APRIL 1949 40¢

RADIO MAINTENANCE

AM·FM·TV

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MONTCLAIR, NEW JERSEY
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KEN-RAD

RADIO AND TELEVISION TUBES

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IMPORTANT NOTE! Are you receiving your copy of "Successful Servicing"? It's Rider's own publication of interest to every Serviceman. Send your name and address, and we'll put you on our list, FREE of charge.

NOTE: The Mallory Radio Service Encyclopedia, 6th edition, makes reference to only one source of radio receiver schematics—Rider Manuals.

ANOTHER NOTE: The C-D Capacitor Manual for Radio Servicing, 1948 edition No. 4, makes reference to only one source of receiver schematics—Rider Manuals.

Test Pointers

ON DC VOLTAGE MEASUREMENTS

DC voltage can be measured in high-resistance circuits provided the measuring instrument does not load the circuit appreciably. A satisfactory instrument must have an input resistance which is high compared to the resistance of the voltage source.

The necessity for using a high-resistance instrument will appear from analysis of the circuit shown in Fig. 1. It is seen that the current drawn by voltmeter V across terminals A and B flows through the 1-megohm resistor. This meter current produces an IR drop across the resistor which causes the voltmeter to read less than the 3-volts of the source.

When measurement is attempted in this case with a 1000-ohms-per-volt meter (3000 ohms on the 3-volt range), meter V will read 0.01 volt instead of 3 volts. When measurement is made with a 20000 ohms-per-volt instrument (60000 ohms on the 3-volt range), meter V will read approximately 0.171 volt. Obviously, neither instrument would be suitable for the application.

However, if meter V has a very high resistance of, say, 10 megohms the reading will be 2.75 volts. The error involved is approximately 8 per cent, which is not excessive in most electronic service work. Measurements of this type are encountered in avc, bias-cell, and various "zero-bias" grid circuits.

Many dc voltages exist only during the time that the circuits carry high-frequency ac, a condition which imposes further requirements upon dc voltmeters. For example, local oscillators, multivibrators, and afc circuits develop dc bias potentials only when ac is present. If the bias is measured at the grid of a local oscillator with a high-resistance voltmeter and direct probe, the reading is usually seriously in error unless special precautions are taken.

The reason is that direct probes have high input capacitance which loads high-frequency ac circuits excessively. Accordingly, dc voltmeters used in electronic service work must contain an isolating resistor in the probe to minimize this high input capacitance. This isolating resistor places a high resistance between the source voltages and the stray capacitance of the test cable. It is found in practice that a 1-megohm isolating resistor is satisfactory.

An electronic voltmeter affords the most practical means of obtaining high input resistance at low input voltages. The grid circuit of its electron tube need consume practically no current to control a large current in the plate measuring circuit. The input resistance of typical vacuum-tube voltmeters ranges from 10 megohms to 50 megohms. A value of 10 or 11 megohms is found very suitable for service work.

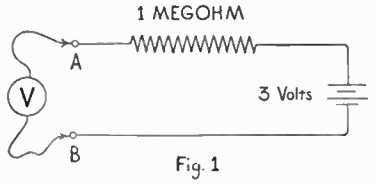

Fig. 1

Electronic voltmeters have further advantage under service conditions because the meter movement is automatically protected against burn-out from overload. The electron tubes in the instrument saturate when excessive input voltage is applied, thus limiting the current through the meter movement.

Radio technicians find little need to measure dc voltages in excess of 1000 volts. However, television technicians who wish to multiply the upper limit of their instruments to 10 kilovolts, or more, can do it by the use of a specially designed high-voltage probe.

The input resistance of such probes is very high. For example, a typical 30-kilovolt probe for use with an electronic voltmeter having 11 megohms input resistance (10 megohms input resistance without the dc probe), utilizes a 1090-megohm resistor in the high-voltage probe tip. Accordingly, the total input resistance to the instrument becomes 1100 megohms. With such a probe, the voltage scale reading should be multiplied by 100.

RADIO MAINTENANCE

INCLUDING
ELECTRONIC
MAINTENANCE

Volume 5 APRIL 1949 Number 4

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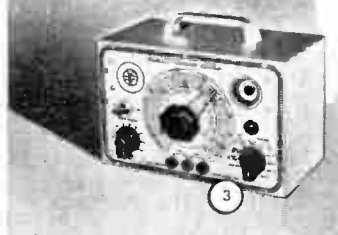

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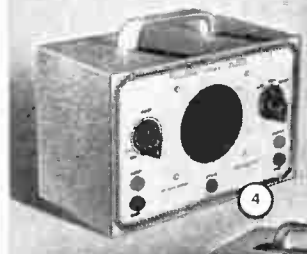

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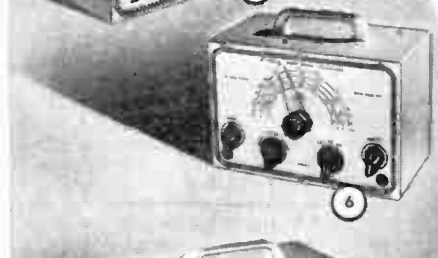

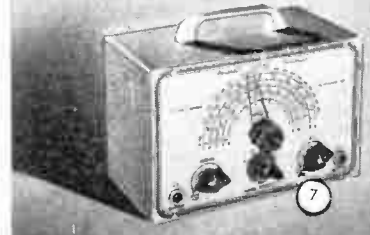

5 *The* NEW 1949 HEATHKIT 5-INCH
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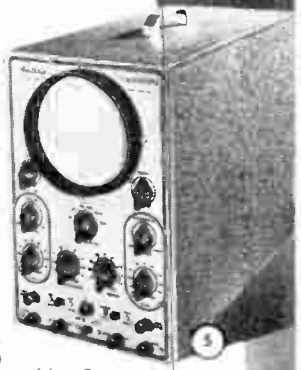

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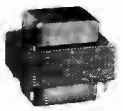

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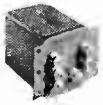

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NO. 229. Convert your military receivers without rewiring the filament. "A" type supplies 500 VCT at 50 MA, 5V. at 2A. and 24V. at ½ A. "B" type supplies 500 VCT at 50 MA, 5V. at 2A. and 12V. at 1 Amp. State whether A or B type desired. Shipping Weight 4 lbs. **$2.95**

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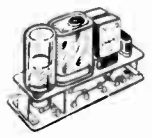
NO. 224. Brand new ten push button tuning assembly from Army FM receiver. Contains 4 gang 100 MMF silver plated tuning condenser. Add postage for 10 lbs. **$2.50** EACH

BC 746 TUNING UNIT



NO. 257. Plug in transmitter tuning unit from army Walkie Talkie. Contains antenna and tank coils, tuning condenser, transmitting and receiving crystals. Ideal transmitter foundation. Shipping Wgt. 1 lb. Each **$1.00**
(Same as above except transmitter crystal in 80 meter amateur band $2.50 each)

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NO. 258. Makes excellent contact microphone for musical instrument or vibration pick-up. Shipping Wgt. 1 lb. $1.00 each
Extension cord with switch for above $ .50 each

BC731 CONTROL BOX with Weston Model 476 AC Voltmeter

NO. 208. Excellent buy in motor control box. Size 8"x10"x5½". Contains Weston 0-150V. AC 3½" voltmeter, motor starting switch, 2B fuses all 30 Amp 110V. and 8 fuse holders. Fuses and holders alone worth the price. Shipping Weight 18 lbs. **$7.95**

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NO. 216. The Army's best — eliminate flat ears and outside noise. Complete with transformer for conversion from low to high impedance. With cord and plug complete.
Add postage for 1 lb. **$1.00**

BC 451 CONTROL BOX

NO. 236. Control box for 274N transmitters. Contains proper cw-voice switch, 4 channel switch, power switch, mike jack and telegraph key.
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No. 641. Heavy 1.5 henry choke in drawn steel case, 50 ohm resistance, conservatively rated at 100 MA. Shipping Wt. 1 lb. 50c

FILAMENT TRANSFORMER

No. 922. 220V. 60 cy. primory supplies 12.6V. at 3.5 Amps, 15.6V at 1 Amp. Supplies 6.3 at 3.5 Amps and 7.8V. at 1. Amp from 110V. Shipping Wt. 8 lbs. $1.50

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Burlington O-300 VAC Meter

No. 290. Model 32XA 3½" round AC Voltmeter 0-300 VAC full scale. Scale also calibroted 0-600V. Bakelite case. A beautiful meter in original carton. Shipping Wt. $3.95

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No. 651. Couples 3000 ohm plate to push pull parallel grids hermetically sealed. Ship. Wt. 1 lb. $1.00

OUTPUT and MODULATION TRANSFORMER

No. 745. Companion transformer to above driver. A push pull output, 3000 ohms to 3.2 ohm voice coil, or to 1250 ohms at 80 MA. A high quality cased unit. Shipping Wt. 2 pounds. $1.00

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Editorial

Sell While You Service

THE radio technician has what is possibly the best opportunity in the radio industry to sell. Salesmen use a word which has a special meaning to them. That word is *entree*. The word might be defined as ability to get in—to gain an audience—to establish contact with the potential customer, etc. A salesman of vacuum cleaners, for instance, who does not have the ability to get past the customer's front door, will never sell his wares, no matter how good a salesman he may be in other ways.

The service technician does not have this problem. His entree is ready-made. When he arrives at a customer's door, he is welcomed. One of the salesman's most difficult problems is solved for him.

The service technician has another advantage in that he is often the first one to know when a receiver is in need of replacement. Each year technicians examine something over 15,000,000 radios. These receivers are in need of repair. Among them are a good portion of the receivers which are discarded. Think of your own past experience, and you will recall more than one instance in which a customer decided that it was time to buy a new radio when he heard your estimate, or when you suggested that he do so. He may also have asked you which make of receiver you thought was best.

Here is an opportunity to sell radio equipment which no one else in the industry is fortunate enough to enjoy. The customer regards you as an expert. If you handle a good product and recommend it, he will buy it. This same opportunity extends to radio accessories. Many organizations installing television receivers have recognized the opportunity and are making handsome profits on products sold in this manner.

If you are not already doing so, consider the possibility of selling while you service.

JJR

Here's what radio men say about SYLVANIA'S DEALER CAMPAIGNS

SCURLOCK'S RADIO SHOP
ELECTRICAL APPLIANCES -- HARDWARE
EVERYTHING PERTAINING TO RADIO
SUMITON, ALABAMA

September 18, 1948

Advertising Department
Sylvania Electric Products Inc.
Emporium, Pa.

Gentlemen:

In 1937 when we started our radio repair business, we used personal postal cards to get our name before our prospective customers. For a beginner, this kind of advertising seemed a little more than we could pay, although it did wonders for our business.

We are happy that the service industry has a great company behind us with national advertising and personal postal cards. During your first co-ordinated advertising campaign we bought 1200 cards and mailed them to our customers according to Sylvania's specifications. The results were so effective that we are going to use the campaign again. We want to see if the campaign is really responsible for the extra business we are enjoying.

The "funny cards", as our customers call them, are even responsible for payment of some of our past due accounts. Our radio sales are up. We are making allowance for old radios which our customers get out for us to repair after receiving our atomic reminder card.

We want to personally thank Sylvania for taking an interest in us and giving us this low cost, yet effective, advertising.

VERY KINDLY YOURS
J. B. SCURLOCK

PHONE: ARDMO

TRY OUR RADIO ... SHOOTERS ... DEPENDABLE

Mike Says

MIKE'S
RADIO AND TELEVISION SERVICE
EXPERT SERVICE ON ALL MAKES
10803½ WEST PICO
LOS ANGELES, CAL.

November 1, 1948

Advertising Department
Sylvania Electric Products Inc.
Emporium, Pa.

Gentlemen:

I would like this opportunity to tell you how much the Sylvania co-ordinated advertising campaign has helped my business.

Although I have used direct mail postal cards in the past for soliciting new business, the tie-in with national advertising offered in the Sylvania campaign was responsible for an extraordinary return. The response I have had from your campaign has been truly amazing.

As an example, I mailed 1000 postal cards in May at a cost to me of $10.00. To date this investment has brought a return of $352.19. During June, July and August I mailed another 1000 cards each month at a total cost of $30.00. To date the return from this investment has amounted to $760.46.

You will note that for a total investment of $40.00 I have, to date, enjoyed an increase in business amounting to $1,112.65 -- all from new customers. I can safely say that there is still more business to come from these cards in future months.

I mailed another 1000 cards to my prospect list of 12,964 names during October and November. I also expect to mail another 1000 cards during December.

Speaking for myself, I would certainly like to see this campaign become a regular 'shot in the arm' at least twice a year. It will do much to help business in the spring and early fall when business is usually slow.

Many thanks and best wishes.

Very truly yours
MIKE'S RADIO SERVICE
By Michael Waxman
Michael Waxman

BRING IN YOUR RADIO TUBES - WE TEST THEM FREE - DEALERS FOR Sylvania ... SEE TESTED TUBES

Like these service dealers you can increase your business

Sylvania's May, June, July and August campaigns are ready for you. Here's what you receive:

4 Postal Card Mailings—one for each month.
4 Window Displays—one for each month.
4 Window Streamers—one for each month.
8 Newspaper Ad Mats—two for each month.
Radio Spot Announcements—several for each month.

Send for full details now! Remember, you pay only the postage on the government postal cards you mail. Sylvania supplies everything else *free!*

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; PHOTOLAMPS; LIGHT BULBS

Sylvania Electric Products Inc.
Advertising Department, R-2004
Emporium, Pa.

Gentlemen: Send full information on your May, June, July and August Service Dealer Campaigns.

Name_____
Company_____
Address_____
City_____ Zone_____
State_____

ELECTRONICALLY SPEAKING

Things to Come? In Wichita, Kansas, servicemen must now pass an examination in order to get a license, must have a license and a city-approved shop to operate. No more work at home. They have formed a group to protest.

RM. We have just received the first issue of Radioman, the servicemen's magazine in India. In English, too. Welcome to the fold.

Let Them Eat Cake. Low-rent public housing tenants in Detroit were told by their officials that tele-sets were not allowed in their homes, admonished them to save toward buying their own homes instead. What, with all of $300?

A Rolling Stone . . . Scott Radio Laboratories scooped everybody by coming out with a phonograph which plays almost any record, 78 rpm, 33⅓ rpm, 45 rpm, 12-inch, 10-inch, and 7-inch, with small spindle hole or large spindle hole. And Webster Chicago Corp. has also taken cognizance of the new RCA disks by bringing on the market an adapter which will convert its dual speed changers for use with the new 45 rpm records. Everybody's right on the ball.

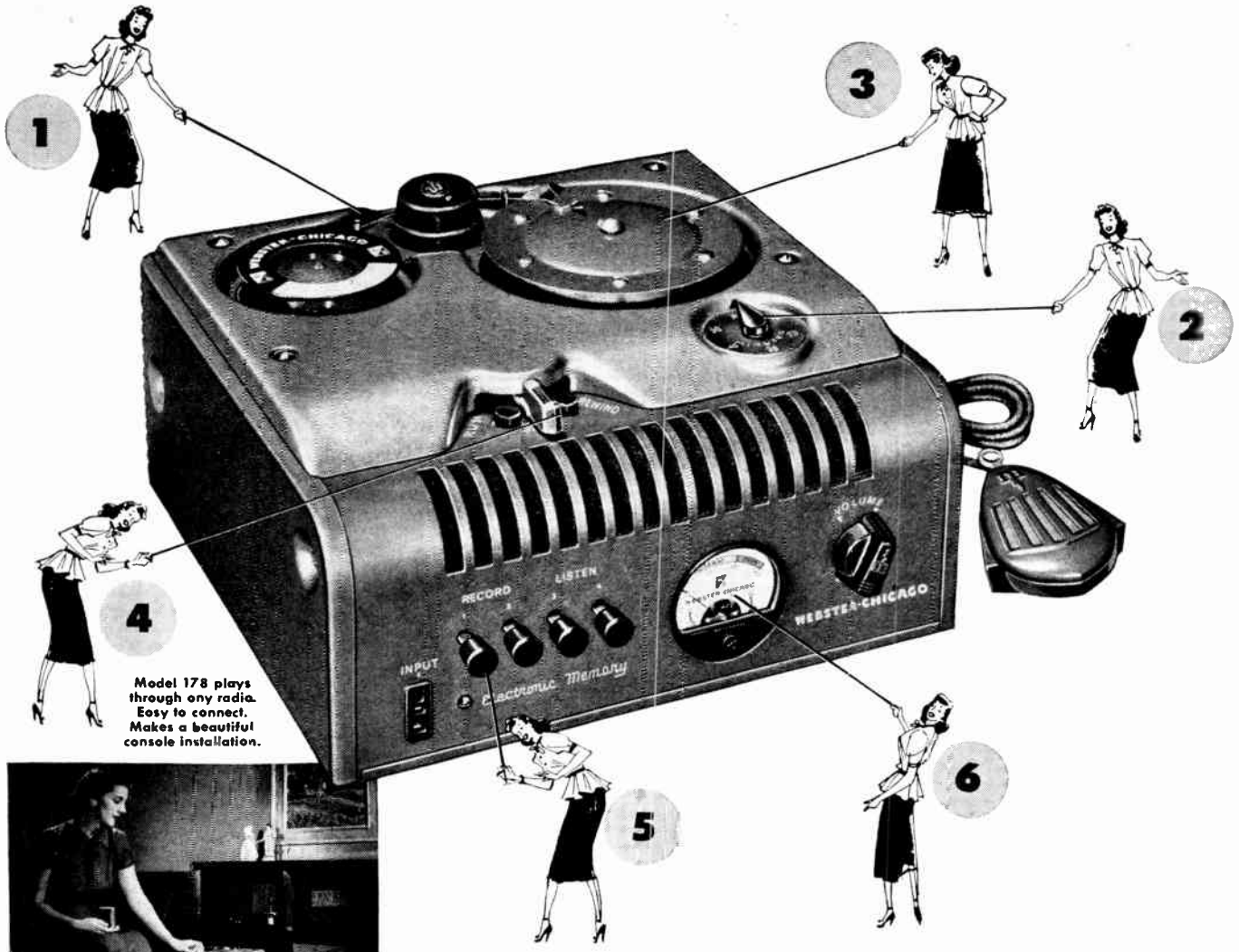
Rhapsody in Blue. RCA sent us a sample package of its new 45-rpm platters the other day, and to our surprise we found that they came in all sorts of colors, seven to be exact. One color for each type of music. Looked very pretty, too. But if you're color blind, you'll have to go back to reading labels.

It Flies through the Air. Interesting news came from Westinghouse and Martin companies on their experiments in telecasting from planes. They've made these tests for the last three years, and they report that good reception was obtained in an area with a radius of 250 miles, with converted B-29's circling at 25,000 feet. Not yet in actual operation, but good news nevertheless.

The Winnah! Harry L. Smith of Long Island, N. Y., walked away with the grand prize in the Hytron Servicemen's Contest, $400.00 worth of U. S. Savings Bonds. Congratulations, Harry. Incidentally, Hytron will produce some of the tools for which ideas were submitted during the contest. These will be sold to servicemen at cost. Your editor enjoyed being one of the judges in this contest and was certainly impressed with the many fine ideas which came before him. The service industry can be proud of itself.

Don't Kill the Goose. We'd like to pass on some remarks of Charley Golenpaul of Aerovox which he made recently to a group of Philadelphia technicians. Said he: "In every locality where television opens up, the dealers and the servicemen should handle this boom with due care. Don't kill it by overselling! Don't kill it by sloppy installations! Don't kill it by badly performing sets! You've got to provide the very best when you're selling a television proposition running well up in the hundreds of dollars."

Seeing is Believing. The other day RCA unveiled a complete 30-tube television receiver spread out over an upright panel of over 18 square feet, and actually operating. It looks like a giant operating schematic, and shows the paths of the audio and video signal, also effects of operating difficulties. It's going to be used in a series of service clinics to be held by RCA's tube department throughout the country. They have already started in Buffalo. As far as we're concerned, the best television teaching aid to date. ✓✓✓



Model 178 plays through any radio. Easy to connect. Makes a beautiful console installation.

HERE'S A WIRE RECORDER

you can sell! Transforms *Any* Radio Into a Wire Recorder Combination

Webster-Chicago *Electronic Memory* Wire Recorder Model 178 is packed with features that make it the top buy of the year for your customers—the top profit item of the year for you.

1. **Automatic Stops—in both directions as the end of the wire is reached.**
2. **Elapsed Time Indicator for accurate location of a recording or any portion of it.**
3. **Removable Take-up Drum for recordings of longer than one hour.**
4. **Lockfast Operating Lever secures in "run", "stop" or "rewind"—releases with light finger pressure.**
5. **Push-button selection of "record-listen" combinations is easy to use.**
6. **Meter-type Recording Volume Level Indicator for accurate recording results.**

These are the features that thousands of prospective wire recorder users are looking for.

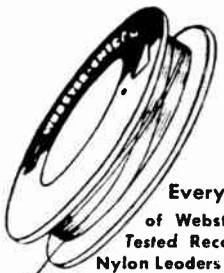
Model 178 gives them all these at an amazingly low cost. It is easy to sell.

Model 178 has Underwriters' Laboratories approval for your protection and increased sales.

CALL YOUR WEBSTER-CHICAGO DISTRIBUTOR

DON'T OVERLOOK RECORDING WIRE FOR *REPEAT BUSINESS*

WEBSTER-CHICAGO
Pre-Tested
Recording Wire
...with the easy-to-handle Nylon Leaders



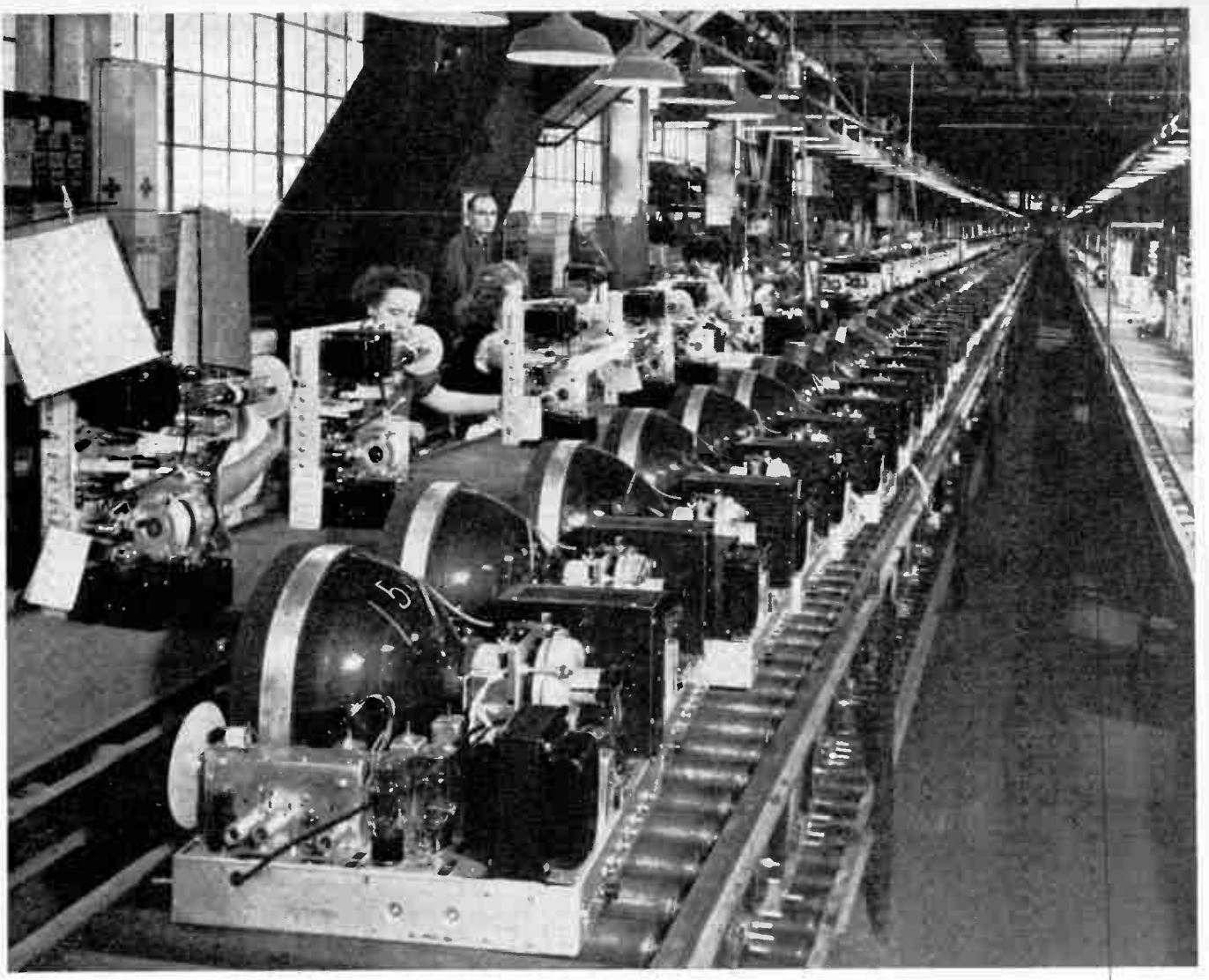
Every New Spool of Webster-Chicago *Pre-Tested* Recording Wire has Nylon Leaders attached for:

- **Easy Threading**
- **Perfect Level Wind**
- **Activating Automatic stops on W/C Wire Recorders**
- **Preventing Wire from running off the spool**
- **Easy handling**

These features make Webster-Chicago Recording Wire the best buy for wire recorder users who want the finest results.

Tell your customers about Nylon Leaders—and see your Webster-Chicago Distributor about stock.

WEBSTER-CHICAGO
5610 W. Bloomingdale Avenue, Chicago 26, Illinois



television is your future

by the editors of RADIO MAINTENANCE

The advent of television constitutes a revolution in the service industry. The technician must fit himself into the new conditions and he must do so soon. The editors have surveyed the field to gauge the extent of the revolution and to see what the future holds in store for the technician

A REVOLUTION is taking place. Just as the introduction of the steam engine completely changed all industry, so is television changing the radio service trade.

Not too many years ago, television was considered an impractical toy without a future by many people who should have known better. Don't make the mistake they made. Television is not a phenomenon characteristic of metropolitan areas. It is going to be an ever-increasing industry for a long time to come; and only the technician who has kept up with its rapid advance will be able to maintain his position in the field.

If you have any doubts about this, perhaps this article will convince you. Perhaps a look into the future will make it very clear to you that the advent of television is indeed a revolution.

Of course, the future progress in television is largely a matter of estimate and educated guess work. But judging from a critical examination of past forecasts, we venture to say that the predictions which we will set forth here will be pretty well borne out by future events. They are based on reports of the industry, the Radio Manufacturers Association, the Television Broadcasters Association, the Federal Communications Commission, and various other relevant sources; and they all indicate one thing clearly: the television field will undergo considerable expansion during the next decade, and probably beyond.

Let us then examine the various phases of television.

Television Stations

Take 1947. At the close of that year, there were 9 stations in operation. By the end of 1948, this number had increased to 54, and applications for new station permits were being submitted to the FCC in great numbers. Basing our estimates on this fact, we can expect a total of 150 stations to be telecasting by the end of this year; and if present frequency alocations remain unchanged, these stations should have grown to 235 in number by the end of 1950. Three years later, at the end of 1953, 400 television stations will probably be on the air. This constitutes the maximum number of stations allowed by the government in the frequency spectrum now assigned to television transmission.

In 1948 there were 32 cities which had television service. By 1953, under present allocation conditions, 140 will be covered. During the latter part of last year, the Federal Communications Commission suspended action on all applications for new television stations, pending the formulation of a revised frequency allocation policy (RADIO MAINTENANCE, *December 1948*). Since that time a number of proposals have been made by the RMA and other sections of the industry to the FCC. One of them would leave unchanged the allocations in metropolitan areas, but would open the u-h-f bands for television use in the smaller communities. Another one would have synchronized stations to cope with the problem of crowded bands and interference.

The freeze on new stations is almost certain to be lifted sometime this spring, with the pronouncement of the new policy of the commission. It is generally agreed that this new policy will have little effect on the usefulness of television receivers now in use. But it will make possible the ultimate operation of 1,000 television stations. This would bring television to every city in the United States with a population of 5,000 or more.

It should be pointed out that not only will the numbers of stations increase, but that networks of stations will expand as well. The sceptics doubted the feasibility of using coaxial cable for the establishment of such links, yet the east and the midwest have already been joined in that manner; and within two years TV networks will probably encompass the entire country.

Receivers in Operation

It is a moot point whether the existence of a station causes a demand for receivers, or whether a demand for television causes a station to go on the air. At any rate, the increase in the number of stations operating has been accompanied by a parallel increase in the number of sets installed.

Let us take a look at the receiver situation.

With 1947 again as our base year, we find that at that time 300,000 receivers were in operation. A year later, when television receiver production hit its stride, this number had grown to 1,000,000.

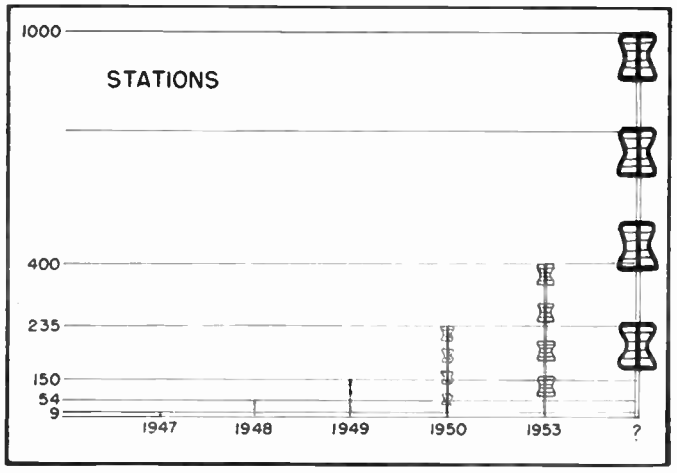
Now, taking into consideration the number of station applications submitted to the Federal Communications Commission, the progress that is being made in linking the various television networks together, advances in programming, technical improvements in receiver design, and reduction in receiver costs, we would estimate that an additional 2,000,000 sets wil be installed during this year, bringing the total up to three million. By 1952 there should be 10,000,000 receivers in homes and public places; and it is not at all impossible that in ten years from today 100,000,000 people ill be watching the screens of 40,000,000 tele-sets.

This is indeed an impressive total. It is based on the asumption that the television industry will develop under the most favorable conditions, and is thus admittedly optimistic. But we have found in the past that, where television forecasts are concerned, it has been the optimist who has been consistently right.

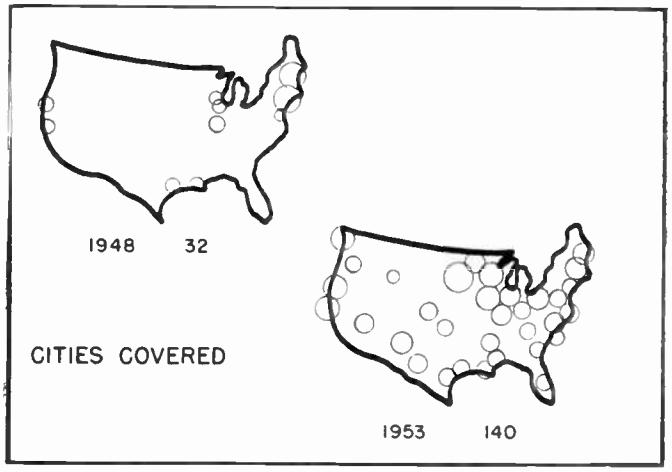
There are, however, factors which tend to arrest this rapid expansion which we can foresee. Let us look at them and see what is being done to eliminate them.

One of these factors is the production process. The industry feels at this point that the number of receivers sold will depend on the number manufactured. Because of a number of bottlenecks which have developed in the manufacturing process, this factor may have serious repercussions on the total picture, and we will discuss it in more detail below.

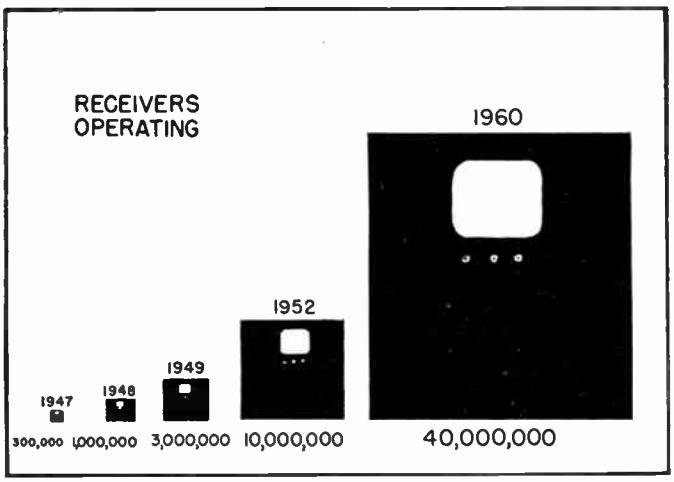
There is also no doubt that, at this writing, a certain amount of resistance has developed in the potential customer against buying a receiver *now*. In a recent survey conducted by The American Magazine, 75% of the people asked were either undecided about buying a set or were definitely not in the market. These peo-



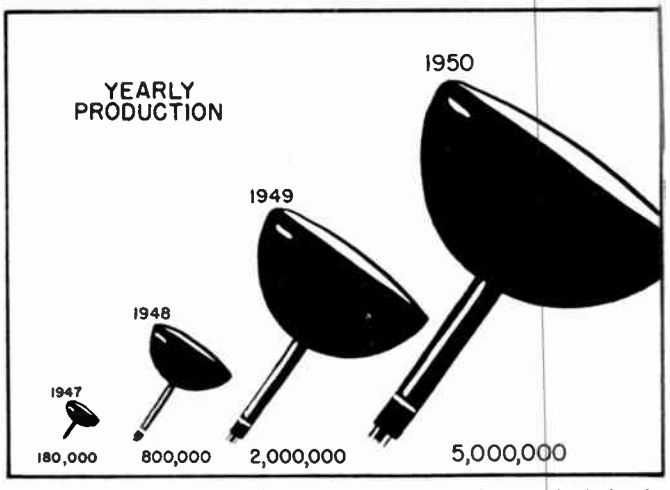
The ultimate number of television stations may reach 1,000



Television may cover all cities with more than 5,000 population



40,000,000 installed tele-sets within 10 years are not impossible



Receiver production will have to be maintained on a high level

ple were in the middle income bracket. This is the most important income group as far as television sales are concerned. H. Leslie Hoffman, president of Hoffman Radio Corporation, has pointed out that more than eighty percent of television receiver sales today are being made to the middle and lower income groups.

Looking into the reasons for this attitude of hesitancy toward buying a receiver *now*, we note this interesting fact: The vast majority of people are holding back because of advances which they expect in the future. They feel that sets will be improved technically, that they will become cheaper, and that television programs will reach a higher entertainment level.

Let us point out here that work is progressing right now which will remove much of these objections. Technical improvements are constantly being developed by the industry and incorporated in the newer models. The introduction of metal picture tubes is not only increasing the rate of receiver production, but is also lessening their cost. Finally, as the national television audiences increases—and the establishment of networks contributes greatly to that end—sponsors will be more willing (and soon very eager) to enter the field on a larger scale. Even now many sponsors are expending considerable capital to assure themselves of good spots on future television program schedules. Faith in a medium of communication can be hardly more graphically illustrated than by competition of sponsors for a spot in it. Once programs will be sponsored by the larger industrial organizations, a marked improvement in their quality will be evident. A television station at this stage is hardly a profitable enterprise. But the days it will stay in the red are numbered.

The industry is fully aware of the buyer's resistance. It cannot fail to notice the commonly known fact that dealers in many areas have been cutting prices considerably, protests from the manufacturers notwithstanding. And the steps it is undertaking are aimed to insure a total of 40,000,000 operating receivers within the next ten years. Helping them along will be intensified advertising campaigns by both manufacturers and dealers.

Production

Our faith in the future of television is shared by almost all receiver manufacturers. Although it is unlikely that any new companies will enter the field at this stage, most of those which are in production expect to increase their output over the next decade, many of them planning to devote as much as 70% of their facilities to television. Just as an example, Philco Corp. anticipates a volume of television business in excess of $100,000,000.

In 1947, the industry put out 180,000 receivers, in 1948 it produced 800,000. At the end of this year, the output of all manufacturers is expected to have reached the 2,000,000-a-year mark; and by the end of 1950, production is anticipated to go along at a rate of 3,000,000 receivers per year.

Again, these forecasts are based on certain conditions which will have to be met in order for the industry to achieve its goal.

The greatest bottleneck in this respect has been, and continues to be, the production of picture tubes. The rigid manufacturing requirements of these tubes have caused them to lag behind the schedules set by receiver manufacturers.

Steps are constantly being taken to remedy this situation. As reported in this magazine (RADIO MAINTENANCE, *February and March* 1949), new processes have been developed which will speed up the rate of production of glass picture tubes considerably. At the same time, additional plants have been, and are being, opened by a number of firms to help meet the demand. Finally, the development of metal picture tubes promises to increase the production rate still further, in addition to cutting costs, so that the industry is not overly apprehensive in this respect.

Another stumbling block on the road to increased production is the shortage of tin. The requirements of the radio industry in 1949 are estimated to be almost one hundred percent greater than they were in 1948. At the same time, it is also estimated that the amount of tin available to them will be only 10% of what they received in 1948. The drastic reduction in one of the most important metals in the manufacture or television receivers will have profound effects unless ways can be found to overcome it. RMA has already established a committee to supervise the allocation of this scarce metal and to make researches into the possibilities of tin-substitutes. Expansion of the industry is largely tied now to the solution of this problem.

Installation and Service

What does all this add up to for the service technician? Clearly, as the market grows, so will his share in it—if he is prepared. For this year, the total dollar volume for installation and service work is expected to exceed one hundred million dollars.

We believe that this total will increase for a number of years. The installation business itself will reach a fairly constant yearly level within about two years, and will remain there for some time. This level should proceed at the approximate rate of 3,000,000 installations per year into the late 1950's.

While the volume of installation business will thus remain relatively constant, there will be an ever-increasing amount of servicing necessary to keep already installed sets operating at top efficiency.

There are a number of considerations which will work toward the spending of much more time in service work by the technician.

The greater sensitivity of the eye as compared with the ear has been repeatedly pointed out by various authorities. Television receivers will therefore not be allowed by their owners to operate at low levels of efficiency, as is the case with many a-m sets.

Moreover, television receivers use almost 5 times as many parts as a-m sets, one of the former constituting five of the latter in terms of electronic components. The technician may therefore expect to do about five times as much servicing on a television receiver as he did on a-m sets.

Another factor making for increased television service requirements is the fact that a tele-set constitutes a heavy investment. The owner will have to have his receiver repaired, he cannot simply replace it with a new set. Even an expensive servicing job will be cheaper than complete replacement. This fact will also produce more sets which are older, and therefore in more frequent need of repair.

Still another factor which may be of interest is the fact that the average life of the picture tube is about 1,000 hours, or about one year with average use. These will have to be replaced at regular intervals.

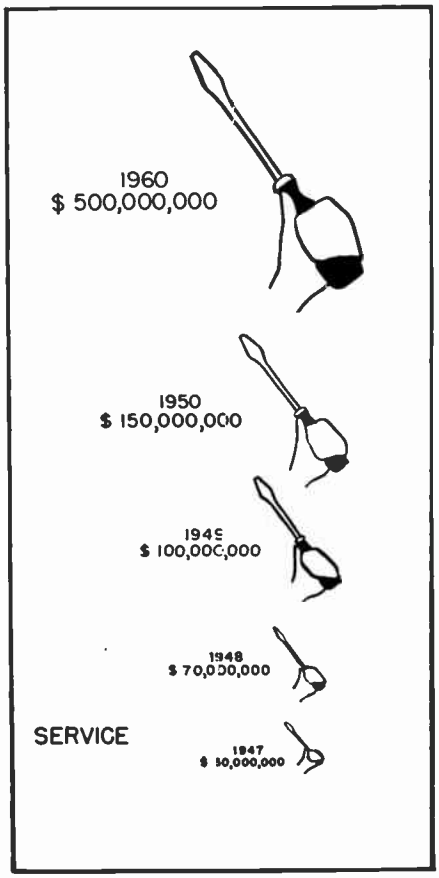
All these aspects of service, not too apparent at the present time, will become increasingly noticeable in the future.

Thus, by the end of 1950, the yearly volume of television installation and service work will have reached more than $150,000,000 and will gradually rise thereafter. This volume may be expected to be around $350,000,000 a year by 1960, provided of course that present price levels remain reasonably constant. Adding to this amount the dollar volume of servicing not connected with television, it is not impossible that the yearly business of the service industry will reach the half-billion mark.

Applied Television

When we speak of television, we do not refer exclusively to the entertainment medium, or to the 7, 10, 15, or 20 inch set. Television is invading other places than the home, and is put to other uses than entertainment alone. Lest these phases of the industry be overlooked, let us briefly summarize them here.

Television for large audiences is going to become a practical reality in the foreseeable future. We reported already (RADIO MAINTENANCE, *January 1949*) that RCA had developed a large-screen projection system which was considered to have operated satisfactorily. Large-scale television is already being employed in England on a fairly extensive scale, and we may be expected to follow soon.



The prepared technician will be able to share in an estimated $500,000,000 industry

Television for purposes of education is also finding increasing acceptance. The Navy has been conducting experimental studies on the feasibility of using this medium for mass instruction of its personnel. Medical conventions have used it to show operating techniques in no other way accessible to the great majority of surgeons. And schools in various parts of the country have been trying out the medium.

Television for department stores and similar places will also make its appearance. This is known as a "closed system." Transmission will take place from one centrally located room, and programs will be piped through the entire building. This operation, by the way, does not require FCC licensing.

The Prospects

Once upon a time we could only see motion pictures. Now we can hear them as well. In the radio field, something similar has happened. First we could only hear things, now we can see them as well. And just as the addition of sound revolutionized the motion picture field, so has the addition of vision changed the radio industry. Just as no motion picture exhibitor would remain in business if he persisted in handling silent films only, so no technician will prosper if he is unable to handle video.

The conventional service organization of yesterday will become as extinct as the model T.

While the technician who does not keep up to date in the television field will be left behind, it is also true that the industry itself will not prosper if there are not enough properly trained technicians to install and service the products it manufactures.

Servicemen have felt in the past that the manufacturers often showed little concern for their welfare; and this feeling was justified in many cases. Today's picture, however, is different. The manufacturer of today is well aware of the importance of the service technician to the prog-

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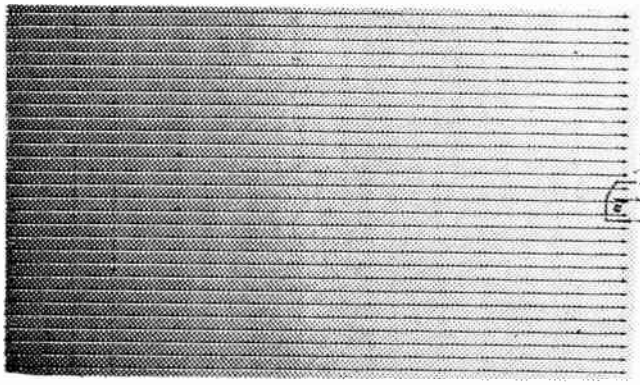

FRINGE INSTALLATION PROBLEMS

by J. Richard Johnson Co-author of "Practical Television Servicing"

Good fringe area reception continues to be a difficult aspect of successful television receiver installation. The various ways of solving these problems which are open to the technician are discussed in this article

MANY servicemen have already been plunged into the problem of installing television receivers in what is known as "fringe areas." Others will be hearing more about this problem and are destined to join the group as more and more stations come on the air and interest continues to grow. There are a number of special problems found in this kind of installation which a growing group of service technicians will need to tackle. In this article we will consider some typical examples of fringe area problems and suggest methods of solution.

First, what is a fringe area? Since apparently no one has ever given an exact definition, this is certainly a reasonable question. However,usage has tied the meaning down to accepted limitations. Fringe areas are generally understood to be those geographical areas in which signal intensity, attenuated mainly by distance (surface ground wave effects due to normal curvature of the earth), is near the value for which ordinary simple antennas cannot produce sufficient receiver input voltage to operate the average receiver satisfactorily. The strength of the signal alone cannot be used for the complete definition, since some locations very close to a transmitter may be characterized by low signal strength due to high mountains and tall buildings, although such locations would not normally be referred to as fringe areas.

The discussion in this article will be confined to fringe areas as defined above.

By operating the receiver satisfactorily, we mean an operation reasonably entertaining to the average individual. Although some kind of a picture can be obtained on some receivers with an input signal level as low as 50 microvolts, a minimum of at least 250 microvolts is usually required for satisfactory clarity, signal-to-noise ratio, and elimination of "snow" on the screen. Much more signal strength is necessary if the area is particularly noisy. Several-thousand microvolt signals are desirable for a safe margin over noise and interference.

Surveys show that fringe areas usually extend from about 25 to 60 miles from the television station. Usually, the stations are located near each other and, in most fringe areas, are far enough away to appear to be coming from the same direction. Only in a few instances are the stations of an area scattered, with some much closer to the receiving location than others. In such cases, of course, a given area may be a fringe area only for those stations from which it is separated for enough so that our definition holds.

Fig. 1 This Oak Ridge DR-3 antenna is a typical example of "straight" dipole antennas

Channel Frequency and Signal Strength

Signals in the low-frequency channels (number 2, 3, 4, 5, 6) are less affected by rough terrain and the earth's curvature than those in the high-frequency channels. In those rare cases (for distant locations) in which an absolutely clear line-of-sight path is available between the transmitter and the receiving location, not much difference will be noted between the signal strengths of high and low frequency signals. If you try to verify this in your own location, however, remember that television stations use different amounts of power. It's hard to be sure that your antenna has equal response at high and low frequencies, and the sensitivity of the receiver naturally has a tendency to fall off in the high frequency range.

Any signals received over a distance of 60 miles or more (airline) will be subject to fits of fading and flutter effects owing to temperature inversion and other sporadic phenomena of propagation. Thus, stable and uniform reception at all times (which the tele-set owner surely has a right to expect) cannot usually be expected from television stations

75 or more miles away. Accordingly, the bulk of service and installation business will be included within this distance for some time to come.

Antenna Choice

The above discussion has concerned itself with the general consideration of whether reception is obtainable in a satisfactory manner, and what factors influence the magnitude of the problem. Once these factors are determined, the technician can proceed to the details of installation.

However, before the job is undertaken, it is important that the receiver owner be given the facts of life about his location and why his distant location makes it much more difficult to obtain a good picture. Experience in the field has shown that the average customer can sometimes be quite sensitive about such things. As an example, some installation men follow a policy, in fringe areas, of adopting a single very good type antenna for all installations. This is because often a customer feels that he is being slighted if his antenna is not as elaborate as his neighbor's and cannot understand that his location is so much better that he doesn't need such an antenna.

In general, each serviceman seems to develop his own special likes and dislikes in antennas and is always seeking something just a little bit better. A number of high gain arrays are now available for use in low signal areas. Since each antenna has its own individual advantages and disadvantages, we will not attempt to recommend any particular type, but point out some examples of those which are finding use in fringe areas.

First, it is important to remember the two basic electrical features necessary in any television receiving antenna. These are:

1. Sufficient gain to supply a usable signal at the receiver input terminals.

2. Sufficient frequency response band width to provide good reception on all channels used in the area.

There are two main approaches to the problem of providing these features. The first is to design and array with good gain and frequency coverage in one assembly.

The other approach involves the use of separate assemblies for the high and low bands (Low band: 56-88 Mc, Channels 2 through 6, High band: 170-216 Mc, Channels 7 through 13).

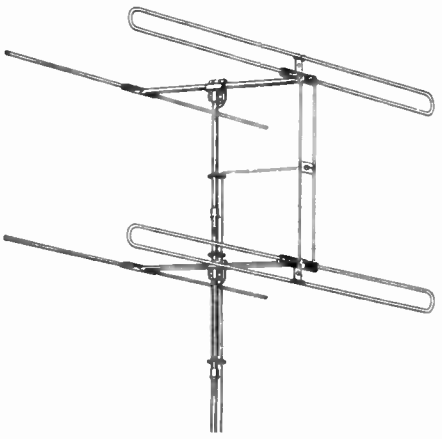

Fig. 2 The Ward TVS-6 antenna is a typical stacked array with parasitic elements

Fig. 3 A high frequency section (top) has been added in this Ward TVH-9 antenna

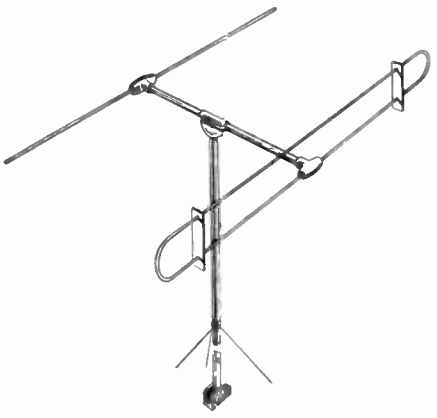

Fig. 4 Folded dipoles, as illustrated in this Cambrun antenna broaden the response

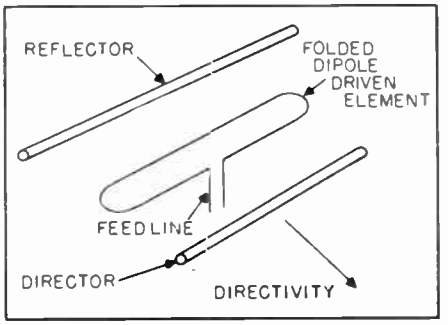

Fig. 5 Parts of a 3-element parasitic array. 4-element arrays have additional director

In the areas in which television was first inaugurated, only the low band channels were used in the beginning. Accordingly, a number of manufacturers produced antennas obviously intended only for 60 to 88 Mc range. Examples of these are shown in Fig. 1 and Fig. 2. In areas of relatively high signal strength, these antennas often proved to be adequate for reception of the higher channels even though their length was such as to favor the lower channels. However, in most fringe areas, it became necessary to add a separate high frequency section, as shown in Fig. 3.

The antennas of Fig. 1 and Fig. 2 use simple "straight" dipoles for their elements. The simple dipole alone has a sharp frequency response characteristic, and addition of a reflector makes it even sharper.

Because of the sharp response of the simple dipole, this type is becoming obsolete in many areas and is being replaced by folded dipoles, both alone and in arrays as shown in Fig. 4. Although the use of a folded dipole for the "driven" element (one to which the feed line is connected) has the greatest effect on frequency response, the change to a folded dipole for the *reflector* also has a broadening effect and is becoming very popular.

Kinds of Antenna Arrays

It may eliminate some confusion to note that the arrays used for television reception in fringe areas are of two general types and many are a combination of the two types.

1. *Parasitic array.* Fig. 1 shows an example of a parasitic array. In this type, the feed line connects to *one* of the elements. The remaining elements have no wire connections to each other or to the feed line. The element which connects to the feed line is referred to as the driven element (carry-over from transmitter applications) and the other separate elements are called parasitic elements. The parasitic elements are excited by energy coupled from the driven element. They then re-radiate this energy so as to build up the signal received by the driven element. Parasitic elements are of two types: *reflectors,* which have a greater physi-

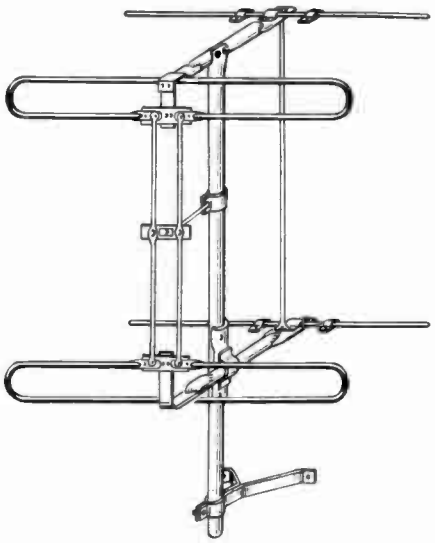

Fig. 6 This Taco 495 is a combination broadside and parasitic high band array type

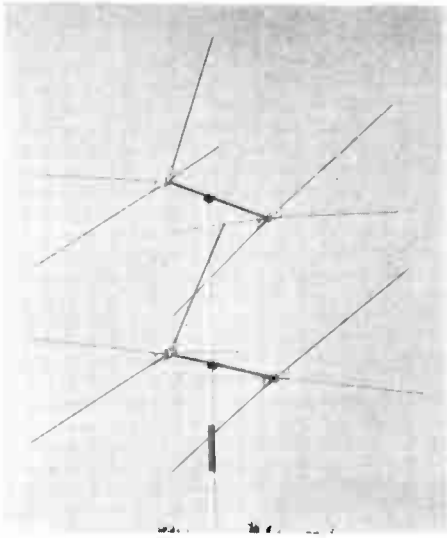

Fig. 7 The Telrex 4X-TV antenna is of the type found very effective in fringe areas

Fig. 8 The Roger Television Yagi-Beam is another fringe area multi-element antenna

cal length than the driven element and are placed on the side opposite from the received signal; and *directors*, which are shorter than the driven element and are mounted in front (toward the received signal). A graphic description of this arrangement is given in Fig. 5.

2. *Stacked or broadside arrays.* The front portion of the antenna of Fig. 2 is an example of a stacked array. In this type, all the elements are connected either directly or indirectly, through transmissions lines, to the feed line. The spacing of the elements and the length and arrangement of the line connecting them are designed to give currents in the elements a phase relation which increases their receiving sensitivity. In television arrays the elements are ordinarily half-wave long for some middle frequency of the range, and are spaced from about an eighth wave to about a half wave length apart. The half wavelength spacing gives better gain, but for the lower frequency range is usually considered too bulky. In high band arrays, however, half-wave spacing is generally used, as illustrated in the antenna array of Fig. 6.

Although the front portion of the array of Fig. 2 is of the stacked type, it is also equipped with reflectors, which are of the parasitic type, making this antenna a combination type, as is also the example of Fig. 6.

Another type of combination broadside and parasitic array which is rapidly gaining popularity in fringe areas is illustrated in Fig. 7. A good broad band effect is obtained by the angled pieces of tubing which in each case act in pairs to produce a large effective diameter due to the current sheet effect. The elements are of different lengths to give coverage of all channels. The author has witnessed tests in a typical fringe area in which this antenna performed very well, comparing favorably with many separate hi-lo antenna combinations.

Because of their relatively sharp frequency response characteristics, three and four element parasitic arrays were at first ruled out for television use. However, certain factors have now again made them more feasible for special applications, especially for the fringe areas we are discussing here.

One of these factors is the opening of the high frequency channels. Because the bandwidth of all television stations is the same (about 6 Mc), the relative (percentage) bandwidth at the highest channel frequencies is much less than at the low channel frequencies. For example, in channel 2, with a video carrier frequency of 55.25 Mc, the 6 Mc bandwidth is over 10% of its carrier frequency. On the other hand, consider channel 13, video carrier 211.25 Mc. The 6 Mc width represents here less than 3% of the carrier frequency.

The relative bandwidth of an antenna must be expressed in percentage of carrier frequency handled, rather than the number of kilocycles or megacycles. Whereas the average three of four element parasitic array constructed with straight rods is too sharp to pass all the side band components of a single channel in the low frequency range, the same type antenna can often be used for high channel reception (with different element length, of course).

Practical parasitic arrays are also broadened by thickening the elements. It is a well-known principle that antennas of greater diameter have a wider frequency response. The array of Fig. 8 exemplifies a type now appearing on many fringe area roof tops. It uses five elements, in a parasitic arrangement, for the highest channels. Notice how thick the elements are made to give broader band effect.

Thickening single elements is of course not the only way in which the response band is broadened. The *effective* diameter of elements is increased in such antennas as the folded dipole and the "bat-wing" antenna type of Fig. 9, by use of two pieces of tubing which act as a unit by forming a current sheet between them. Another example of this effect is the triangular type.

Some manufacturers are producing parasitic arrays of two, three, and four elements, which can be separately resonated, each antenna being adjusted to a different channel. The advantages of such an arrangement are much better sensitivity than a single antenna could give on every channel, and separate orientation for each channel. The latter advantage is especially important in fringe areas which depend on the stations of more than one city for

reception. Of course, one obvious disadvantage to such an arrangement is the bulk of the antenna, especially if four or five channels are thus separately received. In addition, some sort of switching arrangement must be installed, since in parallel operation, the antennas would be very likely to affect each other, producing ghosts or lowering the sensitivity because of loading. In the simpler high and low combinations a switch is not necessary, and a comon feed line can be brought from both antennas in parallel to the receiver.

Antenna Directivity

After the type of antenna for a location is chosen, the proper directivity must be considered. Since in fringe areas the signal is low and gain is important, and at the same time the angle of the received signal is critical, the proper orientation of the antenna is a prime factor in a successful installation. Some servicemen develop an instinctive sense of direction and can erect the antenna properly without further tests, but in most cases, careful checks, while the antenna is rotated, are necessary. Hills and other obstructions which are sometimes not noticed at first can often cause reflection effects. The methods used in orienting the antenna are no different in fringe areas than for areas of higher signal strength closer to the stations, except of course, that you usually have much less reserve signal to play with.

Weak Signal Effects

There is a very important effect in television receivers, when weak signals are being received, about which there seems to be considerable misconception. This matter should be clarified by a slight review here of the response characteristics of a typical television receiver.

The standard i-f response characteristic is illustrated in Fig. 10. The important thing to notice here is that when a receiver is properly tuned to a signal of moderate strength, the response of the i-f amplifier at the video carrier frequency is only 50% (one-half voltage) of that of some of the side band components. This is the only condition of tuning which gives full picture quality, other adjustments causing some kind of side band clipping.

However, on some weak signals, no picture is obtainable with the correct 50% adjustment, whereas incorrect adjustment, where the carrier response is 100% of the maximum, will often increase a limited number of picture sidebands and the carrier to where a semblance of a picture is obtained. So it must be emphasized that the setting for maximum picture brilliance due to tuning is not the proper tuning condition.

The sound carrier has a frequency 4.5 Mc from that of the picture carrier. Accordingly, when the signal is properly tuned for 50% video carrier response, the sound is tuned in perfectly, since this is the manner in which the receiver is aligned at the factory.

Unfortunately, there is a tendency among some servicemen to assume that loss of sound on a weak signal, which must be imporperly tuned to obtain a picture, is due to mis-alignment of the receiver. Actually, such a condition is simply due to lack of sufficient signal strength to operate the picture section at its proper response frequency and the sound at the same time. Here is what happens:

1. We tune the receiver to the weak signal. Usually, we hear some sound but the picture doesn't "give."

2. We tune some more. The screen ilumination increases and we see some sort of picture (usually a poor one under these weak signal conditions).

3. Meanwhile, we note that, having received a picture in which we can make out a few details, we have tuned away from the sound, which is no longer heard.

Correct Conclusion—There is not sufficient signal strength to operate the reciever satisfactorily.

Incorrect Conclusion—The i-f sections are out of alignment since the picture and sound signals cannot be heard simultaneously.

TV Boosters

Adjustment and proper choice of the antenna system constitute by far the most practical way to improve reception in fringe areas. This is because antenna improvement is about the only way a signal can be increased without increasing the noise level appreciably at the same time. Most weak signal noise troubles are the result of random receiver noise. This noise originates inside the receiver and its own strength is not influenced by the type of antenna to any appreciable evtent.

Another method of improving reception in fringe areas is with the help of booster units. These are simply additional r-f amplifier stages connected between the antenna lead and the antenna terminals on the receiver. It must be remembered that the television booster increases noise content at the same time that it boosts the signal. Although it can give some gain and often produce a picture where none was obtained before, this gain is offset by an increase in the absolute noise level which would not be present if the same gain were obtained from an improvement in the antenna system.

For this reason, the most frequent use for boosters is in those locations in which all reasonable efforts to improve the antenna system have resulted in a picture which is not quite good enough. The booster will provide that little extra "boost" to provide good reception.

In a number of cases, however, boosters will be found to have a tendency toward instability and oscil-

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Fig. 9 2 pieces of tubing increase effective antenna diameter in this DuMont "bat wing"

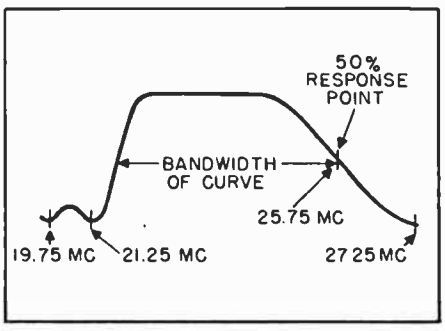
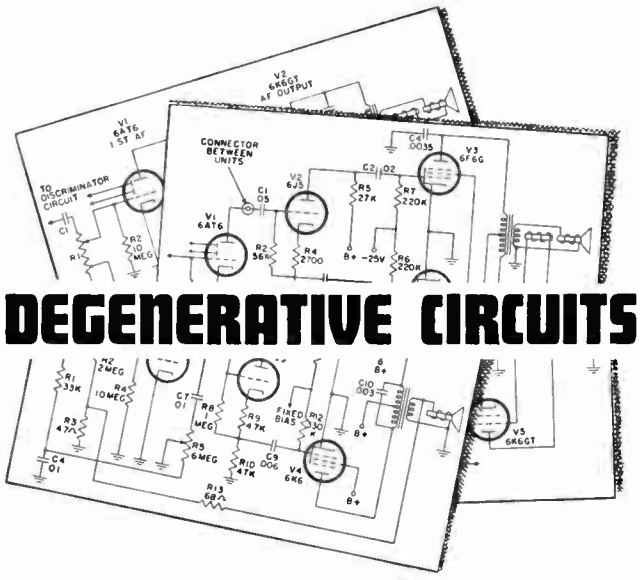


Fig. 10 The graph shown above illustrates the standard i-f response characteristic



DEGENERATIVE CIRCUITS

HOW ONE OF THE BASIC CIRCUITS OPERATES AND HOW IT IS UTILIZED IN A NUMBER OF RECEIVERS FOR IMPROVED PERFORMANCE

by A. T. Parker

THE circuits discussed here are variously known as "Inverse Feed-back", "Negative Feed-back", and "Degenerative" circuits. They have certain advantages and are used by a large portion of the better modern radios in one way or another.

Briefly, degeneration is accomplished by sampling a small percentage of the output of an audio system and applying it to its input. The small audio voltage which is fed back in this manner is applied in opposite phase to the input voltage. Since the feed-back is a percentage of the output voltage, the actual amount of the signal voltage of a given frequency that is fed back depends on the strength of the output signal at that frequency.

For example: the conventional amplifier has a tendency to over-amplify the higher frequencies. If the inverse feed-back circuit feeds back 10 percent of the output, the actual amount of high frequency voltage fed back will be higher. It will be ten percent of a larger voltage. This greater feed-back at the higher frequencies will neutralize more of the input signal. The input at the higher frequencies will, therefore, be lower than normal; and greater amplification at high frequencies will make the overall frequency response more uniform.

Negative or inverse feed-back (degeneration) provides greater stability in audio circuits, making them relatively independent of changes in tube characteristics and supply voltage. Distortion is reduced in direct proportion to the reduction in gain due to the feed-back. True, if a small percentage of the output is fed back to the input *out of phase*, it will cancel that percentage of input and thereby reduce the gain of the system. However, this shortcoming is outweighed by the advantages, since it is usually possible to make up for a loss in gain in a properly designed circuit.

Degenerative circuits may be broken down into two classes: (1) Voltage Feed-back and (2) Current Feed-back. The former tends to maintain a constant voltage, and the later a constant curent in the output circuits.

Voltage Feed-back

The simplest form of voltage feed-back is shown in Fig. 1. The modern Arvin Model 14OP utilizes a feed back circuit which uses just one more component than a conventional circuit and yet achieves the full advantages of feed-back. The 6.8 megohm resistor connected between the plate of the 1S5 and the 3V4 provides what is known as parallel inverse feed-back. The output signal of the 1S5 and a part of the output signal of the 3V4 appear across the 2.2 megohm grid resistor of the 3V4. At the same time, a small part of the output of the first stage apperas at the right hand end or the 6.8 megohm resistor by conduction through the resistor. This small voltage appears along with the output of the 3V4 across the output transformer. If the value of the feed-back resistor were reduced, a condition might arise where the voltage appearing across the output transformer due to the 3V4, and the voltage conducted through the resistor, would be equal and out of phase. They would naturally cancel each other and no voltage would appear across the transformer. For this reason, the value of the feed-back resistor is made sufficiently high to prevent any appreciable conduction in that direction.

The gain of the 3V4 is independent of the amount of feed-back, but the gain of the 1S5 is not. This is the case because the plate load of the first stage consists of the 330,000 ohm plate resistor in parallel with the 2.2 megohm grid resistor, and also in parallel with a "virtual resistance." The value of this resistance is roughly determined by dividing the value of the feed-back resistor by the gain of the 3V4 at the frequency being considered.

At frequencies where the gain of the system is greatest, the voltage fed back is proportionately higher.

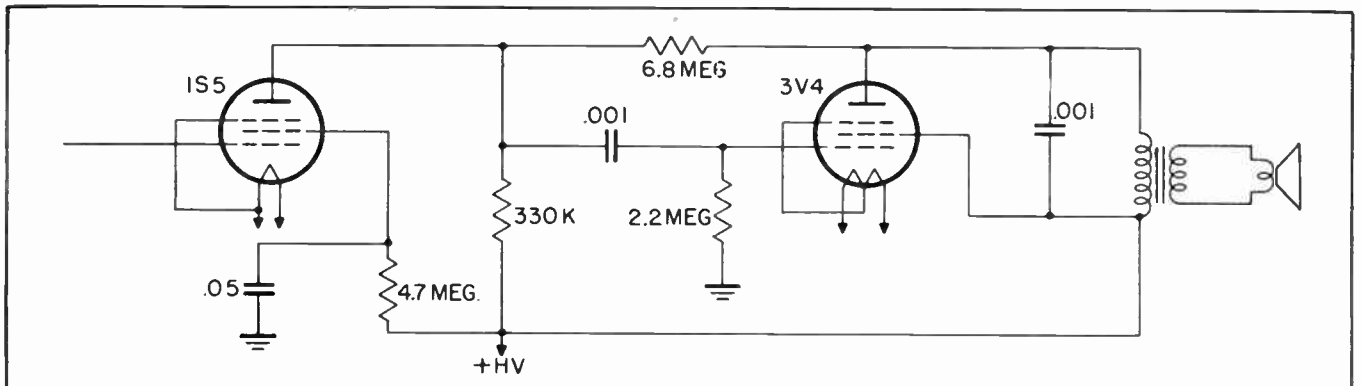


FIG. 1 ARVIN MODEL 140P USES PARALLEL INVERSE FEEDBACK OF CONSTANT VOLTAGE TYPE.

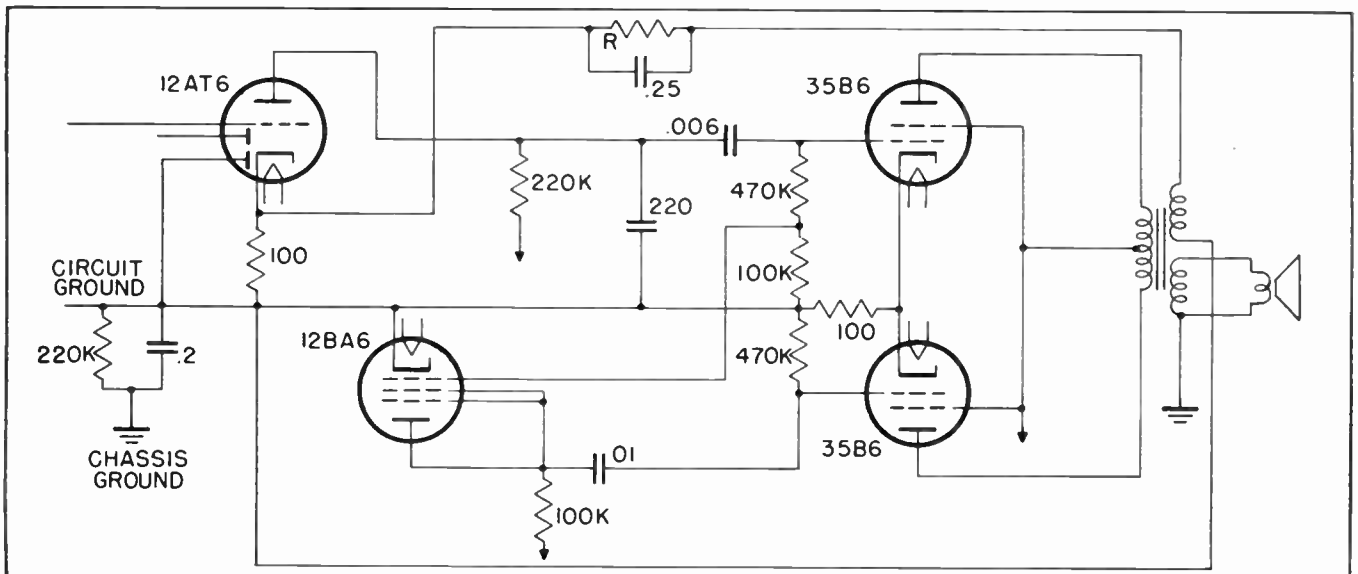


FIG. 2 BENDIX RADIO MODEL 697A IS AN APPLICATION OF PARALLEL FEEDBACK.

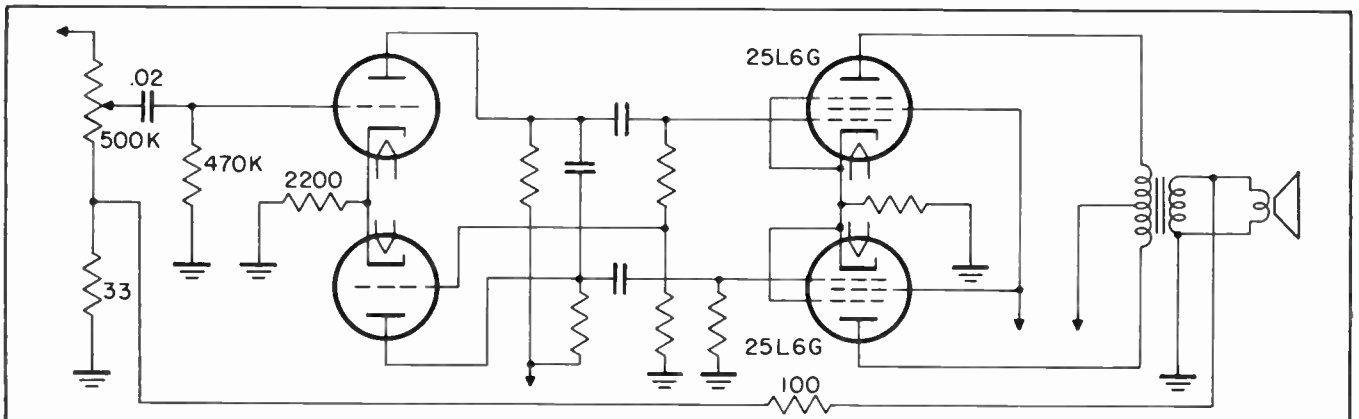


FIG. 3 ECA RADIO MODEL 108 USING FEEDBACK IN COMPENSATED VOLUME CONTROL CIRCUIT.

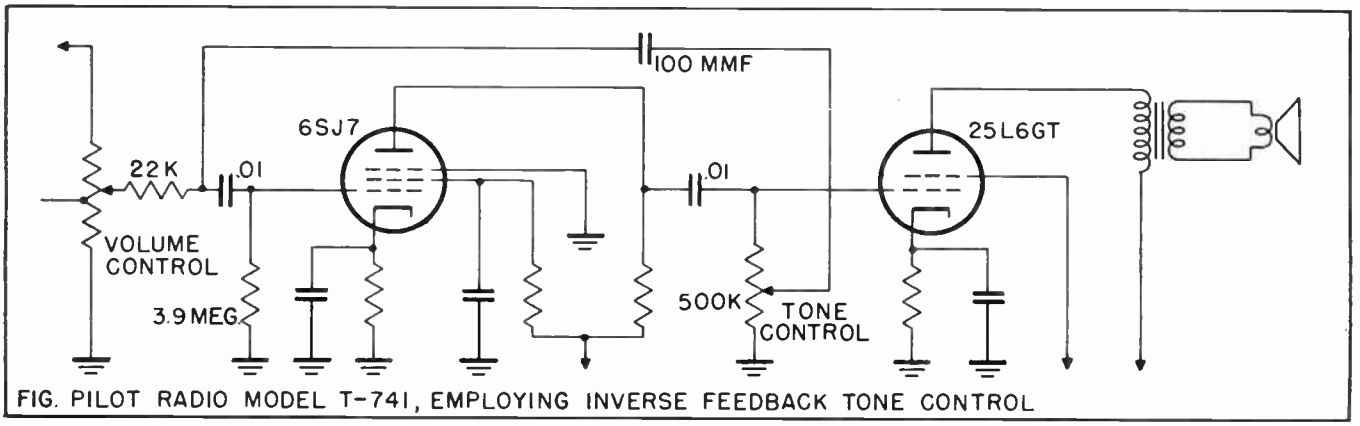


FIG. PILOT RADIO MODEL T-741, EMPLOYING INVERSE FEEDBACK TONE CONTROL

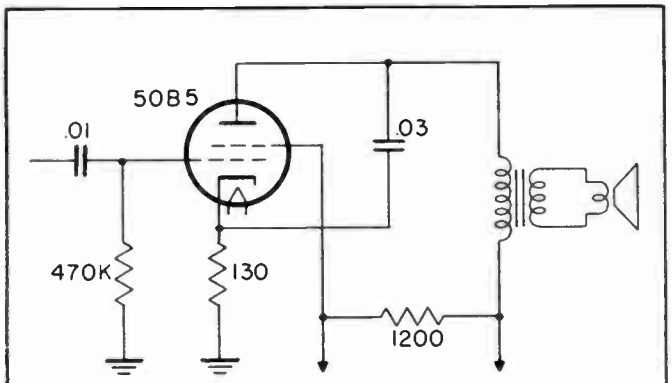


FIG. 5 FADA RADIO MODEL 711 AND 740 OBTAINING FEEDBACK BY OMISSION OF BY PASS CONDENSER.

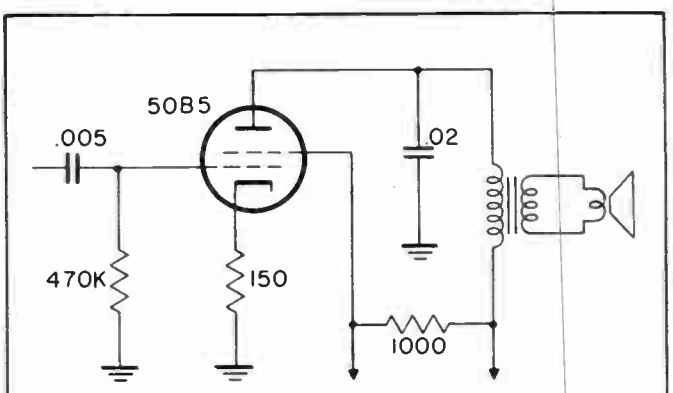


FIG. 6 EMERSON RADIO MODEL 547A OMITS BYPASS CONDENSER TO ACCOMPLISH CURRENT FEEDBACK.

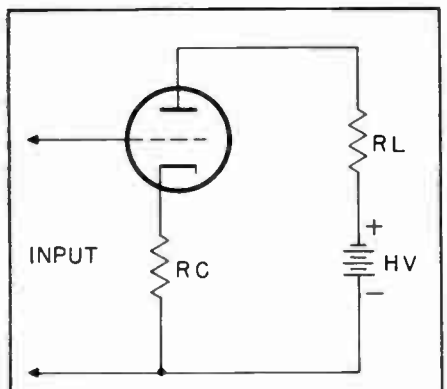


FIG. 7 SIMPLIFIED SCHEMATIC OF CURRENT FEEDBACK CIRCUIT.

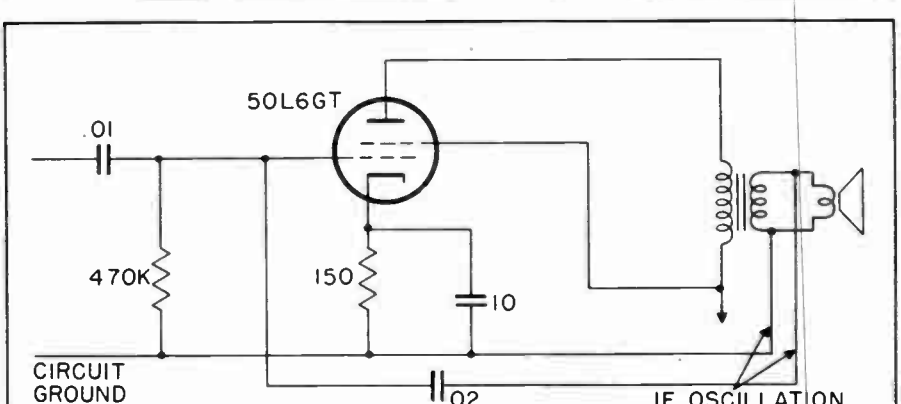


FIG. 8 APPLYING FEEDBACK TO TYPICAL OUTPUT CIRCUIT.

Gain is therefore reduced most at such frequencies. In this way, the feed-back tends to level out the response of the system and greatly improve its quality.

Another application of parallel feed-back is shown in Fig. 2. In the Bendix Radio Model 697A a special secondary is provided on the output transformer to produce the right amount of voltage to be fed back. Degeneration takes place through resistor R and its bypass condenser (.25 mf) to the cathode of the 12AT6 first audio tube. The reactance of the .25 mf condenser varies with frequency so that it appears to be a large reactance at the lower frequencies and a relatively small reactance at the higher frequencies. At frquencies around 100 cycles, for example, the reactance of the condenser is so high that the feed-back is governed almost entirely by the resistor R. The amount of feed-back is therefore inversely proportional to frequency, so that the gain of the system is higher at the lower frequencies. This is, in effect, a bass boost or, more realistically, a treble attenuation.

Control Circuits

Feed-back may also be used to compensate the volume control. In Fig. 3, the ECA Radio Model 108 is shown with the output voltage at the speaker voice coil being fed back to the bottom end of the volume control. In this circuit the amount of degeneration is maximum at the minimum volume control setting, decreasing rapidly as the volume control is increased. The .02 mf condenser at the grid of the 6SL7 is large enough to prevent the proper phase shift from being affected.

The Pilot Radio Model T-741 (Fig. 4) uses voltage feed-back in a tone control circuit. The value of the capacitor between the arm of the tone control potentiometer and the input ahead of the .01 mf coupling condenser is purposely small. This makes for feed-back occuring only at the higher frequencies. With the arm of the tone control at the bottom end, the voltage fed back is small and the gain at all frequencies is normal. As the tone control is adjusted away from the bottom end, the voltage available at the arm of the control gets greater and the gain of the system is reduced at frequencies which can pass through the 100 mmf feed-back condenser. The effect is to attenuate the high frequencies giving the illusion of boosting the bass response of the system.

Current feed-back is accomplished in a majority of modern smaller radios by simply *omitting* a part! The bypass condenser is omitted from the cathode resistor as shown in two typical circuits, ilustrated in Fig. 5 and Fig. 6.

When the cathode resistor is unbypassed, the plate load resistance is divided into two parts. One part is the usual load of the output transformer and the other part is the cathode resistor. The cathode resistor is also part of the grid resistance. Since both input and output currents flow in the cathode resistor in opposite phase, degeneration or cancellation occurs. This is more readily seen in the simplified schematic of Fig. 7.

The cancellation of some of the grid voltage due to the out-of-phase voltage produced by plate current

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TV INTERFERENCE ELIMINATOR

A WAVETRAP WHICH WILL GIVE SATISFACTORY RESULTS IN YOUR TV SERVICING

by Rufus P. Turner

VERY positive elimination of television interference, resulting from amateur and other signals in the frequency range of 2,000 kc to 250 Mc can be obtained by means of the 2-stage wavetrap described in this article. The device may be built in a few minutes by the radio service technician.

The circuit of this interference eliminator is given in Fig. 1. It consists simply of two identical wavetraps connected in series of one leg of the antenna transmission line. The coils of the separate traps are mounted at least two inches apart and at right angles to each other. Rejection of unwanted signals is several times more effective with this arrangement than with a single wavetrap.

The 2-stage circuit has an additional advantage. When interfering signals arise on tow separate frequencies, anywhere within the 2 Mc to 250 Mc spectrum, each wavetrap may be tuned separately to eliminate one of the interfering signals.

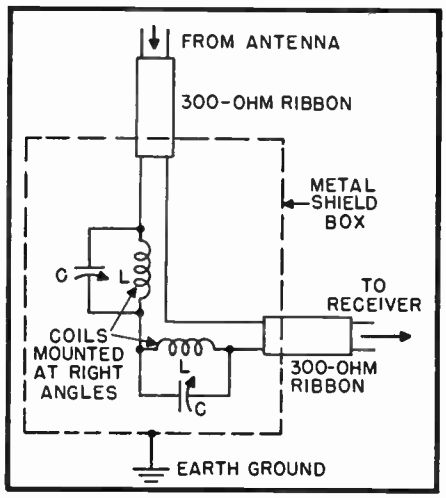


Fig. 1 Shown here is the schematic diagram of the wavetrap described in this article

COIL WINDING TABLE		
COIL	FREQUENCY COVERAGE	SPECIFICATIONS
A.	2 to 6 Mc.	91 turns No. 30 enamelled wire closewound on 1"- diameter bakelite or polystyrene form.
B.	5 to 15 Mc.	42 turns No. 26 enamelled wire on 3/4"-diameter bakelite or polystyrene form. Space to winding length of 3/4 inch.
C.	14 to 32 Mc.	25 turns No. 22 enamelled wire on 3/4"-diameter bakelite or polystyrene form. Space to winding length of 3/4 inch.
D.	30 to 54 Mc.	17 turns No. 22 enamelled wire on 3/4"-diameter form. Space to winding length of 3/4 inch.
E.	52 to 120 Mc.	7-1/2 turns No. 18 enamelled or bare wire air wound, self-supporting, to 5/8" diameter and winding length of 5/8 inch.
F.	115 to 250 Mc.	4 turns No. 18 enamelled or bare wire air wound, self-supporting, to 1/2" diameter and winding length of 1/2 inch.
Use miniature 50-uufc. tuning capacitor (such as National Type UM-50) with coils A and B. Use 15-uufd. miniature tuning capacitor (such as National Type UM-15) with coils C, D, E, and F.		

Fig. 2 The above table gives the coil winding specifications for the different coils used for different frequencies. Coils must be mounted at right angles in the trap

This eliminator is easy to build and need not be expensive. Parts can be obtained from most spare parts boxes. The coils (L) for the desired interference frequency coverage are wound according to the winding table given below. They then are soldered directly to the terminals of the tuning capacitors (C). The tuning capacitors should be of miniature size, and preferably be provided with slotted shafts for screwdriver adjustment. National Type UM capacitors are especially suitable in this application. The tuning capacitors should be rated at 50 mmf for use with coil *A* (2-6 Mc) and coil *B* (5-15 Mc). They should be rated at 15 mmf for use with each of the other coils.

Using the Eliminator

The components should be mounted inside a small metal shield box placed as close as possible to the television receiver and connected to a good earth ground, such as a nearby cold water pipe. No part of the wavetrap circuits should be connected to the box. The adjusting screws of the tuning capacitors must be accessible through two clearance holes driled in the side or cover of the shield box.

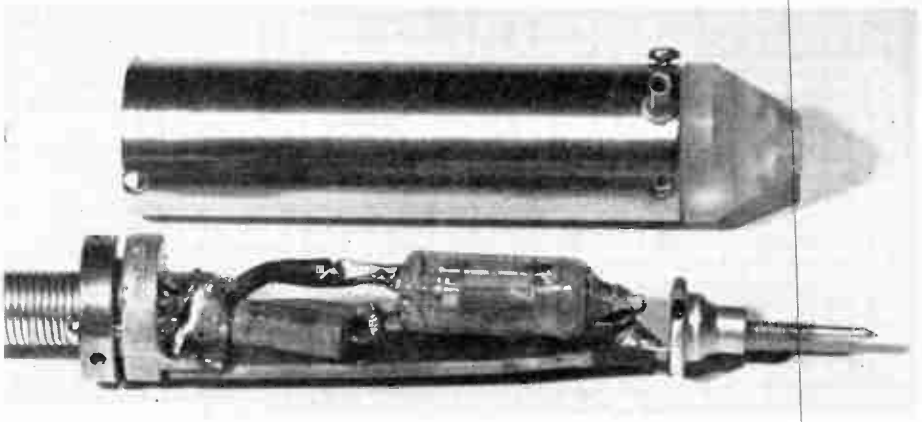
Use of the eliminator is simple.

1. First, determine the approximate frequency of the interfering signal and select the proper coil and capacitor to tune to that frequency.

2. After installation of the eliminator, tune each wavetrap successively (the one closest to the antenna first) for total elimination of the unwanted signal.

3. If no means is available for finding the frequency of the interfering signal, try coil *A* in one trap only, after first installing a wire jumper across the other tuning capacitor. If the tuning trap fails to reduce the interference, try coil *B*, and so on, through coil *F*. When the proper coil has been found, wind a duplicate for the second trap. Any unused coils can be kept for a future interference job.

PROBE UNITS AND SIGNAL TRACING



This Sylvania Polymeter Probe is of the diode type described in this article

by Martin Clifford

DISCUSSING ONE OF THE MOST ECONOMICAL AND VERSATILE PIECES OF TEST EQUIPMENT

WE have extremists in every business, and the field of radio servicing is no exception. We've all heard of the serviceman who insists on tackling a job as complex as an elaborate projection television receiver armed with nothing more than a multitester, and perhaps a screwdriver (The screwdriver is used for testing the presence of B plus voltage). This chap scorns all test instruments (except his little multitester) and wouldn't use a 'scope or audio oscillator if you gave him one as a present.

On the other hand we have the man who is instrument happy. He has so many pieces of test equipment on his bench that most of the time he can't find the receiver he's supposed to be fixing. Even if he did manage to locate the defunct radio, it still wouldn't get repaired. He's too busy fixing the test equipment.

Fortunately, these two types are the exception in this business. Yet even among those who have the right attitude toward various pieces of test equipment, too few take complete advantage of the full possibilities of their apparatus. The signal tracer is a particular instance.

Next to a multitester, the signal tracer is the simplest and most economical piece of equipment you can have on your bench. In addition, the number of jobs it can do for you is really impressive. Its most important function is to tell you quickly (within a matter of minutes) just where in a radio receiver the signal has disappeared. It won't tell you the exact part which has gone bad, but it will do the next best thing. It will localize the area of trouble and keep you from wandering all over the receiver. Wherever the fault, whether in the r-f, the mixer, the i-f stages, second detector, audio (or even defective tubes)—the signal tracer can be put to work. It can be used to check oscillator voltage, follow through on a.v.c. circuits, track down elusive hum, noise, and distortion, test speakers (or be used as a shop test speaker), find faulty circuits, intermittents, test phono pickups, check stage gain, measure voltages and determine their polarity. The signal tracer has the decided advantage that it checks the receiver under actual working conditions.

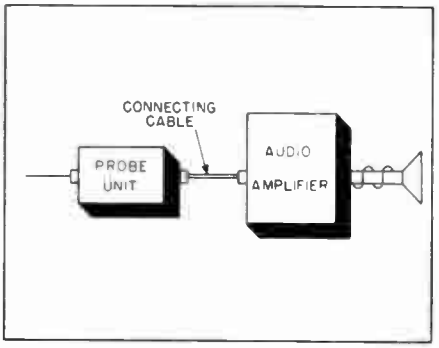


Fig. 1 Block diagram of typical signal tracer. Note that the probe is a separate unit

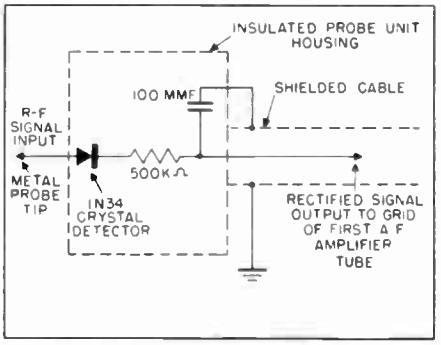


Fig. 2 Schematic of crystal probe. These probes require no filament or plate voltage

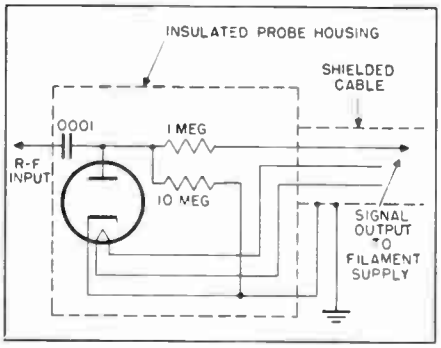


Fig. 3 Schematic of diode probe shows complex probe cable carrying filament voltage

Probe Unit Requirements

The beauty of the signal tracer is its extreme simplicity. It does not contain a single circuit not thoroughly known to all radio service technicians. As a matter of fact, a signal tracer is nothing more or less than an audio amplifier, most ordinarily of only two stages. Used in conjunction with the signal tracer is a detector circuit customarily referred to as a probe. In Fig. 1 is given a block diagram of a typical signal tracer. Notice that the probe is a separate unit and is connected to the audio amplifier portion of the signal tracer through a cable.

It might be thought that since a probe unit is nothing more than a detector circuit, it presents few technical difficulties. This is indeed the case. All probes described here are not in the least complicated. They are all untuned and require no adjustment whatsoever. Yet we must remember that we are called on to service receivers that range from as

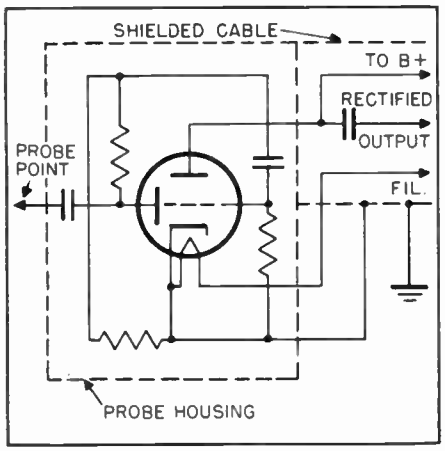


Fig. 4 A 6AT6 is connected as half-wave rectifier diode and audio amplifier triode

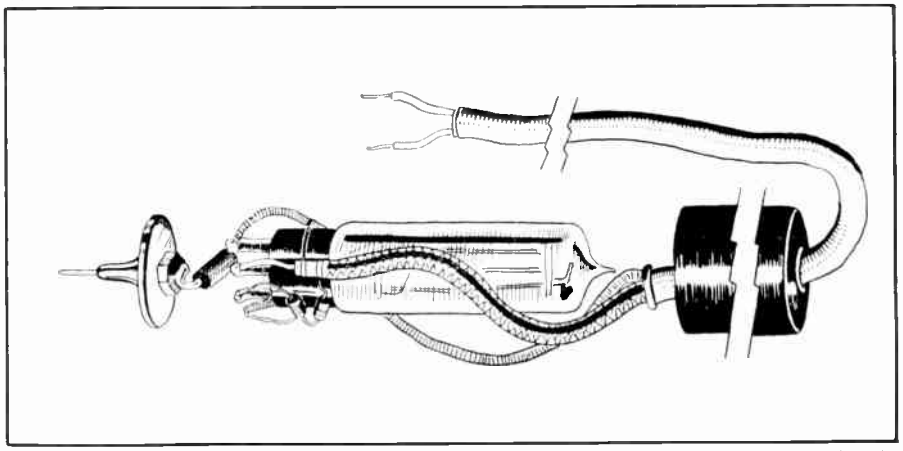


Fig. 5 Above are details of easily made probe using a 955; all leads are soldered directly to pins. Socket has been omitted to increase response at high frequencies

low as 500 kc to over 100 Mc. In addition, the probe must not distort the signal, introduce any hum, or permit itself to be too easily overloaded. It must withstand a moderate amount of physical abuse and yet not be too bulky. It must not load the circuit being measured, but still must be sensitive to signal levels as small as one microvolt. This is quite a large order, and for this reason various probe units have been made available. The majority of probe units come under one of three basic categories: 1) crystal detector, (2) diode detector and (3) triode detector.

Crystal, Diode, Triode Detectors

In Fig. 2 we have a very common type of crystal probe. Note that a 1N34 germanium crystal is used. The use of a crystal probe has several advantages. It is light in weight, economical, it responds to high frequencies (200 Mc and possibly higher), it requires no filament or plate voltage. However, there is no gain in the crystal. It does not have the inherent sensitivity of a vacuum tube. The resistor used in the crystal probe reduces the amount of input loading.

Prior to the introduction of the 1N34 germanium crystal for use as a detector, the diode enjoyed considerable popularity. The diode has the advantage of being able to handle large signals with very small distortion. However, like the crystal, it is not very sensitive. There is no gain in a diode, and as a matter of fact, there may even be a small loss of signal. The diode presents a serious disadvantage in that the tube draws current when the signal on the plate is positive. This flow of current is equivalent to imposing a load on the circuit being tested and may have a slight detuning effect.

Fig. 3 shows how the probe cable has become more complicated than the same cable used for the crystal probe. In addition to carrying the rectified signal from the probe to the signal tracer proper, the probe cable must now carry filament voltage for the diode. This does not present a serious problem, but it does introduce the possibility of hum pickup from the filament leads. This can be minimized by using twisted filament leads, and grounding the center tap of the filament winding supplying the voltage for the diode filament, or by using a battery to supply filament voltage.

Because of the lack of gain in the diode, a diode-triode may be used as the probe tube. This does *not* increase the input sensitivity of the probe to small signals. The triode portion of the tube simply acts as an audio amplifier and helps deliver a larger audio signal to the signal tracer, as shown in Fig. 4. For use at high frequencies, it is advisable to use miniature tubes, such as the 6AL5 or the 955 (acorn tube) in preference to the more bulky 6H6 or 6SQ7.

The details of an easily made probe using a 955 are shown in Fig. 5. In order to increase the response at high frequencies, the base or socket for the 955 has been omitted. All leads are soldered directly to the

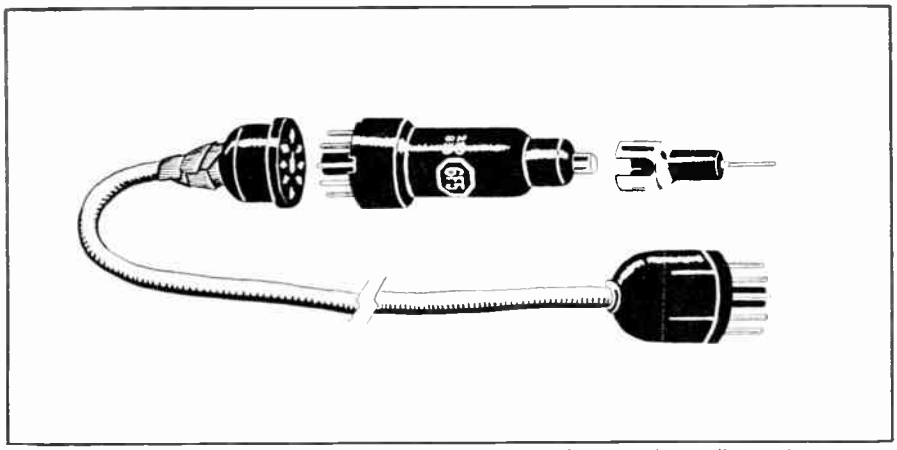


Fig. 6 Details of typical probe unit for measurement of extremely small signals, as encountered across antenna coil of a receiver. These probes are of the grid detection type

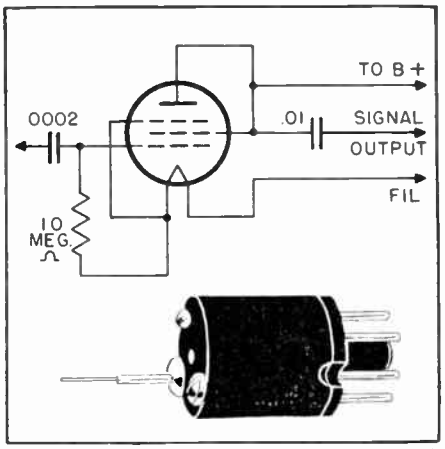


Fig. 7 Shown here is 1T4 miniature pentode connected as triode grid leak detector

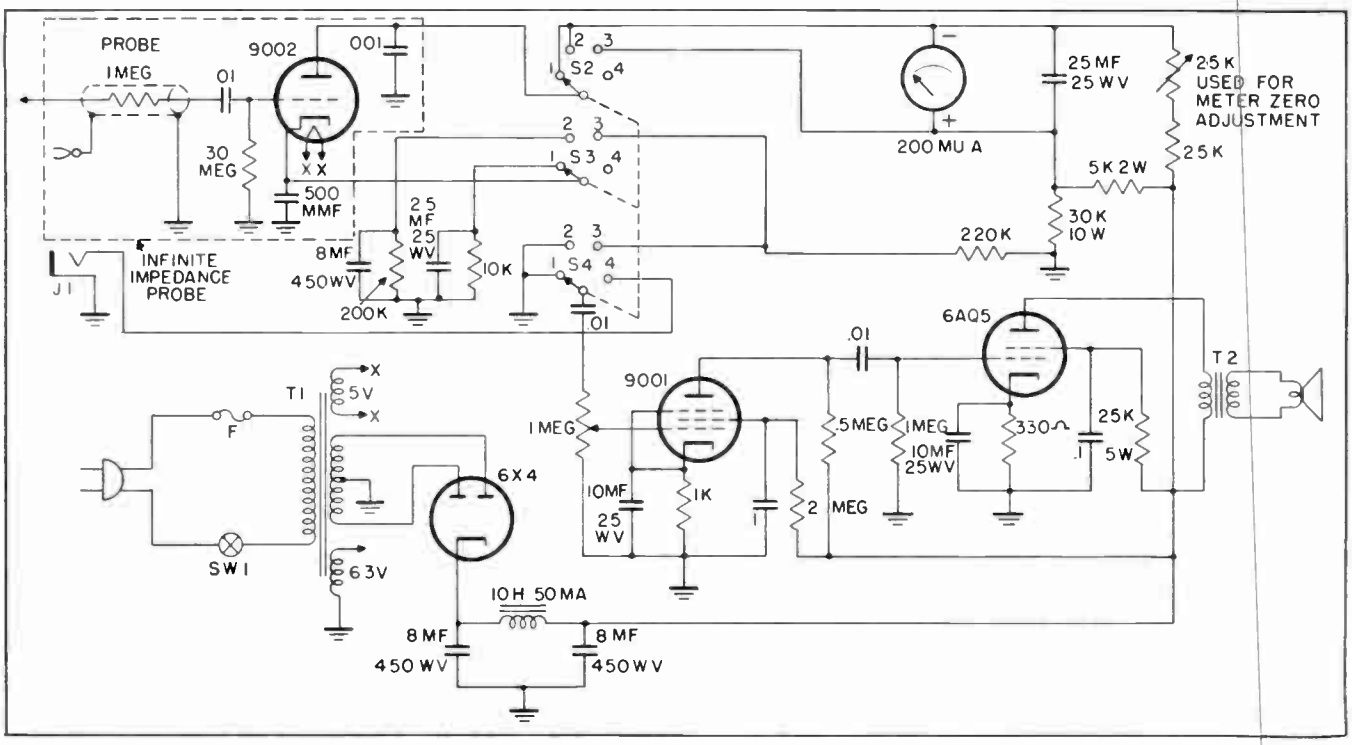


Fig. 8 The above schematic shows how a sensitive 0 — 200 microampere meter is used

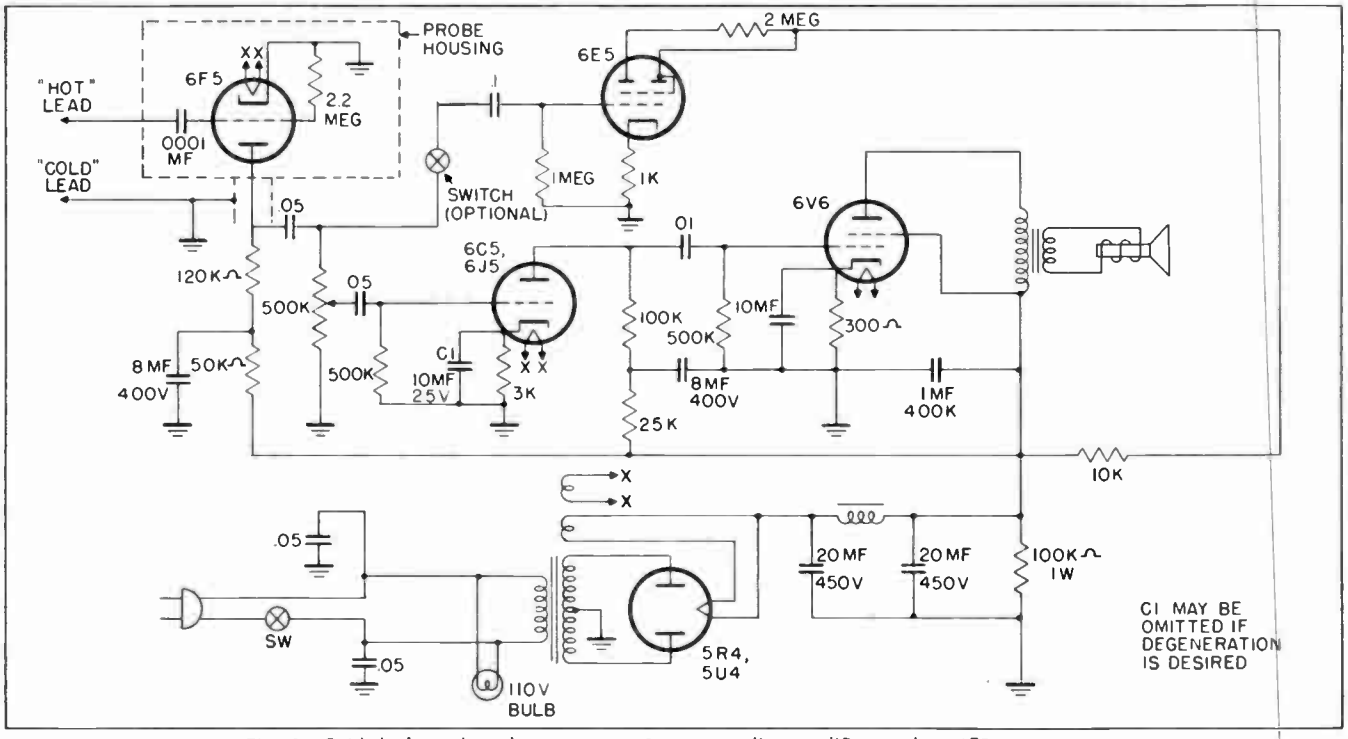


Fig. 9 Grid leak probe above uses a 2-stage audio amplifier and a 6E5 as v.t.v.m.

pins of the 955. Extreme care must be used in making the soldered connections since the connecting pins of the acorn tube are imbedded in glass. To prevent cracking of the glass, the entire tube with the exception of the pin being soldered is covered with moist cotton.

Grid Detection

Where extremely small signals are to be measured, such as the voltage appearing across the antenna coil of a receiver, probe units employing grid type detection are used. The most sensitive detector is, of course, the grid leak or grid rectification detector. Typical probe units are shown in Fig. 6 and 7. For those who wish to experiment in making their own probes, sufficient details may be obtained from these illustrations.

The greatest and possibly the only advantage of the grid leak detector is its high sensitivity. A triode grid leak detector behaves as though it were a diode triode with the grid acting simultaneously as a diode plate and a triode control grid. Because of its sensitivity, the grid lead probe overloads quite easily and unless the input signal level is low, distortion, may take place. It carries the same disadvantage as the diode probe in

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ANNOUNCING . . .

"Three-Sixty" Hypex PROJECTORS

MODEL VR-11 "THREE-SIXTY" HYPEX
(above) *15 WATTS; 280 CPS CUT-OFF.*
MODEL VR-241 "THREE-SIXTY" HYPEX
(at right) *25 WATTS; 140 CPS CUT-OFF.*

TWO *new* Hypex* Projectors—designed for 360-degree sound dispersal—are now available. With sound distributed horizontally in all directions, these new models are intended for installations where coverage of relatively large areas and suspension from the ceiling are desired. Like all Hypex Projectors, these radial units incorporate the famous Hypex formula† which results in improved acoustic performance.

By the addition of the two radials to the four previously announced Hypex units illustrated below, the Hypex line now includes a model for every "sound" need, indoors or outdoors.

Jensen Hypex

JENSEN MANUFACTURING COMPANY
Division of the Muter Company
6617 SOUTH LARAMIE AVENUE, CHICAGO 38, ILLINOIS

**Trade Mark Registered* *†Patent 2,338,262*

Write for Data Sheet 143

In Canada: COPPER WIRE PRODUCTS, LTD., 351 CARLAW AVENUE, TORONTO

MODEL VH-24 HYPEX
25 WATTS; 110 CPS CUT-OFF

MODEL VH-20 HYPEX
25 WATTS; 140 CPS CUT-OFF

MODEL VH-15 HYPEX
15 WATTS, 180 CPS CUT-OFF

MODEL VH-91 HYPEX
15 WATTS; 300 CPS CUT-OFF

COPY AND PIX FOR YOUR AD

"COPY AND PIX" ARE AD MEN'S TERMS FOR THE READING MATTER AND ILLUSTRATIONS IN ADVERTISING. THIS ARTICLE GIVES YOU SOME POINTERS ON PREPARING BOTH FOR RADIO SERVICE ADVERTISING

by Victor M. Turner
Advertising Manager, Radio Maintenance

IN this, the fourth instalment of our series on advertising for the radio service technician, the matter of copy writing and illustration will be discussed.

Last month we covered the preliminary planning of your ads and the basic formula for writing copy. Now we shall go into the details of writing copy—probably the most important step in the preparation of any ad. It is true that the "attention getting" element in your ad is a vital factor, for if it doesn't stop the reader's eye he won't read your message; but the *copy must convince him to buy your services.*

Selling a service is one of the most difficult things to do in advertising. The manufacturer of a product has a much easier job of it, as he can appeal to "pride of ownership." He can display a beautiful, lifelike picture of his product and the biggest part, if not all, of his advertising problem is solved. The reader will want to own this attractive product by merely seeing an effective picture of it.

But *you* must explain everything about your service through the medium of copy. What you say must convince the reader that no one can fix radios as good as you can.

The Headline

We'll start with the headline. The headline must draw the eye of the potential customer to your ad. It has to be compelling enough to make him read more of your copy. Here are some tried and tested techniques for good headlines which will always be effective:

State your basic subject simply and directly. In your case you can use the phrase "Radio Service." This phrase will convey clearly what it would take many words to say in any other way.

Keep your headlines short. If you want it to say, "Are you getting top quality reception on your radio", you can get the short-headline effect by setting parts of it in smaller type, like this:

ARE YOU GETTING
TOP QUALITY RECEPTION
ON YOUR RADIO

In doing this, be careful to put the important words in the large type, and don't make the subordinate words too small. If they are so small that they do not come to the reader's attention, the accentuated words may become meaningless.

Use the "save-money" appeal in your headline. Everyone is drawn by an opportunity to make or save some money, and you can utilize this fact in a headline such as: "Save Money on Radio Repair."

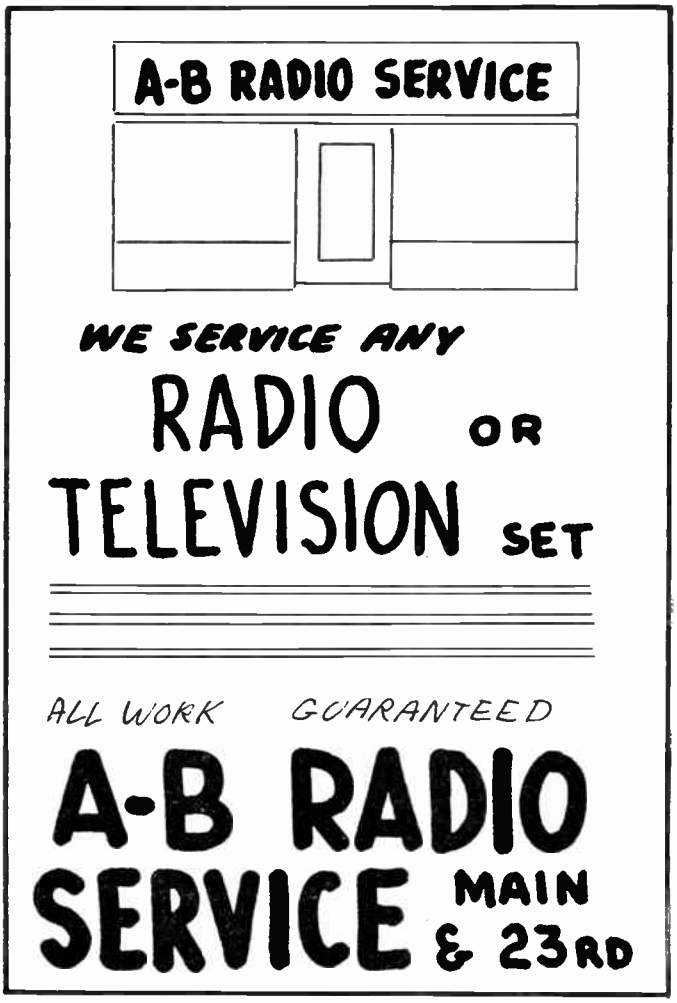
Make a "free offer" in your headline. If you have some item that you can give away free, such as a program list of special interest (farm programs for farms groups, etc.) it can be effectively used in a headline.

The "How to" kind of headline has also proven its value. For example, "How to Get More Out of Your Radio" or "How to Get Reliable, Economical Radio Repair", are headlines which usually attract the eye. The use of the words "how to" in a headline or in titles for books or articles has always been effective.

By use of the above techniques, and applying variations in wording or subject matter, you can achieve successful headlines. Remember that a straightforward, simple approach is best. Don't be misled by trick headlines or glamorous airs used in much of today's advertising. Look through magazines and newspapers for other small-space ads that sell services or other things impossible to illustrate or describe quickly. Note how many of them use the headline styles just described.

These are rough layouts for newspaper or local periodical advertisements....

Suggestions for one-inch high newspaper ads. Keep these small ads Bold!



Two possibilities for R.R. or Bus station posters. Make your address large.

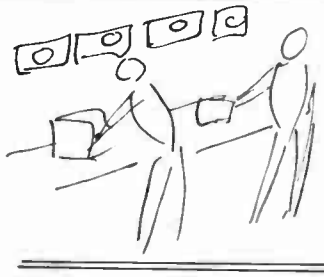
JEB ROANE'S
RADIO SERVICE

Jeb Roane

In a typewritten letter used as a mailing piece, vary your paragraph margins.

FREE COMPLETE EXAMINATION OF YOUR RADIO

THIS WEEK ONLY
PAT'S RADIO SHOP



HAVE YOUR RADIO
COMPLETELY OVERHAULED IN OUR MODERN SHOP

STANDARD RADIO REPAIR

Postcards can be interesting and very effective if varied in each mailing

RAPID **RADIO** SERVICE
& TELEVISION

AUTO RADIOS OUR SPECIALTY.....

BROWN'S RADIO

HIGHWAY 62 & SPRINGFIELD

Rough idea of a billboard. Keep the message simple and very bold.

Watch the Continuity

In writing the copy that follows your headline, be careful to follow through on the impression you first gave the reader. If your headline said "Save money on your radio repair", start giving details as to how he can save money in the first few words of your copy. If you don't, the reader will lose interest and give up looking at your message. Here is a *bad* example of a first paragraph of copy:

SAVE MONEY
ON RADIO REPAIR

The Browning Radio Shop is handy to your home—located in the heart of Townville's shopping district . . . (etc., etc.)

This ad breaks the trend of thought. Even if the save money offer is covered in the next sentence the complete effect of the ad is lost. Hold any other good points about your shop and your service until you have completed the thought that you expressed in your headline.

By all means, say all you can about your service and how it can satisfy the reader more than some other service. There is always a tendency on the part of inexperienced advertisers to say too little. Their idea is to keep the ad "short and sweet" and they are afraid too much copy will repel the reader.

This is very wrong. People will read tremendously long ads *once their interest has been aroused.* If you have a good headline and you present your copy in a clear, easy to read style (both in writing technique and in type face in which it is printed), the reader will go through it.

Tell about the noises and lack of quality in home receivers that are often ignored and left unchecked. You can explain in not-too-technical language what might be the cause of some of these noises and how quickly and at low cost you can remedy them. You'd be surprised how many persons will hear background noise, static, "boom", etc, after these are pointed out to them, but of which they had been unaware before. Stress the fact that you can recondition old radios that may have been given up as hopeless by their owners. Appeal to music lovers by promising to add to their enjoyment of symphonic programs through an improvement in the quality of their radio reception. All this is known as building the "picture" in the mind of the reader and forming the "promise" that you can create this picture in reality for him.

Put into your ad all you can about your shop and how it is well-equipped with all the latest tools and service. Say how it is conveniently located, how quickly you can pick up a radio from someone's home and how it will be carefully handled in transit. Tell about your radio and electronics background and how you have so much experience in this work. Tell also about your assistants and how expert they are. All this is proof of your claim to be a good radio serviceman. And proof is vital in any ad to fully sell the reader on your service.

Then, as a windup, do all you can to make the reader act immediately. Make some special offer, as we suggested before, to make your ad "pull" immediately.

As to your writing technique—just keep in mind that simple, unaffected language is best. Keep your sentences short and avoid long "two-dollar" words technical terms, or slang. There is nothing wrong in humorous copy—but what may seem witty to you may be totally lost or appear stupid to others. It is best to refrain from wit in your ads because, if poorly done, it can do more harm than good.

Subjects for Pix

As to ilustrations in your advertising, you, as a radio service technician, have probably more subjects than you think.

First, we want to remind you of our statement in the first part of this article, that you must sell your service through copy. Any illustration can only be used to aid your copy. The radio manufacturer can throw most of his advertising weight into a handsome picture of his product and spare his copy. But there is no illustration for you that will work that well.

A picture of a man working on a radio can be used in conjunction with copy, but it does not itself arouse in the reader a desire to have his radio repaired as a beautiful picture of a radio (or an automobile, or a bowl of fruit salad) can arouse the desire for ownership.

There's nothing particularly self-satisfying about having a man working on your radio.

A good photograph or a good drawing can, however, be of definite service in your ad. Some subjects for illustrations are these:

1. Man working on a radio in a home, his tools neatly placed on a cloth to protect the floor or carpet, to indicate careful practice.
2. Man installing a television or f-m antenna on a rooftop.
3. Man (or men) removing equipment from service truck in preparation for instalation or repair job. Do not show a picture of your truck alone. This may be O.K. for moving companies, but it doesn't do anything for you.
4. The exterior of your shop.
5. The interior of your shop.
6. Man (or men) working at your service bench, showing impressive test equipment.
7. Last, but far from least, a full-face photograph of a man or woman looking at the reader, as though he or she were speaking the message the ad contains. A full-face photograph is one of the best ways of stopping the reader's eye. If it is your own photograph, so much the better. If your organization is a large one with several men working in it, a picture of a different member or employe of the firm can be used in each ad. It is a good idea to put the man's name under the picture in this case, and name his position. The copy can be written in such a way as to indicate the story is being told personally by the man in the picture.

A photograph of just any man or woman can be used too, as though he or she were a customer of yours, and is endorsing your product. Be careful to get full permission from whoever is in the picture before using it.

A very effective ad campaign can be built around the members of your shop. If you have a partner or one or more assistants, make up one or more ads using a full-face photo of each man. Write the copy as though he were telling about your shop from his viewpoint and giving his own qualifications for the position he holds.

Next month, more on "Advertising for the Radio Service Technician."

Radiomarine Corp. Model ET-8012-D 75-watt radiotelephone

marine radio servicing procedures

by C. C. Erhardt

In this second and concluding article in our series on marine radio servicing we go into details of servicing equipment and servicing techniques

IN OUR first article on Marine Radio Servicing (RADIO MAINTENANCE, *March 1949*) we discussed the establishment of business contacts and other work preliminary to the marine radiotelephone installation. Here we will deal more specifically with the latter.

Before the serviceman may leave his shop to start an installation, he must be sure to have with him all the necessary tools and accessories—down to the last nut and bolt. In many cases, a boat is anchored in a remote spot or moored out in a bay or lake. Just remember that you can't run around the corner to the hardware store when your boat is anchored a couple of miles offshore.

The usual tools (including volt-ohm-milliammeter) found in a serviceman's tool kit will be needed, plus the following: A 0-2 or 0-3 r-f ammeter, a hand brace with a set of wood bits and assorted steel drills. If the installation is made where electric power is available (such as a boat yard), then an electric drill would be more convenient to use than a hand brace. If solder lugs are to be used on the battery cable and antenna wires, then an alcohol or gasoline torch will also be needed. Needless to say, a large assortment of nuts and bolts, wood screws, washers, and other hardware should also be brought along.

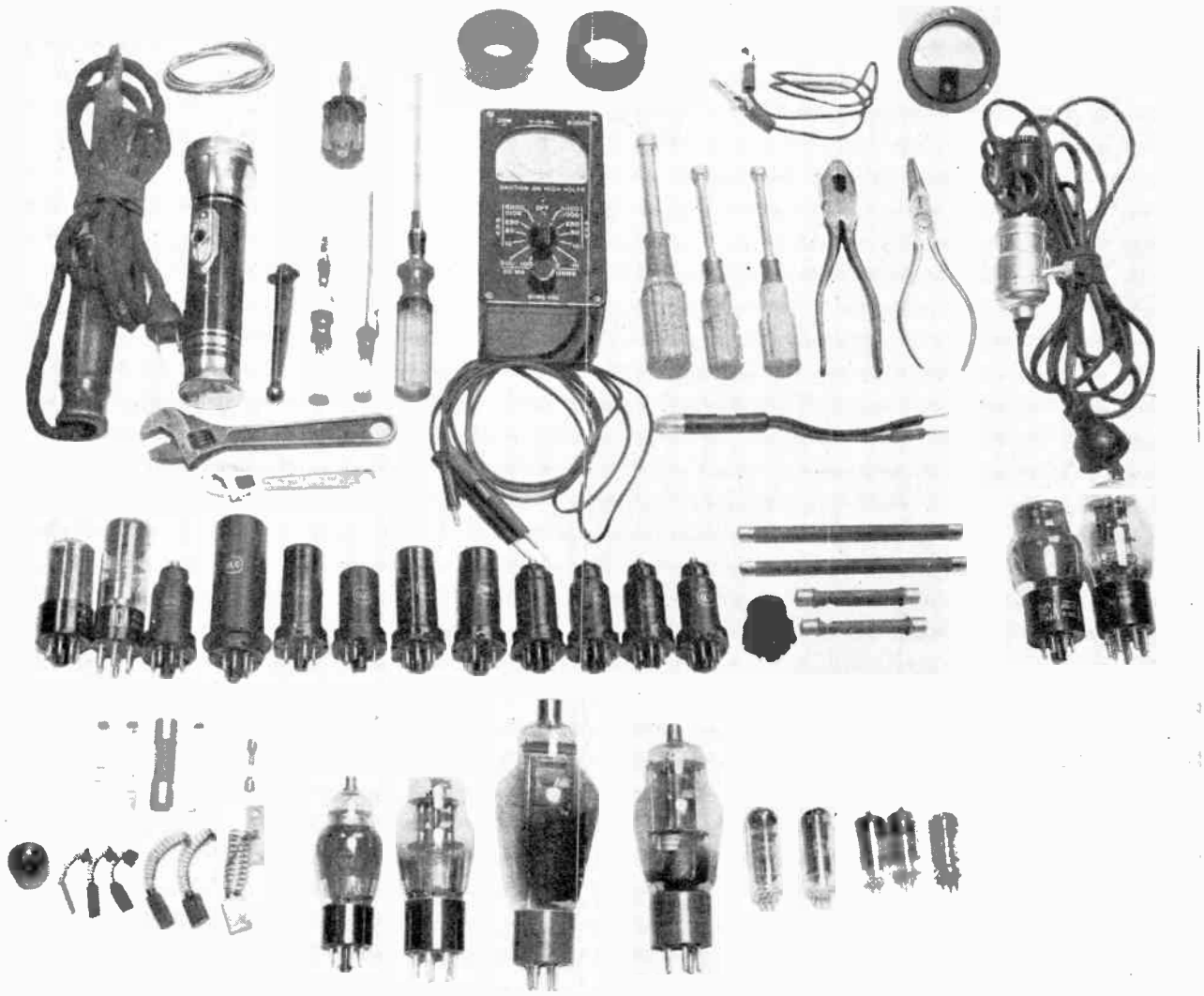
It is at this point that the serviceman will realize the advantage of having made his preliminary inspection. By consulting his notes he can cut off the approximate length of battery cable needed. The type of wire depends on the operating voltage and the desired length. On 6 and 12 volt installations, on runs up to ten feet, number 8 (B & S) insulated wire may be used. For runs up to 15 feet, number 6 wire, and for runs over 15 feet, number 4 wire is employed. On 32 and 110 volt installations, regular marine cable can be used. This is usually lead and armored covered, two conductor number 14 cable. Inasmuch as most pleasure craft carry either 6 or 12 volts, the data contained here will apply to that type of installation.

Antenna Choice and Construction

In many cases, for reasons of convenience or necessity, it is highly desirable to operate the radiotelephone from a remote position on the boat. Remote control units may be custom built by the serviceman, or in some cases, purchased directly from the manufacturer.

In choosing an antenna of the vertical mast type, due consideration must be given to the maximum weight the deck structure can safely carry. Don't mount a 35-foot, 25-lb. antenna on a ¼-inch plywood catwalk if you expect it to stay there long. On the lighter boats, a three section antenna, extending to about 17 feet and weighing about 8 pounds will usually fill the bill very nicely. If an even lighter antenna is desired, some excellent whip antennas may be purchased on the surplus market for three or four dollars. These may be used as they are with guy wires, or they may be modified for use with a standard base. The author has made use of several of these antennas by cutting them down to about 15 feet and then threading the lower member into a Premax number 2P-24 base. The antenna is then self-supporting and requires no additional supporting arm.

If you are working on a large boat of sturdy construction, then by all means use one of the longer antennas of five or six sections. Generally speaking, the higher the antenna the better the radiation pattern of the



A complete marine radio service kit includes the following: Electric soldering iron, coil hookup wire, screwdrivers, rubber splicing compound, friction tape, a voltohmmeter, socket wrenches, pliers, test leads, r-f ammeter, extension light, neon tester, high voltage fuses, cartridge fuses, fuse links, glass fuses, handset push button, carbon motor brushes, and the following tubes: 6V6/GT, 6U5, 6A8, 6L6, 6V6, 6J5, 6F6, 5W4, 6K8, 6K7, 6R7, 6L7, 6H6, 6F6/G, 6A6/G, 6A8/G, 809, 807, 6X4, 6AQ5, 6BA6, 6BE6, and 6AQ6

transmitter. Most radiotelephones are designed to operate at maximum efficiency with an antenna length of about 35 feet.

Steel antennas are usually the least expensive and will give very good service if used on fresh water. However, on salt water they are subject to corrosion. Monel is the only material that is almost absolutely corrosion-proof, and its price several times that of steel. The antenna situation should be discussed thoroughly with the boat owner before the final selection is made.

Lead in wire for the antenna should preferably be number 14 or heavier, flexible rubber covered. The small piece used to connect the base with the feedthrough insulator may be cut to size and equipped with solder lugs at the shop.

Feedthrough insulators, sometimes called deck insulators, also come in a variety of sizes. The smaller ones may be used on deck thicknesses up to ⅜-inch. The larger sizes may be employed on decks several inches thick.

As mentioned in our previous article, the best wire to use for connection to a ground plate is flat copper braid about ¾ inches wide. One end may be soldered into a lug for connection to the ground bolt.

Installation

With preliminary matters disposed of, the installation should proceed without a hitch. The best place to begin is at the battery box. A fuse should be placed in series with the ungrounded side of the battery cable. The fuse which is built into the set does not offer any protection if a short should occur on the battery side of the switch. All necessary holes for the cable should be drilled and an adequate number of clamps used to keep the cable securely in place.

The radiotelephone may now be placed in its permanent position with the cabinet securely fastened to a table, shelf, or bulkhead. If a ringer or remote control unit is also included, these may be mounted at the same time.

If the boat is provided with a ground plate, be sure to observe the following precautions before making any connections to it. Check the storage battery to see which side is grounded. Usually the positive side connects to the frame of the engine which in turn provides an electrical path to the water through the propeller shaft. Now if the set has its nega-

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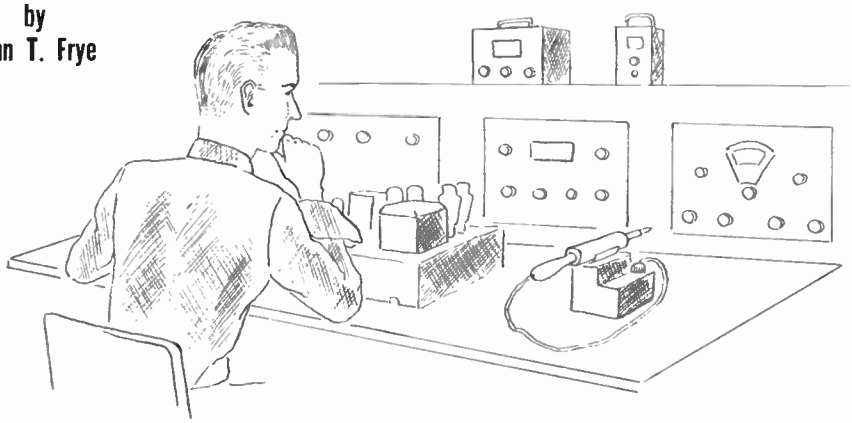
Over the BENCH

by
John T. Frye



I SHOULD like to talk this month about the part that service manuals play in the business of servicing radios. This is a subject about which you can easily find varied and strong opinions; but, in general, service manuals are like wives; those that have them claim they would not be without them, those without rather pooh-pooh their necessity.

I may as well admit right here that I personally consider service manuals as a near-necessity if a person is going to make his living repairing radios. If, of course, radio repairing is just "sort of a hobby" with him and he works on only two or three sets a week, he could hardly afford to purchase a set of manuals. But if he has any repairing business worth mentioning and if he is working to increase that business, he should list a good and complete set of service volumes right alongside his vacuum tube voltmeter and his 'scope when he is listing necessary capital investments.

This is no swivel-chair theory. I have tried servicing radios both with manuals and without them. Back in the thirties when, in comparative value, a modern dollar was about the size of a manhole cover, I had no manuals. What is more, I had no money to buy manuals. Several factors helped in working without the books. For one thing, the radios of that era were fewer in number and more standardized in design than are those of today. Moreover, the circuits were simpler. What was even more "helpful," the sets dribbled into the shop so slowly that the amount of time spent on an individual radio was not necessarily a factor in determining your income. If you only had one set to work on, it did not make much difference if you fixed it in ten minutes or a whole day; you had plenty of time to trace and to puzzle out the circuits.

One thing that impressed me in my visits to various service organizations around the country is that almost invariably the established old-timer will have a complete set of service manuals from one source or another, but quite often the new man will not have a manual in the shop. It is not always a lack of capital that accounts for this, either. For many times the beginner will have as much or more tied up in service instruments as does the old-timer.

When I have casually remarked about the absence of the manuals, I have often been told, "I don't need anything like that. When I was in radar school they pounded radio theory into us until it stuck out our ears. After you have fooled around with radar sets for a while, an ordinary receiver circuit is as simple as ABC."

I think these boys are missing the point. Radio manuals are not intended to make up for a lack of theoretical knowledge. They are simply intended to permit you to find particular information about a particular receiver with a minimum of trouble. Their purpose is exactly the same as that of the index of a book. You can find a particular object in a catalog by a persistent search, but it is much simpler and more time-saving to use the index.

In addition to time saved—which means money earned in the radio service business—service manuals are a help in several other ways. For one thing, they prevent the serviceman from inadvertently upsetting the original design of the receiver. When you do not know the value of a particular component that has to be replaced, you have to draw upon your experience and put in a value that approximates the original. In some places, where the tolerance is wide, this will make little difference; but in other ticklish spots, a deviation of as little as 10% will cause serious changes in the receiver's performance. Then, the next time this component has to be replaced, the service technician who does not know what the original value was may deviate another five or ten percent, and the receiver's performance will suffer still more. If, on the other hand, you have service data on the set, you can adhere strictly to the original design; or, if you prefer, you can make advised, rather than accidental changes.

Another thing that manuals do for you is to instill gradually into you a knowledge of what constitutes "standard practice." As you keep referring to the schematics day after day, you gradually absorb an idea of what to expect in a circuit. A corollary to this is that you are alerted to any deviation from this standard practice, and so you are quick to perceive any innovations in receiver design. These two qualities combine to give you the ability to make a quick and intelligent appraisal of any circuit you encounter. You can quickly push aside the "normal" features and concentrate your attention on what is novel or incorrect.

Still another contribution that manuals make to your business is the psychological impression that your possession of them makes upon your customers. Just seeing them stacked along your shelves or neatly stored away in filing cabinets is bound to have the same effect upon him that the sight of your lawyer's legal

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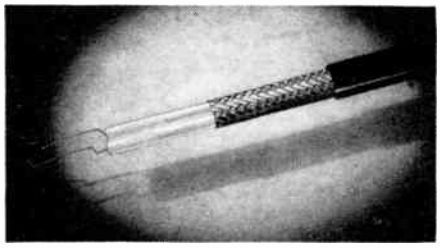
the INDUSTRY Presents



NEW 300-OHM SHIELDED LEAD IN

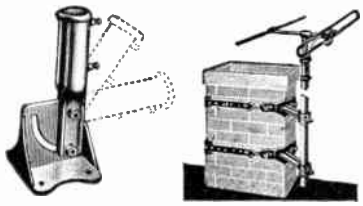
You probably know that up to this date the problem of noise introduced in the unshielded 300-ohm lead in from auto ignition, fluorescent lights, and reradiation from nearby buildings, and the like, has been rather troublesome to television technicians, sometimes causing a loss of sales in areas where noise was excessive. Federal now claims that its new K-111 shielded line shields out all interfering signals normally induced in the transmission line. The company also states that, because of its constant characteristic impedance independent of proximity to metallic objects, the line furnishes a perfect match between antenna and receiver.

Manufacturer: Federal Telephone and Radio Corp., 100 Kingsland Road, Clifton, N. J.

INPUT TRANSFORMER

If you are ever faced with the problem of matching low-impedance microphones and pickups to high impedance circuits, such as audio amplifiers, you may be interested in knowing about a new UTC Input Transformer which matches any source from 50 to 500 ohms impedance to grid. The transformer is provided with a standard jack receptacle of low-impedance plug-in, and the output connections are brought to a standard plug for the high impedance input side of the amplifier. The fidelity of the unit is said to be very high (50 - 10,000 cycles), and the company also claims that stray flux pickup will be very low. Ben Miller, Sales Mgr. will be glad to give you additional information.

Manufacturer: United Transformer Corporation, 150 Varick St., New York 13, N. Y.



TV MOUNTING BRACKETS

Here is another product designed to make television antenna installation work easier. The No. 8000 is a universal mast bracket that you can use at any angle. Two bolts is all your need to tighten the mast in position. The No. 8001 Chimney Mount is also universal, can be mounted on gables, corners, flat surfaces. Both mounts will hold masts up to 1⅜" diameter.

Manufacturer: General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.

NARROW AND WIDE BAND SWEEP SIGNAL GENERATOR

Test equipment manufacturers are keeping right up with television developments. The Series E-400 Sweep Signal Generator produced by Precision is one of many examples. It offers wide and narrow band sweep selection for f-m and television alignment and service. It provides continuous frequency coverage from 2 to 240 Mc in five bands, continuous narrow and wide band sweep direct reading from 0 - 1 Mc and 0 - 10 Mc. Included is a direct reading aluminum dial with 6 feet of 2-color etched scales, and a direct reading venier scale reading to one part in 1500. You can get complete information by writing to Gerald Goldberger, Chief Engineer.

Manufacturer: Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.

KILOVOLTMETER

With this Bradshaw Model Kilovoltmeter you can measure television and x-ray voltages up to 50,000 volts d.c. It is a twenty micro-ampere meter with an input impedance of 1250 ohms. This of course makes for accurate measurement of even very sensitive circuits. The instrument is also provided with several safety features: All voltage is dissipated in the shielded Polystyrene Probe, test leads are shielded and the shields are connected together; and a "Normal-Reverse" key makes possible the use of the probe regardless of the polarity of the voltage under test.

Manufacturer: Bradshaw Instrument Co., 348 Livingston St., Brooklyn 17, N. Y.

CARRYING CASE

Designed to hold any of the matched units of RCA test and measuring equipment, this carrying case resembles a piece of smart looking luggage. Extra storage compartment at right provides space for test leads, adaptors, probes and other accessories. The plywood case has water repellent covering and closes with two luggage type latches.

Manufacturer: RCA Victor Division, Camden, N. J.

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☐ I AM ENTITLED TO TRAINING UNDER G. I. BILL.

Over the Bench

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library has upon you. But when you are able to show him that you have diagrams, alignment instructions, and even pictures of his very receiver, you are certain to impress him with your preparation to take care of his set—as well as the thousands of other sets that he can see must be contained in the pounds and pounds of service data you have on hand.

In conclusion, then, we may say that the beginner, who has the least practical experience to fall back on, needs the manuals even more than does the old-timer—who would not think of trying to get along without them. In these post-war days when hundreds of manufacturers are turning out thousands of models of every kind of receiver, from ac-dc midgets to television, the possession of a complete, up-to-date collection of service information in manual or other form is no longer a luxury about which the serviceman can debate as to whether or not he can afford it. It is a necessity! ✓ ✓ ✓

TV is Your Future

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ress of the industry. Such leading manufacturers as RCA, DuMont, Philco, and others, have instituted programs to help the service man make his adjustment to the new situation. And the industry-wide sponsored Town Meetings of Radio Technicians have added their contributions. Many servicemen, judging from attendance figures, have been taking advantage of these programs. Finally, newspapers and magazines in the industry have been featuring both technical and business material to aid in the transition of the serviceman into the video field.

And the end of development is not yet in sight in that field. Color television is almost certain to make its appearance in the not too distant future, and the advent of three-dimensional television is also only a matter of time. Both these events will again have expansive effects.

The opportunities are there. They have but to be grasped by the technician. The future holds rich promise for those who can realize its shape. ✓ ✓ ✓

Fringe Installation

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lation, especially on the higher channels. Any such tendency results in a tremendous increase in noise level. The random noise thus resulting produces a strong snow effect in the picture, giving the viewer the impression that he is moving rapidly through a blizzard and the flakes are driving toward his face. In most cases such instability is a result of a defect in the unit itself, or in the design of the particular booster used. Some boosters will actually burst into violent oscillation when switched or tuned to the higher channels.

The wise serviceman will avoid such pitfalls and investigate all such factors before purchasing a booster unit, while also making sure that some change in the antenna system will not provide the same benefit. ✓ ✓ ✓

Industry Presents

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WIRE RECORDER

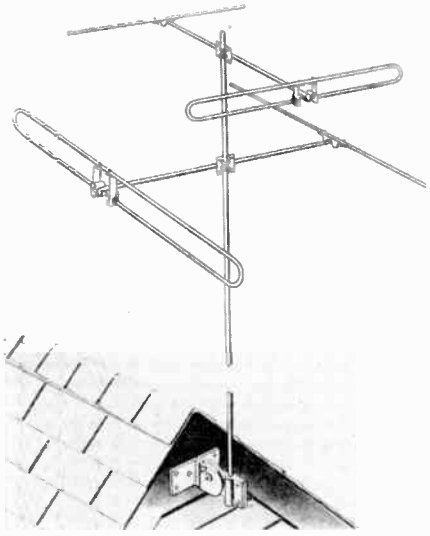
This instrument plays 12" and 10" 78 rpm records, is a public address system all in itself, and serves as a wireless phono oscillator. Still ,it's a wire recorder, recording and playing back on standard .004" magnetic wire. Its wire take-up spool serves as a rim-driven turntable, and the wireless phono oscillator permits tuning its output on a radio up to 150 feet away. It's called the Knight Wire Recorder.

Manufacturer: Allied Radio Corp., 833 W. Jackson Blvd., Chicago, Ill.

INDOOR ANTENNA

The "Intenna" is a folded dipole television antenna mounted on a walnut finish wood standard and base for use indoors. This antenna is portable and adjustable for various television channels by means of two trombone slides.

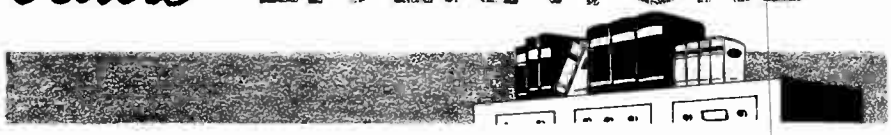
Manufacturer: Special Products Co., Silver Spring, Md.



ANTENNA KITS

The feature of these kits is the high degree of flexibility which allows adaption to all local television requirements. Universality of construction allows for additive combination as the situation requires. The parts are taken to the point of installation and assembled there. All parts packed in the Flexi-Kits may be ordered as individual replacements. Manufacturer: Brach Mfg. Corp., 200 Central Ave., Newark, N. J.

trade LITERATURE



Installation and Servicing of Low Power Public Address Systems, *by* JOHN F. RIDER. *(John F. Rider, Publisher, Inc., 208 pages $1.89)*

A well balanced combination of fundamental theory and practical application characterizes this book on p-a systems. The first two chapters cover the basic subjects of sound and microphones, with both of which the practicing technician will have already some familiarity. Then, building up on this groundwork, the author proceeds to go into the specific subject of public address systems. In this section we find a practical and thorough discussion of such topics as impedance matching, amplifiers, and loudspeakers. Finally, the last two chapters of the book deal with the problems of installation and servicing.

The author, well known to the radio industry for many authoritative books, has written a good introduction to the field of public address systems. The text is clear and easily understood; and illustrations and schematics are provided throughout. To the serviceman who wants to enter the field and has been looking for a good place to start, this book is recommended. Those that are already working in it, will gain from this volume a better understanding of their field.

Most-Often-Needed Television Servicing Information, *by* M. N. BEITMAN. *(Supreme Publications, Chicago, 144 pages, $3.00)*

We have here a compilation of factory data on various television receiver models of 12 manufacturers, slanted very specifically to aid the technician in servicing these various sets. Although differing somewhat from model to model, the data are generally presented in this manner: specifications, tube complement, operation of the receiver, test patterns, alignment procedures, description of circuits, and trouble shooting charts. The models covered are: Admiral 30A1, Belmont 22A21 and 22A22, DuMont RA-103, Farnsworth GV-260, General Electric 803, Hallicrafters T-54 and 505, Motorola VT71 and TS-4D, Philco 48-1000, 48-1001, and 48-1050, RCA 8TS30, Sonora 700, and Stromberg Carlson TV-12.

The information in the book is authentic and will be of definite value to the technician. What we don't like about it is its poor index. For a volume which is obviously a reference book a short table of contents seems inadequate. We would have liked to see a fairly complete index by the use of which the desired information could be easily located.

Otherwise, the arrangement of the book is good, the type and diagrams clear.

Rider Television Manual, *Volume I (John F. Rider Publisher, Inc.)*

This is the first volume in the Rider Television Manual Series. Rider Manuals are too well known to need further discussion here. This particular manual follows the pattern of the earlier ones *(Perpetual Trouble Shooter, volumes I-XVIII)* and will probably become as important to the television technician as the earlier volumes became to the radio serviceman. It is probably the most complete reference book available on television receiver servicing. Part of the Manual is the *Television, How it Works* book, a 203-page introduction into the theory of television, which covers the field fairly extensively. The *How it Works* book serves as a good starting point for the subject and provides a sound basis on which the technician can build a further knowledge and understanding of television.

The second volume in the Television Manual Series is now on the presses.

Photofact Television Course, *based on a series of lectures by* ALBERT C. W. SAUNDERS, *edited by* B. V. K. FRENCH *(Howard W. Sams & Co.) 220 pages, $3.00*

The Photofact Television Course appeared originally in serial form and was available only to Photofact Serv-

ice subscribers. The material has now been collected into one book and is offered to the entire service industry.

The book assumes that, to the service technician, the only thing really new in television is the picture tube, and on that basis it takes it as the starting point.

The volume is divided into three sections covering Beam Formation and Control, Beam Deflection Systems, and Beam Modulation and Synchronization.

The *Photofact Television Course* does an excellent and thorough job of presenting the fundamentals of television. The presentation is clear and authoritative, and the book is amply illustrated with diagrams, drawings, and photographs. It covers the entire receiver, and includes a rather good antenna section.

We believe that this volume will constitute an important part in the library on television which the forward looking technician will build for himself.

Most-Often-Needed 1949 Radio Diagrams, *compiled by* M. N. BEITMAN *(Supreme Publications) 160 pages, $2.50*

The selection of various receiver circuits, which constitute this book, is claimed to represent those circuit diagrams which will be most often needed in 1949. Although of use to the beginner who is interested in some typical radio circuits, the book contains but a fraction of the circuits found in receivers produced in 1948.

The type on some of the pages is not always clear. In the section describing the Philco models it is so small that any prolonged study may turn out to be fatiguing; and some print appearing on a schematic on page 128 of the book is entirely undiscernible.

Catalogs and Pamphlets

Miniature Electron Tube Guide. All miniature tubes, regardless of make, announced to date, are listed in this Hytron Reference Guide. Pertinent characteristics, data and basing diagrams are given, and similar larger prototypes are also listed. This is the latest edition of the guide, six pages. Free on request to Hytron jobbers or direct to Hytron Radio & Electronics Corp., 76 Lafayette St., Salem, Mass.

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Degenerative Circuits

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flowing in the cathode resistor reduces the gain of the stage and reduces the distortion in direct proportion. A disadvantage to this method of obtaining degeneration is that it causes the plate impedance of the tube to increase. This tends to accentuate the high frequency response of the speaker. In most practical applications, therefore, the plate is bypassed by a suitable condenser, as shown in Fig. 5 and Fig. 6.

A Practical Application

The enterprising service technician who wants to improve the tone quality of some of the cheaper midget receivers may be interested in the simple improvement suggested by H. J. Hicks of St. Louis. Mr. Hicks is well known for his book *Principles and Practices of Radio Service*. This circuit is particularly helpful in sets using 50L6GT, 50A5, or other high voltage heater type output tubes having considerable inherent harmonic distortion. As shown in Fig. 8, the improvement is accomplished by adding a .02 mf condenser from one side of the voice coil circuit to the grid of the output tube. The other side of the voice coil circuit is connected to the circuit ground. In most cases nowadays, the circuit "common" or "bus" or "ground" is isolated from actual chassis ground by a condenser and resistor in parallel, so be sure to use the "circuit ground" in making this improvement. If the set oscillates after these connections have been made, interchange the two wires added to the voice coil circuit. Do not disturb the original voice coil wiring to the speaker. If the tone is too deep, use a larger condenser. If the tone lacks bass response, use a slightly smaller value of condenser. The receiver will suffer a loss in volume after the change is incorporated, as all feed-back arrangements do. If the volume is reduced too much, put a small value of resistance in series with the feed-back condenser.

The radio serviceman having a basic understanding of degenerative circuits should experience no great difficulty in performing repairs on receivers using them. It is well to bear in mind that the resistance and capacity values used in these circuits have been established by careful design, and the attitude that "anything will do" as a replacement part will not always meet with suitable results. Replacement condensers should be high quality paper or mica insulated with low leakage and a voltage rating at least as high, if not higher, as the unit being replaced. Resistance values should be kept within the limits of plus or minus ten percent for best results. If output transformers are replaced, the phase of the connections to the feed-back circuit must be correct, or the receiver will oscillate.

Trade Literature

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Television Components. A 4-page flyer put out by Standard Transformer Corporation, Chicago 18, Ill., and listing its transformer line, signifies the entry of that firm into the television field. It may be obtained by writing directly to the company.

Television Catalog. If you are interested in the House of Television line of Tele Filters, Multivision Screens, and its Signal Kleer line of television accessories, you may want to write for a free copy of its catalog. This is a 12-page booklet to fit standard binders. Address The House of Television, Starrett-Lehigh Building, New York 1, N. Y.

Electro-Voice Bulletin No. 144. This bulletin gives data and information on the new E-V line of microphones for f-m and a-m broadcast service. The bulletin explains the various performance and construction features and gives detailed specifications. Listed also is the E-V Model 425 Shock Proof Desk Stand. Free copy of this bulletin can be obtained from Electro-Voice Inc., Buchanan, Mich.

Supplement No. 118. To keep its catalog up to date, Allied Radio has issued this 56-page supplement, listing the latest product development in the radio and television industry. Allied Radio is located at 833 W. Jaskson Blvd., Chicago 7, Ill.

Lemons make the best Lemonade. Philco has issued this 36-page booklet as an aid to the most successful establishment of a service department. Although written primarily for the appliance dealer who wants to add such a department to his store, it contains very many valuable suggestions for the service technician, including actual shop layouts, and other business practice information. The book is being made available through Philco wholesale distributors.

Electric Drill Catalog Free upon request to Portable Electric Tools, Inc., 255-259 W. 79th Street, Chicago 20, Ill., is descriptive catalog page on that firm's new ¼-inch electric drill. If you think of buying an electric drill, you may want to take a look at it. ✓ ✓ ✓

Marine Radio

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tive terminal connected to the chassis, and if the ground plate is connected to the chassis, it is obvious that a short circuit will take place through the water with resultant electrolysis effects. It is remarkable how often this error has been made. The remedy is very simple: reverse the two input leads and reverse the vibrator.

Needless to say, antenna installations may be made in dozens of different ways so only the barest generalization may be given here. When mounting the base of a vertical antenna it is very important to have a metal plate (preferably brass) mounted on the underside of the deck. This will prevent the bolts from pulling up through the wood whenever there is any strain on the antenna. The plate may be made of 1/16 or 1/8 inch stock and should be at least six inches square. The supporting arm or guy wires may be mounted next and the deck feed-through insulator mounted as close to the antenna base as practicable. In running the lead in wire from the bottom of the deck insulator to the set, small standoff insulators should be used to keep the wire away from the bulkhead.

Tuning Procedure

In order to permit free access to the trimmer condensers and other controls it is usually a good idea to remove the chassis from the cabinet when making tuning adjustments to the receiver and transmitter. The manufacturere's instruction manual will give detailed information on this subject. However, inasmuch as the tuning is pretty much the same on the various types of sets, we may generalize the procedure somewhat.

It will be found that when the front panel selector switch is set at the desired channel, the proper receiver and transmitter crystals and trimmers will be connected into the circuit. With the power switch turned on and antenna and ground attached, the adjustment trimmer(s) for the desired band (receiving) are rotated with an insulated aligning tool until maximum signal background noise is obtained. This is repeated for each channel.

Transmitter tuning procedures will vary somewhat with the different

manufacturers, but in all cases the condition to strive for is minimum amplifier plate current with antenna disconnected, and maximum r-f antenna current with antenna connected. While the larger sets usually have a plate milliammeter mounted on the front panel, the lower power sets provide a jack into which an external meter may be plugged. On most sets all that is necessary to start up the transmitter is to press the handset button. Some of the more elaborate models incorporate the "Vodas" circuit, which puts the carrier on the air when speaking into the microphone.

With the milliammeter plugged in, antenna removed, and amplifier tank condenser set at half capacity, the tap on the amplifier tank coil is varied until minimum plate current is secured. With an r-f ammeter in series with the antenna, the tap on the antenna coil is varied until maximum current is registered on the meter. Repeat this procedure for each band. Under normal tuning conditions, proper modulation will be shown by a rise in the r-f antenna current when whistling into the microphone.

Actual tests may now be made on the air by calling the marine operator or other boats and asking for a signal strength report. A little listening on the air will soon acquaint the technician with the proper calling procedure.

The ringer may be tested by having the marine operator dial the boat's code number.

Service Hints

The serviceman will frequently be called upon to make radiotelephone repairs once he has gained a toehold in the marine field. This section has been included for his guidance.

1. Receiver completely dead. Check fuses, vibrator, loose terminal posts, low battery voltage. "On-off" switches which are part of the volume control have a bad habit of opening up. Make sure antenna lead is not broken or grounded. Also, don't overlook the possibility that someone may have tampered with the r-f or i-f adjustments.

2. Weak reception and no transmission. These two usually go hand in hand and will invariably be caused by low battery voltage. With the set turned on, check the voltage right

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Probe Units

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that filament voltage must be supplied, circuit loading takes place, and, unless properly designed, is not very useful at high frequencies.

A variation of the triode probe is the infinite impedance detector probe. Such a detector will not load the circuit being measured, but it does have the disadvantage of introducing distortion.

Each particular probe, whether crystal, diode, or triode, has its own particular limitations or uses. If these characteristics are kept in mind, then the fullest advantage can be taken of your particular probe unit. The germanium crystal works well at all the frequencies encountered in the servicing of f-m and television receivers. Manufacturers of vacuum tube probes invariably specify the upper frequency limit of usefulness of their probes. A top figure of about 10 Mc. may be assumed, unless the probe uses a tube which works satisfactorily at high frequencies. Tubes that are designed for low frequency work provide excessive loading on f-m and television circuits and, as a result, the rectified output from such a probe may become exceedingly small; so small indeed that circuits which are working well may appear to be defective.

Variety of Uses

We have said that a signal tracer is basically an audio amplifier with a separate detector unit called the probe. If you have an audio amplifier available, then you have a signal tracer—provided you get yourself a probe. Any receiver, in an emergency, can be used as a signal tracer by simply taking the output from the probe and feeding it into the phone jack of the receiver. This is most easily done with the crystal type probe.

The audio amplifier portion of the signal tracer can have its usefulness increased through some minor changes. The signal tracer can be used as a v.t.v.m. through its incorporation of a Magic Eye tube, such as the 6E5, or through the use of a meter.

Fig. 8 shows how a sensitive 0—200 microampere meter is used. The probe unit itself is a variable sensitivity infinite impedance detector.

The signal tracer may be used as a variable sensitivity v.t.v.m., as a signal tracer, or as a straight audio amplifier. The various functions are controlled by the ganged wafer switch, S2, S3, S4. When the switch is in position 1, as shown on the circuit diagram, the audio amplifier input is grounded, and the instrument is used as a v.t.v.m. for large signal input. When the switch is advanced to the second position, it is still used as a v.t.v.m., but with considerable increase in sensitivity to small signals. The variable sensitivity feature is controlled through variation of bias in the grid-cathode circuit of the 9002 (C5—R3 and C6—R4). When the wafer switch is in position 3, we have the infinite impedance detector probe feeding its rectified signal into the audio amplifier. In this position, R5 and C2 form the bias system for the detector. In the fourth position, the meter and probe are disconnected from the circuit, the audio signal is fed directly into J1, and the tracer acts as an ordinary audio amplifier.

Just a word of caution on the audio amplifier itself. The audio amplifier should be as free of hum, distortion, and microphonics as possible. Taping up miniature tubes with adhesive tape, or cushioning them in sponge rubber helps minimize microphonics. Degenerative feedback will help flatten the frequency response and lower the hum level. Keep the amount of degenerative feedback within small limits, since the signal output level in the speaker is decreased when this type of feedback is used.

Decoupling filters in the plate leads will decrease hum and reduce the possibility of "motorboating." Some service technicians prefer using both the meter or magic eye tube, and listening to the output on the speaker at the same time. This is an advantage since a constant check is thus maintained both on the signal level and its quality. If the meter only is desired, the speaker in the signal tracer may be switched out of the circuit; but when doing so, a load, representing the impedance of the voice coil must then be switched in across the secondary of the output transformer feeding the speaker.

A grid leak probe using a 6E5 as the probe tube, followed by a two stage audio amplifier, and using a 6E5 as a magic eye v.t.v.m. is shown in Fig. 9.

Marine Radio

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at the input terminals to determine if any drop is taking place in the line. Check the storage battery with a hydrometer to see that it is properly charged. If you are working on a set that has been installed by someone else, see that the battery cables are of sufficient size to carry the load. And above all, if a ground plate is used, make sure that it is connected to the proper side of the line.

3. Receiver OK but transmitter dead. If the transmitter is operated from a separate power supply such as a dynamotor, see that the brushes are fitted properly. Here again, low battery voltage may be responsible. In many cases, the voltage is high enough to operate the receiver but will be inadequate when subjected to the heavier load of a dynamotor. Inspect the relays to see that the contacts are clean and straight. Of all the tubes in the transmitter, the final amplifier will need to be replaced most often.

4. Ignition noise. This is the bugaboo of marine servicing and is the most difficult to cure. Suppressor condensers are worse than useless when used on the ignition system of gasoline driven engines as they interfere with its operation. The only sure method of eliminating ignition noise is by using a commercial ignition shielding package. This package consists of metal shields for all parts of the ignition system. The reason this system has not met with more popularity is its high initial cost. Because of this, most boat owners prefer to use the radio when the engine is not running.

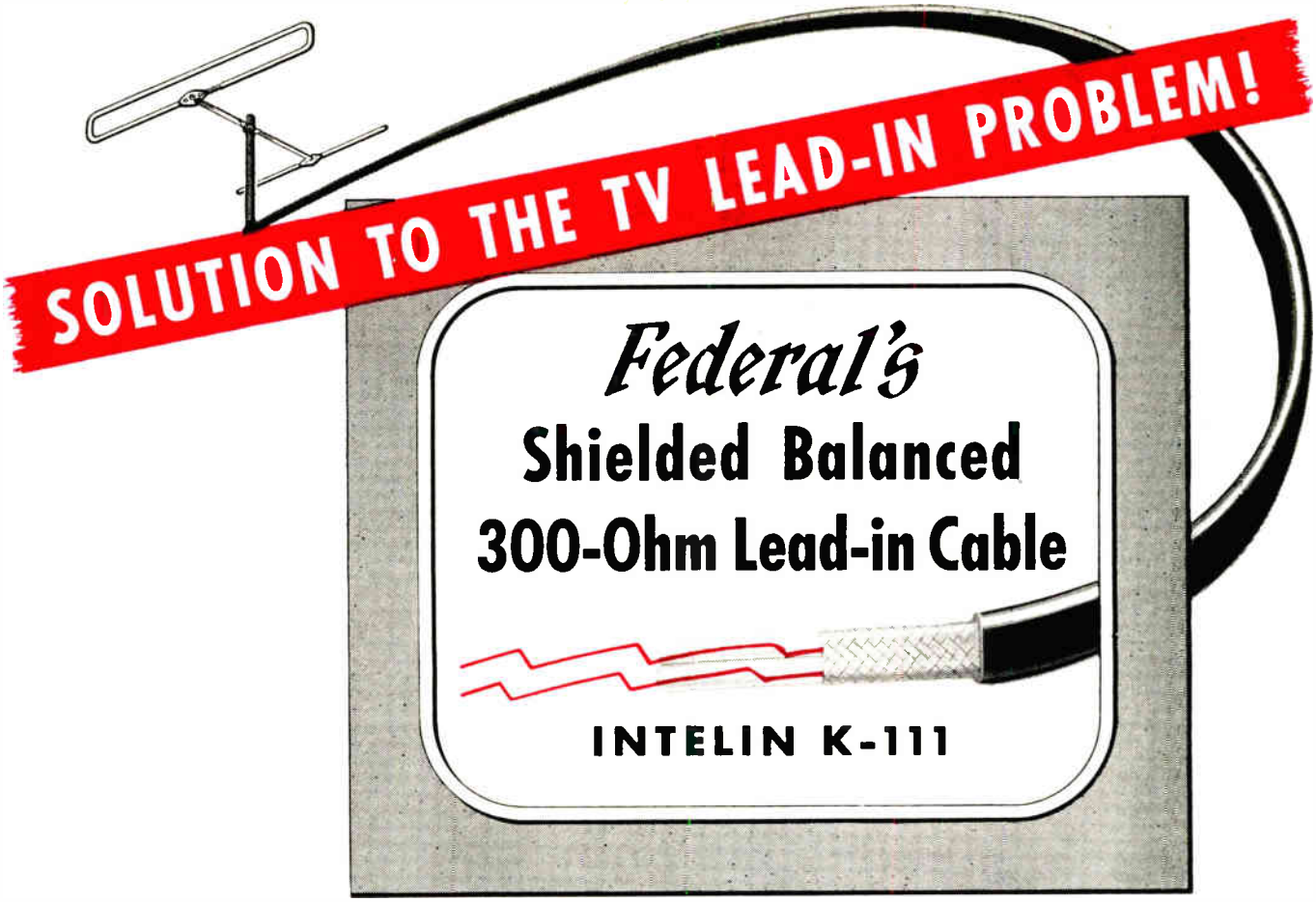
On noise coming from electric fans, electric refrigerators, and so on, suppressor condensers may be used to good advantage.

In conclusion, it may be pointed out that a radiotelephone is subject to all the ills of more conventional radio equipment. Tubes, condensers and resistors will need to be replaced occasionally, and a goodly assortment of these, together with some spare fuses and vibrators should always be carried in the serviceman's tool bag.

Experience is the best teacher. Any serviceman with a good technical background will take to marine radio like a duck to water, once he has mastered its fundamentals. ✓ ✓ ✓

Index of Advertisers

SOLUTION TO THE TV LEAD-IN PROBLEM!



Minimizes Noise, "Snow" and "Ghosts" Due to Transmission Line Pick-Up!

A MAJOR ADVANCE IN TELEVISION TECHNIQUE

Developed by FEDERAL
Offered Only by FEDERAL
Patent Pending
AVAILABLE IMMEDIATELY

Here is the development for which the industry has been waiting.

It is a *shielded*, balanced 300-ohm line—Intelin K-111—developed and produced by Federal—and only by Federal.

Tests have given positive proof that Intelin K-111 goes far toward solving the lead-in problem that has been a major obstacle to television progress. K-111 protects against transmission line pick-up of ignition, streetcars, fluorescent lights, diathermy and practically every other type of noise, "snow" and "ghosts" which interfere with picture clarity. This new lead-in won't pick up re-radiation from nearby lead-ins in urban areas. In rural areas, where signal strength is weak, Intelin K-111 provides greatly improved reception by reducing the noise level.

Now manufacturers can obtain a lead-in that *protects* the quality performance they build into receivers of 300-ohm input impedance. Antenna kit makers can greatly improve their products. And, by changing to Intelin K-111, servicemen can call a halt to many of the customer complaints that take the profit out of service policies.

Intelin K-111 is also recommended for a pick-up-free connection between antenna post and input stage of FM and TV receivers—and for test equipment and other HF applications. For information, write to Department D-166.

KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

Federal Telephone and Radio Corporation

SELENIUM and INTELIN DIVISION, 900 Passaic Ave., East Newark, New Jersey

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
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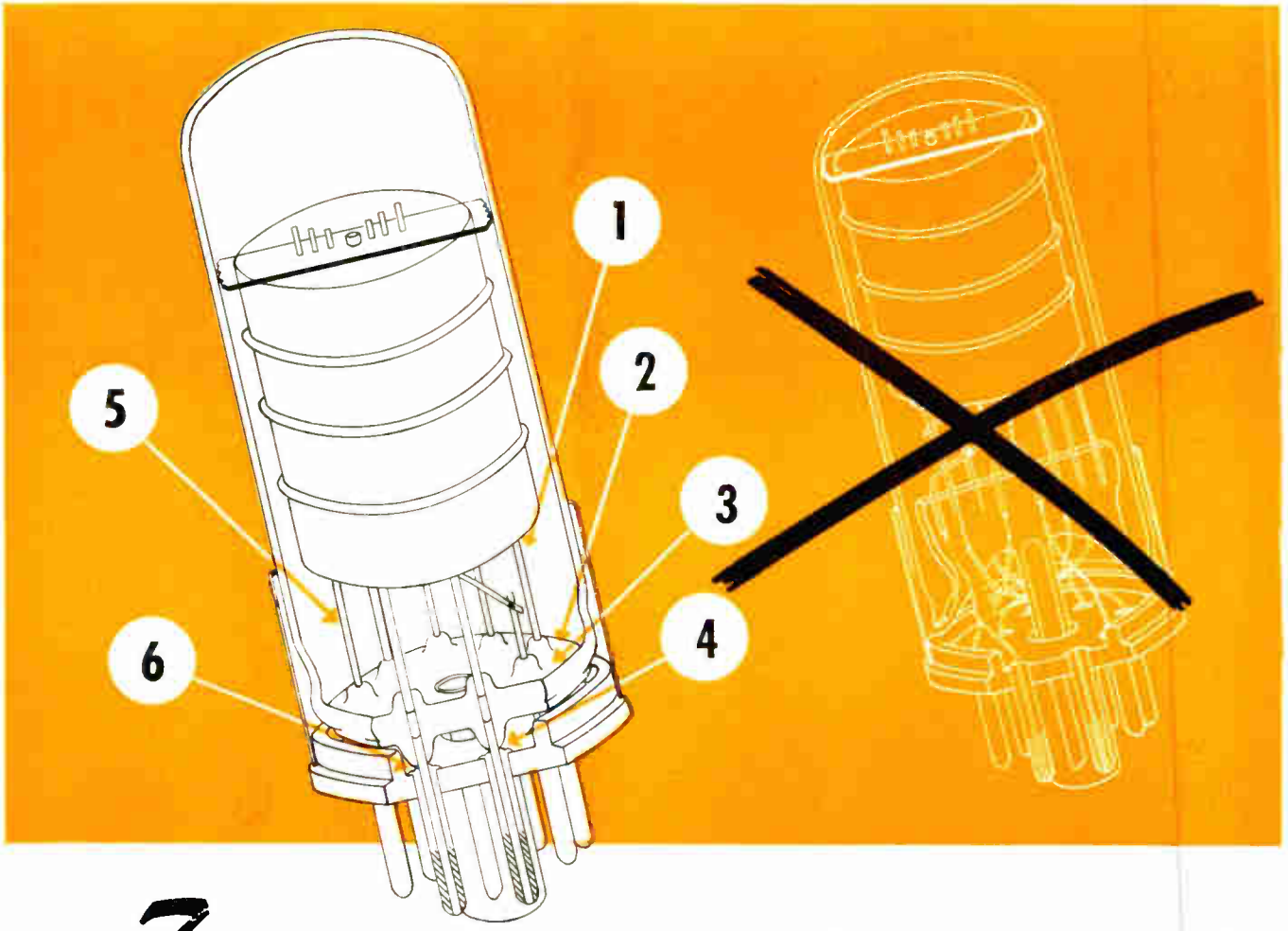

7 WAYS BETTER*...YET THEY COST NO MORE

THAT'S THE NEW RAYTHEON BANTAL TUBE FOR YOU!

1 MORE RUGGED
Eight-pillar construction

2 LOWER LOSS
Glass button stem

3 LESS INTERNAL LEAKAGE
Wider lead spacing

4 NO BASE SHORTS
Direct, non-flexible connections

5 GREATER STABILITY
Low grid-plate capacitance

6 SUPERIOR HIGH FREQUENCY PERFORMANCE — short base leads

7 EASIER TO STOCK AND SELL
One Raytheon *Bantal* takes the place, without shielding, of either the ordinary GT or metal equivalent. Made in eight popular types — 6SA7GT — 6SJ7GT — 6SK7GT — 6SQ7GT — 12SA7GT — 12SJ7GT — 12SK7GT — 12SQ7GT. Ideal for replacement in sets or equipment requiring tubes of great mechanical strength and dependability for long trouble-free service.

**These are not the only advantages of the Bantal Tube. Space does not permit enumerating them all.*

YOU CAN DO MORE BUSINESS AND MAKE MORE MONEY SELLING RAYTHEON BANTAL TUBES

RAYTHEON MANUFACTURING COMPANY
RADIO RECEIVING TUBE DIVISION
NEWTON, MASSACHUSETTS • CHICAGO, ILLINOIS • LOS ANGELES, CALIFORNIA

RADIO RECEIVING TUBES • SUBMINIATURE TUBES • SPECIAL PURPOSE TUBES • MICROWAVE TUBES