester will indicate quickly which of the two circuits is directly connected to ground. The method of use will be covered later. Continuity testing by means of neon lights is often useful, but modern high-range ohm-meters will serve for this purpose equally well. It is the very low resistance ranges that are covered best by the buzzer method.

For the antenna connections for bench use, it is considered worthwhile to install two separate antennas—one of a high-quality noise-reducing type, such as the RCA Magic

Wave, and another of the specialized type suitable for FM and television, if your location warrants it. At the time of construction, it is just as easy to make provision for possible future requirements for an F-M antenna, and save re-cutting when it does become necessary. By the time this article appears, it is just possible that some enterprising manufacturer will have announced a good antenna that combines both of these requirements, and does both equally well—if so, the necessity for two separate units will be eliminated. Figure 2 shows the completed instrument panel from the front.

## Other Instrument Possibilities

The relative merits of the vacuum-tube volt-ohm-meter and the standard type of multimeter were fully stated in another article in the February issue of Radio Maintenance, "Fundamentals of Vacuum Tube Volt-meters." The vacuum-tube meter is slightly more expensive, generally has less ranges than the ordinary multimeter, requires a source of power, and is presumably subject to a greater number of failures due to the greater number of components used. But there is no denying the fact that there are many measurements that cannot be made with the multimeter, and for which a vacuum-tube volt-ohm-meter is essential. For a permanent, built-in meter, the objection relative to the power requirement is eliminated. A suitable choice of vacuum-tube instruments will eliminate the third objection, for the particular type chosen here, being built with a wide variety of ranges. And in order to get the advantages of the VTVM, the slight additional cost is well worth while. The products of a reliable manufacturer are subject to a minimum of component failures. The advantages of low circuit loading, stability of adjustment, and wide variety of D-C, A-C, and R-F voltage ranges warrant the selection of the vacuum-tube instrument for this bench.

Some service men may object to the use of the coaxial fittings for antenna and ground connections. The fittings selected were chosen with a view towards as much simplification as possible, and both the ordinary broadcast-band antenna and the F-M di-pole appear on the same type of socket, and the same cord and plug can be used for both.

## Choice of Equipment

Before making any selection of the vacuum-tube instrument to be used in the panel, let us take a good look at the requirements. It is felt that the following are the minimum ranges that should be available:

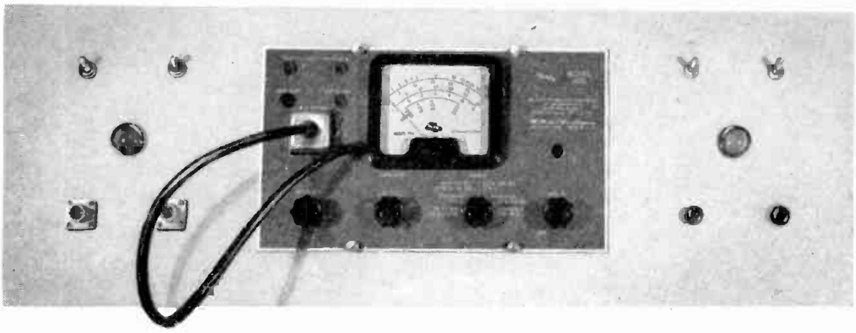

**Fig. 1. Front view of the panel.**

| | *Min. full scale reading* | *Max. full scale reading* |
|---|---|---|
| D-C volts | 5 | 3000 |
| D-C milliamps | 11.0 | 1000 |
| D-C amperes | 1.0 | 10 |
| A-C volts | 5 | 3000 |
| R-F volts | 5 | 500 |
| A-F volts, db scale | —10 to +50/1 mw, 600 ohms | |
| Ohms | 2000 ohms | 20 megs |

In addition, it is felt highly desirable that the meter should be equipped with some sort of R-F probe tube that would cause minimum loading of the circuit being measured, and that stability of adjustment is a very important feature. It should not be necessary to readjust the meter for each scale of the ohm-meter, and after a reasonable warming-up period, the instrument should be stable for an indefinite time. One other factor that influenced the choice was that of shape and housing—the panel of the instrument should be horizontal without a host of controls in the line of sight, and for most satisfactory use, the cabinet for it should be made of metal. One instrument found entirely suitable for this permanent panel mounting and one which is currently available is the Silver "VO-MAX."

Coming again to the continuity tester, Fig. 2 shows its circuit. The buzzer is operated by a 4½-volt "C" battery, attached to the panel where it is reasonably accessible for replacement. With just a few words about the continuity testing method, the desirability of this accessory will be evident. It is a known fact that the D-C resistance of transformer windings is often quite low, but they do have inductance. If the measurement is made with some source of alternating or pulsating current, the presence of the inductance will have the same effect on the indication as a resistance in series would have with the conventional ohm-meter. Furthermore, the buzzer provides an audible test, making it possible to make measurements without the necessity of watching a meter. The difference in pitch of the buzzer will tell when an inductance or resistance

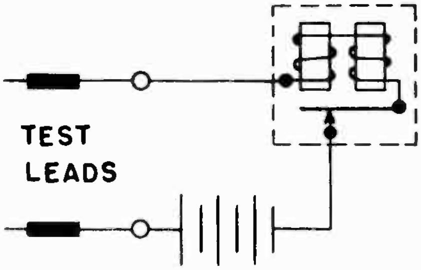


**Fig. 2. Continuity tester circuit.**

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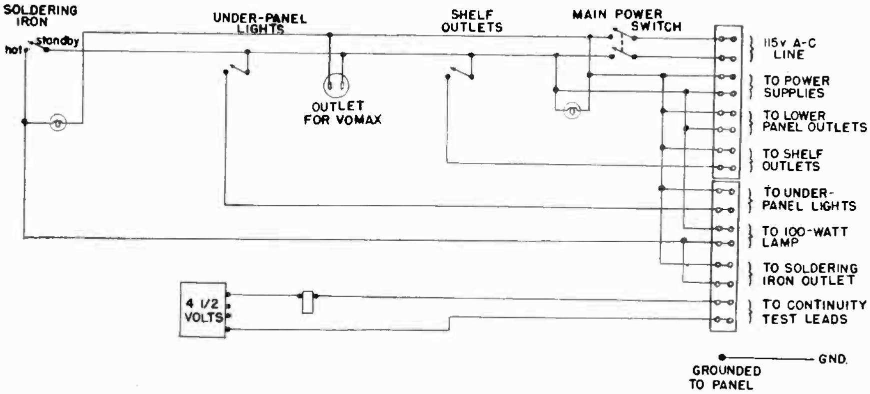


**Fig. 3. The wiring diagram of the panel and bench.**

# Test Panel for the Modern Bench

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is in series with the buzzer and battery. This tester is also of advantage in checking continuity of cables and wiring, and will furnish a quick method of checking circuits. The buzzer selected is a very good quality unit—not the standard doorbell type—and it has an adjustment for the contact. The pitch is not as high as with those buzzers used for code practice, but it is somewhat above the raucous note of the doorbell buzzer. It is felt that a month's use of the continuity tester will convince anyone that it is well worth the extra expense. As a caution, do not attempt to work the buzzer from a transformer—the A-C supply to any buzzer will force it to vibrate at 120 cps (on 60-cycle supply), and the advantage of judging the resistance or inductance in series, by noting the difference in pitch, will be considerably lessened.

The switches selected were a good grade of toggle switch with "bat" handles, which look somewhat better than the standard toggle switch. The pilot lights are large, a red light indicating that power is applied to all the bench circuits on the "master" switch circuit, and a green light indicating the heating of the soldering iron. When the iron is on full heat, the light glows brilliantly—when the iron is half-heat, the light is dim. This control of soldering iron temperature is provided by means of a 100-watt lamp wired in series with the soldering iron outlet; when full heat is desired, the lamp is shorted out. The pilot light is wired directly across the iron outlet, and the reduced voltage will cause a dim indication. The wiring is shown in Fig. 3, which is a complete schematic of this portion of the bench. It will also be noted that one switch controls the lights under the instrument panel and another applies power to the outlets on the upper instrument shelf for the tube tester, oscillograph, signal generator, and such other instruments as may be used occasionally. The switch for the vacuum-tube volt-ohm-meter is a component part of the instrument, and no additional switching is required.

The schematic of Fig. 4 shows the antenna circuits in their entirety. A "flat-top" of 30 to 50 feet in length is used for the all-wave noise-reducing antenna, although it may be more convenient to use a vertical "whip" of 12 to 16 feet in height. The antenna proper is connected to a transformer on the roof, and a good ground connection is made to a vent pipe as near the transformer as possible. The antenna transformer contains a lightning arrester inside the weatherproof case, but it is suggested that a 2000-ohm- 2-watt carbon or metallized resistor be connected across the antenna and ground binding posts of the transformer to bleed off static charges. Otherwise, reception will be

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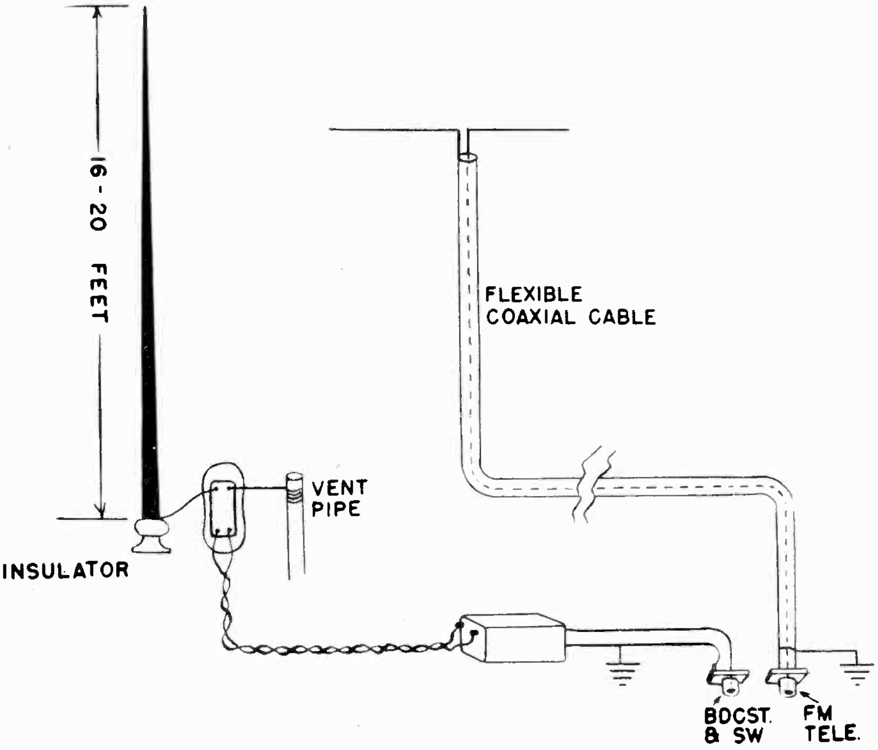



**Fig. 4. The antenna circuits. A transformer and trap are shown in the broadcast and short wave frequency antenna.**

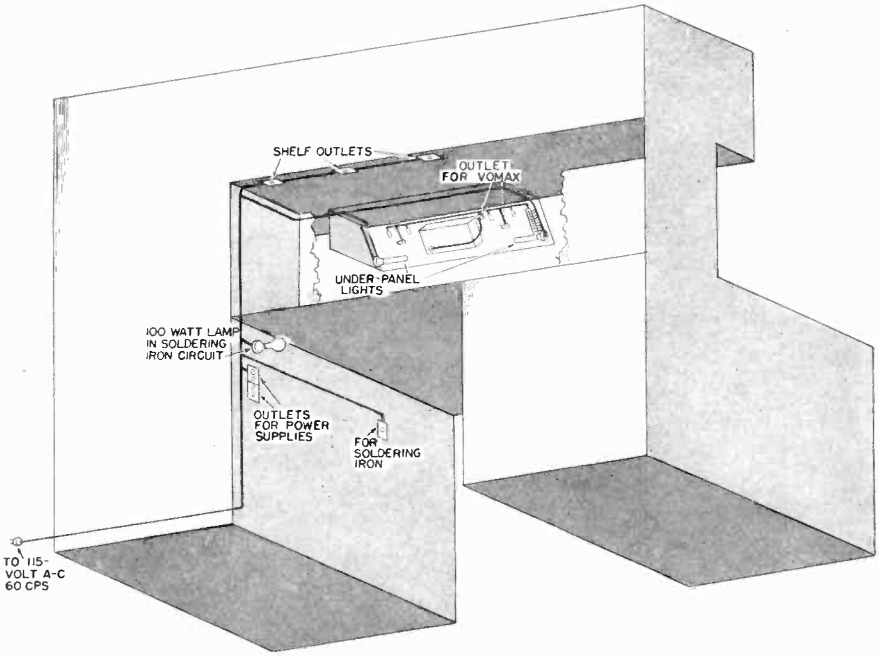
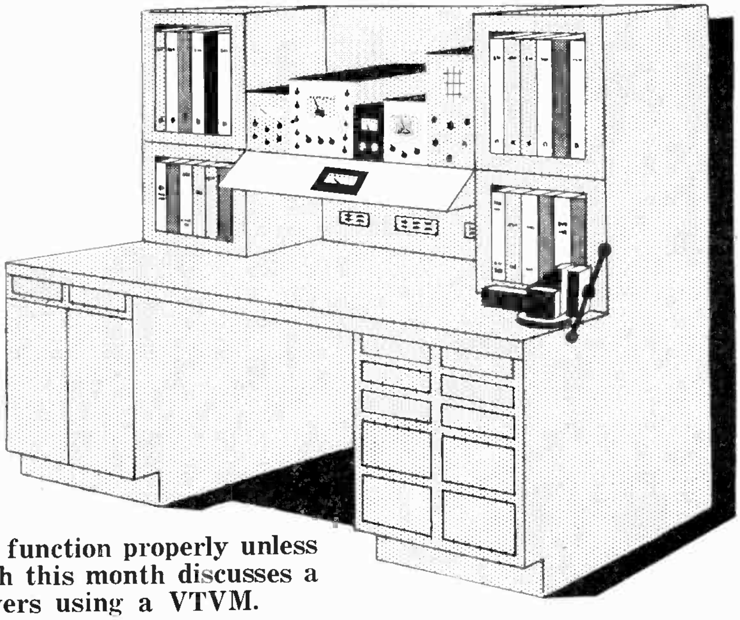



**Fig. 5. Rear view of the bench showing the panel in place.**

# The Radio Service Bench



**Unlike an AM receiver an FM set will not function properly unless carefully aligned. The Radio Service Bench this month discusses a simple method of aligning FM receivers using a VTVM.**

WHILE THE ALIGNMENT PROCEDURE for FM receivers is more complicated than that for AM receivers, it is a simple process once something is known about frequency modulation receiver circuit functioning.

This article will not stress the theory of operation of FM, but will discuss that part which is necessary to properly align an FM set.

There is not much difference in stage line-up between FM and AM receivers. Both use the superheterodyne principle of frequency conversion, that is, by mixing a locally generated signal with the incoming signal and amplifying the resultant before detection. The FM receiver therefore has a converter, an oscillator, and a number of I F stages. All of these circuits, although they operate at a higher frequency, are basically the same as those in an AM receiver. Fig. 1 shows a block diagram of an FM receiver.

The difference between the FM and AM receiver lies in the method of detection. In FM receivers, a stage known as a limiter is used before the detector. The limiter removes all amplitude modulation from the signal and presents to the detector a frequency modulated signal of constant amplitude. The detector is called the discriminator. This circuit converts the frequency modulated carrier into an audio signal and feeds it into the first audio amplifier. The most common discriminator circuit in use is the Foster-Seeley shown in Fig 2.

The above-mentioned circuits are the only ones found in an FM receiver which are basically different from those in an AM receiver. The alignment procedure specified below has been used successfully on the Foster-Seeley circuit.

There are a number of ways in which an FM receiver may be aligned depending upon the equipment the service man has available. The method to be described here requires a signal generator of suitable frequency, that is, from 4 to 16 megacycles for the IFs and 42 to 108 megacycles for the RF section. A VTVM is used to take readings of output.

## Intermediate Frequency

Before attempting to align an FM receiver the Intermediate Frequency must be known. Pre-war receivers used IF's of 4.3, 6.25, 8.25, 12.25, and 15 mcs with 4.3 mcs, the commonest. The intermediate frequency may be found in the manufacturer's instructions, or if they are not available it may be determined by the following method. Set the signal generator for maximum output. No modulation should be used. Connect the output of the signal generator to the control grid of the mixer stage, as shown in Fig. 3. Connect the VTVM to the ungrounded cathode of the discriminator stage. Vary the frequency of the signal generator from 4 to 16 mcs. The frequency giving the greatest voltage reading on the VTVM is the intermediate frequency, or is very close to the intermediate frequency. As an example, if the maximum voltage reading is found at 4.285 mega-

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Fig. 1. Block diagram of an FM receiver

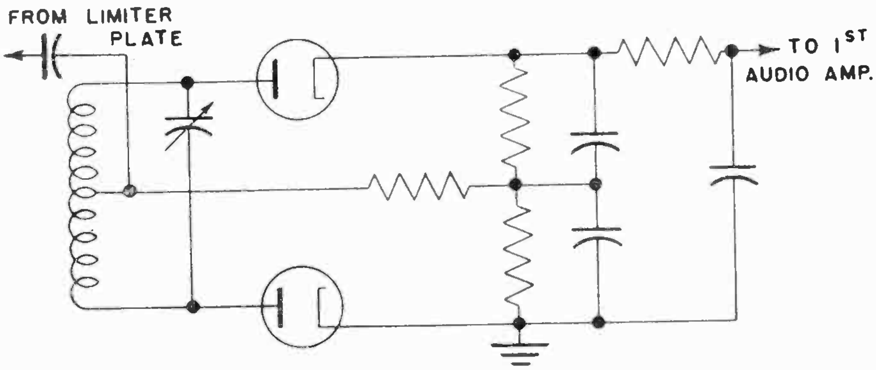


Fig. 2. The Foster-Seeley discriminator circuit. Most pre-war FM receivers used this circuit.

# The Radio Service Bench

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cycles the intermediate frequency is 4.3 megacycles.

## Aligning the IF's

Now that we know the intermediate frequency we may proceed with the alignment of the receiver. In the explanation that follows we will assume that the intermediate frequency of the receiver we are to align is 4.3 megacycles. When aligning receivers using other intermediate frequencies, the same procedure should be followed, setting the signal generator at the proper frequency for the particular set being worked on.

The IF stages are aligned first. Set the signal generator to 4.3 megacycles. No modulation should be used. Connect it to the control grid of the converter as shown in Fig. 4. This connection should be made through a mica condenser of from 50 mmf to 300 mmfs. Connect the VTVM to the grid of the limiter tube (in receivers using more than one limiter use the grid of the first limiter stage). Set the VTVM on a low voltage scale. With the receiver turned on and warmed up, adjust the IF trimmers starting with the last and working back toward the converter stage. Repeat this procedure until maximum voltage is indicated on the VTVM. When maximum indication is secured the IFs are properly aligned.

## The Discriminator

The next step is to align the discriminator. Do not change the connection or setting of the signal generator. Connect the VTVM to the ungrounded cathode of the discriminator stage as shown in Fig. 3. Detune the secondary of the discriminator input transformer by changing the setting of the secondary trimmer. Adjust the primary trimmer of the transformer until maximum voltage is indicated on the VTVM. When maximum voltage indication is secured leave the primary trimmer as is and adjust the secondary trimmer for zero voltage indication.

The discriminator should now be checked for proper alignment by setting the signal generator first 50 kc above 4.3 megacycles and then 50 kc below 4.3 megacycles. If the two 50 kc deviation readings are equal and 75 kc deviation readings are also equal the discriminator is operating properly.

If the above checks indicate that the discriminator is not operating

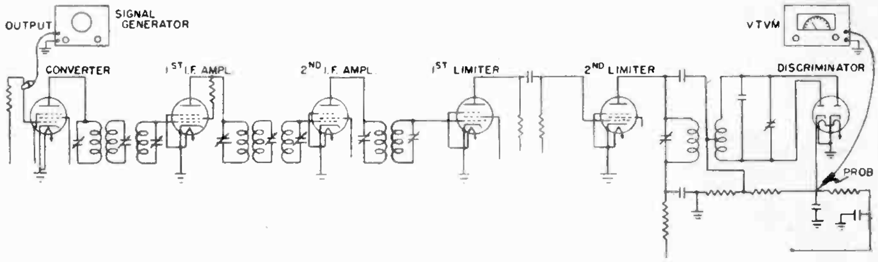


**Fig. 3. Connection of the signal generator and VTVM to find the intermediate frequency of the receiver, and when aligning the discriminator.**

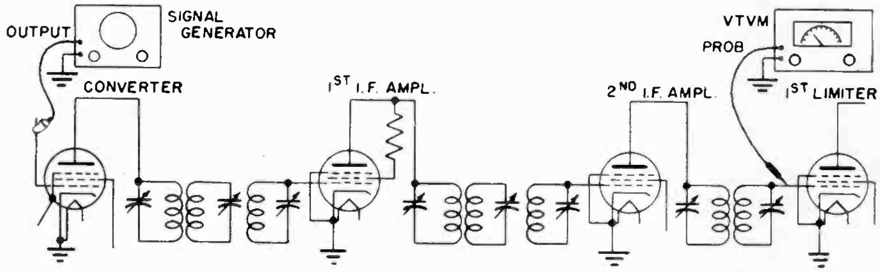


**Fig. 4. Connection of the signal generator and VTVM when aligning the IF stages.**

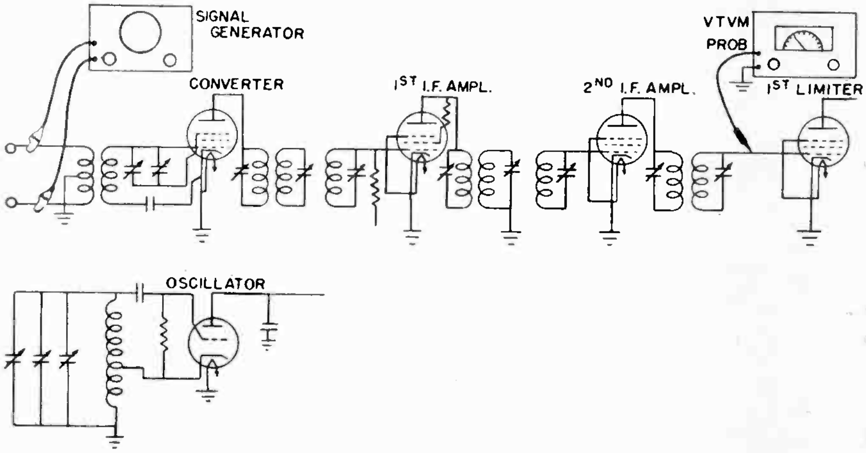


**Fig. 5. Connection of the signal generator and VTVM when aligning the RF stages of the receiver.**

properly the discriminator alignment procedure must be repeated. After repeating the alignment, the stage should again be checked. It may be necessary to repeat the procedure again until the discriminator checks properly.

## The RF Stages

Having adjusted the IF stages and the discriminator, the RF section may now be aligned. Connect the VTVM to the control grid of the limiter tube (use the control grid of the first limiter stage in receivers using more than one limiter). Connect the signal generator to the antenna connection of the receiver through a small mica condenser (50 to 300 mmfs) as shown in Fig. 5. Set the signal generator to the center of the FM band. Use as little RF input to the receiver as possible. Set the tuning dial of the receiver to the same frequency as the signal generator. Adjust the oscillator trimmer until maximum voltage is indicated on the VTVM. Adjust first the mixer and then the RF trimmers for maximum voltage readings on the VTVM. Set the signal generator to the high end of the band and tune the receiver to the same frequency noting whether or not the calibration is correct and if there has been any appreciable change in voltage reading on the VTVM. Repeat the above at the low end of the band. Slight changes in the setting of the RF and mixer trimmers may be made to obtain greatest output at both ends of the band.

If the above method is followed carefully, no difficulty will be found in aligning pre-war FM receivers. With the change in frequency recently ordered by the F.C.C. changes are being made in receiver designs. Future issues will give information which will enable the service man to handle all types of FM receivers as they are produced.

# ELECTRONICALLY SPEAKING

Declaring that pre-war experience indicates that television manufacturers should assume a major responsibility for installing and servicing their television instruments, Mr. Elliott revealed that RCA Victor plans to establish its own service shop facilities, manned by thoroughly competent and trained personnel, in all of the initial television market areas —New York, Philadelphia, Los Angeles, and Chicago. In addition, he said, the company will undertake an intensive, well-planned program of continuous education to train wholesale distributors, retailers, and members of the service profession in the fundamentals and techniques of television installation, servicing, and maintenance.

---

Postwar planning and sales for Jensen Company include a complete redesign of both field coil and PM speakers to incorporate the new and powerful Alnico 5 magnet material so successfully used by the Jensen Company in its military production. Plans also cover new Coaxial speakers, and reproducers housed in Bass Reflex cabinets.

---

Because John Meck, president of the John Meck Industries, mushrooming radio manufacturers located at Plymouth, Indiana, feels that a dealer's store should reflect the quality of products handled, plans are underway to supply Meck's dealers with suggestions and material to not only make the store more attractive to the discriminating customer but to work toward a completely planned Meck shop.

"Whether a customer realizes it or not, instinctively he is drawn to the store that not only has quality products but one that presents an inviting interior," said Meck.

Following this premise, Meck's dealers are being sent material that will dress up their stores and promote Meck radios and phono combinations.

Plans to date include suggestions for a modern interior paint job; special wall paper bearing electronic designs; merchandise display material; unique window displays; special seats and settees; and a specially constructed sound proof test room. Samples of the test room are being constructed by the Burgess Battery Company, acoustical wall board manufacturers. The booth will enable the customers to study the functions of the Meck set under completely undisturbed conditions.

Meck dealers have already been shipped an advertising kit for the Meck "Trail Blazer," which was the first completely new post-war radio set produced by the industry. Included is special window display material, advertising mats and promotional and publicity releases.

---

The proportion of newcomers in the radio set field, at least so far as OPA pricing is concerned, continues to increase, according to an RMA analysis of prices issued by OPA through the week of February 15.

One hundred and eleven companies, including three mail order houses, have obtained prices on radio receivers, and only 38 were in production before the war. OPA officials, however, believe that many of the newcomers are not producing because of unsatisfactory prices.

One of the heaviest schedules of radio set and phonograph prices was contained in the OPA weekly report for the week of February 1. It listed prices on 86 radios and 25 phonographs. Prices had been fixed on 515 radios and 118 phonographs up to February 15.

---

Contrary to some newspaper reports and labor union implications, manufacturers of consumer durable goods, including radios, have not withheld their production from market in hope of obtaining better prices, according to a survey made by the Civilian Production Administration and released recently.

A spot check on the stocks of 34 leading producers of electrical refrigerators, washers, radios, ranges, and ironers at the end of December showed no excessive inventories of finished products being withheld from the market, the CPA disclosed.

A total of 526,046 units—electrical refrigerators, washers, radios, ranges or ironers were made since reconversion by the 29 spot-checked producing plants. Only 47,350 units of this total were in inventory at the end of December, the period when this survey was made.

CPA officials checked 15 companies in the electrical radio industry. Three of these firms were found to be not in production at the end of December because of difficulties in obtaining components. The 12 producing firms had made 160,155 electric radios (mostly in October, November and December) and had an inventory of 18,299.

---

RCA Tube Department Demonstrates Sight-Sound Sales Meeting Application: The first demonstration of television as a vehicle for presenting a sales and merchandising program to company officials was held last week when the RCA Tube Department used NBC's television facilities to present to top management executives of the RCA Victor Division its plans for production, merchandising, advertising, and sales through 1946.

The program was regarded as a

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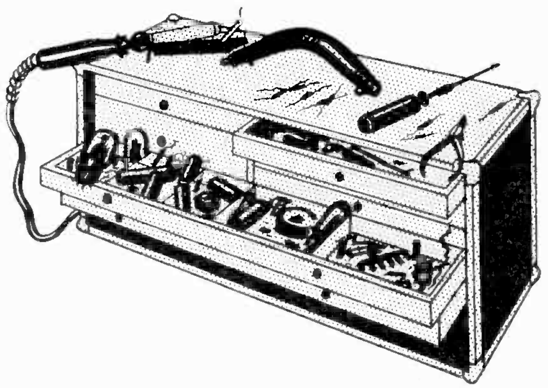
# Service Kit



**Eliminating interference created outside the receiver**

LAST MONTH WE DISCUSSED the case of noise problems which are caused by sources within the receiver itself. By no means are these the only or even the most common sources of troublesome noise. No service man of any experience will agree that all noisy sets are due to mal-functioning innards. On the contrary, while it is often easy to determine whether the noise is internal or external, it is often difficult to locate the source if it is found not to be within the set.

External noise may take any of three forms. First, it may be due to atmospheric disturbances — electrical storms, discharges between clouds, etc.—so-called atmospheric or strays. These discharges produce a damped wave against which the receiver cannot discriminate.

Second, it may be caused by an accumulation of electrical charges on the antenna—so-called static. At the instant that these charges reach a high enough value, they discharge through the receiver antenna circuit producing the familiar crashes or clicks.

The third form of external noise is caused by electrically operated devices. These often create so-called man-made static.

There is little that can be done to reduce the effects of atmospherics, at least as far as A-M receivers are concerned. Theoretically, conditions may be such that atmospherics may be reduced by using a directional antenna. This may be of assistance if the direction of the atmospherics is different from that of the desired signal. In this connection, it is of interest to note that the greatest source of interference is from the South. Therefore if the receiving antenna is designed to respond to East-West transmission an improved signal-to-noise ratio is possible. However, for obvious reasons, this expedient is of doubtful value.

It has been shown that the amount of background noise due to external causes is directly proportional to the receiver band width. A familiar example of this phenomenon is a radio telegraph receiver that is capable of receiving intelligible signals under signal-to-noise ratios half as high as necessary for radio telephony. This has led to the development of variable-band-width receivers in which wide band reception is used only when the signal-to-noise ratio is low. Several so-called "static eliminators" have appeared whose prime function is to reduce the effective band-width of the receiver.

Another expedient makes use of the fact that atmospherics take the form of high strength impulses, after amplification and rectification, and are used to block the receiver. This improves reception somewhat, despite the fact that a small amount of distortion is introduced.

However, from the serviceman's point of view, these measures are of little practical value since the cost of incorporating these refinements is apt to be prohibitive. They are mentioned here in order to convey some idea of the magnitude of the problems involved.

## Atmospheric Noise

Static charges on the antenna may be reduced by shortening the total antenna length. Theory indicates that where static is bad, a short, low antenna will give better reception than a high, long antenna. Excessive charges may be prevented from building up on the antenna by providing a leakage path to ground. This is accomplished by connecting a high resistance (about .25 meg.) from the receiver antenna input to an earth ground.

From the foregoing, it will be seen that little can be done to minimize external noise due to natural causes. Once the service man has convinced himself that the customer's complaint is based upon static or strays, he should make every effort to explain the seriousness of the problem. Any work that is done, should be undertaken with the explicit understanding that results cannot be guaranteed.

## Man-Made Noise

In the case of man-made static, a little better condition exists, although there are numerous instances in which the serviceman is faced with insurmountable obstacles.

At the outset, it may help in understanding the problem, to realize that practically all man-made static has one distinguishing characteristic. Any motor or set of contacts that is giving interference is acting like a miniature broadcast station. This means that the noise signal will be radiated into space since this noise signal is essentially an amplitude modulated wave, any receiver antenna located in the radiated field will pick up the signal. If the intensity of the noise signal is at all comparable to the strength of the desired signal, it will be amplified and reproduced. Moreover, since the noise signal is of pulse character, a very large number of different frequency components are present, thus making it impossible to tune out the undesired signal.

A further complication arises from the fact that noise sources are usually line operated. Therefore, in addition to radiating a signal into space, an electrical device can set up a noise current in the power mains, and once there, the signal may be carried to the radio by direct conduction through the power lines.

The power lines may act like antennas and re-radiate the signal into space. This latter fact explains how a noise source may cause disturbance in a receiver located at a considerable distance from it.

In the majority of cases, it will be discovered that noise enters simultaneously through the power line and

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**JOBBING DISTRIBUTING ORGANIZATION FOR PRODUCTS OF THE SPRAGUE ELECTRIC CO.**

# SERVICE KIT

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the antenna, and means must be found to prevent its entrance through both these paths.

The most direct method of eliminating interference is, of course, to kill it at its source. The greatest obstacle to this, however, is locating the source.

### Locating Noise Source

Many articles have been written describing the construction of elaborate noise tracing equipment. These articles would have the radioman strap a receiver on his back and carry a T-shaped "divining rod" in his hand. Looking like a gold prospector, he is to flit from roof to roof, up and down fire escapes, and in an out of business establishments looking for the offending device.

The serviceman who built one of these "Handy Andy Noise Locators" usually was forced to quit when his tests located the source of trouble ten feet above the roof. If the equipment worked, it might lead him, unerringly, to an elevator motor. (A midget affair of 2 or 3 horsepower rating with #0 wire running to a massive junction box complete with fuses an inch-and-a-half thick.) In this case, he made a mental note to read his book on "Design and Construction of Industrial Motors" and tried to sell a hard-hearted landlord the idea of having the motor overhauled.

Frequently he would trace the disturbance to the corner liquor store where a neon sign accomplished the dual purpose of extolling the virtues of a famous snake-bite remedy and providing a cacophonous accompaniment to the radio programs.

The author's own experience has been that unless the customer himself is the owner of the offending equipment, it is not very practical to go looking for it. For one thing, the question of who shall pay for the work of eliminating the interference can become very involved. Even in those rare instances when Mr. Smith will pay you for suppressing the noise from Mr. Jones' refrigerator motor, you will very likely get a very nasty call, a year or two later, from Mr. Jones informing you that his motor has stopped. The impression will be very forcibly conveyed that you are responsible for the trouble inasmuch as the motor worked okay prior to your visit.

If the source of trouble is in the customer's home, it is not very difficult to locate it. Generally, the customer himself has observed the coincidence of the starting and stopping of his oil burner or refrigerator, with the starting and stopping of noise in the radio.

Since motors are the most frequent cause of noise, the remedial measures that are to be described will deal with motors. However, much of this information will be applicable to any type of electrical device causing noise.

Having located the motor, the next step is to ensure that it is free of defects. If it uses brushes and a commutator, then the commutator must be thoroughly clean and the brushes properly seated so that sparking is at a minimum. Commutators may be cleaned by holding a piece of sandpaper against the commutator while the machine is running. In the event that the need for undercutting and turning down the commutator is apparent, turn the job over to a competent motor repairman, unless you have the facilities.

Brush sparking may sometimes be reduced by shifting the position of the brush-holders, although, here again, you would do well to turn the job over to a motor repairman, unless you have a thorough knowledge of motors.

### Installing Filters

The next step is the installation of a filter. Figures 1 to 5 show some of the common arrangements. The simple filters of Fig. 1 and Fig. 2 are very effective if they can be installed close to the terminals of the motor. By close is meant placing one end of the condenser under the same lug that holds the brush pigtail.

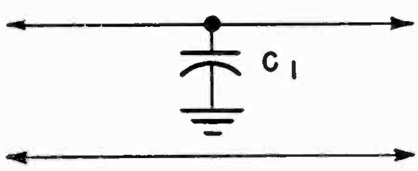


**Fig. 1. Condenser connected to motor to prevent it from feeding noise into the line.**

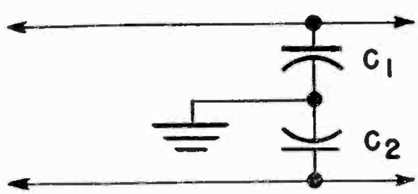


**Fig. 2. Two condensers connected as shown are often more effective than the method of Fig. 1.**

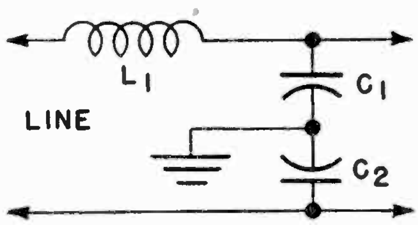


**Fig. 3. Another filter for connection to a motor using a condenser and hash choke.**

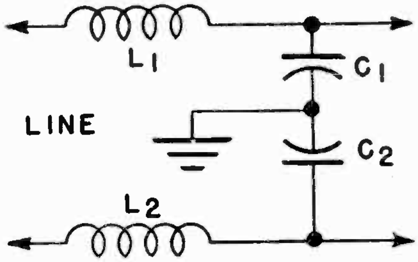


**Fig. 4. The addition of another choke will make the filter of Fig. 3 more effective.**

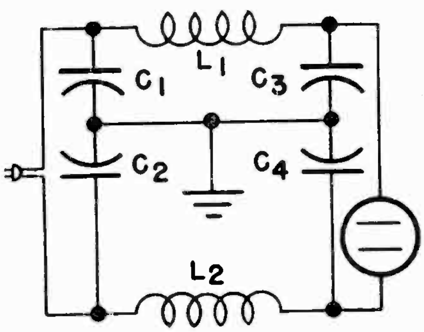


**Fig. 5. This filter will be found almost 100 per cent effective. It is recommended in cases where the motor is feeding a great deal of noise into the line.**

The filter of Fig. 5 is recommended in stubborn cases. If properly made and installed it will be found close to 100% effective. $L^1$ and $L^2$ each consist of approximately fifty feet of No. 14 enameled wire (larger if motor leads are heavier) wound on a one and one-half inch diameter form. If the winding length is kept to two-and-one-half inches, about four layers will be required. Most any of the common materials may be used for insulation although two thicknesses of .005 Kraft paper between each layer will be satisfactory. $C^1$-$C^4$ should be high quality paper condensers of at least 400 volts peak rating. The filter should be installed in a convenient metal box. For ease in installation, an outlet and cord should be provided as shown in Fig. 5.

The cover of the box should be bonded to the box with heavy braided

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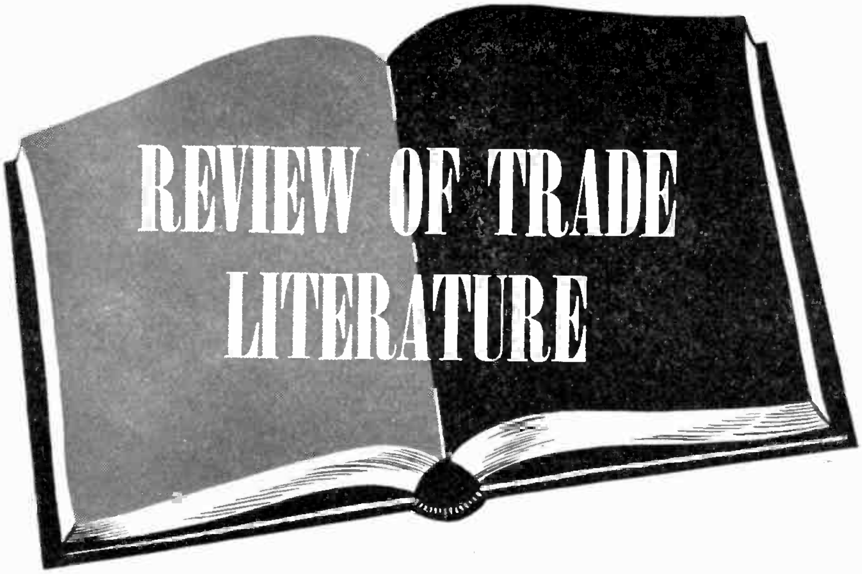


A recent announcement reveals the resumption of "Philco Service," —The world-wide association of radio and appliance servicemen.

As announced by Philco, here is what the service does for the serviceman:

1)—Gives your business the distinction and prestige which goes with recognized membership in an international organization sponsored by Philco.

2)—Helps you to do better service work by giving you all types of technical literature on Philco products.

3)—Helps you to get more service work through planned advertising.

4)—Gives you the benefit of tremendous Philco merchandising and advertising programs and the backing afforded by this great Philco Service plan.

5)—Provides you with suggested Standard Labor Charge sheets which you can display in your shop so that you can receive a fair price for your higher quality work.

6)—Makes available to you expert personal technical training and schooling from your Philco Service headquarters.

7)—You receive a handsome membership certificate showing that you are an authorized member of this world-wide organization.

Metropolitan Electronic & Instrument Co., 6 Murray Street, New York 7, N.Y., has issued a new catalog which is available on request.

The catalog features test equipment available for immediate delivery from stock. It includes the Model #705, Signal Generator, Model CA-11 Signal Tracer, volt-ohm-milliammeters and tube testers. If you are interested drop a line to Metropolitan.

HERE THEY ARE! AT LONG LAST! — "SOCKETTE" TUBE ADAPTERS. Manufactured by J. F. D. Manufacturing Co., 4111 Fort Hamilton Parkway, Brooklyn, N.Y. New and plentiful miniature tubes can be substituted in place of popular but hard-to-get types such as 6SA7, 12SA7, 25Z5, 50L6, and many others.

Write J.F.D. today, for their special listing on the "Sockette," which includes a substitution guide.—And you can tell them that we tipped you off.

The first in the new series of Garod Service notes, featuring Model 6AU-1, The Commander, a six-tube superheterodyne set, can be obtained by writing Garod Radio Corporation, 70 Washington Street, Brooklyn 1, N.Y.

The pamphlet with advice on Operation and Service, includes tips on installation, controls, operation, caution, minor reasons for failure to function, and alignment. Also included are a Trimmer & Tube Location diagram and a reproduction of the circuit diagram.

## BOOKS

Starting & Operating a Profitable Electrical or Radio Business.
by H. C. Lewis, President Coyne Electrical School. 180 pages. Numerous illustrations.

A paper backed volume containing chapters on Advantages of a business of your own, Capital needed to start a business, Choosing a location, Types of service you can offer, Choosing a name, How and what to buy, Letterheads, invoices, statements and business cards, How to get business thru advertising, direct mail, canvassing, personal and telephone contact, Pointers on good salesmanship, Legal angles of business, Keeping business records.

For those who are planning to start in business this new book published by the Coyne Electrical School, 500 South Paulina Street, Chicago, Illinois, may be just the thing you are looking for.

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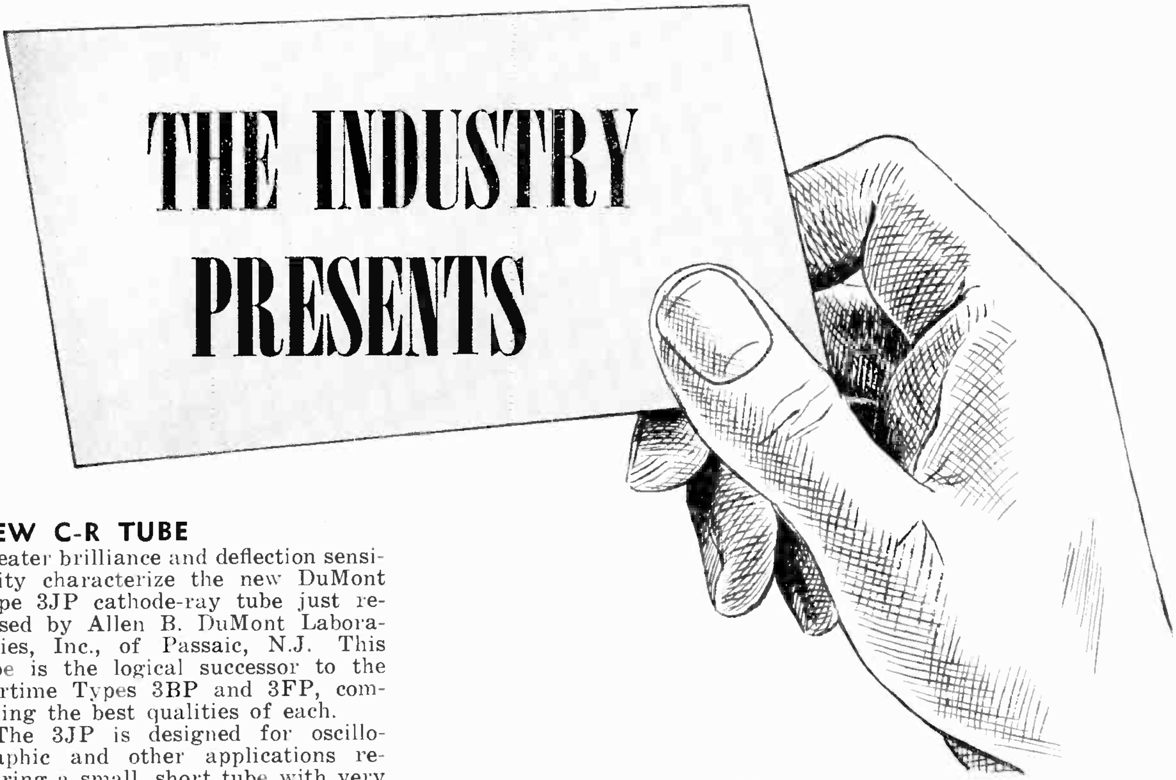
A Giant size manual on Electrical and Radio trouble shooting, with 500 easy-to-follow diagrams. A step-by-step course in locating troubles on any Electrical or radio equipment. Can be obtained on a seven-day free trial basis. Price $8.00 cash or $8.95 on time payable $3.00 after examination and $3.00 per month. Also includes free—one year of consultation service and technical bulletins.

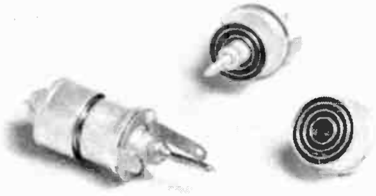



## NEW C-R TUBE

Greater brilliance and deflection sensitivity characterize the new DuMont Type 3JP cathode-ray tube just released by Allen B. DuMont Laboratories, Inc., of Passaic, N.J. This type is the logical successor to the wartime Types 3BP and 3FP, combining the best qualities of each.

The 3JP is designed for oscillographic and other applications requiring a small, short tube with very high light output and deflection sensitivity.

Engineering specifications of the DuMont 3JP (which is on the Joint Army-Navy Preferred List) may be had on request.



## NEW ULTRA-COMPACT HIGH-Q AIR TRIMMER CAPACITOR

A new and novel air-dielectric capacitor of unusually high Q, extraordinary stability both mechanical and electrical, easy of adjustment, small in size and useful up through 500 megacycles as either trimmer or tuning capacitor is now available. Produced at the famous Philips works in Holland, this new capacitor is brought to American amateurs and experimenters through Silver jobbers by the McMurdo Silver Co., Hartford, Conn.

## MIDGET CAPACITORS

Type GA Midget Capacitors introduced by the Stackpole Carbon Company, offer a reliable component for use where required low capacities have frequently been obtained in the past by makeshift "gimicks" constructed of two short insulated wires twisted together.

Stackpole GA Midget Capacitors are easy to install. They find widespread use for purposes of neutralization; capacity coupling in antenna, R-F and I-F coils; feedback; R-F by-pass. injection of R-F and audio voltages, and various others.

Standard capacities include 0.68; 1.0; 1.5; 2.2; 3.3 and 4.7 micro-microfarads. Standard tolerance is 20%.

## INTERMODULATION TEST EQUIPMENT

Intermodulation test equipment consisting of a signal generator and Intermodulation analyzer designed and manufactured by Altec Lansing Corporation of Hollywood is now available for delivery.

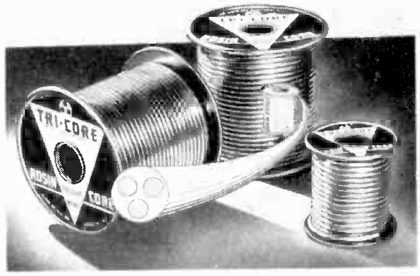
This apparatus is designed to facilitate the measurement of intermodulation distortion in all audio amplifiers, A.M. and F.M. broadcast transmitters, film, disc and tape recording, reproducing equipment and loudspeakers.

The signal generator is assembled as one unit which is portable or can be rack mounted. It contains two independent sine wave oscillators and combining units. The low frequency oscillator supplies 40, 60, or 100 cycles. The high frequency oscillator supplies 1000, 7000 or 12,000 cycles. By means of switches and controls any low frequency may be combined with any high frequency for the test.

The Intermodulation analyzer is in a second unit of similar construction. It contains the necessary input controls, power absorbing network, filters, demodulator and meters to measure intermodulation distortion directly in per cent. The sensitivity is such that it can read distortion from 0.1% up to 100%.

Switches are provided so that in addition to reading intermodulation, the internal vacuum tube voltmeter can read volts and millivolts and has a full scale sensitivity from 0.3 millivolts up to 100 volts.

The analyzer is capable of directly reading intermodulation distortion, noise levels and output power on equipment being tested over a range from 50 watts (+47 dbm) down to —90 dbm.




## NEW 3-CORE SOLDER

Tri-Core, the solder with three independently filled cores of pure rosin flux is a new development of Alpha Metals, Inc., Brooklyn, N. Y. This new product offers users faster soldering and elimination of dry joints, in addition to substantial savings in tin.

Tri-Core solder exceeds A.S.T.M. Class A specifications and is available in all alloys, all flux percentage and all gauges. Bulletins and engineering test samples are available from Solder Development Division, Alpha Metals, Inc., 369 Hudson Avenue, Brooklyn 1, N. Y.

## STACKPOLE SINTERED ALNICO II

Complete facilities for engineering and producing Sintered Alnico II in a wide variety of small magnet sizes and odd shapes have been announced by the Stackpole Carbon Company, St. Mary's, Pa. Licensed under G.E. patents, it offers magnetic properties equivalent to those of the cast product.

# PA SYSTEMS

→ From Page 9

door, and the microphone and speaker wiring. The remote volume control shown at the bar is of the constant-impedance type, of voice-coil impedance. It should be remembered that the current in a circuit of voice-coil impedance is relatively high, and that when an installation of this type is made, wire smaller than No. 14 should be avoided.

### Wide-Angle Distribution

In Fig. 11, we have a slightly different problem. The orchestra is located in the center of one of the long wells of this room, and the dance floor is directly in front of the orchestra platform. Very little reinforcement is necessary for music, so the main need for the PA system is to give sufficient volume to enable the vocalist to be heard by the diners. This being the case, the recommended speaker location is shown in Fig. 12.

It will be observed that sometimes it is advisable to determine microphone placement first, and at other times it is necessary to think about the speakers first. The writer is firmly of the opinion that no hard and fast rule can be laid down in this regard, and that each installation will have to be analyzed on its own merits. There are certainly many places where the choice of mike placements is governed by speakers and their location, and vice versa. For this particular installation, only one microphone seems to be necessary, that for the singer—and it is simply mounted on a floor stand in front of the orchestra. Practically any type of microphone can be used here, but the uni-directional type has so many good features that it should be selected for this installation. Its pattern precluded pickup from the dancers' feet, and removes doubt as to the acoustics of the room—it is dead towards most of the area, as shown in Fig. 13.

This is another installation where the use of the remote control amplifier should be resorted to, unless it

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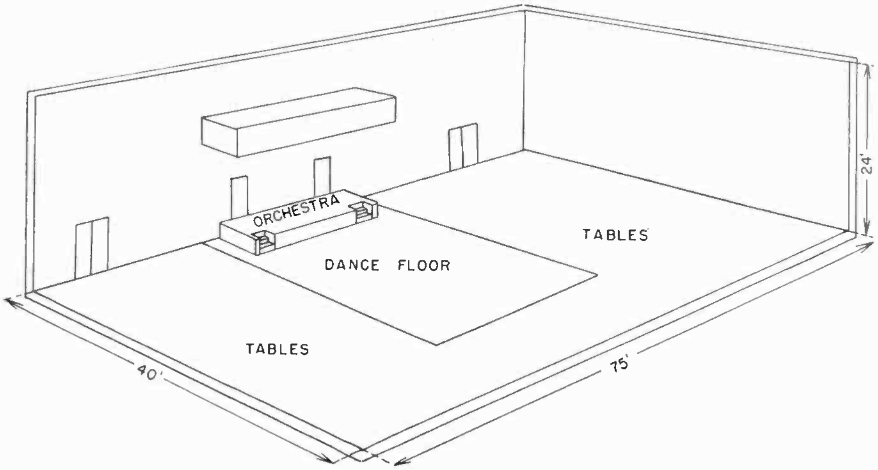


**Fig. 11. Dimensions and layout of night club.**

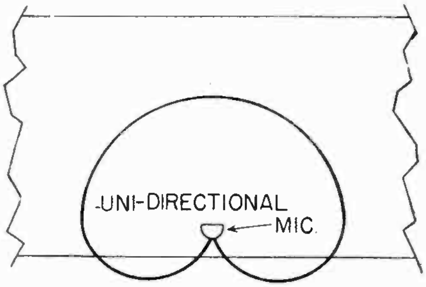


**Fig. 13. Directivity pattern of microphone used in night club installation.**

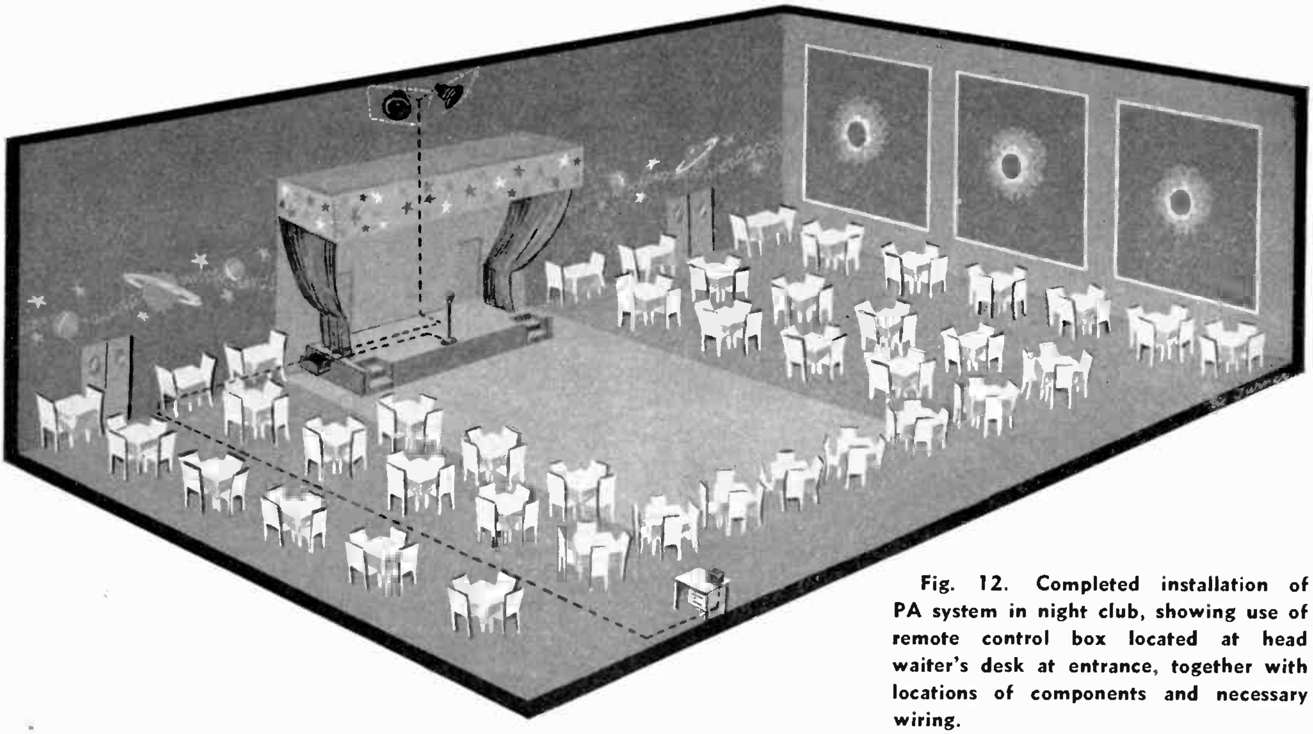

**Fig. 12. Completed installation of PA system in night club, showing use of remote control box located at head waiter's desk at entrance, together with locations of components and necessary wiring.**

# PA SYSTEMS

→ From Preceding Page

is convenient to mount the amplifier itself where the head waiter can have access to it. The remote control type of equipment requires a minimum of wiring, and puts a small, inconspicuous box at the head waiter's desk, as shown in Fig. 12. The amplifier itself can be put practically anywhere that room is available. Mounting it in a "drawer" under the orchestra platform puts it in an accessible place, and conserves space. It might be added that it keeps it in a location where it cannot be tampered with easily during a performance.

### Specifications and Bid

After you have decided upon the various elements entering into the complete system, you must give your client some sort of bid and specification. It is suggested that this be done in a rather formal fashion, and that it should outline the projected system, and all details about its installation. But before listing the information that should be included, a few suggestions about the bid itself should be offered. The bid must be based on a number of facts, and all must be included. They are: cost of material, wire, cable, conduit, cabinet work, painting, and any refinishing that may be necessary due to the installation; cost of any labor involved in the installation; reasonable charges for your own time in engineering the installation; and a reasonable profit on the various costs involved.

The material costs should be figured on the retail list price of all of the components—thus giving you a profit factor on material. Labor costs for the wiring, cabinet work, painting and the like should be figured at your cost plus about 15 per cent. Any of your own time required in making the installation should be charged for at the same rate as your hourly charges for radio servicing work, as determined along the lines set forth by Joseph J. Roche in "Business Management for the Radio Dealer." Your profit figure should be based on your responsibility towards the installation after it is completed, as you will surely have to guarantee it for a specified period. All of this must be included in the bid, although there is no particular reason to break the cost total down into these divisions when presenting it to the client.

You should specify the extent of your guarantee of performance of the entire installation; because the client does not know what he needs, nor how to fulfill his requirements, and he has turned to you to make these decisions for him. If you underestimate some of the requirements and have to make good on some part of it, that will have to come out of your pocket, and you must have sufficient reserve for such a contingency. The writer is of the opinion that it is better to turn a job down than to do it at a loss, or to do it under any other condition than that of making a reasonable profit over and above the payment for the labor involved. You have spent some time in learning your business, and your knowledge is valuable to you—a client should pay you a reasonable amount for this knowledge. Of course, there are times when it is advisable to reduce the amount of profit in order to get the job, especially if it is necessary to keep a number of employees busy, but no job should ever be undertaken without some profit.

In your Specification, it is well to outline the system, in a non-technical manner, indicating the number of microphones and the number of speakers to be installed, and the character of the wiring. Include a guarantee of performance, and a guarantee of service from the equipment itself. This guarantee on equipment should be for a fixed period, such as 90 days from date of completion, unless the client wishes to have the entire installation maintained for a longer period. If this is necessary, add the cost of maintaining the system for a year, based on the same sort of reasoning as is used in making charges for fixed radio service guarantee plans—$50.00 for a year's service guarantee is a reasonable figure for installations of the size of those described.

Provide the client with sketches showing the entire installation prepared in a manner similar to those in this article, particularly Figs. 3, 6, 10, and 12. These are simple and easily understood by non-technical clients.

Specify the time to be taken in making the installation, keeping in mind the difficulties of material procurement and the possibilities of labor shortage for the work you will not do yourself.

And last, but not least, the writer has always followed a policy of getting a sufficient advance deposit on the installation to cover the cost of all material involved, especially when the clients' business is of an entertainment nature, for these are often dependent on little things like human nature, and the popularity of a dance spot or a restaurant is often apt to rise and fall rapidly with no apparent reason. If possible, get a substantial deposit; if you are a small operator be sure that it is sufficient to cover all your outlay in assembling the system. By doing so, you will not get out on a limb for the actual money you have to put out and perhaps have trouble with your jobber when the first of the month rolls around.

This discussion of the economics of PA system business may sound as though it has lots of pitfalls. It has. But if you are thoroughly interested in the work technically, and you know the business aspects sufficiently well that you do not get out on that limb, you will find it interesting and profitable, and there is no apparent end to the many uses to which PA systems can be put.

### MATERIALS LIST

### NIGHT CLUB

| Component | Type and Characteristics | Placement |
|---|---|---|
| 1 Microphone | Uni-directional, -55db | On stand, front of orchestra |
| 1 Stand | Heavy base, for above | |
| 2 Speakers | Good quality, PM dynamic, 10-watt | At sides of platform |
| 1 Amplifier | 15-watt, 110-db gain, with electronic remote control facilities | In "drawer" at one side of platform under orchestra. Remote control box at head waiter's desk |
| Cabling | Shielded, for microphone No. 14 Rubber Covered, for speakers 3-wire, for remote control | |

## Ringing the Bell

→ **From Page 13**

clusion of staples and wire in the service kit. Many an extra dollar may be earned quickly if you are prepared to run an extension neatly and re-locate the radio in a spot more desirable to the customer than its present one. Aside from its value in providing replacement parts, an antenna kit should be a must and is handy to have along as many a new installation can be sold. Lead in strips are inexpensive items; always carry spares.)

Leaving at 1:20, Fred arrives at 1613 Washington Avenue promptly at 1:55. To Mrs. Walsh's cordial, "Hello," he replies:

"Good afternoon—Williams' Radio Service"—handing her one of his business cards. (Business cards are excellent "door openers" and serve the purpose of establishing your identity in a business-like manner. Use a card that is neatly printed on good paper; keep advertising to a minimum, a card is not the place for it.)

Mrs. Walsh was struck by the contrast between the neat appearance of this man and his predecessor. His dignified, courteous manner stamps him as a man of distinction—one who obviously took pride in his appearance.

Once in, Fred removes his topcoat and hat, walks over to the radio and turns it on. While waiting for it to heat up, he opens his service kit and brings out a small square of canvas which he spreads on the rug to protect it when he removes the chassis. (This little trick is worth dollars in creating customer good-will.)

His preliminary checks completed, Fred removes the chassis, tests all tubes thoroughly, and wipes each tube carefully. On a small, gummed label bearing the firm name, he notes the condition of the tube, and sticks it on. (This is excellent advertising—in addition, it removes any grounds for dispute as to which tubes are yours and which are the customers.)

The '55 second detector A-F driver, and a 2A5 output tube were definitely bad. The remainder of the tubes check fair, though all have low emission.

Since all operating voltages check okay, he replaces the two tubes and turns the set on. Selectivity and sensitivity are good. A slight rattle of the speaker reveals the need of a cone re-centering job. In addition, two 8-mf electrolytics show effects of deterioration. Observing a low hum while volume is lowered, Fred decides they should be replaced. A .01 mfd. coupling condenser is noisy when tapped.

His tests completed, he calls Mrs. Walsh. "There are two different types of servicing jobs possible on your radio. In the first, I can restore your radio to acceptable playing condition by replacing two tubes and a condenser, and recentering the speaker. Now while this will restore your set to working condition, it is not the job I would recommend."

"Why is that?"

"Well, to begin with, all the other tubes in your set are rather weak. Despite the fact that they test fair right now, there is no way of telling how long they will stay that way—they may last a month or two, or again, they may last only a week. In addition, notice these condensers (he points to the accumulation of residue on the outside of the electrolytics) when this type of condenser begins to leak it is generally only a question of time until they fail completely, so you can see that if I replace only two tubes and one condenser, you have no guarantee that your troubles are over."

"How about price?"

"The first job I mentioned will cost $7.50. The second job, which I call an overhaul will cost $24.50."

"Heavens! Isn't that a lot of money?"

"Not necessarily. You have had this set for 9 years. That means less than $3.00 a year or about 6 cents a week for upkeep, which is not high. Actually, this job is the more economical since I shall be able to do it all on one call rather than two or three which might be necessary if you decide to postpone replacement of these parts until they actually fail. Another consideration is that in the event these condensers go bad, they might damage other parts which right now are good."

With this kind of selling, I think it is unnecessary for me to say that Mrs. Walsh took the $24.50 job.

In drawing these two characters, I may have exaggerated in spots—but I think the object lessons are clear. If the reader looks in the mirror and sees the reflection of Joe MacJerk he had better "get on the beam!"

In justification for the price of the overhaul job, which may seem a little high for the work to be done, I believe it is good practice to allow a little for reserve. Once you have overhauled an old set, you are "married" to it—you will find that the customer expects a "gratis" job if any further trouble occurs within the time of the guarantee period, even though the defect may be in one of the original components. If you allow a little margin, you can do the job free in case of a call-back—a much better arrangement than getting into disputes as to where responsibility rests.

## Electronically Speaking

→ **From Page 19**

successful test of television techniques for such commercial applications as the visual transmission of executive messages, statistical exhibits, and product demonstrations to groups of executives, salesmen, or engineers gathered together at meetings.

Speakers, charts, and selected product exhibits were picked up by the television cameras in NBC's television studio on the third floor of the RCA Building in Radio City, New York, and images were transmitted by special wire to the Tube Department's demonstration room on the ninth floor of the same building. NBC's television production staff assisted in staging the unique event.

### THE RADIO SERVICEMAN GROWS UP WITH RADIO

by

JOHN MECK,

Pres., John Meck Industries

Five years of war has resulted in a twenty-five year stride in radio development. During the emergency and under stress of war, radio engineers and research specialists performed virtual miracles in the laboratory and on the production line, so that the radio one buys today is actually the radio of many tomorrows. Electronic and radar developments and applications, FM and television have made radio more of a specialized science than ever before.

It is reasonable to assume that the radio serviceman must match strides with radio development and it is gratifying to see that he *is* doing this. He is as important to radio as the sum total of developments and perfections given over to it. Besides a general and specific "know-how" he must have a genuine desire to give an intelligent service to the radio consumer.

That the better class of radio service men wonder what the public thinks of them, their business methods and pricing scales is evidenced by

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# Service Kit

→ From Page 23

shielding and the box should be bonded to the frame of the motor. Often the motor leads are in the conduit. If this is the case, the filter might well be installed in a regular fuse box.

In some instances it may help to connect the motor frame to an earth ground. However, this ground lead must be very short in length, since it can re-radiate the noise signal. Occasionally motors are shock-mounted. Here noise may sometimes be reduced by bonding the motor housing to the main unit.

If the source of the noise cannot be found, the filter unit must be installed at the receiver outlet. Here again short leads are of paramount importance—the filter must be placed as close to the power outlet as possible.

If the filter does not remove the interference entirely, then it is apparent that part of the trouble lies in the antenna system.

### Antenna Systems

In reducing the effects of radiated interference, one fact is of importance. Noise is most intense near the ground. If the antenna can be elevated sufficiently, noise pick up will be at a minumum. This can often be done. The problem then is one of

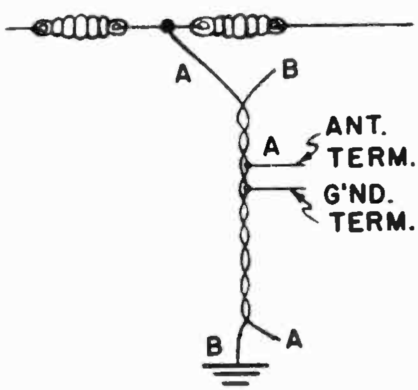


**Fig. 6. An effective noise reducing antenna lead-in.**

preventing the interference from being induced into the lead-in. One method of accomplishing this is to use shielded lead-in, provided the length of the lead-in is not excessive. Generally matching transformers are necessary in order to keep losses at a minimum.

Inasmuch as several noise reducing aerials are available commercially in kit form, further description is unwarranted.

Transposed lead-in cable is also highly effective — again commercial kits are available. However, if the cost of a commercial kit is too high, a highly efficient system may be constructed as shown in Fig. 6. Do not use anything but a high grade of wire for this lead-in as losses due to moisture will render it worthless if made of cheap wire.

The author once saw a twisted-pair line constructed on the spot by a clever radio man who has his choice of making it up or traveling 10 miles to his shop. He dropped two sixty-foot lengths of rubber covered wire from the roof after tying them securely to a vent pipe. On the ground, he placed the two free ends in the chock of a portable electric drill. Holding the wires taut, he started up the drill. Some seconds later, he had a sixty foot length of twisted pair.

Neat, but not gaudy!

**Radio Maintenance Is Not Sold On Newsstands**

# Test Panel for The Modern Bench

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marred by a popping sound whenever any atmospheric disturbances begin to appear. This is particularly useful in the case of the vertical whip antenna which acts as a "lightning-rod" and emits a constant discharge during times of electrical stress in the atmosphere. From the antenna transformer, a twisted pair lead-in is run to the bench, where it is terminated at another transformer. The secondary of this transformer is connected to the co-axial fitting, with the shell grounded and the center lead connected to the antenna terminal of the set transformer. This latter is mounted on the back of the instrument panel, making the antenna lead as short as possible. For the F-M antenna, any type recognized as suitable for this purpose, such as the Shur-Antenna-Mount, and the lead-in recommended is a length of co-axial cable, running from the di-pole to the terminal plug on the panel. A 4-foot length of the same cable, with a male plug on one end and a pair of clips on the other will serve to connect the set to whichever antenna is desired.

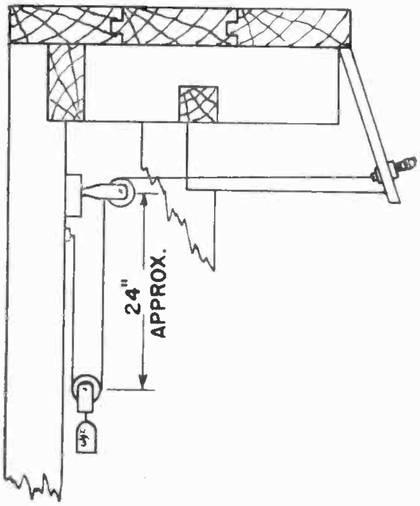



**Fig. 6. The construction of the retractable leads used with the continuity tester.**

## Construction

The panel material selected for the bench being built by the staff of Radio Maintenance was ⅛ inch dural, the size of the panel being 10½ x 30 inches. The metal panel was chosen because of the advantage of a solid ground on the panel itself and the cabinet of the vacuum-tube voltmeter, which is a necessity to be sure of completely stable and accurate operation. Dural is very easy to work, being much softer than iron or steel plate, and not as "gummy" to work with as aluminum or copper. It may be said that dural works like soft steel does if the tools are extremely sharp and hard. In addition, after thoroughly sanding the surface, it takes a good finish by lacquering. If an automobile paint shop is close, do not try to do the paint job yourself. It is much better done by an air brush, and professional painters know the precautions relative to having metal surfaces thoroughly clean before applying any paint or lacquer. It is advisable to apply a base coat first, letting it dry thoroughly before applying the finishing coats. It is suggested that at least three finishing coats be used. Some users may give some thought to the idea of using the panel without a colored surface, but using the panel without a darkening finish will prove that it is too bright. Some outfits are prepared to "plate" aluminum with a coating which becomes a part of the panel, and which is very durable. It is done by creating, by some chemical means, a surface which will take a dye. Such a finish is highly recommended, although not every city has companies with these facilities. The color selected for the panel is a dark gray, which matches the enameled panel of the VTVM.

The panel should have all necessary accessories mounted on it, and the wiring to these parts made, all wiring terminated on a terminal strip as shown, before the panel itself is mounted on the bench. The mounting may be done by means of six oval-headed wood screws, 1"-10 being a good size. After the panel is mounted, the external wiring connections can be made. Figure 5 is an isometric view of the entire bench in phantom, showing the wiring outlets for soldering iron, 100-watt lamp, antenna circuits, instrument shelf outlets, and the main power inlet for this section of the bench. The figure should be self-explanatory. A further innovation in the form of retractable leads for the continuity tester is sketched in Fig. 6. While this may take a bit extra work, it is a desirable addition because it makes the leads always available yet never lying on the top of the bench. The overall schematic of Fig. 3 is planned for the use of the retractable leads, and provides connections to the terminal strip for all facilities on the instrument panel.

BILL OF MATERIAL

1 Silver "VOMAX" Model 900
1 Dural panel, 1/8" x 10 1/2" x 30"
2 Jones #8-142 Barrier Terminal strips
2 Drake #75 Pilot Light Assemblies
1 Heavy duty DPST Bat Handle switch
3 SPST Bat Handle switches
1 Edwards "Lungen" #0 Buzzer
1 4 1/2-volt heavy-duty "C" battery
2 Amphenol #93C Co-axial cable connectors
1 Amphenol #93M Co-axial cable connector
2 ICA #1891 Insulated Banana Jacks
1 Receptacle for 115-volt plug, surface mounting
5 Dual receptacles, flush mounting
1 Single receptacle, flush mounting
3 Porcelain sockets, surface mounting
1 100-watt, 115-volt Mazda lamp
2 75-watt Lumiline Lamps
1 RCA Stock No. 9813 Set Transformer
1 RCA Stock No. 9849 Antenna Transformer (for roof)
Necessary co-axial cable for F-M antenna lead-in
Necessary antenna transmission line (twisted-pair)
Necessary wiring and cabling for A-C circuits

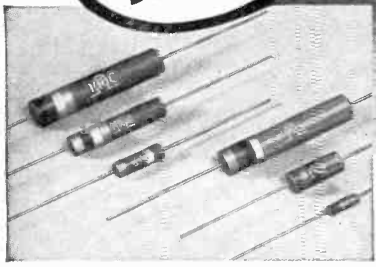
## Electronically Speaking

→ From Page 28

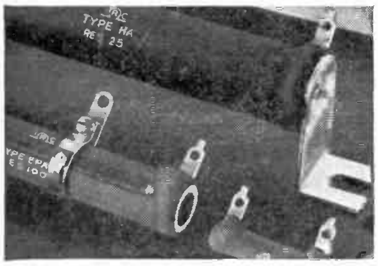
the sincere objectives toward improved techniques that they have set for themselves. They, as the public they serve, shudder at the tactics employed by the "screwball-mechanics" who did not grow up with radio and who do not care to employ ethics in their dealings with the public. Yet, they continue to force their service on the public. Fortunately, they are in the minority as compared to the high class and legitimate radio serviceman.

Whether one is for or against various licensing committees and associations, one thing is certain, and that is that the forming of these associations is evidence of the growing concern of the radio serviceman's relation to the public. Ordinance to license and regulate radio repair shops in various cities and communities may or may not be the solution due to many salient factors, but at least radio servicemen are cognizant that something must be done to keep the repair industry equal to the radio industry.

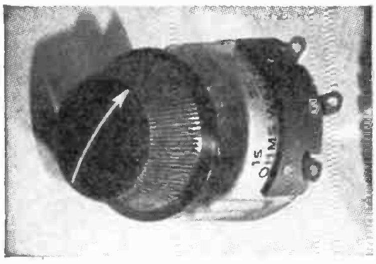
# *Not too many . . . not too few!*

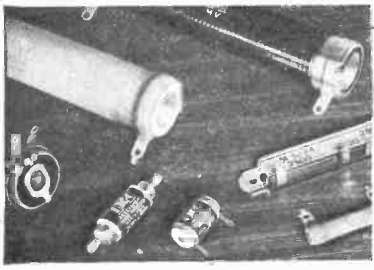
TYPE BT INSULATED METALLIZED and TYPE BW INSULATED WIRE WOUNDS ...the perfect combination.



POWER WIRE WOUNDS ... rugged, moisture proof, completely dependable.



POWER RHEOSTATS (above), Precisions, Wire Wound Controls, Bleeders, Non-inductive Wire Wounds, etc. (below)—for many service needs.



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The controls in the *IRC Century Line* were carefully selected after exhaustive study of IRC sales records and of the requirements of receivers and equipment now in use.

These studies showed that the number of types previously listed could be reduced considerably, yet give adequate coverage. But it also proved that reducing the number of available types to anything *less* than the 100 now comprising the Century Line, would make the service engineer's replacement problem extremely difficult.

On that basis, we established the Century Line—not too many, not too few—but just right to give you properly designed, easily installed controls for the widest variety of replacement needs.

Best of all, it's *not* necessary for you to actually stock all the 100 Century Line types! We recommend you maintain a minimum stock of at least the 18 Type D Controls listed on page 6 of IRC Catalog #50—they'll handle 87% of your replacements—and you can depend upon your IRC distributor for other types, as required.

And don't forget, *only IRC controls* give you such quiet, smooth, dependable performance! . . . because they're the only controls with the famous IRC Metallized Element, the Five Finger Contactor, and the Silent Spiral Connector!

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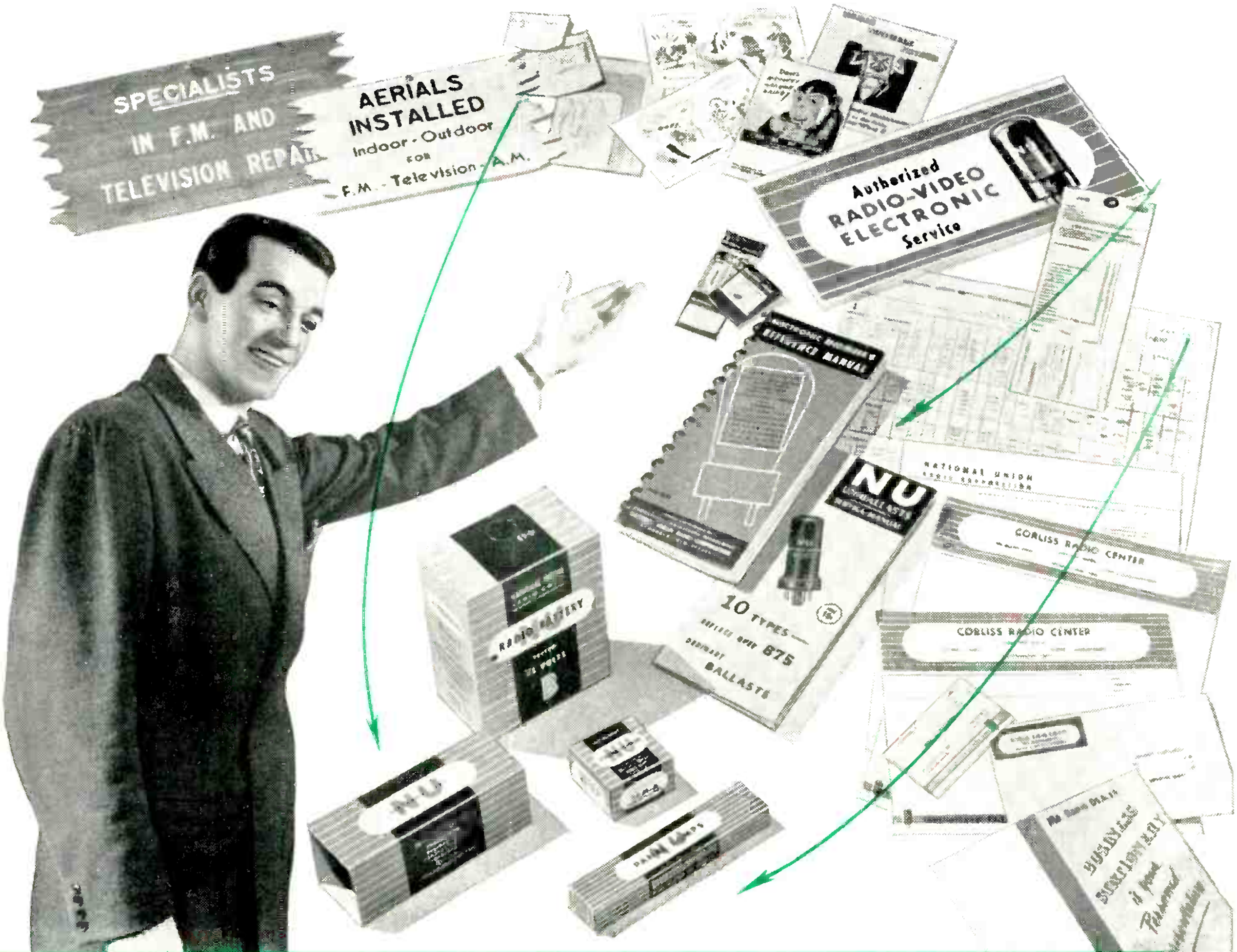


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