PHOTOFACT

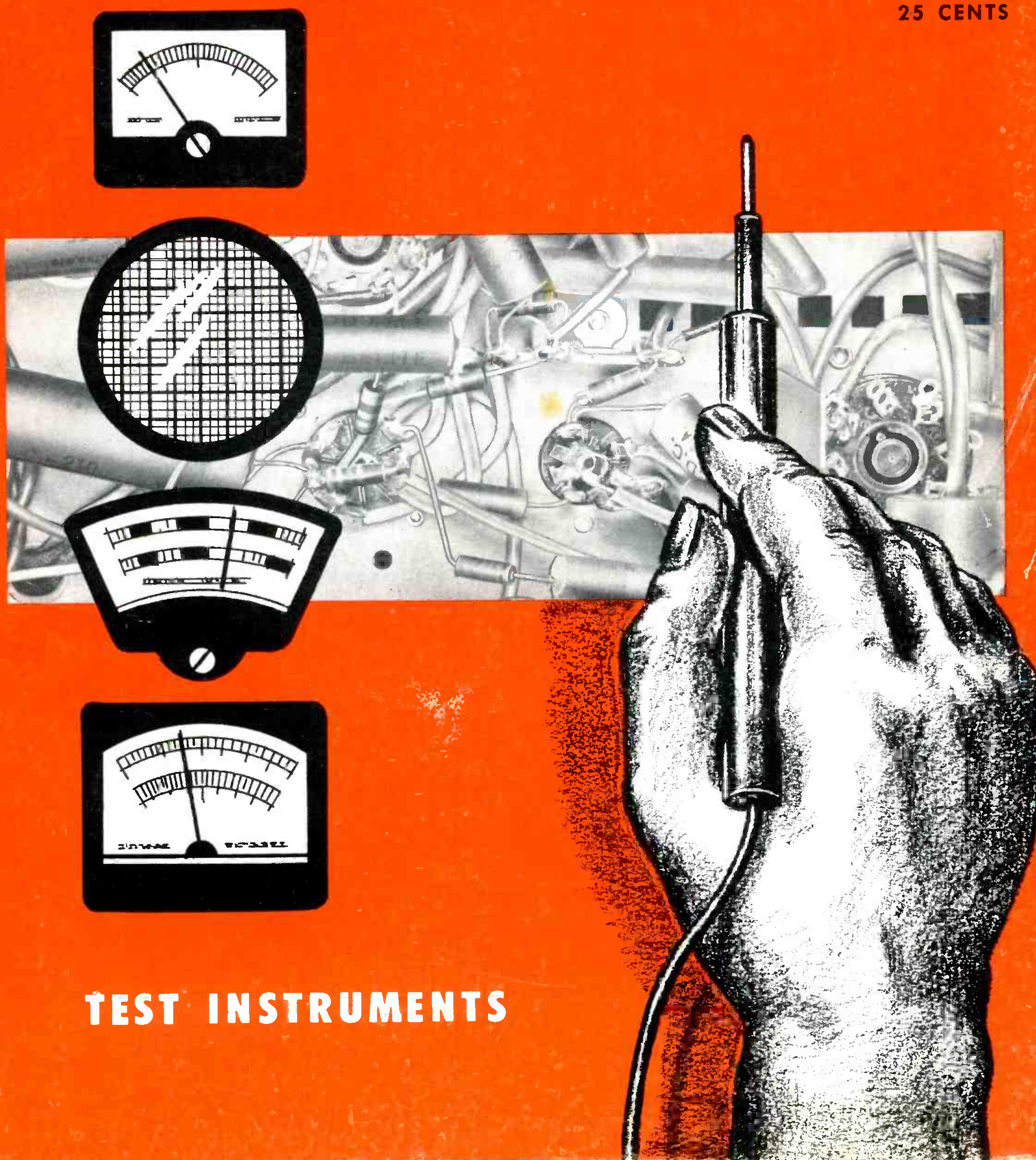
PF INDEX

FEBRUARY • 1954

the monthly REPORT to the

ELECTRONIC SERVICE INDUSTRY

25 CENTS



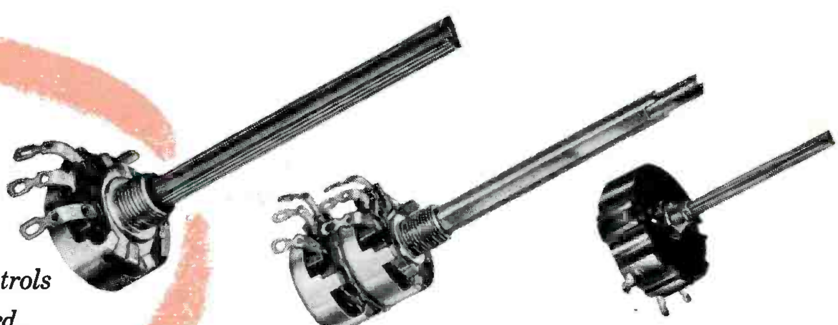
TEST INSTRUMENTS

NO. 1 CHOICE

of service technicians for

TV CONTROLS*

* *Not Claims! Not Predictions! But Plain Facts! More Service Technicians prefer IRC TV Controls than the next 2 brands combined. Proved by unbiased, authoritative, independent surveys.*



ASK FOR IRC TV CONTROLS... MOST SERVICE TECHNICIANS DO!

IRC

Wherever the Circuit Says -ᴧᴧ-

INTERNATIONAL RESISTANCE COMPANY

423 N. Broad Street, Philadelphia 8, Pa.

In Canada: International Resistance Co., Ltd., Toronto, Licensee

FROM COAST TO COAST —

the nation has seen the Regency Remote TV Control on television. Garroway sold it for you to a fresh market. Now, 20,000,000 TV set owners can adjust the TV picture from where it is seen with the Regency Remote TV Control.

TODAY'S GREAT OPPORTUNITY IN TELEVISION ACCESSORIES —

close the sale Garroway started

A NEW PRINCIPLE in Remote Universal Control Devices!

- It works on as much as 100 feet of cable (permits running cable around room periphery!)
- Changes channels!
- Sharpens contrast!
- Brightens the picture!
- Controls volume!

MODEL RT-700 $69.95 LIST

Regency

DIVISION OF I.D.E.A., INC.

Makers of VHF Boosters, FM Boosters, UHF Converters, Professional High Fidelity Equipment and Television Remote Controls

Burton Browne advertising

JAMES R. RONK
Editor

LESTER H. NELSON
Managing Editor

W. WILLIAM HENSLER
Technical Editor

Editorial Staff

PHYLLIS J. AUKERMAN
WILLIAM E. BURKE
HENRY A. CARTER
ROBERT B. DUNHAM
DON R. HOWE
FRED McKINNEY
GLENNA M. McROAN
MARGARET NEFF
EVELYN S. MOUSER
C. P. OLIPHANT
GLEN E. SLUTZ
PAUL C. SMITH

ANTHONY M. ANDREONE
Art Director

GLENN R. SMITH
Staff Artist

ROBERT W. REED
Photography

ARCHIE E. CUTSHALL
DOUGLAS BOLT
Production

★

HOWARD W. SAMS
Publisher

Business Department:

Donald B. Shaw, V. P.
Treasurer

F. T. Dobbs, Secretary

Joe H. Morin, Sales Mgr.

Ann W. Jones, Advertising

Shirley A. Owens, Literature
Service Mgr.

J. C. Keith, V. P.
Charge of Circulation

Printed by
THE WALDEMAR PRESS
Joseph C. Collins, Mgr.

Howard W. Sams

PF PHOTOFACT® **INDEX**

the monthly REPORT to the
ELECTRONIC SERVICE INDUSTRY

VOL. 4 · NO. 2 FEBRUARY · 1954

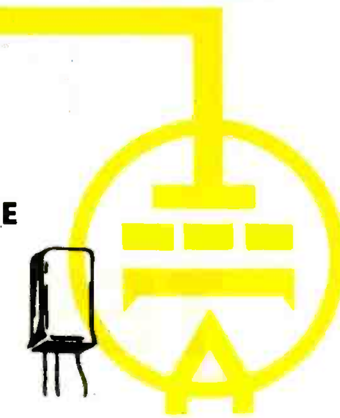
CONTENTS

SUBJECT REFERENCE

The PF INDEX is published monthly by Howard W. Sams & Co., Inc., 2201 East 46th Street, Indianapolis 5, Indiana. The PF INDEX is on sale at 25¢ a copy at 1093 jobbers of Electronic Parts throughout the United States and Canada. (In Canada 30 cents.) When available, back numbers may be obtained by sending 35¢ for each copy desired. Acceptance under Section 34.64 P. L. & R. authorized at Indianapolis, Indiana

SUBSCRIPTION DATA: For those desiring the convenience of delivery to their homes or shops, each issue of the INDEX will be mailed direct, promptly upon publication. The subscription charge is $4.00 annually in the United States and U. S. possessions.

The Transistor Story



WILLIAM E. BURKE

Part II

How the Transistor Can Be Made to Detect, Amplify, or Oscillate

The first article of this series, which appeared in the September-October issue of the PF INDEX and Technical Digest, stated that the internal elements of the transistor can be compared directly with those of a vacuum tube. A transistor base can be compared to the tube grid, a transistor emitter can be compared to the tube cathode, and a transistor collector can be compared to the tube plate. This comparison does not apply to the circuits which are utilized with the tube and the transistor, because they are so basically dissimilar that no direct comparison can be made between them. The tube is a voltage-operated device, and the transistor is a current-operated device. A mathematical comparison can be made by means of Kirchhoff's equations, but that is beyond the scope of this article.

When relating transistor circuits to tube circuits, the principle of duality is useful. Any two components or circuits are called "duals" if the current in one behaves like the voltage in the other. Maximum current in one circuit and maximum voltage in another under like conditions establish two circuits as duals. A parallel-resonant circuit and a series-resonant circuit are duals, because the first produces maximum voltage at resonance and the second produces maximum current at resonance. To use this principle of duality in a practical manner, each component in a vacuum-tube circuit is exchanged for its counterpart by the duality principle when changing over to a transistor circuit. For example, in an amplifier using tubes, the circuit components are selected to provide the maximum signal voltage if maximum gain is to be achieved. If the tube is to be replaced by a transistor, the circuit components will have to be replaced with those which will develop maximum current. The chart in Fig. 1 gives some of the basic components and circuits which can be exchanged by the principle of duality. Some thought on the behavior of current and voltage in other circuits will establish many of them as duals.

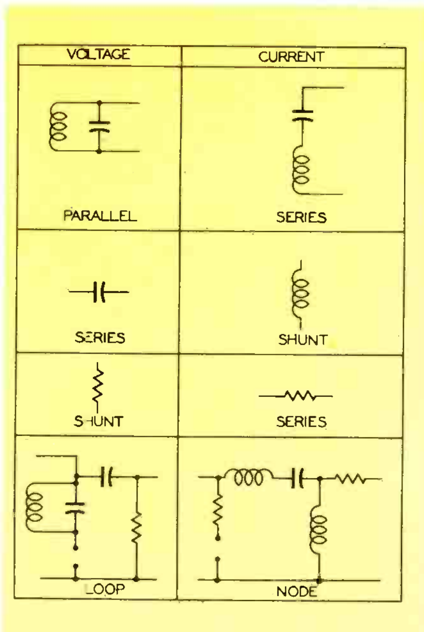


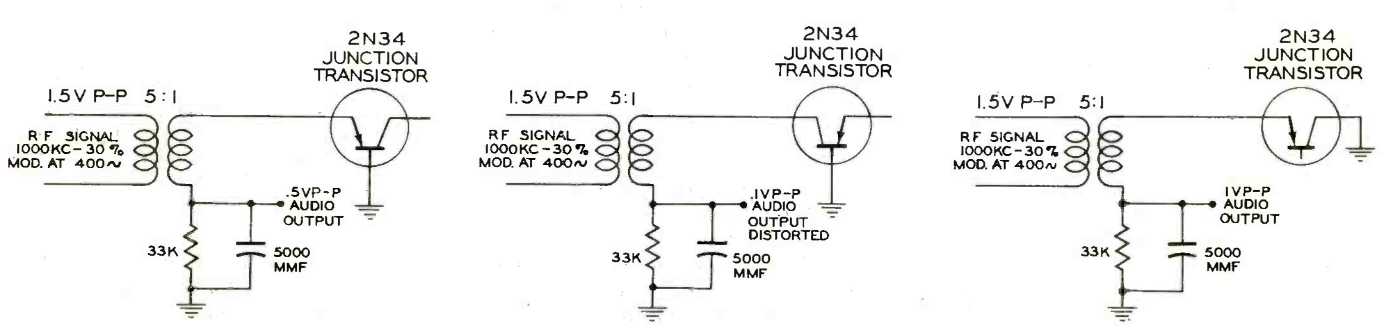
Fig. 1. Chart of Typical Duals.

There are three electronic functions which are fundamental to all radio and television circuits. These are detection, amplification, and oscillation. Vacuum tubes have been used to provide each of these functions, and it is possible to utilize a transistor to do the same. There is a fourth function, namely that of switching, which can employ either the tube or transistor. This function has been confined almost exclusively to electronic computers and calculators, and it has not been used a great deal in radio or television circuitry. For this reason, it has been omitted in the explanations that follow.

Detection

In any system of communications using radio transmission, the intelligence that is transmitted is contained as modulation of an RF carrier frequency. To obtain this intelligence at

* * Please turn to page 81 * *



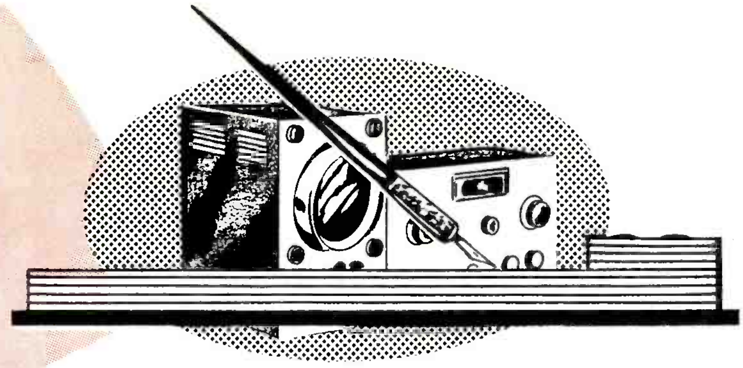
(A) Detector Circuit Using Emitter-Base Connection.

(B) Transistor Detector With Collector-Base Connection.

(C) Detector Circuit With Emitter-Collector Connection.

Fig. 2. Typical Transistor Circuits.

notes on TEST EQUIPMENT



by **PAUL C. SMITH**

Presenting Information on Application, Maintenance and Adaptability of Service Instruments

Over a period of years we have received many letters from service technicians requesting assistance in matters involving test equipment. The questions which have been posed are certainly too great in number to enumerate here. By thinking back, however, we find that almost all of these inquiries can be generalized into three basic questions:

1. How can presently owned test equipment be used to best advantage?

2. What repair work, if any, should be done on presently owned equipment in case of failure?

3. What new test equipment will be available, and what is it intended to do?

The first of these questions involves the application and operation of test instruments without which some of the more obscure servicing troubles are very difficult to trace. Although the service technician can accomplish wonders by reasoning and deduction, eventually he reaches for the test leads to check that component or circuit which his reasoning has told him must be defective. How to use his equipment efficiently toward this end is something which he needs to know and which we will try to cover thoroughly in this column.

Since the service technician is so dependent on test instruments, he is handicapping himself if he allows them to fall into a state of disrepair. This brings us to the second question concerning the kinds of test-equipment repair which can be undertaken by the service technician. Some repairs may be readily made by the technician using his instruments; others may require the use of specialized equipment not found in the average service shop. The operational manuals on some test equipment outline that amount of servicing which is practical for the technician himself to perform. From time to time, we will discuss various recommended procedures which may be followed in the checking and maintaining of test equipment.

The third basic question has to do with new pieces of test equipment. Recent years have seen great advances in the electronics field, specifically in UHF and color TV; but as fast as the need arises for new test equipment to meet the requirements of UHF and color TV, test-equipment manufacturers are responding with new models or revisions of previous ones. As an illustration, several manufacturers are at present designing UHF signal generators which when used in conjunction with VHF sweep generators produce a UHF sweep signal.

Since color TV is now a reality, the service technician is naturally very concerned with its possible effect on his test-equipment requirements. Some of his specific questions on this subject pertain to the adaptability of his present equipment, the nature and amount of new equipment required, and the techniques to be learned.

These are your questions, and it is with this in mind that we begin this column in the PF INDEX. To discuss all phases of test equipment in a single issue would be an impossibility. We will, however, present as much timely material in each issue as space will allow. Some of this material will be of sufficient length to warrant separate articles.

Two such articles appear in this issue: "Color TV and Your Test Equipment" and "Intermittent Recorder." The first covers the adaptability of presently owned equipment to color receiver servicing and also presents some requirements for future equipment. The article "Intermittent Recorder" describes an instrument which has been designed specifically to perform one of the most difficult of all servicing operations, that of servicing an intermittent receiver.

Checking the 1B3GT

Occasionally when checking tubes to locate a receiver fault, one finds a tube which checks weak according to the tube tester, yet substitution of a new tube does not appear to improve the receiver performance. Some service technicians may have had such an experience with the 1B3GT.

This tube is subject to comparatively high voltages in use. The cathode is of the directly heated type and operates at a large potential difference with respect to the anode, or plate. Being negative with respect to the plate it is attracted to it, the attraction varying inversely as the square of the distance between the two elements. As the tube ages the filament may sag and this allows the filament to approach the plate more closely where the attraction is even greater than before. Eventually portions of the filament may be torn off or the filament may break and short to the plate. To forestall this possibility a type of construction similar to Fig. 1 has been developed. Here a metal ring "A" has been added and is connected electrically to one terminal of the filament. When connected in this manner it serves as an electrostatic screen between the filament and plate, reducing the attraction between these two elements. Also since its potential is slightly different from that portion of the filament nearest it, it may function as a grid. This latter action does not hinder its operation in a receiver

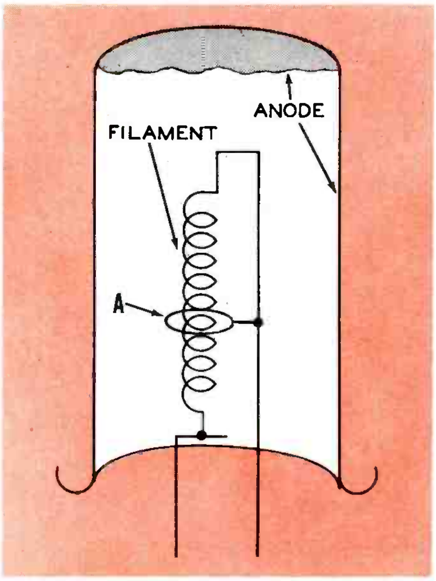


Fig. 1. Internal Construction of Some 1B3GT Tubes.

but may make an appreciable difference at the comparatively low potentials at which a tube tester operates, causing the tester to read in the weak or reject portion of the scale.

A suggested remedy for this condition is to obtain several good tubes of this type of construction and check them in the tube checker. Vary the bias setting, English setting, or plate setting (depending upon the tube tester in question) until a reading of "good" is obtained for the weakest of the group. Note the setting and use it thereafter when checking tubes of this type of construction. Tubes of such construction can be identified by inverting the tube and peering into the plate interior, where the filament and ring should be visible. Currently available General Electric tubes of the 1B3GT type incorporate this construction.

Synchronizing the Scope

Sometimes, when attempting to view a waveform on the oscilloscope, the operator has difficulty in obtaining or maintaining a satisfactory stable synchronization. Or improper synchronization may result in a misleading appearance of the waveform. A few hints may make the operation of synchronization easier.

Normally the functioning of a scope's sync circuits is as follows. An oscillator stage provides a sawtooth voltage which is controlled by a step- or coarse-frequency switch and by a variable- or fine-frequency control. Without synchronization, this oscillator is free running at a certain frequency determined by the setting of the controls just mentioned. It is possible to obtain a degree of synchronization by merely adjusting these controls alone, but the pattern on the scope will drift across the screen of the cathode-ray tube unless a certain amount of synchronizing signal is applied to the sweep oscillator. Therefore a portion of the voltage signal to be viewed is taken from some point of the vertical amplifier stages and fed to a sensitive part of the sweep-oscillator circuit. When recurring pulses in this applied signal are of a frequency near that of the free-running sweep oscillator, they trigger the sweep oscillator and it fires in step with the applied signal. Thus synchronization is obtained, and the waveform appears stationary on the oscilloscope screen.

The most stable synchronization is obtained when the free-running frequency of the sweep oscillator is just slightly lower than the repetition rate of the applied signal. This condition is similar to that encountered in the sweep oscillators of a TV receiver. In this case, the sweep oscillator is free running in the absence of a TV signal (or, if the sync signal is lost, in a faulty sync circuit). The synchronization signal is obtained from the sync pulses of the TV signal. The receiver operator varies the frequency of the sweep oscillator by turning the hold control; and when this frequency approaches very nearly that of the sync pulses, the picture locks into synchronization. The hold controls of the TV receiver can be compared to the vernier control on the scope in that all are adjusted to provide operation of an oscillator at a frequency which can be synchronized at the desired repetition rate.

The amplitude of the applied sync signal in the scope is important. This can be adjusted by the sync amplitude or locking control. Generally speaking, only enough sync amplitude should be used to just effect synchronization. More than this may distort the observed waveform.

When the sync-amplitude control is advanced too far in order to force synchronization in spite of a frequency vernier setting that is considerably misadjusted, the result quite often is multiple synchronization (alternate long and short sweep traces). This can give rise to some waveforms of very peculiar appearance. The situation is easy to avoid, by making the vernier adjustment first and then by following with the sync-amplitude adjustment.

In scopes which have the sync take-off at some point following the vertical gain control, operation of this control will result in a change of sync signal amplitude. This explains why some scopes will fall into or out of synchronization when the setting of the vertical gain control is varied.

Sometimes a circuit under observation may furnish a signal so weak that synchronization is not obtained even with the maximum settings of both vertical gain and sync amplitude. In that case, it may be possible to take the synchronizing signal from a later point in the circuit under test, thus taking advantage of increased amplification of the signal. The sync signal from this new point is applied to the external sync connection and the sync selector switch is turned to the external position, thus applying the amplified sync signal to the sweep section.

Another factor in obtaining stable synchronization is the polarity of the applied sync signal. This would be especially true in a case where the waveform under observation was unsymmetrical with sharp positive peaks in contrast to smooth negative peaks. In this case, the sharp peaks would be much more effective in maintaining synchronization. Some oscilloscopes have a provision which permits the selection of a sync signal of either polarity. Lacking this, the scope may be connected to another signal point where 180-degree phase reversal is obtained. If a change in the signal take-off point is not desirable, the source of the sync signal may be changed as described in the preceding paragraph. In this manner, a sync signal of the desired polarity may be obtained.

The following procedure is recommended as a simple step-by-step method for obtaining proper synchronization.

1. Reduce the sync-amplitude setting to zero or a very low value.

* * Please turn to page 66 * *

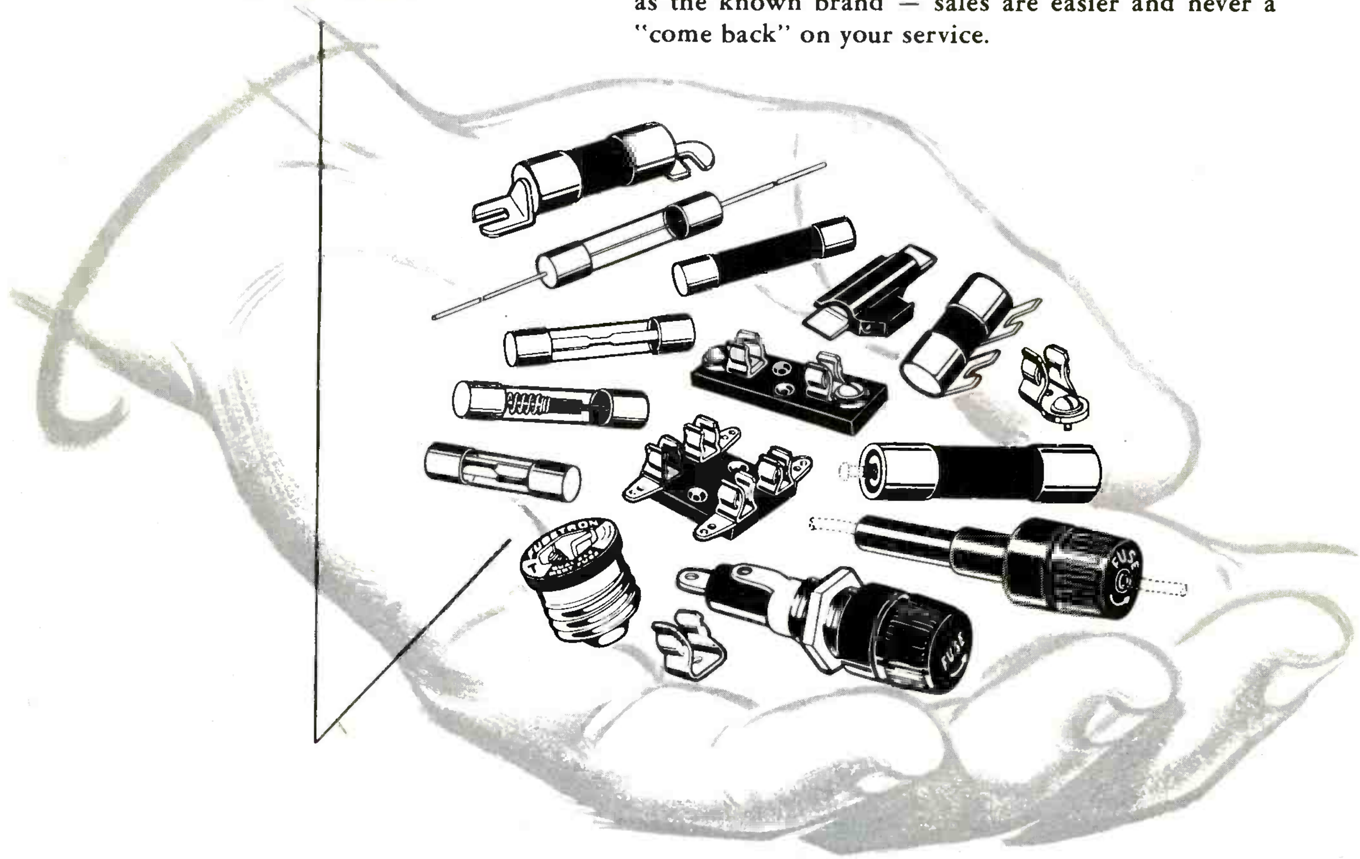
For Your Exact Fuse Needs there's A BUSS FUSE

BUSS is the one source for any fuse you need: — standard type, dual-element (slow blowing), renewable and one-time types . . . in sizes from 1/500 ampere up.

BUSS Fuses can be relied upon for dependable electrical protection, elimination of needless blows, and top quality in every detail because — EVERY BUSS and FUSETRON FUSE USED IN THE ELECTRONIC TRADE IS ELECTRONICALLY TESTED. The sensitive testing device rejects any fuse that is not correctly calibrated, properly constructed and right in all physical dimensions.

That's why manufacturers and service organizations for over 38 years have turned to BUSS for their fuse needs — no matter how exacting.

And a customer instantly recognizes quality when he sees BUSS Fuses. Millions of fuses for home, farm, commercial and industrial use have established BUSS as the known brand — sales are easier and never a "come back" on your service.



FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Bulletin SFB gives the facts on

Buss Small Dimension FUSES and HOLDERS

Send today for your copy — it's FREE!

Shop Talk

MILTON S. KIVER

President, Television Communications Institute

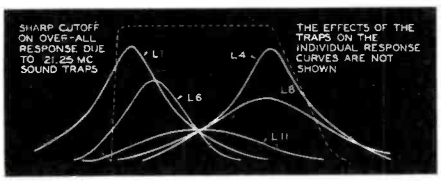


Fig. 1. Individual Response Curves of IF System in Fig. 2.

Touch-Up Alignment

Alignment of the video IF system, which is one of the more important alignments of a television receiver, should be followed in the recommended order. For most sets, this involves individual peaking of the various coils followed by a look at the over-all response curve to see what final adjustments may be required to bring it exactly to the desired form.

When making these final touch-up adjustments, it will help the service technician to keep in mind how the over-all response curve is formed. That is, each tuned circuit in the video IF system contributes some share to the over-all shape. The contribution, however, is greatest in the vicinity of the peaking frequency of that tuned circuit. Consequently, changing the tuning of any coil will alter the shape of the over-all response in some respect.

An excellent illustration of the individual curves that go to make up a composite video IF response is shown in Fig. 1 for the IF system of Fig. 2. There are five individual tuning circuits in all; and while each individual response curve is rather broad, each does possess a peak. Peak frequencies range from 21.8 mc at the low end to 25.3 mc at the high end; in this particular arrangement no two peak frequencies coincide, although there is considerable overlapping for the rest of the curves.

The over-all response is shown in Fig. 3 with certain frequencies indicated at various points along the curve. Suppose that after following the alignment instructions as to the preliminary steps, we connect a sweep generator and an oscilloscope and find that the over-all pattern is not precisely what is specified. What is the best way to bring the pattern into line?

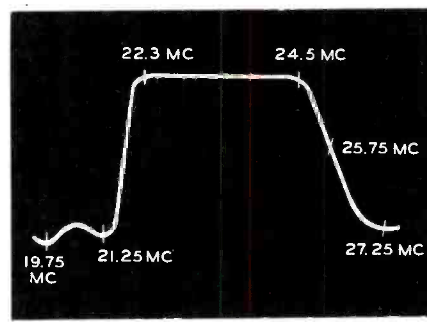


Fig. 3. Over-All Response Curve for IF System in Fig. 2.

The first step is to check the response curve at various points with a marker generator and note which sections of the curve need correcting. Then, we would not haphazardly rotate the various coil slugs; rather, we would choose the slugs in that coil or coils with the peak which was closest in frequency to that portion of the response curve that needed correction.

To illustrate, suppose we find in the response curve of Fig. 3 that

* * Please turn to page 43 * *

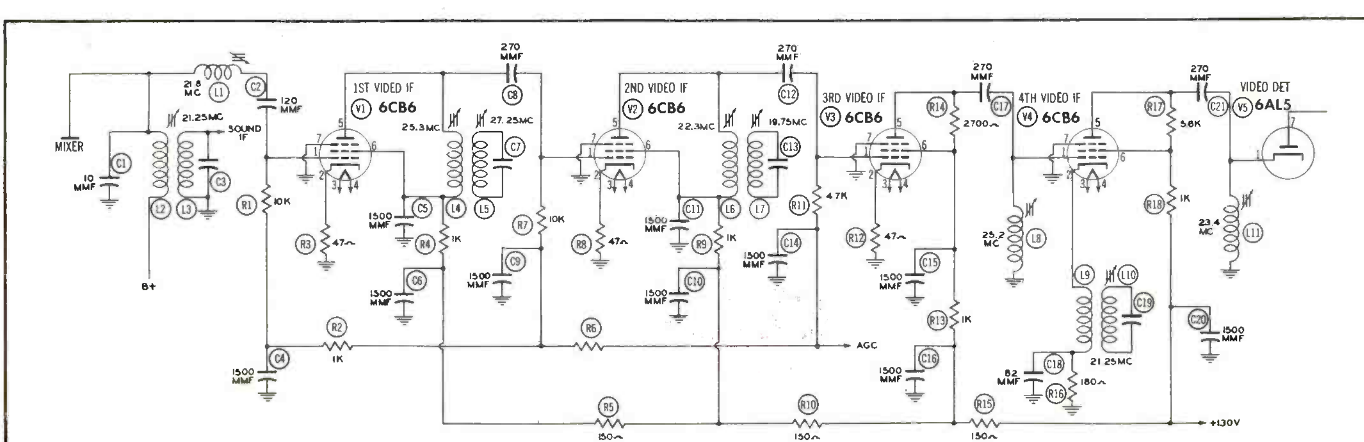
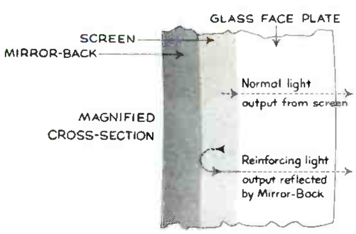


Fig. 2. A Stagger-Tuned IF System.

GET BETTER THAN NEW-SET PERFORMANCE

WITH CBS-HYTRON MIRROR-BACK SCREEN

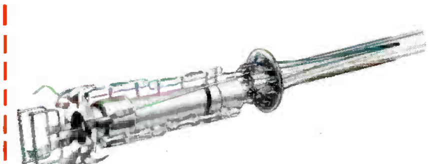


Mirror-Back (aluminized) screen mirrors *all* the light output to the viewer. Offers: Brighter pictures. Greater contrast. Better resolution. Reduced strain on other components. Full effective anode potential. Prevention of cross-burns. And longer life. For greater customer satisfaction . . . more profit, replace with original CBS-Hytron Mirror-Back tubes. Many types now available.

WITH CBS-HYTRON BLUE-WHITE SCREEN

Ever notice how a shirt laundered with bluing appears whiter? With the CBS-Hytron Blue-White screen, whites are whiter; blacks, blacker. Expanded gray scale gives noticeably sharper pictures in fringe areas. No wonder CBS-Hytron's original Blue-White screen has become the universally preferred standard. Your customers, too, will prefer Blue-White screens.

WITH CBS-HYTRON SMALL-SPOT GUN

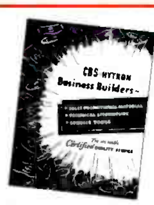


Smaller the spot produced by electron beam, sharper the picture. New lens focusing system of CBS-Hytron Small-Spot Gun reduces spot size 30 per cent. Prove it. Replace with a new CBS-Hytron Small-Spot tube. *See*, yourself, the superior resolution. Profit more. Combine all three: CBS-Hytron Mirror-Back . . . Blue-White Screen . . . Small-Spot Gun. Get and give that better-than-new-set thrill!

LOOK TO CBS-HYTRON FOR COLOR, TOO!

New CBS-Colortron stresses simplicity. Offers many advantages: Simpler construction. Fool-proof assembly. Lower cost. Lighter weight. Adaptability to mass production in large sizes. Improved contrast. Simplified focusing . . . circuitry . . . adjustment. Resistance to overload. Greater stability. All stemming from unique spherical mask and face plate. You'll appreciate these advantages when *you* start servicing color TV.

FREE CATALOG . . . CBS-HYTRON BUSINESS BUILDERS



Describes all CBS-Hytron Business Builders to date: *Certified* Quality Service tags, streamers, decals, illuminated and flange signs, clocks, postal cards, and ad mats. The famous CBS-Hytron service tools. Technical literature. Price lists. Special offers. Get your Business Builders Catalog, PA-37, today . . . from your distributor, or direct.

NEW . . . *FREE* CBS-COLORTRON DATA

For a look into the future, get complete advance data on the new, revolutionary CBS-Colortron: Construction . . . operation . . . application . . . installation and adjustment . . . electrical and mechanical data. FREE . . . from your CBS-Hytron distributor . . . or direct.

CBS HYTRON
Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Mass.
A Division of Columbia Broadcasting System, Inc.
A member of the CBS family: CBS Radio • CBS Television • Columbia Records, Inc. • CBS Laboratories • CBS-Columbia • and CBS-Hytron

RECEIVING • TRANSMITTING • SPECIAL-PURPOSE • TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

COLOR TV and your TEST EQUIPMENT

Adaptability of Present Equipment and Predictions for Future Needs

by W. William Hensler

A big question which must be in the minds of many service technicians is "What test equipment will be required for servicing color TV receivers?" It is difficult to foresee all of the requirements at this time, but we would like to discuss those which are now apparent and also point out the adaptability of existing equipment to color-receiver servicing.

A color television receiver incorporates many of the same circuits that are employed in a monochrome receiver plus those circuits which are required for the production of color. The servicing of the color receiver naturally presents more problems because of these additional circuits, the adjustment of which is quite critical. The synchronization of the color set is the most critical of all functions. Loss of synchronization of the vertical- or horizontal-deflection systems in the color receiver produces the same effect that is encountered in a monochrome receiver. These deflection circuits in the color receiver are similar in many respects to those found in the black-and-white receiver. Thus, the servicing of these circuits should present no problem to the service technician who has had experience in monochrome work. He can use the same servicing technique and, most important of all, the same test equipment which he now has.

The deflection-angle requirements of color picture tubes which are currently available are far below those of the 21-, 24-, and 27-inch black-and-white tubes that are enjoying widespread usage by the manufacturers of black-and-white receivers. This lower deflection-angle requirement results in a circuit which should be easier to service than that of the 27-inch deflection system.

The experimental color receivers which have been designed to date employ a flyback high-voltage system. In order to obtain high voltage of sufficient level to supply the color tube, a doubler system is used. At the output of the high-voltage system, one design incorporates a shunt regulator tube for the purpose of stabilizing the high voltage. The servicing of this high-voltage system will require a high-voltage probe of at least a 30-kv range. Many of the test probes now being used are of the 30-kv variety and will serve to analyze the high-voltage system of a color receiver.

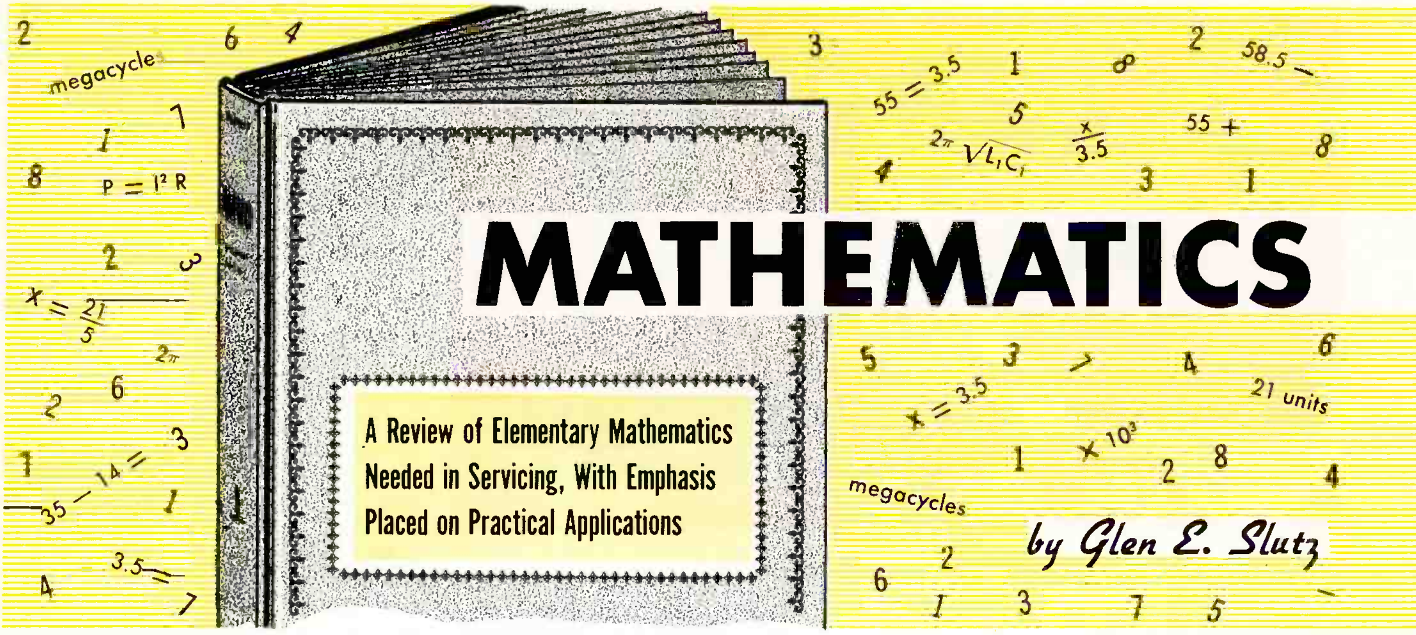
The vertical-deflection system is so nearly identical to those encountered in monochrome receivers that no special procedure is required for servicing it. For example, one experimental receiver incorporates a single 6BL7GT tube which performs the functions of the vertical-oscillator and vertical-output stages. The oscillator section is of the blocking-oscillator type, the output of which is fed to the vertical-output stage. Three controls are incorporated: the vertical-linearity, height, and vertical-hold controls. As can be seen, these are identical to those which are found in the black-and-white receiver. This section, then, will not require any special equipment over that normally used in the servicing of the black-and-white receiver.

Before discussing the color-synchronizing section of the color receiver, let us consider the servicing requirements of the tuner, video IF, and sound IF sections. These circuits perform an identical function to those in the monochrome receiver. There are some special requirements which must be met, however, in the video IF section. A wider bandpass than is normally found in the monochrome set will be required in the color receiver. The average bandpass of the black-and-white receiver is around 3 mc. Some IF systems in black-and-white receivers may be designed so that they provide a 3.5-mc bandwidth, but very few surpass this figure. The color-burst frequency that is employed in color transmission is 3.579 mc. Obviously, the bandpass of a color receiver must be adequate to pass this frequency; otherwise the color signal would be lost.

The tuner does not present much of a problem in this respect since most of them are designed to provide at least a 6-mc bandwidth. On the high channels 7 to 13, the bandpass may be from 10 to 12 mc on some tuners. The alignment of the color receiver tuner can be considered on a par with that required in the black-and-white receiver. The only extra precaution which will be required is that of making sure that adequate bandpass is obtained on all channels. In aligning the tuner of a monochrome receiver, a compromise is often made on some channels in that a narrower bandpass than normal might be allowed. In the color receiver such a compromise might result in improper operation of the receiver, while in the monochrome set such a compromise would result only in a degree of picture degradation. One thought which should be kept in mind during the alignment of the color receiver is that insufficient bandwidth will result in more than just picture degradation, because complete loss of color synchronization might result. Concerning the problem of tuner alignment, the service technician should hold no fear of his ability or of the capabilities of the equipment which he has been using on monochrome receivers while aligning the color receiver tuner.

As previously mentioned, a great many monochrome sets have a 3-mc bandwidth in the IF section. It would be rather difficult for the service technician to align these circuits for a bandpass of 3.8 to 4 mc. In some cases, it might be possible to do this, but the gain of the receiver would suffer. The design of the IF system of the color receiver is such that it will provide for a wider bandpass characteristic which is consistent with a good gain figure. Since this circuit in a color receiver has been designed to provide adequate bandpass, no particular trouble should be encountered while aligning it. Again in this case, the same equipment which has been used for the alignment of the black-and-white receiver can be used with the same degree of accuracy to align the video IF section of a color receiver.

* * Please turn to page 77 * *



MATHEMATICS

A Review of Elementary Mathematics Needed in Servicing, With Emphasis Placed on Practical Applications

by Glen E. Slutz

Faced with the everyday necessity of having to use schematics and service literature and to know circuit operation, the service technician must be somewhat familiar with mathematics. Besides being a review of one of the three R's, this article should serve to point out the extensive yet sometimes hidden role which mathematics plays in the service industry.

What does the future hold as far as the use of mathematics in servicing is concerned? We foresee that an increase in circuit complexities, particularly with the advent of color television, is gradually going to bring the service technician closer to the engineer who has long considered mathematics a very real and meaningful tool in his trade.

Of course, we cannot treat the subject of mathematics to the extent that a textbook would cover it. Nevertheless, we intend to analyze a few of the typical mathematical problems which confront service technicians, and we hope the methods presented will be found applicable to many other kinds of service problems as well.

One definition of mathematics states that it is the science dealing with the properties and relationships of quantities. Let us then consider the extent to which the service industry is involved.

Properties and Relationships of Quantities

The "quantities" encountered in service work are resistance, voltage, power, current, inductance, and capacitance, to name just a few. Important "relationships" exist between these quantities such as, for example, the current-resistance-voltage relationship expressed by Ohm's law. The "properties" of electrical quantities must also be known by the service technician and are frequently expressed mathematically. Voltage, for instance, has the property of polarity indicated by plus or minus signs. It has the property of magnitude which is specified by choosing a suitable unit called the volt as a reference and by comparing all other voltage magnitudes to this unit. Voltage may have the property of change, such as in the case of an alternating voltage; this change can be, and often is, expressed mathematically.

Choosing Correct Wrench Size

The application of mathematics in the service industry extends beyond the bounds of purely electrical matters. The service technician automatically employs mathematics in the routine selection of drill and wrench sizes. Perhaps he chooses a 5/16-inch socket wrench and finds it too large for his particular needs. Mentally he performs the following subtraction:

$$\frac{5}{16} - \frac{1}{16} = \frac{4}{16} \qquad (1)$$

He does not have a wrench with the fractional figure "4/16" stamped on it, so he mentally arrives at its equivalent by dividing the numerator and denominator by 4, an operation which he knows will not alter the value of the fraction.

$$\frac{4}{16} = \frac{4 \div 4}{16 \div 4} = \frac{1}{4} \qquad (2)$$

He tries a 1/4-inch wrench; but suppose, now, that this size proves to be too small. The size he needs probably lies midway in value between 1/4 inch and 5/16 inch. He can arrive at the correct size by finding the arithmetical mean of the sizes he has tried. This is done by adding the figures and dividing their sum by 2.

$$\left(\frac{1}{4} + \frac{5}{16}\right) \div 2 = \left(\frac{1}{4} + \frac{5}{16}\right) \times \frac{1}{2} \qquad (3)$$

$$= \left(\frac{4}{16} + \frac{5}{16}\right) \times \frac{1}{2}$$

$$= \frac{9}{16} \times \frac{1}{2}$$

$$= \frac{9 \times 1}{16 \times 2}$$

$$= \frac{9}{32}$$

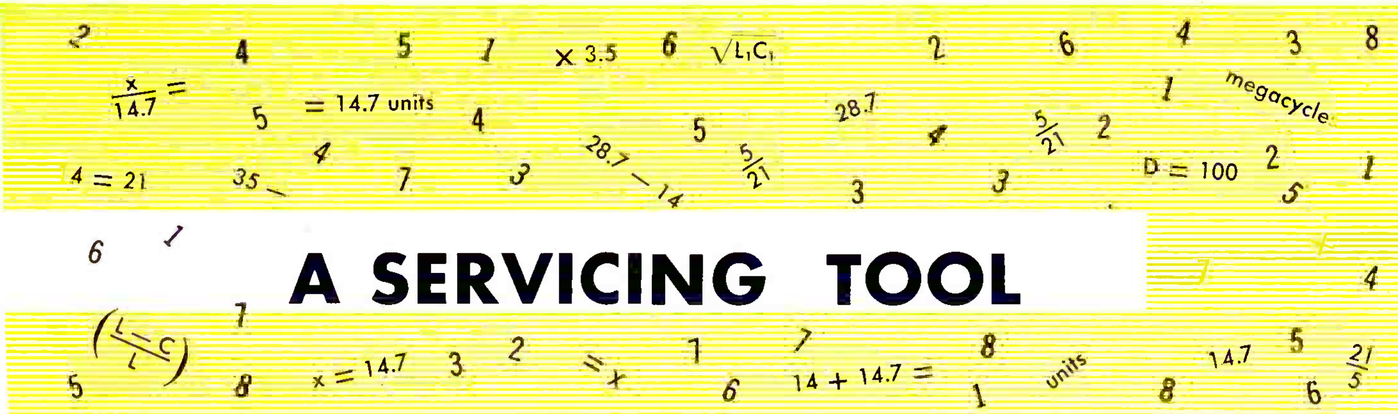
An alternative method of arriving at this intermediate size can be utilized by the service technician. Instead of subtracting 1/16 from 5/16 as he did in his first computation (1), he subtracts 1/32, or one-half of 1/16, from 5/16.

$$\frac{5}{16} - \frac{1}{32} = \frac{10}{32} - \frac{1}{32} = \frac{9}{32} \qquad (4)$$

Many technicians will perform the foregoing steps scarcely noticing the fact that mathematics is involved. Some individuals use wrenches and drills so often that the order of sizes becomes memorized and computations are unnecessary.

Powers of 10

An exponent is a number placed at the right of and above another number to indicate how many times the latter is to be used as a multiplying factor. Examples are:



A SERVICING TOOL

$$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \quad (5)$$
$$= 1{,}000{,}000$$

and

$$10^1 = 10 \quad (6)$$

An exponent may be a negative number, in which case the value of the term is the reciprocal of what its value would be if the exponent were positive. Examples are:

$$10^{-6} = \frac{1}{10 \times 10 \times 10 \times 10 \times 10 \times 10} \quad (7)$$
$$= \frac{1}{1{,}000{,}000}$$

and

$$10^{-1} = \frac{1}{10} \quad (8)$$

Terms having exponents and having the same base number (10 in these examples) can be multiplied and divided very quickly. Remember that in multiplying, exponents are added to each other; in dividing, exponents are subtracted from each other. Examples are:

$$10^6 \times 10^2 = 10^{6+2} = 10^8 \quad (9)$$

and

$$\frac{10^6}{10^2} = 10^6 \div 10^2 = 10^{6-2} = 10^4 \quad (10)$$

A number with an exponent of zero has a value of one.

$$\frac{10^6}{10^6} = 10^{6-6} = 10^0 = 1 \quad (11)$$

This discussion has been presented, because exponential numbers are encountered frequently by the service technician. The base number 10 with an exponent is very commonly used as a multiplying factor in order to abbreviate extremely large or extremely small figures. It is helpful therefore to be able to work with these powers of 10.

Converting from One Unit Size to Another

Converting units in formulas and equations from one size to another has proved to be somewhat of a problem to service technicians who may have tried this operation in order to make a formula or equation more applicable to a particular need. To illustrate the problem, let us consider the formula for the resonant frequency of a tuned circuit. This formula is stated conventionally as follows:

$$f = \frac{1}{2\pi\sqrt{LC}} \quad (12)$$

where

f = resonant frequency, in cycles per second,

L = inductance, in henrys,

C = capacitance, in farads.

The units employed in this formula are seldom, if ever, encountered in common practice. Consequently, it would be very helpful if the formula were restated so that the number of practical units could be substituted directly. Let us assume that the practical units for a certain application are megacycles per second, microhenrys, and micromicrofarads. The problem is to modify the formula (12) so that it uses the factors:

f_1 = resonant frequency, in megacycles per second,

L_1 = inductance, in microhenrys,

C_1 = capacitance, in micromicrofarads.

At this point, emphasis should be made of the fact that the letter symbols in any formula or equation stand for the numbers of certain units and not for the units themselves. Failure to realize this has caused most of the difficulty which technicians have had with unit conversions.

To convert units in the resonant frequency formula, the first step is to establish some equalities:

$$f = 10^6 \times f_1 \quad (13)$$

where

f = number of cycles per second,

f_1 = number of megacycles per second.

$$L = 10^{-6} \times L_1 \quad (14)$$

where

L = number of henrys,

L_1 = number of microhenrys.

$$C = 10^{-12} \times C_1 \quad (15)$$

where

C = number of farads,

C_1 = number of micromicrofarads.

The second step is to substitute these equalities in formula (12) according to the axiom which states that equals may be substituted for equals in any equation without destroying the equation's validity.

$$10^6 \times f_1 = \frac{1}{2\pi\sqrt{10^{-6} \times L_1 \times 10^{-12} \times C_1}} \quad (16)$$

Multiply both sides of (16) by 10^{-6}. Hence,

$$f_1 = \frac{10^{-6}}{2\pi\sqrt{10^{-6} \times L_1 \times 10^{-12} \times C_1}} \quad (17)$$

Multiply within the square root sign, and (17) becomes

$$f_1 = \frac{10^{-6}}{2\pi\sqrt{10^{-18} \times L_1C_1}} \quad (18)$$

Since $\sqrt{10^{-18}} = 10^{-9}$, (18) can be stated

$$f_1 = \frac{10^{-6}}{2\pi \times 10^{-9}\sqrt{L_1C_1}} \quad (19)$$

Multiply numerator and denominator on the right side of the equation by 10^9. Then,

* * Please turn to page 62 * *

New 650 C WHITE DOT *Generator*

COMPATIBLE FOR COLOR or BLACK and WHITE

HICKOK

Another HICKOK First . . .

The Model 650C is another example of HICKOK pioneer engineering and originality in test equipment design to meet the practical necessities of TV maintenance.

NOTE FOR VALUE . . .

To the thousands of you who already have a Model 650, you will appreciate knowing that its design is so complete that only a simple conversion is necessary for color use. This conversion assembly, completely wired, is available from the factory for $5. You can add this assembly to your present 650 in a matter of minutes and thus convert to provide all features of the latest Model 650C White Dot Generator for Color TV, as well as retain the black dots for black and white receivers.

• • • • •

You can always count on HICKOK engineers to make special efforts to keep your present equipment up to date and operating to full specifications. It is interesting to note that due to HICKOK engineering cooperation many HICKOK testers, well over 25 years old, are still delivering top performance in everyday use. It is policy such as this that has contributed a great deal to the present HICKOK position of "First in Preference". See the complete HICKOK line at your nearest Radio Parts Jobber . . . and write today for the new HICKOK Equipment Catalog No. 29.

MODEL 650C

For Color TV . . .

The new 650C is an absolute must for accurate registration adjustment of the three color guns in the tube of the new color TV receivers.

Simple to Use . . .

Just connect to the antenna of the color TV receiver and adjust the 650C to produce WHITE DOTS on the screen. Adjust color guns until colored fringes disappear from around the white dots. With the 650C, color register adjustments are a fast and easy job. Without the 650C . . . a near impossible task.

The 650C provides the means for accurate adjustment of Focus • Convergence • Centering of Individual Beams • Purity Yoke • Dynamic Convergence • Linearity and Aspect Ratio.

In Addition . . .

The 650C is an excellent instrument for fast trouble-shooting in black and white receivers . . . and includes all features of the present 650 model.

MODEL 650C

THE HICKOK ELECTRICAL INSTRUMENT CO.

10566 Dupont Avenue • Cleveland 8, Ohio

The WILLIAMSON AMPLIFIER

a modified design

by ROBERT B. DUNHAM

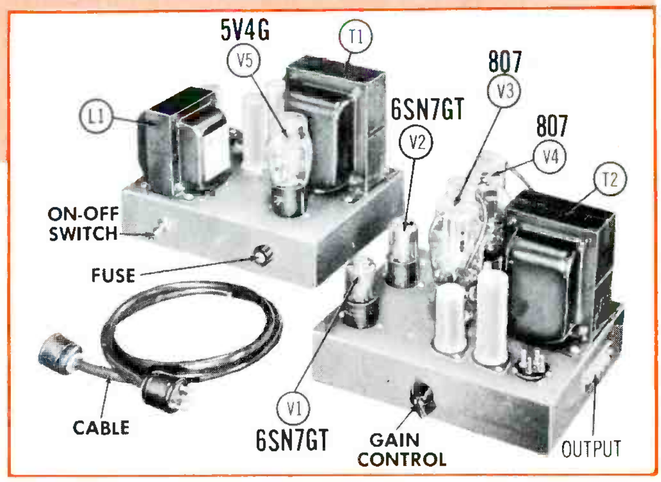


Fig. 1. Modified Williamson Amplifier With Power Supply and Cable.

In discussing the Williamson amplifier in the "Audio Facts" column in PF INDEX and Technical Digest No. 30, for January-February 1952, we mentioned that since its introduction by D. T. N. Williamson in 1947 it had become one of the most popular and well-known amplifier circuits. Its popularity certainly has not waned, on the contrary it has increased.

Many manufacturers now produce their own versions of the Williamson amplifier. For instance, one English-made amplifier, built to Mr. Williamson's specifications and carrying his signature, has been placed on the market in this country. American and foreign-made output transformers designed especially for this circuit are available, as well as various kits composed of the most important large components or complete to the last small item in some cases.

The amplifier using Stancor components, constructed by us, and described in the aforementioned "Audio Facts" article has had a great deal of rough service; but its performance has been above reproach, giving us no reason for complaint. No doubt this is representative of the results obtained by Williamson users in general.

In fact, about the only thing to be considered as a deficiency in these amplifiers was the maximum power-output rating, which was not so high as some desired it to be or thought it should be to handle adequately the high-amplitude peaks encountered when reproducing some musical selections. Various methods were tried in an effort to increase the power output. The most successful one was the use of push-pull parallel output stages which required a larger and heavier power supply.

* * Please turn to page 56 * *

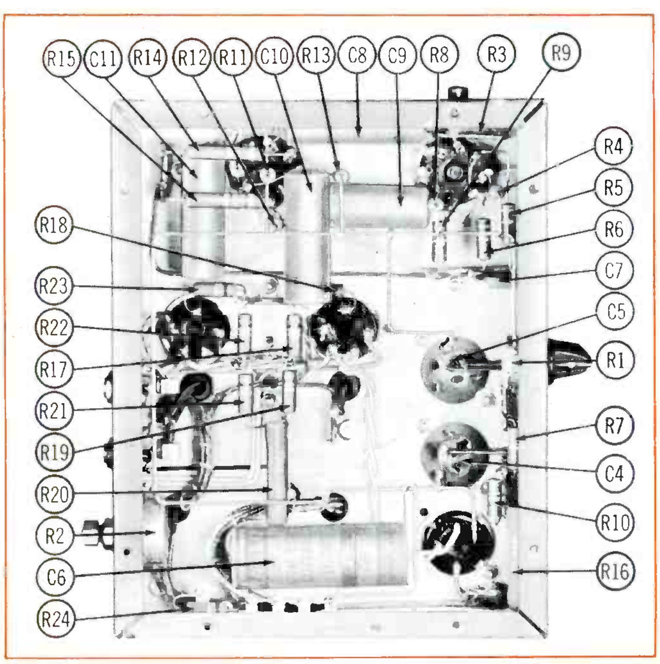


Fig. 2. (A) Bottom View of Amplifier.

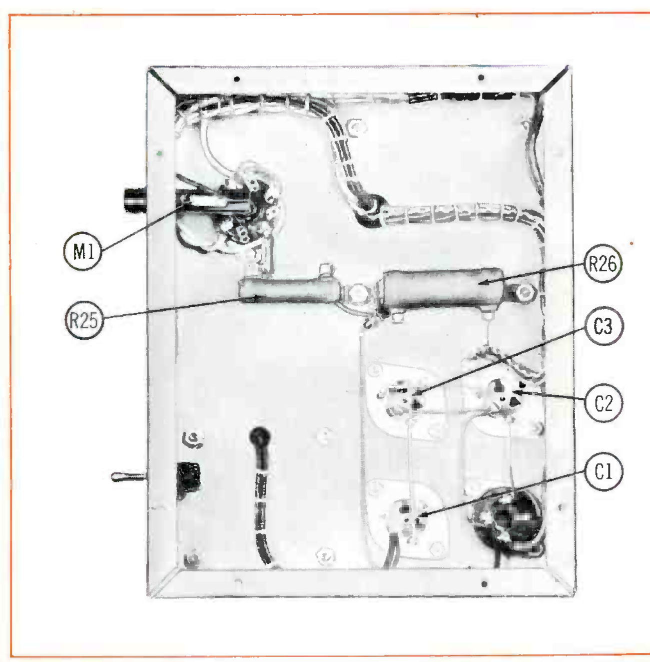


Fig. 2. (B) Bottom View of Power Supply.

WALSCO *Imperial*

INTRODUCING the greatest advance in Conical antennas . . . it's the *all-new* WALSCO *Imperial*. Featuring a new "barrier disc" insulator with 2 inches of air space between the terminals to prevent *shorts*. Soot deposits, dirt, moisture, salt, etc., *cannot* affect this insulator. The WALSCO *Imperial* will therefore maintain *lasting* high gain performance *anywhere*, regardless of weather conditions. Contact surfaces and terminals will *never* rust or oxidize. Front end hardware is *stainless steel* to prevent corrosion losses *permanently*. Front end elements are pre-assembled to holding plates which are fastened to the insulator with one wing nut. Less than 2 minutes to assemble.

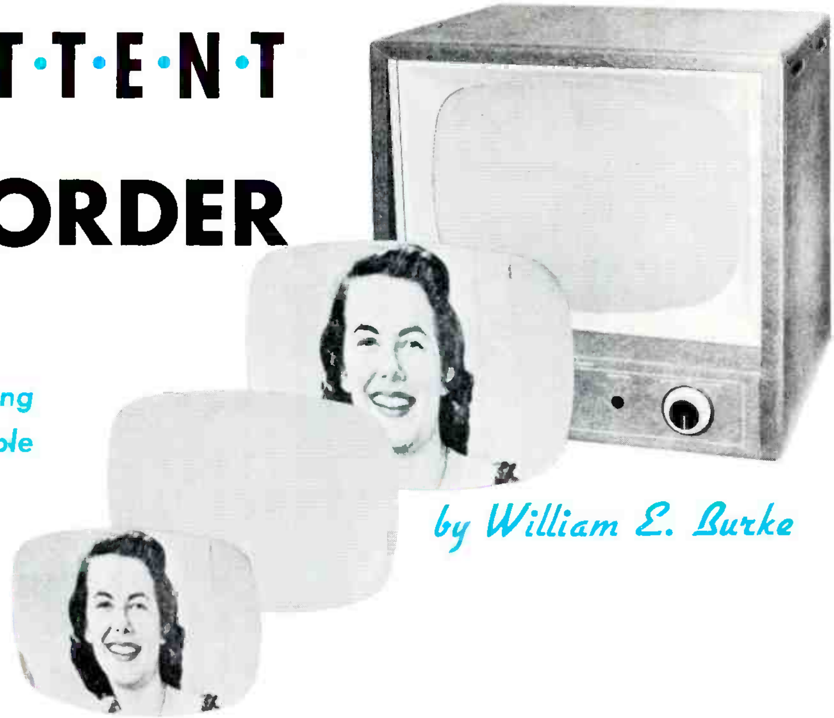
MOST REVOLUTIONARY CONICAL ANTENNA IN 4 YEARS

Guaranteed lasting high gain on all VHF channels

3 year unconditional guarantee!

WALSCO ELECTRONICS CORPORATION
3602 Crenshaw Blvd., Los Angeles 16, Calif.

I·N·T·E·R·M·I·T·T·E·N·T RECORDER



An Instrument for Determining Causes of Intermittent Trouble

by William E. Burke

A television receiver which operates intermittently often requires many hours of labor before the cause of the intermittent operation can be found. The Magne-Pulse Type 202 intermittent recorder pictured in Fig. 1 has been designed for the express purpose of shortening the length of time required to identify a trouble of this nature. The recorder is so constructed that the service technician can connect it to a receiver and service other receivers while waiting for the intermittent trouble to occur. The technician is notified that the trouble has appeared when a panel lamp on the recorder lights and an internal buzzer sounds. A bench scene showing the use of the recorder is presented in Fig. 2.

Intermittent troubles can be divided into two classes: (1) those that exist for extremely short time intervals and (2) those that exist for a longer period. The first type is difficult to identify, because the conventional meter type of instruments will not follow the variations in voltage which occur at the instant of trouble. The second type is almost equally difficult to service, since it includes those troubles that disappear as a result of an unbalance introduced by the connection of a conventional test instrument. The recorder is effective in tracing both types of trouble because of its fast response time and the fact that it is connected to the receiver before the trouble appears.

The Type 202 intermittent recorder consists of three VTVM circuits of different sensitivities and ranges and of a regulated, self-contained power supply. The schematic diagram is shown in Fig. 3. Each VTVM circuit is identified by a particular color for the panel lamp and the input lead associated with that circuit. The input of each VTVM can be switched to accept positive or negative DC voltages or AC voltages. The following paragraph is a description which applies to any one of the three VTVM circuits.

The input voltage from the receiver being tested is connected to a switch which inserts a diode in the circuit for AC voltages or removes it for DC voltages. This switch also reverses the polarity of a 1.5-volt bias cell to compensate for positive or negative DC voltages. The bias cell is included as a reference voltage to which the input voltage is compared. A portion of the input voltage is selected by the setting of the METER ZERO potentiometer to be exactly equal to the voltage of the bias cell, but of opposite polarity. Thus, for normal operation, zero voltage is

* * Please turn to page 35 * *

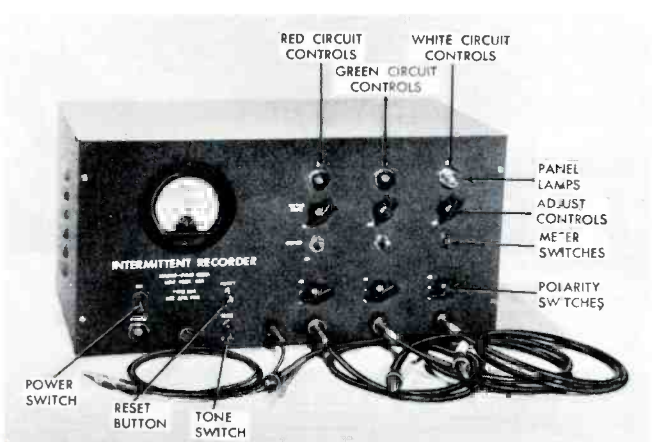


Fig. 1. Magne-Pulse Type 202 Intermittent Recorder.

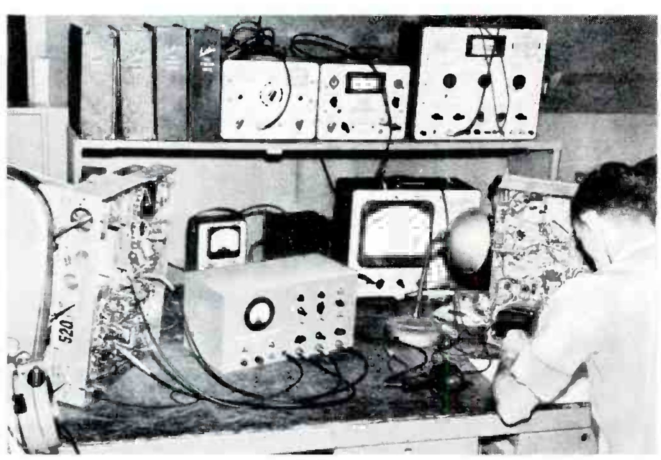


Fig. 2. Bench Scene Showing a Technician Engaged in Servicing a Receiver While the Intermittent Recorder Monitors Another Receiver.

FIRST ...in more ways than one!

First On The Market . . . more than 20 years ago Mallory produced the first commercial Vibrators.

First As Original Equipment . . . today Mallory produces more Vibrators for set manufacturers than all other makes combined.

First With Servicemen . . . surveys show that Mallory Vibrators are preferred and used by 5 out of 6 servicemen.

Your Work Is Right The First Time when you use Mallory Vibrators. The patented, tuned mechanism assures completely dependable performance . . . always. Ask for Mallory Vibrators by name.

Cover 75% of Your Replacement Needs with just 6 Mallory Vibrators!

Ask your Distributor about Mallory Deal 2448 which includes these 6 fast moving Vibrators.

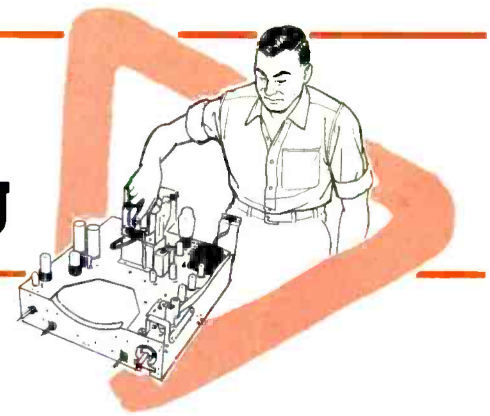
And be sure you have a copy of the current Mallory Vibrator Guide. It is a complete cross reference listing and service guide—the most recent edition of a publication serving servicemen for nearly 25 years.

P. R. MALLORY & CO. Inc.
MALLORY

CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA



In the Interest of . . .

Quicker Servicing

by DON R. HOWE

CBS-Hytron Tube Socket Locators

How many times have you been faced with the problem of inserting a miniature tube in a socket which is not visible because of its location on the chassis? Possibly you may have been forced to remove the chassis from the cabinet so that the socket is visible in order to align the tube properly for insertion. Such steps not only are trying on one's patience, they are a waste of considerable valuable time in performing what would otherwise be a simple operation.

A socket locator has been developed to be used advantageously in a situation like that mentioned. This locator makes the insertion of a miniature tube practically as simple as that of the octal type of tube with its built-in locating key. The locator consists of a thin circular wafer about the size of a dime. It has two circles of holes with one circle matching the pin arrangement on a 7-pin miniature tube and the other corresponding to that on a 9-pin tube. In the center of the wafer there is a post which is designed to fit the hole in the center of the miniature socket.

The procedure for using the socket locator is as follows: (1) if necessary, straighten the tube pins with a pin straightener; (2) slip the locator over the ends of the tube pins no more than half way, as shown in Fig. 1; (3) move the tube about in the region of the socket until the center post on the locator falls into the center hole of the socket (take care not to slip the locator up on the tube pins during this process); (4) rotate the tube until the pins properly engage; and (5) press the tube downward, which process will slip the socket locator up on the tube pins and allow the pins to make connection. The foregoing procedure makes it necessary to leave the socket locator on the tube, but the construction of the wafer is such that it will not affect the operation of the circuit.

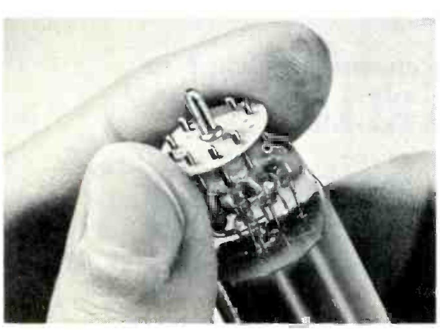


Fig. 1. Tube Socket Locator. (Courtesy CBS-Hytron.)

Currently, CBS-Hytron is making these socket locators available in connection with a quantity tube purchase, with the offer extending through February 1954.

Picture-Tube Breakage

In a recent survey conducted among members of the RETMA Service Committee by the Radio-Electronics-Television Manufacturers Association, some interesting results were obtained. The purpose of the survey was to determine the number of picture-tube implosions as well as the types of picture tubes involved. The survey revealed that most implosions occurred to 21-inch tubes having cylindrical faces. One of the questions asked on the survey was, "What type of tube failed in this manner?" From the answers to this question, the tubes that failed were the "21-inch rectangular cylindrical in most cases, a few 27-inch cylindricals, and a few 17-inch rectangular sphericals." It is believed that the use of the 21-inch cylindrically faced tube will decline because of its extra weight and susceptibility to breakage.

Another question asked on the survey was, "In what percentage of the cases of tube implosions did the protective glass shatter?" The answer provided an average figure of 69.7 per cent. At first thought, this would lead one to believe that the safety glass does not perform the job for which it is intended; however, this is not the case. The energy required to break the safety glass reduces the effect of an implosion tremendously. For the service technician, the best answer to the implosion problem is to handle all picture tubes with extreme care and to pay particular attention to those with cylindrical faces.

These notes were compiled from a report by the Radio-Electronics-Television Manufacturers Association.

New Horizontal-Deflection Amplifier

The failures of 6BQ6GT tubes have caused considerable trouble for no apparent reason in some TV receivers. One trouble is in the form of periodic breakdowns of this tube even though the operation of the circuit is normal. The question then becomes, "What can be done to effect a more permanent repair of the receiver?"

One tube manufacturer has developed a new type of tube intended to overcome this situation. He states that this tube will provide longer

* * Please turn to page 83 * *

Fig. 2. The 6CU6 Horizontal-Output Amplifier.

A PF INDEX
UHF COVERAGE

A description of circuits and equipment for Ultra High Frequency reception.

by GLEN E. SLUTZ

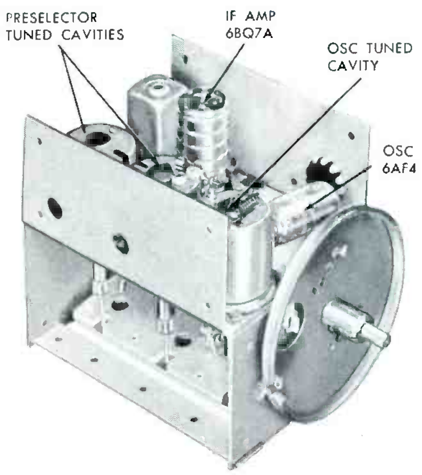


Fig. 1. Granco UHF Coax-Tuner Model UH-1.

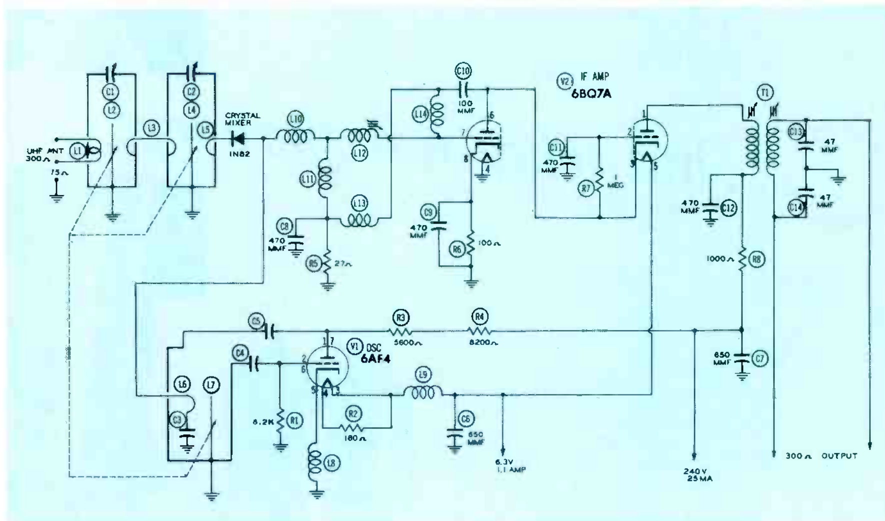


Fig. 2. Schematic of Granco UHF Coax-Tuner Model UH-1.

Granco UHF Coax-Tuner Models UH-1 and UJ5

The Granco Model UH-1 and Model UJ5 are UHF tuners designed to be added to existing VHF television receivers to provide all-channel UHF reception. The Model UH-1 differs from the Model UJ5 only in that the latter has provisions for an attached, slow-speed tuning drive. The description of one will thus suffice for both.

The Granco Model UH-1, shown in Fig. 1, is a small unit intended to be mounted inside the cabinet of any television receiver having sufficient space to accommodate it. In addition, the receiver must be capable of supplying the tuner with the necessary power for operation: 240 volts DC at 25 ma and 6.3 volts AC at 1.1 amps. The arrangement of the mechanical tuning drive is left to the installer's discretion.

The tuner, in combination with the VHF tuner in the receiver, provides a double conversion of the UHF signal to the receiver's IF. The schematic diagram of the Granco Model UH-1 is shown in Fig. 2. Note that the antenna input circuit consists of two coaxial cavities which form a broadly tuned bandpass preselector. The UHF signal leaving the preselectors is coupled to a 1N82 crystal mixer. The oscillator signal is also coupled to this mixer, and the resultant difference signal is applied to a self-biased 6BQ7A cascode IF amplifier. This stage is connected in cascode to provide low-noise amplification of the signal. The IF output transformer may be adjusted to set the tuner output on either channel 5 or channel 6 for acceptance by the VHF tuner in the receiver.

The output circuit of this Granco UHF tuner has a balanced 300-ohm impedance. To connect the tuner to the VHF tuner in the receiver, disconnect the VHF antenna from its original terminals. The output of the Granco unit is on a short length of 300-ohm line which is long enough so that it may be attached to the antenna terminals of the receiver if the tuner is mounted close to these terminals. In some cases, this line may have to be extended in order to make connection. When both UHF reception and VHF reception are desired, an antenna change-over switch should be inserted in this lead. A low-capacitance, double-pole double-throw wafer is recommended for switching the receiver input from the VHF antenna to the UHF tuner output and vice versa. It may be desirable in some instances to break the B+ lead to the UHF tuner when receiving VHF; the switch contacts for this function may be incorporated in the antenna switch. Opening the filament lead to the tuner is not advisable.

The UHF antenna input circuit of the Granco Model UH-1 tuner has a balanced 300-ohm impedance. If a 75-ohm input impedance is called for, the antenna transmission line can be connected between one of the antenna terminals and ground.

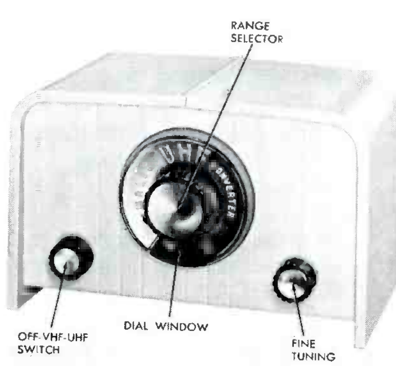


Fig. 3. Walsco UHF Converter Model 2000.

Walsco UHF Converter Model 2000

Designed for use with any VHF television receiver capable of tuning channels 5 or 6, the Walsco UHF Converter Model 2000 will provide reception of channels 14 through 83. Fig. 3 is a photograph of the Walsco unit and shows the front-panel layout. The knob on the lower left is the

* * Please turn to page 51 * *

They look alike...

. . . but what a difference!

These RCA types today give you . . .

RCA receiving tubes provide the superior performance and reliability usually associated with higher priced specialty designed types. That's because RCA receiving tubes are constantly being improved to meet the changing requirements of radio and television applications.

For instance, the RCA-5U4-G features a new electrolytic coating on its channel filament which produces a uniform, hard emitter, leading to greatly increased life over the older version.

Or take the RCA-6W4-GT. This type now uses a new RCA-developed carbonized plate-coating material which has improved heat-dissipating properties, thus contributing to longer tube life and increased reliability.

The RCA-6AL5 now utilizes double helical heaters to insure low hum and pinched cathodes to minimize cathode shift within the mount. These features make possible greatly reduced microphonics.

The superior performance of *regular* RCA receiving tubes—at *regular* prices—eliminates unnecessary call-backs, assures you of greater customer satisfaction, results in increased profits for you.

When you sell a receiving tube, your reputation and profit depend on its *performance* and *reliability*.

↑ ↑ ↑

So, you just can't afford to buy anything less than the best in receiving tubes . . . and that's RCA.

Longer Life

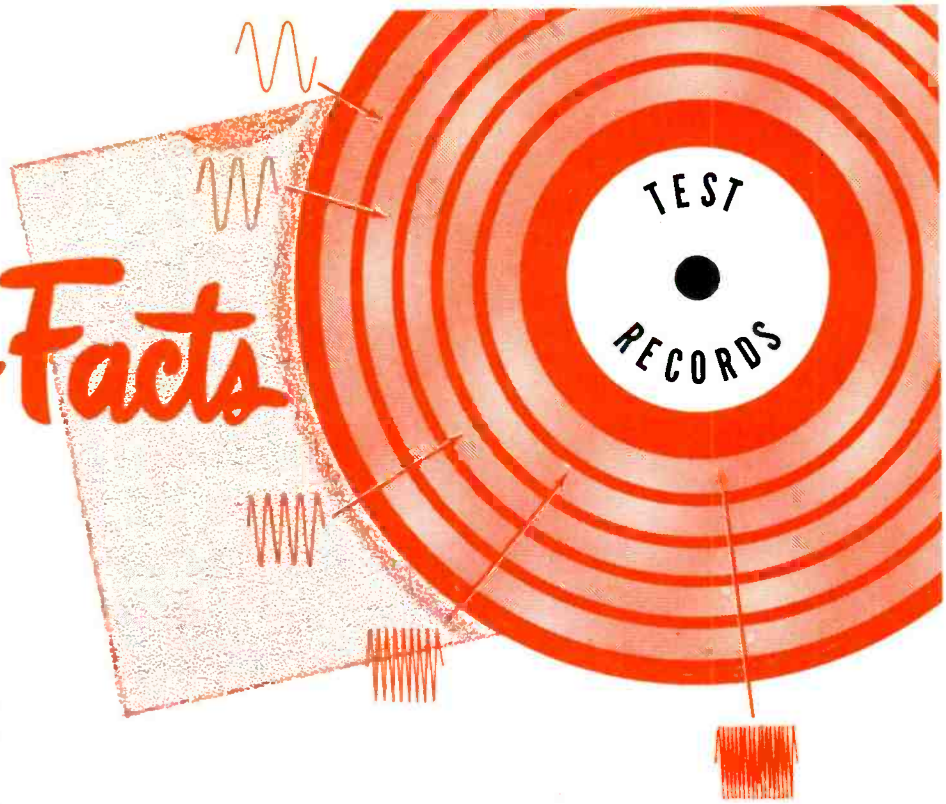
Superior Performance

At No Extra Cost

RADIO CORPORATION of AMERICA

ELECTRON TUBES **HARRISON, N. J.**

Audio-Facts



by ROBERT B. DUNHAM

There may be some doubt as to whether or not a sound system is operating as it should. Maybe it has just been installed or maybe it has been in use for quite some time, but it does not sound just right. And, too, maybe the reproduced sound is so bad that we know definitely that something is wrong. In any case one thing is certain, we need some method or means of testing or checking to enable us to locate the trouble so that it can be corrected.

Experience and familiarity with audio equipment are great assets to possess when adjusting or checking a sound system. The ear alone cannot be relied upon for critical work. Actually something more is needed if we are to measure the performance of any or all sections of the sound system. A few simple tests with the right equipment can ofttimes locate the difficulty or defect quickly and without guesswork.

Many of the instruments commonly used when testing electronic equipment, including radio and television receivers, can also be used in audio work; but some methods and certain pieces of equipment have been developed particularly for checking high-fidelity systems.

One such method of testing is the one making use of test records. This is logical since a record makes use of every section of the sound system from the turntable and pickup to the loudspeaker and the room in which the listening is done.

Some of the many test records now available can be used by the individual to provide for a listening test only. Others require the use of additional test equipment, such as meters and oscilloscopes, and may also require some technical knowledge on the subject. The tests made with these records can give very definite clues as to what the trouble is and where it is located.

As far as test records are concerned, probably the demonstration record must be considered the basic one. The Hi Fi enthusiast has always had his pet records which he used to judge the merits of a sound system. Maybe just a few extremely low tones, a cymbal crash, or a flurry of drums were the only portions used; but he was able to form an opinion on the fréquency response of the system and on its ability to handle transients.

Although the art of recording has advanced to the point where the majority of the present-day records can qualify for use as demonstrators, the various demonstration records issued by the different manufacturers do serve a very useful testing purpose. A record such as Capitol's "A Study in High Fidelity" certainly does provide program material suitable for displaying the ability or lack of ability of a sound system to reproduce a wide range of musical effects. The text (most of it written by Charles Fowler, editor of High Fidelity Magazine) accompanying this record adds to its value.

The test records, such as the Clarkstan Sweep Records (discussed and demonstrated in "Audio Facts" in PF INDEX and Technical Digest #35, November-December 1953) and those furnished by Cook, Dubbings, RCA Victor, Columbia, and others do provide more specific and technical information. We will discuss the features of some representative records and consider some of the things to be accomplished with them.

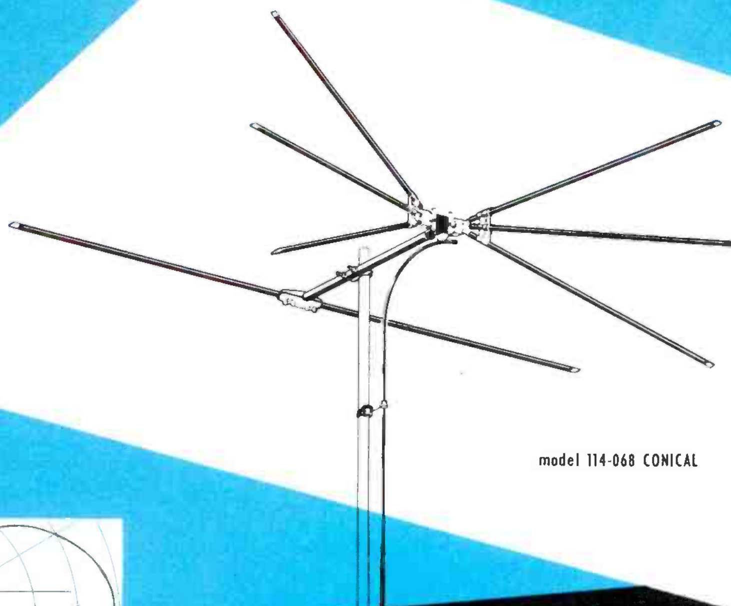
The Dubbings' D-100 test record carries these descriptive words "The Measure of Your Phonograph's Performance" on the front of its protective sleeve. Most of this measuring is done by just listening to the recording as it is being played according to the instructions printed on the back of the sleeve.

It is a 12-inch 33 1/3-rpm LP microgroove record which is to be played with a 1-mil stylus. The two sides (each cut in twenty bands) are identical. One side is to be used for making tests while the other is kept in reserve and only used as a reference for the test side. Fig. 1 shows a section of this record.

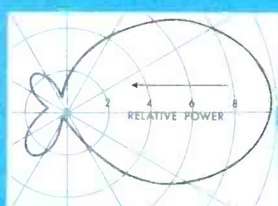
The first and logical test is for adjustment of the weight of the pickup on the record. This is done by counterbalancing the arm. With some arms one can attach paper clips, a small coin, or such to the tail end of the arm to attain balance; and with other arms the counterbalancing spring will have to be adjusted to the weight which will

* * Please turn to page 75 * *

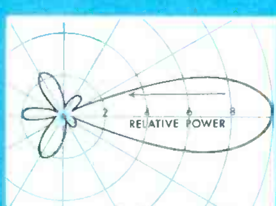
now!



model 114-068 CONICAL



69 mc—channel 4



195 mc—channel 10

Directivity patterns of the CONICAL are exceptionally clean. The strong major lobe indicates fine directivity.

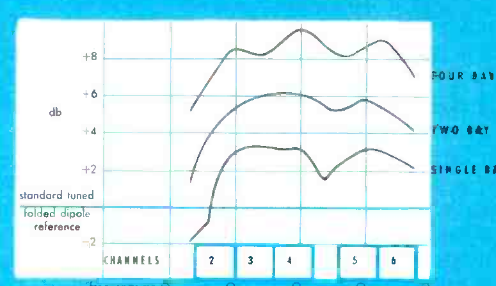
a VHF CONICAL antenna built to the Quality Standards of AMPHENOL

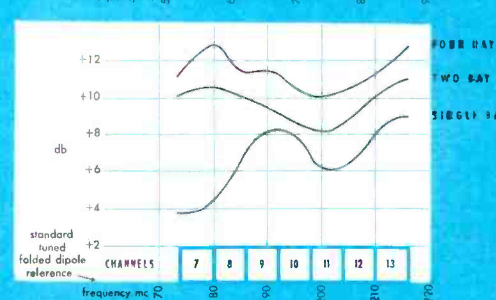
Now ready to join the fastest-growing and fastest-selling antenna line in the United States is a new AMPHENOL VHF antenna. Designed to supplement the fabulous INLINE* for VHF reception, the new CONICAL antenna will give true-picture reception in *every VHF signal area*: major, fringe and long-distance. Gain and directivity have been engineered to the high AMPHENOL standards that have set the quality goal for the entire industry; craftsmanship attention to the small but important details make the CONICAL another example of AMPHENOL's fine antenna work.

AMPHENOL CONICALs are available in single, two and four bay models. The stacked models use unique phasing harnesses for extra gain. The CONICAL may be obtained in packaging that contains all the necessary stacking equipment or else the individual antenna may be purchased one or two to a carton. In addition, the single bay CONICAL is available in a complete antenna installation kit.

All elements of the CONICAL are constructed of sturdy, long-lasting seamless aluminum tubing — assuring rust-free years of top performance.

*Reissue U. S. Patent 23,273





High gain of the CONICAL is illustrated in the gain charts for single, two bay and four bay models. Measured in accordance with proposed RETMA standards, the charts also show the desirable flatness of the gain.

AMPHENOL

AMERICAN PHENOLIC CORPORATION • *chicago 50, illinois*

Examining DESIGN FEATURES

by HENRY A. CARTER

Printed Circuit IF Strip

A new product has recently been made available to the television industry by the Radio Corporation of America. This product is a complete, printed-circuit, IF assembly employing three 6CB6 tubes as IF amplifiers and a 1N64 crystal diode as the second detector. The assembly is designed for use in television receivers of the intercarrier type employing a video IF of 45.75 mc and a sound IF of 41.25 mc. A top view of this unit appears in Fig. 1.

All components of this assembly are mounted on a panel 8 25/32 inches long and 1 15/16 inches wide. Fig. 1 shows how these components are arranged on the mounting panel. The leads of the individual components are fed through the panel to the printed wiring underneath, and they are then secured physically and electrically by a dip-solder process. This soldering process eliminates the individual soldering of each connection and provides more uniform connections throughout the strip. Mass production of the units is simplified by this procedure. The printed wiring and dip-soldered connections are shown in Fig. 2.

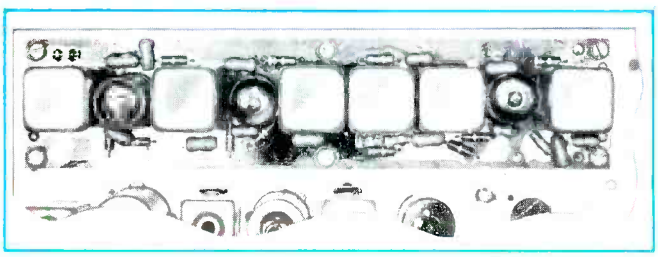


Fig. 1. Top View of the RCA Printed-Circuit IF Strip Installed in a Television Receiver.

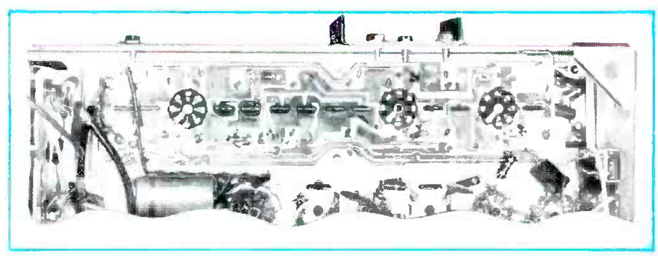


Fig. 2. Bottom View of the RCA IF Strip Showing the Printed-Circuit Wiring.

The coils and transformers used in this unit are also of the printed-circuit type. One of the coils and its associated shield can are shown in Fig. 3. The coils are fabricated on plastic strips by the RCA photo-etched, copper-foil process resulting in flat coils with rectangular windings. A higher degree of tolerance can be maintained by this method. These coils are tuned by a metal disk which is screwed closer to or farther from the coil. The tuning adjustments are accessible through holes in one side of the shield can. All the holes are located on the same side of the IF assembly. The alignment of the IF strip may therefore be made from the top of the chassis, thus facilitating the alignment procedure.

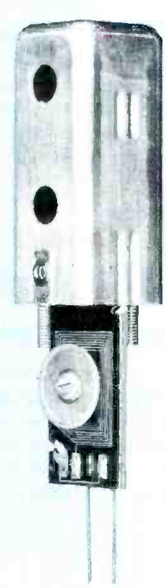


Fig. 3. A Printed-Circuit Coil Partially Removed From Its Shield Can.

A schematic diagram of the IF strip appears in Fig. 4. Reference to this diagram will show that the output of the tuner is fed through a shielded cable to the input circuit of the first IF amplifier. The input circuit features two of the printed-circuit coils contained in a single shield can. The coil L2 in series with the grid of V1 is tuned to 43.5 mc. This coil and the tuned coil in the plate circuit of the mixer provide a double-tuned circuit. Coil L3 is tuned so that it will be series resonant with capacitor C5 at a frequency of 39.75 mc. These latter two components form a trap for attenuating the adjacent picture carrier signal.

The plate circuit of the first IF amplifier and the grid circuit of the second IF amplifier contain a rather unique circuit. Four of the printed-circuit coils are used to form a double-tuned, double-cutoff bandpass filter. Coil L6 and capacitor C11 are series resonant at 41.25 mc which is the frequency of the accompanying sound signal. This sound signal will therefore be attenuated by the series trap. The trap formed by coil L7 and capacitor C12 is resonant at 47.25 mc. This is the frequency of the adjacent-channel sound signal. Coils L4 and L5 form a double-tuned circuit which gives the desired bandpass. The combined action of coils L6 and L7 offers a high impedance to frequencies within the desired bandpass. This results in a higher degree of coupling between the plate and grid circuits.

The second and third IF stages are transformer coupled to each other. The transformers used in this application have tuned primary and tuned secondary coils. Transformer coupling is also used between the third IF stage and the crystal detector.

Motorola Model 53F2

The Motorola 53F2 radio-phonogragh combination contains a rather unusual system of record reproduction. The entire radio, with the exception of the antenna circuit, is used in this system of reproduction.

* * Please turn to page 73 * *

SERVICEMEN:

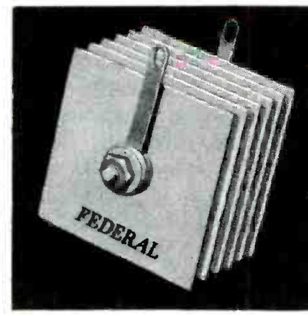
PROFIT MORE IN '54

with *Federal's* TV-4

❶ *Federal* SELENIUM RECTIFIERS

The complete line—packaged for unit and bulk sales

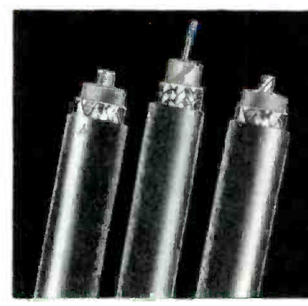
Now in their new color, *"Rectifier Red,"* Federal selenium rectifiers are available in a wide range of package types: 8-unit replacement kits; Universal replacement line (boxes of 12); Standard replacement lines (boxes of 12 and 24); single rectifiers in packages for sale through Federal's self-service counter dispenser. Also available: All-purpose assembly kits and "packaged power" stacks. Servicemen *know* Federal... through millions of profitable replacement jobs . . . in TV, radio and many other fields!



❷ *Federal* COAXIAL CABLES

For Trustworthy Transmission—HF, VHF, UHF

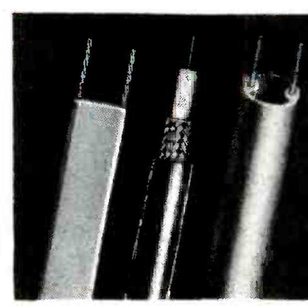
Whatever your transmission line requirements—look to Federal—America's top source of regular RG types—including the Federal-developed low-temperature, non-contaminating thermoplastic jacket. Federal coaxial cables are quality controlled throughout the manufacturing process. Every possible test is made to insure constant efficiency of physical and electrical properties under the most rugged conditions. Check with your Federal Distributor . . . specify Federal RG type cables and you'll always be sure!



❸ *Federal* TV LEAD-IN CABLES

For North, East, South, West—wherever you find TV

With Federal in stock you have the answer—and a profitable answer—to your customers' lead-in problems . . . for initial installation or replacement. Federal's quality-controlled cables meet the needs of Community TV, urban centers and fringe areas . . . regardless of local conditions. Moreover, Federal has a cable for *every electronic application*. Federal is a leader in cable production . . . Federal has pioneered in the field for years. Millions of feet sold is proof that you can profit with Federal . . . !



❹ *Federal* "S-C-S"* GERMANIUM DIODES

Another outstanding Design Achievement by Federal

One of the newest members of the Federal Product Line . . . "S-C-S" Germanium Diodes . . . engineered, designed and precision-made to provide thousands of hours of dependable performance. Federal's "S-C-S" diodes are a notable contribution to diode progress . . . offering the same high-quality single-crystal germanium and the same precision techniques used in transistor production. Get the facts about "S-C-S" diodes . . . with features that are sure to lift them to a top spot in the diode sales picture!

*** SINGLE CRYSTAL STABILIZED**

Federal Telephone and Radio Company

SELENIUM-INTELIN DEPARTMENT 100 KINGSLAND ROAD, CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

See your Federal Distributor or write to Dept. F-9118

Test Instrument Coupling Methods

by Paul C. Smith

Service technicians are by nature an inquisitive lot, forever asking themselves "Why?" This natural curiosity is their stock in trade, so to speak, and the pleasure that comes from solving a particularly "knotty" problem gives them a gratifying sense of achievement apart from the monetary reward they hope to obtain.

During the course of a receiver alignment the technician may read, "Dummy antenna -- .1 mfd" or "50 mmf," as the case may be. Not having that particular value at hand at the moment, he may substitute the nearest value he does have and possibly with satisfactory results. This naturally leads to the questions, "What determines the proper method for connecting a test instrument to the receiver?" or "What determines the value of the capacitor or resistor to be used?"

Perhaps the simplest application would be the use of a blocking capacitor. As the name implies, it is used to block any DC voltage present at the point of connection. This serves two useful purposes: (1) it keeps harmful voltages from being applied to the test instrument, and (2) the circuit in question is not disturbed by additional current drain. Of course, the test instrument may already be protected by its own blocking capacitor, but many do not have this feature. This is especially true of modern sweep generators and RF signal generators, which usually have their output terminated in an attenuator designed to present a nearly constant impedance output at all settings. If this output attenuator is accidentally connected across a voltage source without the protection of a blocking capacitor, damage is very likely to result.

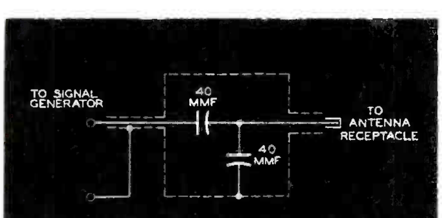


Fig. 1. Dummy Antenna for Use with Automobile Receivers.

When used in this manner, the value of the capacitor is not critical. Values used commonly range from .001 mfd to .5 mfd. The main requirement is that the reactance of the capacitor be low enough at the frequencies involved so that most of the output signal is applied to the circuit under test. The voltage rating of the capacitor should be high enough to withstand any voltages encountered.

Some alignment instructions for AC-DC receivers may recommend the use of a .1-mfd blocking capacitor with the further instruction that this value be changed to .001 mfd or to 200 mmf, if AC power is used without an isolation transformer. The reason for the change to the smaller values is to reduce hum modulation of the signal, a condition which would make alignment of the receiver more difficult. With the capacitor of the larger value, a portion of the 60-cycle line voltage may be applied to some portion of the signal circuit of the receiver. The reactance of a .001-mfd capacitor is 100 times that of a .1-mfd capacitor, so the use of the capacitor of the smaller value will reduce the hum-signal input considerably. The RF signal is attenuated also, but the attenuation is negligible compared to that of the 60-cycle signal.

In cases where the test instrument is to be connected to a tuned circuit, the choice of capacitor for coupling appears to be more critical. In checking several radio receivers, the use of a capacitor of value smaller than that recommended had no adverse effect other than to decrease the signal strength applied to the receiver. When a value larger than the recommended value was used, the tuning of the circuit was changed slightly. The higher the frequencies involved, the more effect a larger capacitor will have. Any form of isolation serves to reduce the effect. An example would be the use of a transformer in an antenna circuit, with the transformer having a tuned secondary winding and an untuned primary winding. A connection to the primary would have less effect on the tuning of the secondary than a direct connection to the secondary.

The dummy antenna for use in aligning automobile receivers will usually be chosen to simulate as nearly as possible the normal conditions one meets during actual operation of the receiver in an automobile. In addition, alignment instructions usually specify that the antenna trimmer should be repeaked with the receiver installed in the car and with the antenna extended as for normal use. Incidentally, although the term "dummy antenna" is loosely applied to any device for connecting the test instrument to its associated circuit, in this case it is more nearly correct because the dummy antenna is designed to duplicate the electrical characteristics of the real antenna.

A typical dummy antenna for use with automobile receivers is shown in Fig. 1. In use, the two capacitors are effectively in parallel across the receiver input.

The standard dummy antenna recommended by the IRE for use in receiver alignment and testing is shown in Fig. 2. This antenna is designed to give optimum results over as wide a frequency range as possible.

Where sweep generators are to be used in aligning and in checking the over-all response of a circuit, it is important that the impedance of the generator be properly matched to the input of the circuit under consideration. Otherwise, standing waves will occur on the generator output cable, and the response curve will be distorted.

The standard 300-ohm FM dummy antenna is shown in Fig. 3. R1 and R2 are of equal value, and R3 is the output impedance of the FM generator. The total value of R1 + R2 + R3 equals 300 ohms.

* * Please turn to page 55 * *

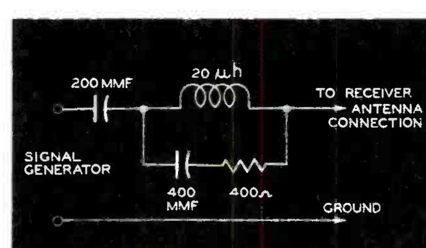
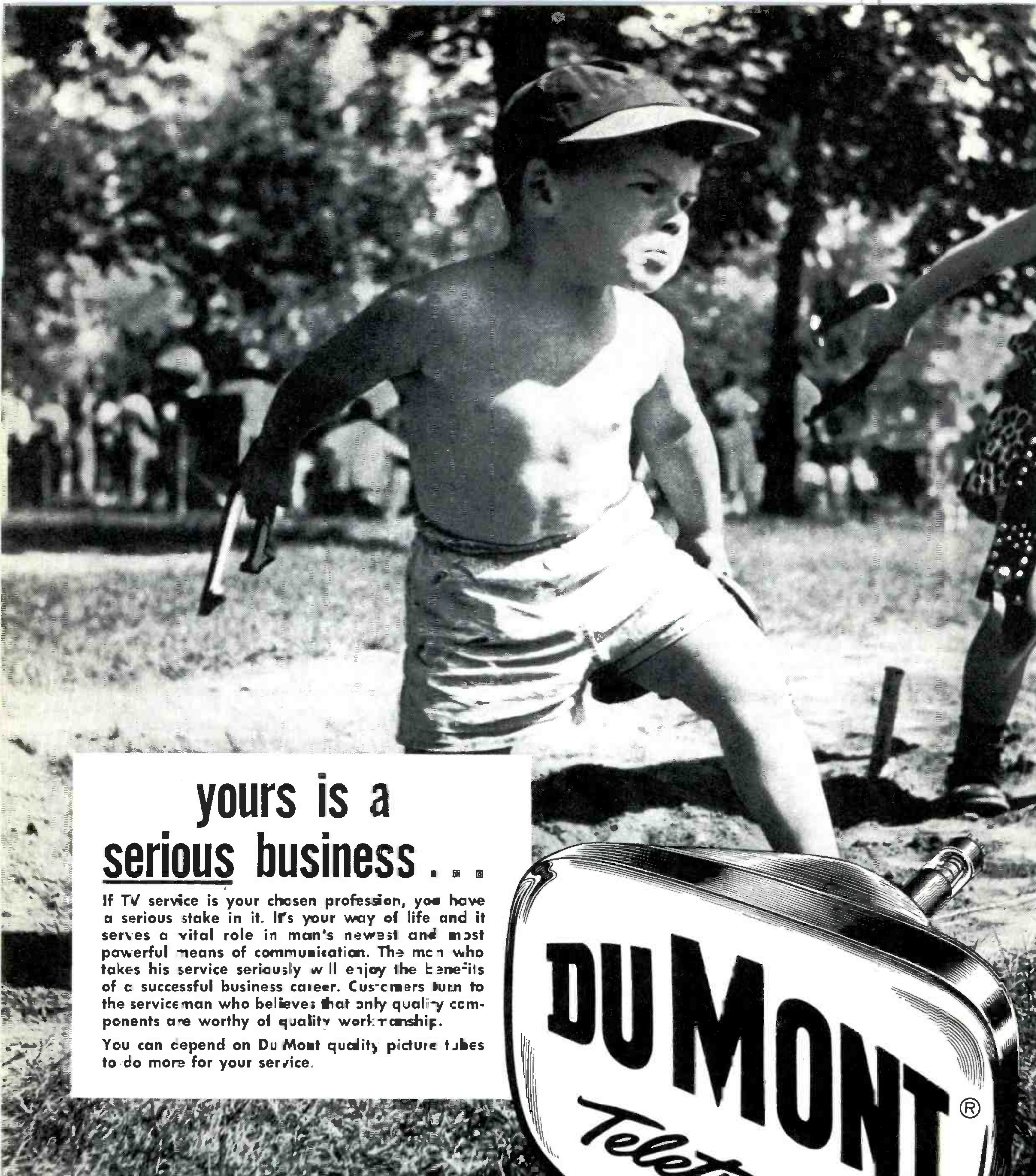


Fig. 2. The IRE Standard Dummy Antenna.



yours is a serious business . . .

If TV service is your chosen profession, you have a serious stake in it. It's your way of life and it serves a vital role in man's newest and most powerful means of communication. The man who takes his service seriously will enjoy the benefits of a successful business career. Customers turn to the serviceman who believes that only quality components are worthy of quality workmanship.

You can depend on Du Mont quality picture tubes to do more for your service.

Photography Magazine Contest Winning Photo by Cornelius E. Westveer

Replacement Sales, Cathode Ray Tube Division

Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

PIONEER IN BIG PICTURE TUBES • ORIGINATOR OF THE FAMOUS BENT-GUN AND SELFOCUS • LEADER IN HIGH-RESOLUTION • MAJOR SUPPLIER TO MOST FINE TELEVISION RECEIVER MANUFACTURERS

*Trade-Mark

RHOMBIC TV DESIGN

Theory of Operation and a Guide for Construction

by DON R. HOWE

Long-distance television reception is of interest to many TV viewers, particularly those who are many miles away from the nearest station. An installation for long-distance reception requires that many points be taken into consideration. The importance of several of these points will be dependent upon the individual installation, while many points will be common to all. Such installations are not unlike the proverbial chain which is only as strong as its weakest link. Every "link" from antenna to receiver must work properly because of the low intensity of the available signal.

One of the prime considerations is the selection of a suitable antenna. The desirable characteristics of such an antenna are: high gain, sharp directivity, and broad frequency response. High gain is desirable because of the low strength of the signal that will be received. Sharp directivity is important to eliminate unwanted signals which may cause interference and ghosts. The directional pattern also reduces the noise pickup which would be detrimental to a good picture presentation. If signals are available from several stations, an antenna with broad frequency response will permit a retention of high-gain characteristics over several channels. One of the antennas which exhibits these characteristics is the rhombic. The disadvantage of a rhombic antenna for reception of VHF television channels lies in its large size. This factor requires that a large space be available for its erection and also makes the antenna impractical for rotation. Where space is not a major problem, this rhombic antenna will usually prove to be a good choice.

Before considering the design of a suitable rhombic antenna for VHF television reception, a brief discussion of the theory of such an antenna will be beneficial. The theoretical consideration for VHF departs somewhat from the considerations as applied to the lower frequencies. At frequencies between 5 mc and 35 mc, a transmitted signal is reflected from the ionosphere and returns to the earth at some angle. This angle is called the wave angle. At long distances from the transmitter, this wave angle must be considered as a basis for the design of low-frequency rhombics. The primary signal path for VHF is line of sight rather than reflected path. In this case the wave angle becomes zero degrees and necessitates a different approach to a practical antenna design.

A rhombic antenna, as viewed from above, is shown in Fig. 1. The major lobes of each leg are also indicated in this figure. The proper combination of these lobes gives the antenna its directivity and high gain. Signals in lobe 2 and lobe 4 combine in such a manner as to reinforce each other. Since the signal in lobe 2 is 180 degrees out-of-phase with the signal in lobe 4, some method must be employed to permit the lobe-2 signal to arrive at point "C" in proper phase relationship to add with the signal in lobe 4. This is accomplished by making distance "AC" in Fig. 1 one-half wavelength shorter than the "ABC" distance, where points "A" and "C" are midpoints in their respective legs. This one-half wavelength difference will exist when the tilt angle "θ" has the correct value for the desired leg length. The angle "θ" thus becomes a

* * Please turn to page 79 * *

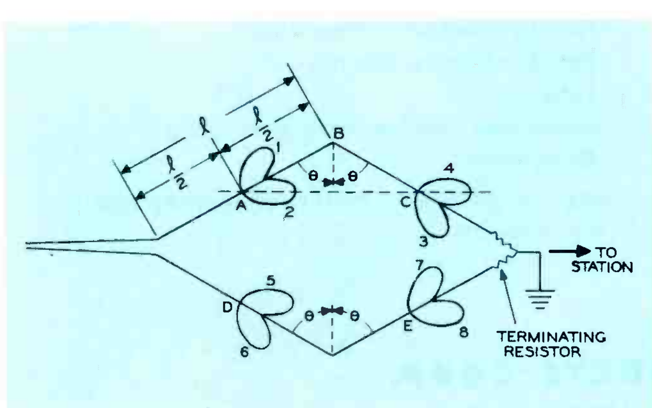


Fig. 1. Lobe Patterns of a Rhombic Antenna.

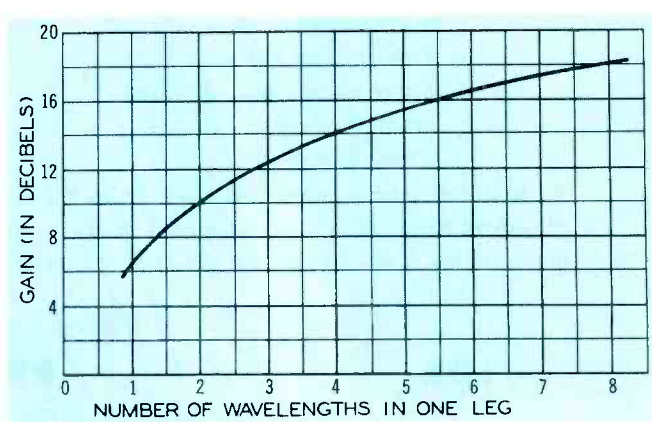


Fig. 2. Graph Showing How Gain Varies With Leg Length.

WARD TELE-VANES

styled for **NEW BEAUTY on the housetops**
INCREASED SALES of TV antennas

Sell the antennas that are "selling" for you. Ward is promoting their new line of Tele-vane Antennas right to the consumer with national advertisements in:

- The American Home
- Architectural Forum
- Better Homes and Gardens
- Business Week
- House Beautiful
- Popular Mechanics Magazine
- Popular Science Monthly
- Time
- House and Garden Book of Building
- Newsweek

Write today for the giant Tele-vane Sales Kit that gives you the complete schedule plus many, many more selling aids. Tie-in with this gigantic selling campaign for the newest, most revolutionary idea in TV antennas yet.

THE WARD PRODUCTS CORP.
DIVISION OF THE GABRIEL COMPANY
1148 Euclid Avenue, Cleveland 15, Ohio

A GABRIEL PRODUCT

In Canada: Atlas Radio Co., Ltd., Toronto, Ont.

MICROVOLTS PER METER

by

DON R. HOWE

The rapid advancements made in the fields of radio and television have required the service technician to become progressively more technically minded. During the course of advancement, terms formerly used only by engineers have become increasingly important to the service technician. "Microvolts per meter" is an example of such terminology. Unfortunately, considerable confusion has surrounded its meaning, and this article is presented in the hope that a clearer understanding may be obtained.

Electromagnetic waves radiated by a transmitter are accompanied by electrostatic waves which produce a stress in space. The stress increases as the strength of the field increases. Since this stress may be measured in volts, field intensity may also be represented in terms of volts. However, if the stress developed across five meters in space were measured, the resultant voltage would be greater than that measured across two meters in space. This makes the measurements meaningless unless the length used is specified. In order to eliminate this confusing aspect, a standard of one meter was adopted. From this one-meter standard, the term "microvolts per meter" was derived. As a result, all field intensities expressed in this term may be compared directly. It should be understood that the word "meter" refers to a linear measurement and is not representative of the wavelength which is also commonly expressed in meters.

Absolute field-intensity values, expressed in microvolts per meter, are commonly arrived at by two methods. The first method is by calculations employing various known factors. This method is used to predict the field intensity at some point without taking actual measurements at this point. The number of factors employed and the complexity of the calculations are dependent upon the accuracy desired. The relationship of these factors is revealed in the following formula used for predicting absolute field intensity. This particular formula does not account for the earth's curvature. For directive transmitting antennas, the formula indicates field intensities in the direction of maximum radiation.

$$E = \frac{3.2\, a\, h \sqrt{W}}{\lambda d^2}$$

where

E = field intensity, in microvolts per meter.

a = height of receiving antenna above ground, in feet,

h = height of transmitting antenna above ground, in feet,

W = effective radiated power (ERP) of the transmitter, in watts,

λ = wavelength, in meters,

d = distance from the transmitting antenna, in miles.

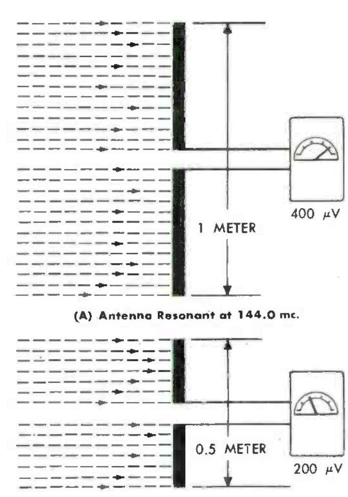
Examination of this formula reveals that the field intensity is directly proportional to the heights of the antennas and to the square root of the radiated power. It is also shown that increasing the wavelength (decreasing the frequency) will correspondingly decrease the field strength. Doubling the distance from the transmitter will decrease the field intensity by one fourth, as shown by the d^2 term. This formula is used for line-of-sight propagation at frequencies up to 250 megacycles. Actual field intensity will vary somewhat from the value found in this formula because of the effects of terrain and atmospheric conditions.

The second method of determining absolute field intensity at a particular location employs actual measurements which are transformed by calculations into microvolts per meter. This system requires rather elaborate equipment and usually demands a known standard as a basis of calculation. Field-intensity measurements taken by the service technician with the equipment available to him are generally expressed in relative values and not in terms of microvolts per meter.

Additional problems arise when absolute field-intensity values are used to estimate receiving conditions at some point. For example, consider a dipole which is resonant at 144.0 megacycles and which has an effective length of 1.0 meter. A similar antenna for 288.0 megacycles will have an effective length of 0.5 meter. The voltage induced across the 144.0-megacycle antenna by a 144.0-megacycle signal of a given absolute field intensity would be approximately twice the voltage induced across the 288.0-megacycle antenna by a 288.0-megacycle signal of the same intensity. The longer antenna has more voltage induced in it because its capture area is twice as great. This is illustrated in Fig. 1. The readings on the meters are only indications of the voltages induced in the two antennas and not true measurements of absolute field intensity.

It may be seen from Fig. 1 that a greater field intensity would be required at the higher frequency in order to produce the same voltage

* * Please turn to page 50 * *



(A) Antenna Resonant at 144.0 mc.

(B) Antenna Resonant at 288.0 mc.

Fig. 1. The Effect of Antenna Length on Induced Voltage.

SOLVED! Your TV tuner small parts problem!

THE STANDARD TUNER
(not included in kit)

Get the handy, all-new STANDARD Tuner Replacement Parts Kit No. 1011

Now . . . 104 small TV tuner parts are at your fingertips in one convenient, low-cost kit that's sturdy, compact, fully labeled for quick reference. You get the most-called-for parts servicing Standard tuners series TV-200, TV-1500, TV-2000 and TV-2200. Each item is individually boxed, except the very small.

More Profit—$25.03 worth of tuner parts for only $22.50.

Save Time—Hard-to-find tuner parts right at hand for quick, sure selection.

Build Customer Goodwill—Replace tuner parts direct from your Standard kit, so your customer will *know* each part is completely new.

Plan now to speed up your service work, bring new order and efficiency to every job. Get your Standard tuner replacement parts kits today! Call, write or wire your parts jobber, or address Standard Coil Products Co., Inc., 2085 N. Hawthorne Ave., Melrose Park, Ill.

IN TV IT'S STANDARD

Standard
COIL PRODUCTS CO., INC.
CHICAGO LOS ANGELES BANGOR, MICH.
NO. DIGHTON, MASS.

Export Agent:
Rocke International Corporation, 13 E. 40th St., New York City

Dollar and Sense Servicing

by *John Markus*

Editor-in-Chief, McGraw-Hill Radio Servicing Library

NAMES. New inventions, new techniques, and new industries are just like new babies—they need names. Right now, one new enterprise is trying to choose from a variety of possibilities, while another doesn't even have a single good name yet.

What's your choice among these: (1) subscription TV, (2) tollivision, (3) C. O. D. TV, (4) pay-as-you-peek TV?

What can you offer for the magnetic-tape recording industry? It needs three related names corresponding to photographing, photograph, and photographer. Despite the tempting $100 reward offered by the new magazine, Tape and Film Recording, we can't dream up even a single possibility. Each time we give the brain a whirl we end up with Magnecording, Magnecord, and Magnecorder, which of course are out because one far seeing tape equipment manufacturer put them to commerical use long ago. We'll just have to wait and see what wins this jackpot. The contest ended Dec. 30, 1953.

You can still become a charter subscriber to this interesting new bimonthly, getting Vol. 1, No. 1 (a collector's item) and the next five issues for two dollars. The address is Severna Park, Md.

WHISTLE STOP. High-fidelity equipment is stopping traffic on the highways as well as in the shops these days. One chap who lives up the turnpike a bit from us decided to try out his brand-new LP recording of railroad sound effects at full volume. When it came to the part where the train whistles for a crossing, there was a wild screech of brakes outside; a passing motorist had reacted instinctively. Wonder if he ever found the train.

KEEPING UP. Back in 1945, the Electronics Dictionary which we put out in collaboration with Nelson Cooke had some 6,500 terms. A search of the literature published since then reveals just about 6,500 new terms that aren't even in; thus, in just eight years the terminology of the industry has doubled. This dramatically points up the importance of reading and studying your technical periodicals, where all new terms first occur.

Take this very issue of the PF INDEX; the odds are that a thorough reading will add at least a dozen new terms to your vocabulary. Learning them month by month comes easy; but when you let yourself get behind for years, that's when it gets tough.

Anybody want to be an electronics lexicographer? Here are a few samples of what need defining: scattersounding, moire effect, debunching factor, dispenser-type emitter, mirror polaristor, diamagnetic dielectric, blanking clamper, stereovectorcardiograph.

LINE VOLTAGE. Where line-voltage regulation is so poor that good radio or television reception is impossible yet the power company ignores complaints, T. L. Bartholomew offers a solution in the December issue of Radio-Electronics. It involves some trouble and expense, but there are often cases where this would be justified.

His procedure, based on years of work for power companies as well as consumers, is to make just one complaint to the power company. If this doesn't work, get a strip-chart type of recorder and make a recording of line voltage for seven days. Put time of day and date indications in the margin, have the chart signed by one or two witnesses, then present it to the Public Service Commission having jurisdiction over the company in question. Be sure, of course, that you are using a reliable instrument; if possible, have it checked by the local power company beforehand. He says this technique has never failed to bring about voltage stability, even though correction of the trouble is a real expense to the power company.

HONEYCOMB. For something new in speaker grille cloth, watch for the honeycomb Saran weave made by the Lumite Division of Chicopee Mills. It's all plastic, comes in a variety of decorative patterns and colors, and has essentially no effect on passage of sound waves.

A research report containing response curves shows that it apparently even amplifies sound. With a General Radio sound-level meter positioned to pick up the constant output of a speaker, placing the new grille cloth over the speaker made the meter go up. It was not much, to be true; and at certain other frequencies the meter went down instead, so it's apparently just a frequency-selective acoustic-lens effect.

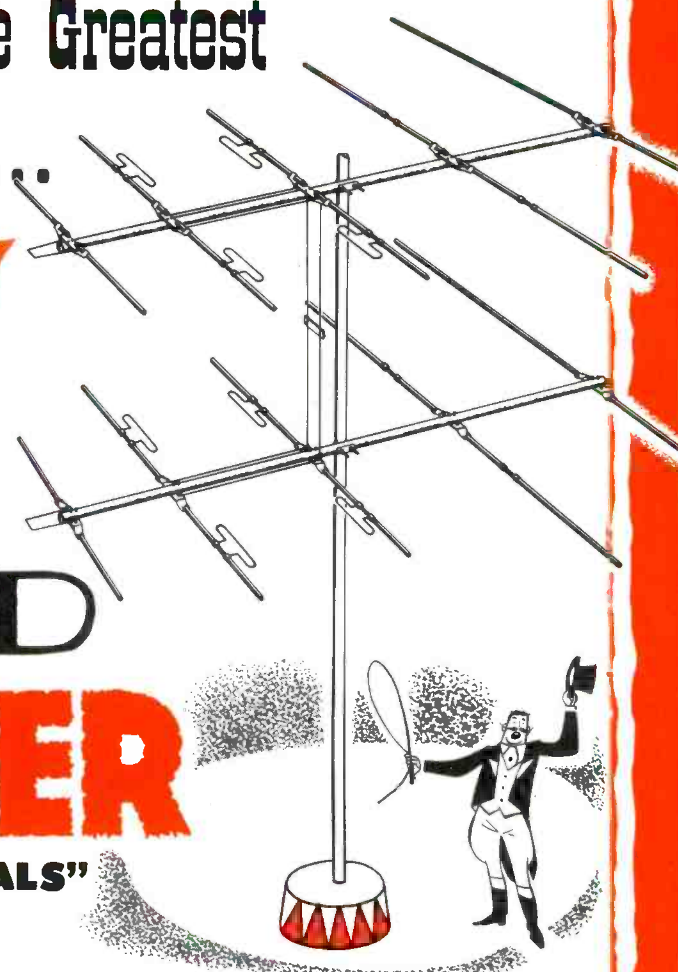
The plastic cloth will take even more punishment from "kids" than Lumite's highly popular Saran window screening.

* * Please turn to page 85 * *

Announcing the Greatest Antenna on Earth...

2 thru 13

the TACO TRAPPER



"TRAPS ALL VHF SIGNALS"

★ TRUE BROAD BAND TUNING

★ YAGI DESIGN FOR SUPER YAGI PERFORMANCE

★ RUGGEDIZED DEPENDABILITY

★ TACO CLICK-RIG CONSTRUCTION

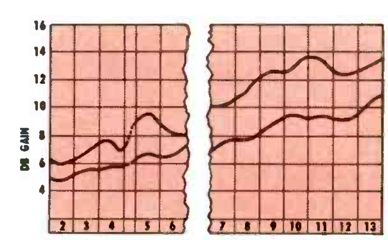
The first high-gain, broad-band colinear-yagi for coverage of all VHF channels. Not a composite of a high-band and low-band antenna but a **basically new development**— DESIGNED SPECIFICALLY TO RECEIVE ALL 12 VHF CHANNELS.

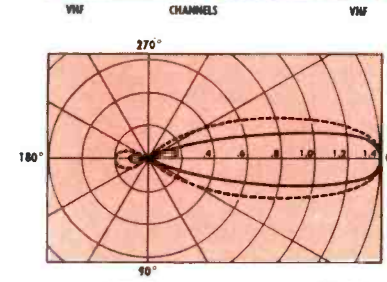
The Taco Trapper ends all questions of antenna selection. One model fills all VHF reception needs. Used singly, the Trapper out-performs all broad-band antennas. Stacked, the Trapper answers all fringe and ultra-fringe requirements.

Packaged — two Trappers per carton to reduce your inventory problem.

Cat. No. 1880 Taco Trapper for Channels 2 thru 13. List $19.75 each

Cat. No. 1882 Twin Trapper Stacking Line. List $1.75 each





TECHNICAL APPLIANCE CORPORATION, SHERBURNE, N. Y.
In Canada: Hackbusch Electronics, Ltd., Toronto 4, Ontario

TACO

Intermittent Recorder

(Continued from page 17)

fed to the next stage which is a 12AX7 connected as a cathode-coupled phase inverter. With zero voltage at the grid, the voltages at the two plates will be equal; thus, no output voltage will be produced. The phase-inverter stage will operate when the voltage input to the instrument varies either higher or lower. The voltage applied to the grid of the phase inverter will go positive or negative according to the input voltage, and the two plate voltages will vary in opposite directions. The resulting potential difference is directly coupled to the plates of a 6AL5 which is connected as a full-wave rectifier. This circuit produces an output voltage which is proportional in value to the potential difference between the phase-inverter plates but which is always positive. The grid of a 2D21 thyratron receives this voltage. During normal operation, the 2D21 grid is biased just below the conduction level. When the input voltage to the recorder varies as a result of intermittent trouble, a positive voltage is applied to this grid and the tube will conduct. A relay in the plate circuit is actuated and lights the panel lamp associated with this circuit. The buzzer will also sound if the tone switch is in the TONE position. The controls and indicator associated with any one VTVM circuit occupy positions in a vertical row directly above the input connector for that circuit. This arrangement can be seen in the front view of the recorder shown in Fig. 1.

One of the characterisitcs of a thyratron is that the grid loses control of the plate current once the tube is conducting. Thus, the lamp and buzzer remain activated even though the input voltage returns to normal. The RESET button must be depressed to cut off the lamp and buzzer. An additional feature of this recorder is that the VTVM circuit which is first activated disables the other two circuits. Such an action results from the fact that the cathodes of the three thyratrons are connected together; and when one tube fires or conducts, the common cathode voltage rises from 105 volts to 140 volts positive. Effectively, this imposes a negative 35-volt bias on the control grid of all three tubes, and the other two tubes are thus prevented from firing. This disabling feature insures that only the first effect of a trouble in a receiver will produce an indication on the recorder. Almost any trouble in a television receiver will produce an effect not only in the circuit in which the trouble occurs but also at various other points in the receiver. These extraneous effects will appear at various short-time intervals after the original effect of the trouble and are misleading to the service technician. With this instrument, the service technician is informed as to which effect occurred first; so he is led toward the actual trouble location.

Each of the three VTVM circuits has a different range and sensitivity as follows: the red circuit reads from 0.5 volt to over 500 volts and actuates with a change of approximately ±40 per cent in input voltage; the green circuit reads from 3 volts to over 500 volts and actuates with about ±15 per cent of change; and the white circuit reads from 15 volts to over 500 volts and actuates with about ±15 per cent of change.

Since the red circuit has the lowest range, it should usually be reserved for the points in the receiver which have the lowest voltages. Such points include the video-detector output, the IF grids, and the AGC line. The green and white circuits may then be used in all other circuits in the receiver except where DC or AC voltages in excess of 500 volts are present.

The operation of the intermittent recorder is based on the condition that the receiver being tested operates normally most of the time. Thus, the recorder must be connected and adjusted during a period of normal operation in order to insure correct indications. The connection and adjustment of the recorder is accomplished as follows:

1. Connect AC power to the recorder, place the POWER switch in the ON position, and connect the recorder chassis to the ground circuit of the receiver by means of the ground lead supplied with the recorder.

2. Connect the red lead to a selected point in the receiver while bearing in mind the value of the voltage to be monitored. If there are 3 volts or more, it would be best to use the green circuit for this point. This is not required but is merely suggested.

3. The voltage-selector switch labeled for AC and for negative or positive DC and associated with the red circuit should be positioned for the type of voltage to be monitored. If the type of voltage is unknown, an attempt should be made to perform step 4 for each position of the switch. When a balance cannot be attained, the voltage at the selected point is less than .5 volt. In this case, it becomes necessary to select an alternate point — one which will give a similar indication as to the source of the trouble but which has a higher voltage.

4. Depress the METER switch and vary the METER ZERO knob to produce a zero-center reading on the meter.

5. Repeat steps 2, 3, and 4 for the green and white circuits, making sure that the voltages at the selected points are sufficiently high. The green lead requires 3 volts or more, and the white lead requires a minimum of 15 volts.

6. The use of all three leads at once is not a necessity; for in many cases the possible sources of trouble can be narrowed down to one circuit or stage, and only one point needs to be monitored. The unused circuits can be disabled by turning the METER ZERO controls for these circuits to the OFF position.

7. Depress the RESET button to extinguish all the lamps. If one lamp remains lighted, step 4 should be repeated for the circuit of that color.

8. If an audible signal is desired when the trouble appears, the tone switch should be placed in the TONE position.

The instrument is now ready to detect an intermittent fault in the receiver.

The proper use of this recorder can best be illustrated by describing some actual field experiences. A television receiver was brought in for servicing with the complaint that it lost horizontal synchronization for short periods of time. It was noted that the horizontal hold control was effective in regaining a normal picture during these periods but that the sync was very erratic. These symptoms indicated that the horizontal AFC circuit was not operating properly. Examination of the schematic of the receiver disclosed that the set used the AFC circuit shown in Fig. 4. Improper operation of this circuit could have been due to a faulty component in the stage, a loss of horizontal-synchronization pulses, or loss of the feedback signal. Conventional testing methods were attempted, but the trouble did not persist long enough at any one time. The intermittent recorder was then connected to the receiver as follows: the red lead was attached to point "A" with the meter balanced for AC voltage, the green lead was attached to point "B" with the meter balanced for positive DC voltage, and the white lead was attached to point "C" with the meter balanced for AC voltage. In this way the recorder was

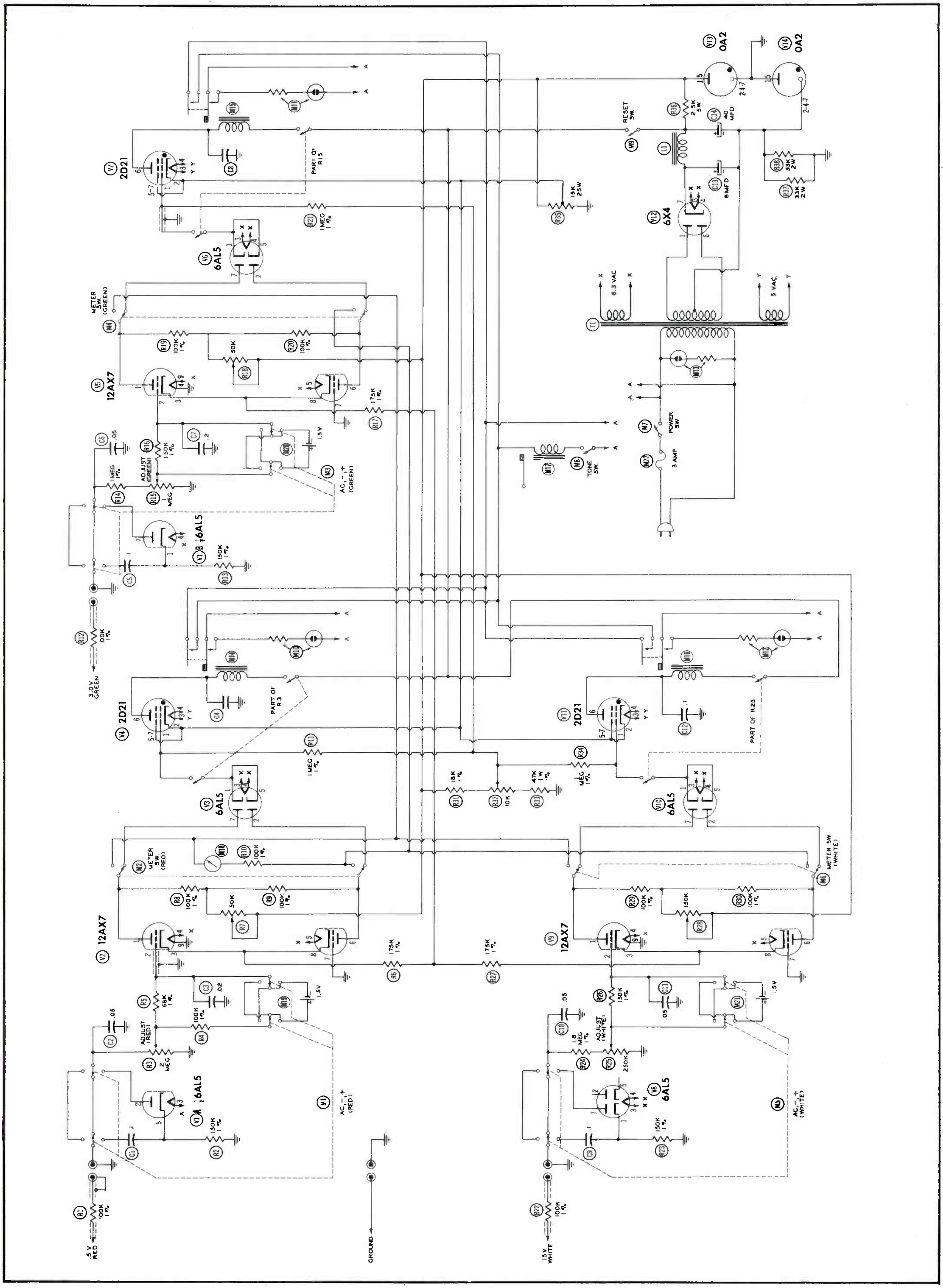


Fig. 3. Schematic Diagram of Intermittent Recorder.

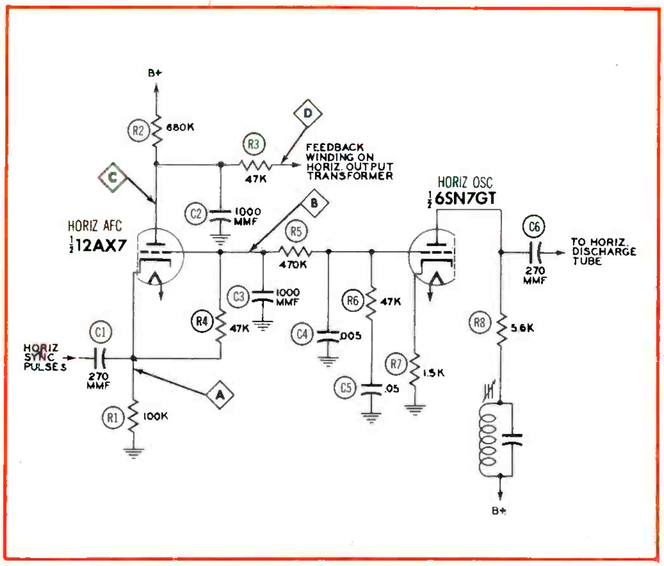


Fig. 4. Horizontal AFC Circuit Showing Connection Points for the Use of the Intermittent Recorder.

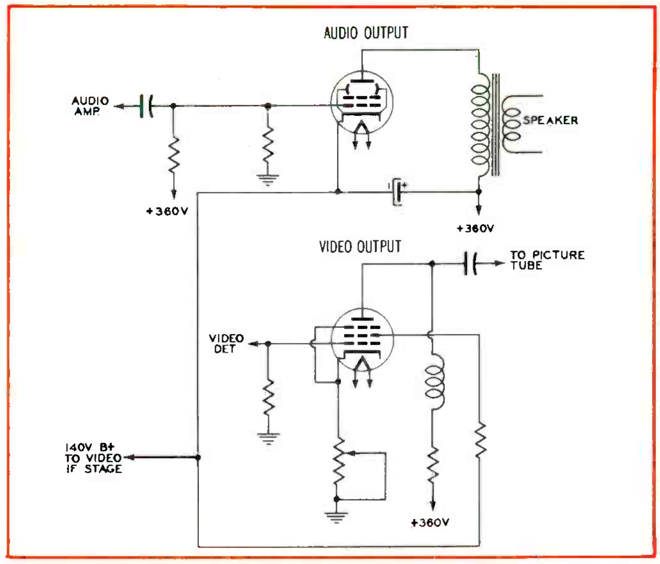


Fig. 5. Voltage Distribution in Receiver Described in Text.

set up so that the red and white circuits monitored for a loss of the sync and feedback signals, respectively, and the green circuit monitored for a change in DC voltages in the AFC stage. Thus, the three possible causes of trouble were covered.

When the intermittent trouble first appeared after the setup of the recorder was completed, the white panel lamp on the recorder lighted. This indicated that the first effect of the trouble was a momentary fluctuation of the AC voltage at point "C". Therefore, the fault must have been at point "C" or in some circuit associated with point "C". Logically the feedback signal must have varied. To check for this, the red lead was attached to point "C", and the green lead was attached to point "D". Balance for AC voltage was obtained for both circuits. This decision evolved from reasoning that the AC voltage at point "C" had to be less than that at point "D" because of the voltage division of R3 and C2. Thus, the more sensitive red circuit was used to monitor point "C". The reoccurrence of the trouble lighted the red lamp on the recorder, indicating that the trouble appeared at point "C" before it did at point "D". The possibilities of trouble were thus reduced to an intermittent short in capacitor C2, an intermittent open in resistor R2, or a faulty soldered connection. It was decided that C2 was most likely defective. Replacement verified this and removed the trouble.

In another instance, the use of the intermittent recorder was demonstrated on a receiver in which the sound and video were both intermittent. Examination of the receiver schematic narrowed the trouble to the RF, IF, and video-amplifier stages. The white lead of the recorder was connected to the plate of the video-output stage, and an unsuccessful attempt was made to obtain a balance for AC voltage. The white lead was then replaced by the green lead, and an AC balance was obtained. The red lead was attached to the output of the video detector and balanced for AC voltage.

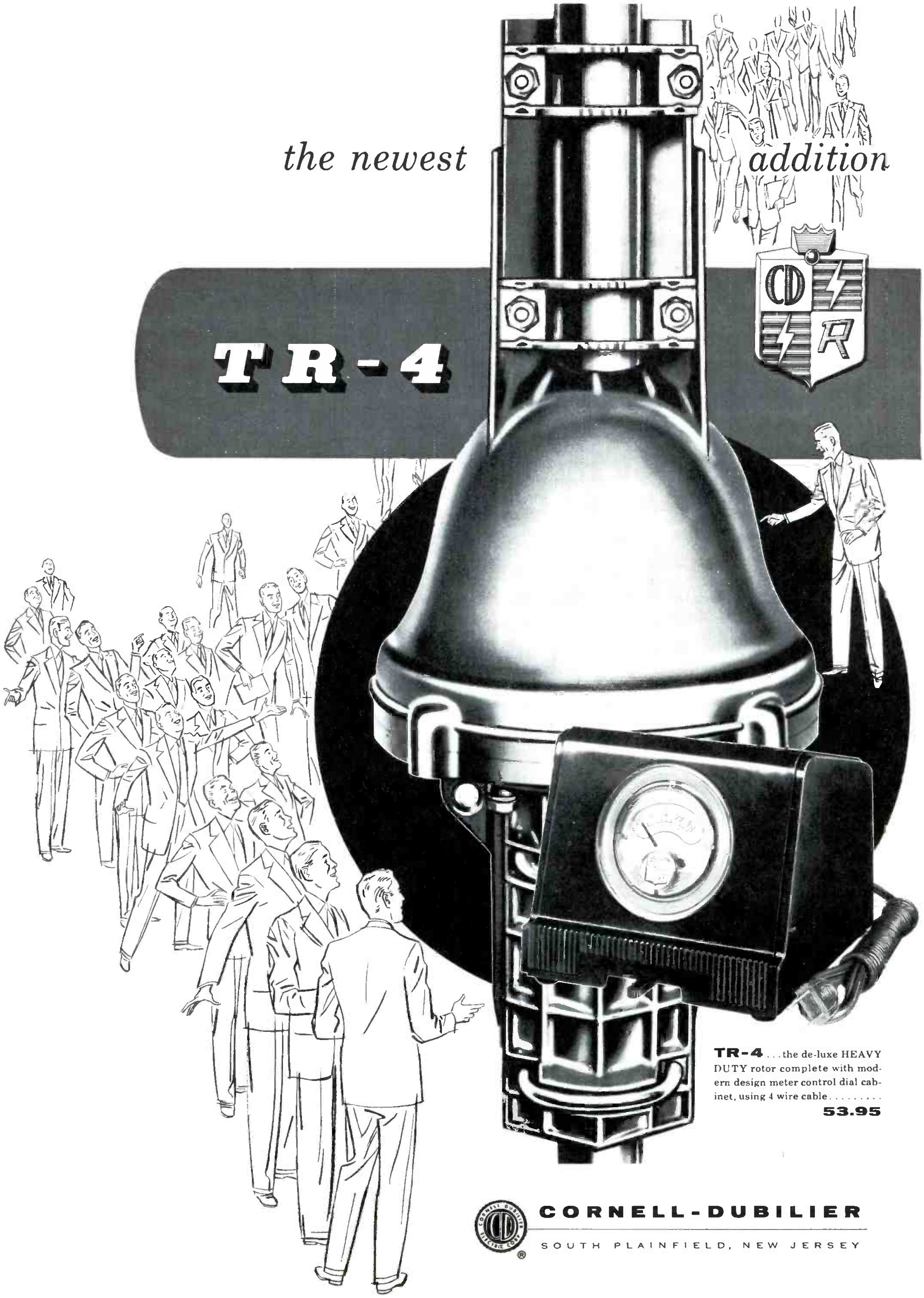
The red lamp came on when the intermittent trouble occurred, thus eliminating the video-amplifier stages from suspicion. Since the signal in the IF circuits is at a high frequency and a low level, all monitoring operations by the recorder in the IF stages must be made for DC voltages. Consequently, the red lead was attached to the plate of the second IF stage, the green lead was attached to the third IF plate terminal, the white lead was connected to the fourth IF plate, and all VTVM circuits were balanced for positive DC voltages. This time the white lamp lighted because of the trouble. The source of the trouble therefore had to be in the fourth IF stage. A visual inspection of the components in this stage was made, and a poorly soldered connection to the plate terminal on the socket was found. Resoldering of this connection removed the intermittent condition.

We might consider next a hypothetical service problem which illustrates the importance of forethought prior to the actual connection of the recorder. An intermittent trouble might manifest itself by intermittent audio and a momentary increase in picture contrast. Since both the sound and video would be affected, one might immediately assume before checking the receiver schematic that the trouble existed in RF, IF, or video output stages; and he would concentrate his search in these sections of the receiver. A correct analysis of symptoms should have started with the schematic diagram, and the method of DC voltage distribution as shown in Fig. 5 should have been noticed. It can be noted on this partial schematic that the audio-output tube is used as a voltage divider to provide the B+ to the video IF stages. Thus, a trouble in the audio stage would produce indications of trouble in these IF stages.

A certain amount of mental deduction on the part of the operator is required in the use of the intermittent recorder. A voltage variation, which the recorder is designed to detect, could be due to any number of component defects; the recorder indicates that a variation has occurred and determines the point in the receiver at which the variation originated. The recorder cannot determine the exact defective component; the operator must do that by reasoning based upon his knowledge of television circuits.

The requirement of thoughtful reasoning cannot be stressed too strongly, especially in those cases wherein the trouble appears only momentarily at intervals of an hour or more. Much time can be wasted if the recorder has not been connected so as to present conclusive evidence concerning the source of the trouble. Skill in the proper use of the intermittent recorder can be gained through practice by injecting simulated troubles into a properly operating receiver and then by using the recorder to identify these troubles.

William E. Burke

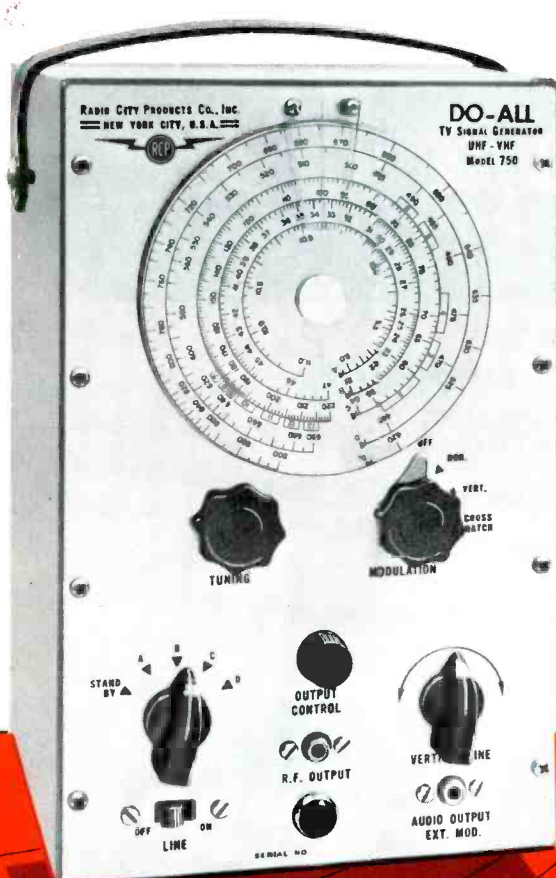


TR-4 . . . the de-luxe HEAVY DUTY rotor complete with modern design meter control dial cabinet, using 4 wire cable . . . .
53.95

CORNELL-DUBILIER
SOUTH PLAINFIELD, NEW JERSEY

FOR TOMORROW...

AS WELL AS TODAY!



UHF and VHF

RCP "DO-ALL" TV SIGNAL GENERATOR MODEL 750

3 INSTRUMENTS IN 1

- Signal Generator
- Marker Generator
- Pattern Generator

SPECIFICATIONS

BANDS: 9-11 MC, 21-47 MC, 54-220 MC, 465-690 MC, 650-900 MC.

TUNING: Special anti-backlash drive combined with the inductuner guarantees the extreme accuracy. Dial is continuously calibrated through 340°.

MODULATION: 360 cycles and 141.75 Kilocycles internal modulation has been provided—unmodulated carrier signal is also available.

SIZE: 10¼" x 6½" x 5⁹⁄₁₆"

WEIGHT: 9 lbs.

PRICE: $79.50

Completely covered in one instrument—a Signal Generator, Marker Generator and Pattern Generator covering all the UHF and VHF channels for every TV and FM receiver.

There's no need to put more money in more instruments as long as Radio City Products puts more in one instrument. This latest "DO-ALL" engineered by RCP reflects the very finest in RCP design efficiency.

Versatile in concept the RCP Model 750 can check, test and align front ends, IF's, sound and pix traps, linearity, syncs, sweeps, positioning, focus and deflection. Designed for portable or bench use, the 750 reflects the finest in construction and appearance. It is handsomely finished in an attractive brushed aluminum panel with a steel carrying case.

- **Inductuner insures accuracy of within ½ of 1% over the entire range of 9 Mc to 900 Mc.**
- **All VHF frequencies are on fundamentals.**
- **RF's and IF's are clearly calibrated on a large etched aluminum dial.**
- **Steady horizontal bars, vertical bars and crosshatch pattern individually produced on all channels.**

Remember... You Can Do More With A "DO-ALL"

RADIO CITY PRODUCTS CO., Inc.
152 WEST 25th STREET • NEW YORK 1, N. Y.

RCP

Shop Talk

(Continued from page 9)

the right-hand side did not possess the proper slope. Let us say that the over-all curve appeared as shown in Fig. 4. As a first step toward correcting this condition, we would adjust the slug in the 21.8-mc coil. This should be done carefully while keeping an eye on the scope screen. If you find that no position of this slug will bring the curve to its desired form, adjust the slug until the response comes closest to where you want it. Then turn to the 22.3-mc adjustment and rotate it.

By following this procedure, you avoid making unnecessary and frequently disruptive adjustments in the response-curve parts which have no direct bearing on the section of the curve that requires correction.

In the video IF response of Fig. 3, the 21.8-mc and 22.3-mc adjustments deal principally with the left-hand side (or low-frequency portion) of the over-all curve. The 25.2-mc and 25.3-mc slug adjustments are concerned with the opposite or high-frequency side of the curve. The central portion is governed chiefly by the 23.4-mc slug.

Since all of the individual response curves have a fairly broad base, rotating their respective slugs will cause some change in shape all along the over-all response. That is to be expected, but the principal effect will be centered in that section which encompasses the same frequencies as those to which the coil peaks.

A number of service technicians who are somewhat experienced frequently skip the preliminary steps

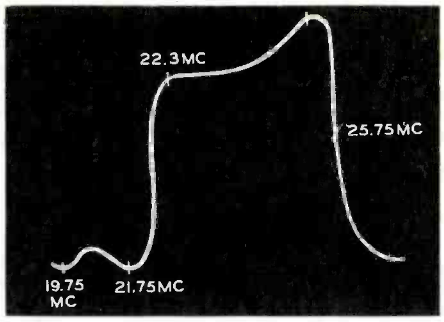


Fig. 4. Response Curve Showing Low Gain at Low-Frequency End.

in a video IF alignment and proceed directly to the over-all check. For them, it is of the greatest importance to recognize the relationship between the peaking frequency of a coil and the portion of the response curve which it most markedly affects. For without this knowledge, they can "fiddle" around for an hour or more before they stumble onto the right combination, if indeed they ever do.

Alignment and the Test Pattern

Service technicians repairing sets in the home will sometimes attempt corrective adjustments in the video IF system and use a test pattern as their guide. As a matter of fact, service technicians have done this in the shop as their final air check of a video IF alignment. Whatever the reason, this procedure is not the most accurate solution to this problem although, as stated, it is being practiced. Since this is so, it may help matters if the service technician realizes the correspondence between the video-coil IF frequencies and the portion of the test pattern they are most likely to affect.

Consider the fairly common test pattern shown in Fig. 5. It contains two sets of wedges: one horizontal set and one vertical set. Of particular interest in this discussion are the vertical wedges, since these reveal the horizontal resolution which in turn is dependent upon the bandpass of the receiver circuits. This is so because the vertical wedges indicate how closely lines or details can be placed next to each other horizontally. When the system is no longer able to resolve these thin white lines and black lines, they become indistinguishable and the limiting resolution has been reached.

In Fig. 6, the same test pattern is shown with specific resolution values included. Along the top vertical wedge, the horizontal resolution in lines is shown; along the lower vertical wedge, the corresponding bandpass is given in megacycles. If the lines remain clear and distinct down to the center circles, the video IF bandpass is 4.0 mc. If this condition is true for less than the full length of the wedge, the video bandpass is reduced correspondingly. (The resolution is also shown for one horizontal wedge. This is done simply for comparison and has no bearing on the bandpass of the receiver.)

We can interpret the clarity of the vertical lines as representing the video response curve on its side. A wide response would be indicated by lines distinguishable well up to the narrow end of the vertical wedge; a narrower response would be indicated by a blending of lines at the narrow end, leaving only the outer and wider portion of the wedge clearly distinguishable.

Now suppose you are out in the field and you decide to use the test pattern to sharpen the alignment of a receiver. You do this by rotating the various slug adjustments in the video IF system while keeping an

Fig. 5. A Typical Test Pattern. Courtesy of NBC

Fig. 6. Same Test Pattern as Fig. 5, With Resolution Shown at Various Points Along Wedges. Courtesy of NBC

NOW! EVERY CHANNEL–

2 to 83, with one antenna –one transmission line

THE telrex

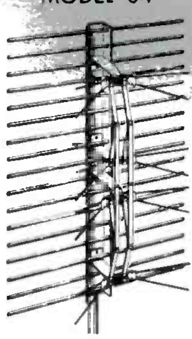
DUO-BAND "CONICAL-V-BEAM"*

*REGISTERED TRADEMARK

BETTER BY DESIGN... RAIN OR SHINE!

telrex

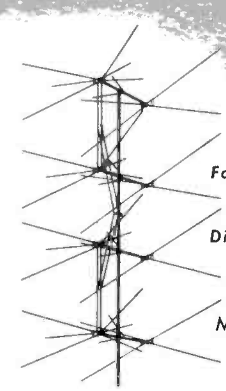
ULTRA-HI GAIN UHF "CONICAL-V-BEAM" MODEL 84



- Four bay uni-directional array
- All in-phase signal addition at all frequencies with no lobe splitting
- All aluminum, light weight and rugged

"CONICAL-V-BEAMS" ARE PRODUCED UNDER RE-ISSUE PATENT NUMBER 23,346 and SOLD ONLY THRU AUTHORIZED DISTRIBUTORS

- DUO-BAND "CONICAL-V-BEAM" — The TELREX "DUO-BAND" extends the "Conical-V-Beam" principle with the addition of two supplementary V splines which compact and add in-phase the higher frequency signals.
- TRANSITION FROM VHF to UHF is AUTOMATIC and PERFECT! (No "lossy" filter or isolation networks.) VHF and UHF signals are picked up at same cone apex.
- NOW! WITH A SINGLE TRANSMISSION LINE! Uniformly high gain with one major lobe. Channels 2 to 83. Actually improves reception on Channels 7 to 13 over standard "Conical-V-Beam."
- EXCELLENT DIRECTIVITY ON VHF-UHF — A clean, uni-directional pattern, assures high signal-to-noise ratio and freedom from "ghosts." The perfect array for reception near or far. Rugged design—light weight—low wind resistance—stacked models for increased sensitivity.
- MODIFYING EXISTING "CONICAL-V-BEAMS" WITH TELREX KITS — Existing "Conical-V-Beams" can be modified to operate efficiently on Channels 2 to 83 by means of the new TELREX Modification Kit.



Famous for Distance

MONARCH MODEL 8X-TV

The ultimate in long distance arrays. Guaranteed to out-perform any antenna or combination of cut-to-frequency antennas. When used with Duo-Band splines it comprises the ultimate in reception on Channels 2 to 83. If the Telrex 8X-TV does not produce a usable signal TV reception is either impossible or impractical!

telrex INC. AMERICA'S STANDARD OF COMPARISON

"CONICAL-V-BEAMS"

ASBURY PARK 10, NEW JERSEY

Originators and Manufacturers of "CONICAL-V-BEAMS"—insist on the Original!

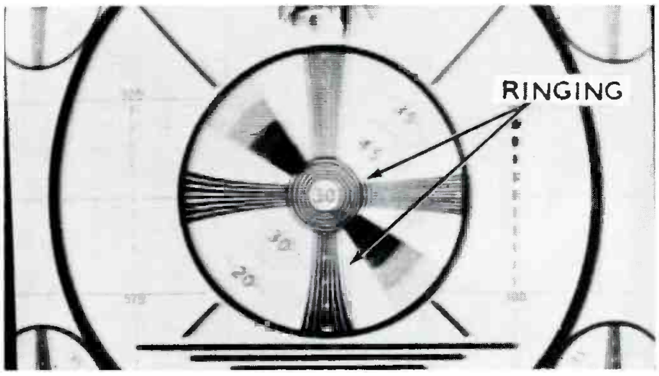


Fig. 7. Multiple Lines Following Detail in Test Pattern Are Due to Ringing.

eye on the test pattern with the aid of a mirror. To do as effective a job as you can, here are certain pointers.

1. The highest video frequency which governs the resolution of the narrowest segment of the wedge is represented by the lowest video IF frequency. This is true of all split-sound sets and of practically all inter-carrier receivers. (At one time, several manufacturers designed their receivers so that on the low VHF channels the local oscillator frequency was above the incoming signal, while on the high VHF channels it was below. This shifted the video and sound IF carriers from one side of the response curve to the other between high and low VHF channels. The practice, however, never gained appreciable popularity.)

2. When the video IF carrier is at the 50-per-cent point on the response curve, the vertical and horizontal wedges will be equally dark (assuming that there is sufficient bandpass in the video IF). Dropping the video carrier appreciably below the 50-per-cent level will cause the vertical wedges to become darker than the horizontal wedges. The over-all background brightness of the picture will also decrease. Conversely, when the carrier moves above the 50-per-cent level the reverse occurs; i.e., the horizontal wedge becomes darker than the vertical wedge, and the background brightness will rise.

3. Any slug adjustment which depresses the video carrier below the 50-per-cent level on the response curve can lead to poor sync control and smearing. On the other hand, the temptation to raise the carrier up to the top of the response curve should be vigorously resisted. With weak signals, the results may appear to be beneficial. However, just let the signal level in an intercarrier receiver rise even a moderate amount and you will be faced with an irate owner complaining of a buzzing sound. This has happened too many times to be ignored.

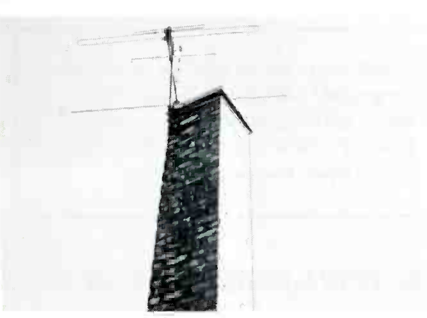


Fig. 8. Chimney Vulnerable to Damage With Extra Wind Load Imposed by Antenna. (Courtesy NFPA.)

4. If you overpeak at the high-frequency end, ringing or multiple lines will appear on the test pattern. See Fig. 7. The multiple lines due to ringing are frequently mistaken for ghosts. The two can be distinguished from each other by the fact that all sections of the image are repeated with a ghost; whereas in ringing, only fine lines and detail are repeated. Furthermore, rotation of the fine-tuning control will affect the lines due to ringing; it will have much less effect on ghosts.

As a practical note, a slight amount of overpeaking is often desirable because it tends to sharpen your picture. Just how much can be tolerated is best judged by observing a regular broadcast rather than a test pattern. Ringing, nonlinearity, and other effects of overpeaking may stand out prominently on a test pattern but will often affect a broadcast to only a negligible extent.

5. If the response curve has a sharp peak at any particular frequency, it will show up as a dark stripe across the vertical wedge. Its position along the wedge will depend upon which portion of the response curve is affected.

6. As a practical consideration, no slug should be too far in or too far out. It may occasionally happen that such a situation is normal for a particular receiver, but usually it is not.

7. Be careful when attempting to raise the high-frequency resolution of a circuit that you do not at the same time increase the amplification accorded the sound carrier. This will lead to aural buzz and sound in the picture. The latter is evidenced by a fine-grained 4.5-mc stripping (sometimes referred to as "worminess") or by sound bars. These will come and go, both in frequency and intensity, in accordance with the program's speech or music.

There is one final note of caution on any phase of visual alignment. Leave trap adjustments alone. Once you disturb these, the chances are that only an instrument alignment will set you straight.

REVIEW. An interesting article on the safe installation of television and FM antennas appeared in the July 1951 NFPA Quarterly. The letters NFPA stand for National Fire Protection Association. The article was entitled, "Television and FM Antennas" and was written by Charles L. Smith, an NFPA electrical field engineer.

The rapid expansion of VHF and UHF television throughout the United States has been accompanied by an equally sharp rise in outside antenna installations. Even today when transmitting powers far in excess of 50,000 watts are not uncommon, the best pictures are still those produced by outside antennas.

There are two principal aspects to every successfully installed antenna. First, there is the proper choice of array and location to insure that the set receives as powerful and as ghost-free a signal as possible. Second, there is the actual erection of the antenna and its supporting structure so that neither presents any electrical or physical hazard either to the set owner or to anyone else who may be in the immediate vicinity. Certainly, one aspect is as important as the other; and yet in service literature, antenna installation procedures have not been given

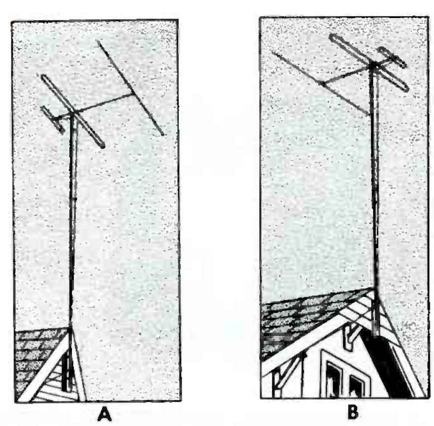


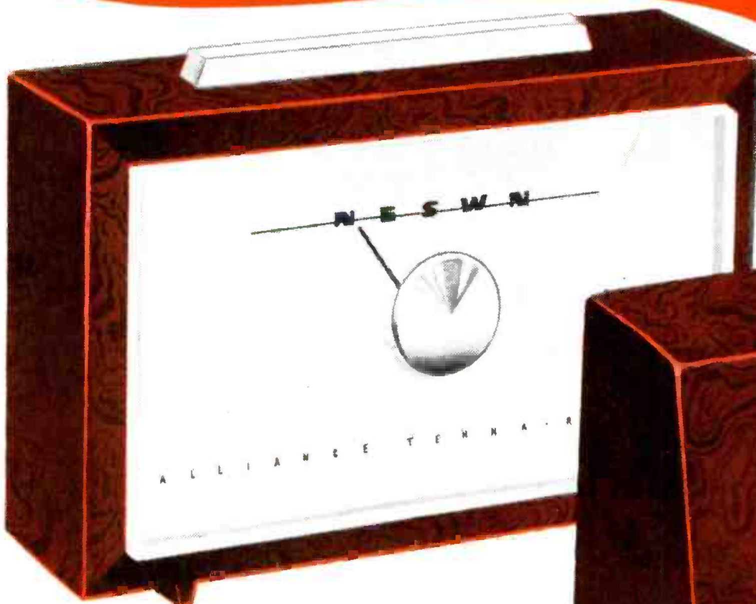
Fig. 9. Recommended Methods of Mounting Antennas.

BACK THE LINE THAT BACKS YOU!

ALLIANCE

New, Restyled Models + $500,000 Ad Campaign

REDESIGNED ROTATOR UNIT—Speed increased to 2 rpm. ***New double-action magnetic anti-drift brake.*** Smoother synchronization with control units.



MODEL T-10, finger-tip electrically controlled Alliance Tenna-Rotor with direction indicator dial. Extremely accurate. Modern styling by Reinecke & Associates **$44.95**

MODEL U-83, the only *fully automatic* antenna rotator on the market. Just "set it—forget it"—this new model automatic Alliance Tenna-Rotor. Reinecke-designed . . **$44.95**

Here's how Alliance *pre-sells for you!*—

1 **New styling sells on sight!** Style's the thing, and Alliance has it! More eye-appeal, more buy-appeal in these smart, new Alliance Tenna-Rotors and the Alliance TV Converter! Boost your sales, boost your profits with Alliance—the line that backs you!

2 **$500,000 ad campaign sends sales your way!** Alliance keeps spring promises!

TV Spots—eye-compelling "home" demonstrations—more than 16 million viewers on more than 100 stations—*this is our fifth straight year of TV advertising!*

ALLIANCE TV CONVERTER

adds all new UHF channels. Advertised on TV! The quality converter built to last! **$42.50**

LIFE Magazine —full-page ad in this top consumer magazine! Newspapers—dominant, sales-making ads in key markets! Point-Of-Sale Displays—full-color, on-the-spot reminders!

OVER ONE AND ONE-QUARTER MILLION ALLIANCE TENNA-ROTORS NOW IN USE!

ALLIANCE MANUFACTURING CO., ALLIANCE, OHIO

Fig. 10. Antenna Should Not Be Grounded to Sanitary Vent Pipe. (Courtesy NFPA.)

sufficient explanation. You will find no end of advice on how to select an antenna; you will find very little guidance on how to install that very same array safely.

In essence, this is a review of certain sections of Article 810 of the National Electrical Code (NEC). These pertain specifically to outdoor antenna installations peculiar to TV and FM receivers. In this review, common practices which can lead to fire hazards are pointed out so that installation crews will avoid using them in the interest of safety.

Walk down the street of any television-blessed city, and chances are that you will find more antennas mounted on chimneys and parapet walls than on any other section of the buildings. Why? Because these are the easiest and most convenient supports to use. Unfortunately, however, chimneys and parapet walls are also the most vulnerable to damage because they are less solidly buttressed than any other portion of the building. The dead weight of a television antenna is frequently negligible; what causes the damage is the live stress developed by the force of high winds and the weight of accumulated ice. Because of the leverage brought about by the length of the mast, these forces can apply considerable stress to the chimney structure. There are instances known where antennas, mounted as shown in Fig. 8, have resulted in damage to the chimney below the roof line.

Figs. 9A and 9B are examples of recommended methods of mounting television antennas. With this method of support, possible roof damage is slight.

Another item which is given careful attention in the National Electrical Code is lightning arrestors. Here is, in summary, what is recommended.

Each conductor of a lead-in from an outdoor antenna should be provided with a lightning arrestor approved for the purpose, except that if the lead-in conductors are enclosed in a continuous metallic shield (as is true in the case of coaxial cable) the lightning arrestor may be installed to protect the shield or may be omitted if the shield is permanently and effectively grounded. Lightning arrestors should be located either outside the building or inside between the point of entrance of the lead-in and the receiver. In both cases, they should be as near as practicable to the entrance of the conductors to the building. Lightning arrestors should not be located near combustible material nor in a hazardous location.

A common practice among installation men is to ground the antenna mast to a nearby vent pipe on the roof (Fig. 10) and to consider this as ample grounding for the entire system. The method is simple and, of course, it dispenses with lightning arrestors. Unfortunately, this method is undesirable for several reasons. First, the vent pipe may not lead to ground. Second, even if it does, the grounding resistance may be too high. Finally, even with the vent presenting a low-resistance path to ground, it still leaves the receiver open to damage.

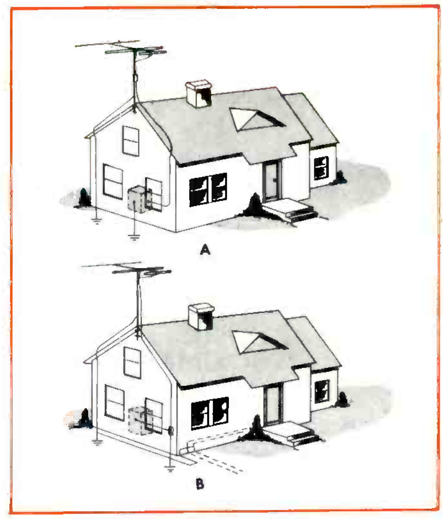


Fig. 11. Wrong and Right Ways of Installing a Lightning Arrester. (Courtesy NFPA.)

Antennas are seldom struck directly by a bolt of lightning. Much more frequent is the accumulation by induction of electrical charges due to lightning. If the antenna has its own direct connection to ground (which, by the way, is required by NEC regulations), then a major portion of the discharge will be carried to ground via that path. Some energy, however, will be passed down the transmission line; and if the receiver is not protected by a lightning arrestor, then this energy will find a path through the receiver to ground (generally via the 117-volt power line, one side of which is grounded). The least that can happen in the set is a burned-out RF tuner; the worst is complete destruction of the set, plus serious fire and life hazard.

A lightning arrestor also offers added protection, should anything cause the antenna grounding path to open.

Sometimes service technicians will install the lightning arrestor for the receiver on the antenna mast it-

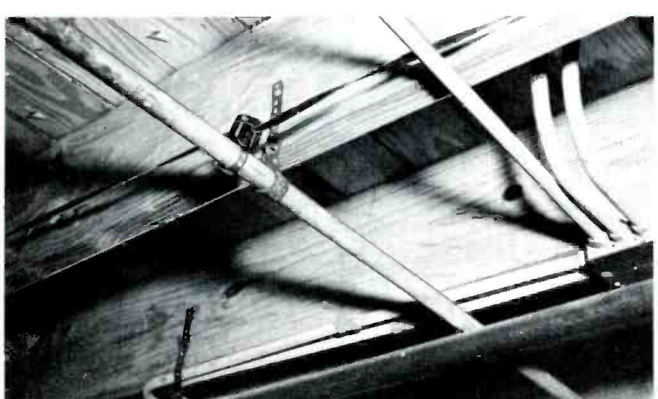


Fig. 12. Approved Installation of Lightning Arrester Inside Exterior Wall of House. (Courtesy NFPA.)

Fig. 13. Improper Method of Running and Connecting a Grounded Conductor. (Courtesy NFPA.)

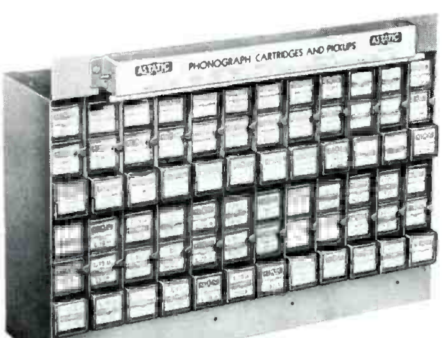
WHY IT'S BETTER BUSINESS TO REPLACE WITH

Astatic Crystal Pickup Cartridges

IN APPROXIMATELY 75 percent of all cases, the original crystal pickup cartridge for which you are supplying the replacement will be an ASTATIC! The record player manufacturer's highly skilled engineers have carefully selected each Astatic Cartridge because . . . down to the last detail . . . its performance characteristics match the requirements of the particular player or changer. Thus, for finest results, the serviceman replacing the cartridge must again match these requirements. AND ONLY THE PRECISION-BUILT, RECOMMENDED ASTATIC REPLACEMENT CARTRIDGE WILL DO IT. And, despite quality results, cost is almost invariably lower.

One way or another, a substitute cartridge is bound to fall down. It is not sound business to stake your reputation on such substitutions. Beware particularly of claims that ALL cartridge replacement needs can be filled by six or eight magic models. Actually, it takes an absolute minimum of 24 different cartridge models to meet all of today's requirements. The far-sighted jobber or dealer, knowing that what is good for the record-playing public is good for him, sees to it that the kind of cartridge originally intended is used on all replacements. Usually, too, he MAKES DOUBLY SURE OF BEST RESULTS BY RELYING ON ASTATIC CRYSTAL CARTRIDGES.

NEW STEEL STORAGE CABINET AND DISPENSER FOR ASTATIC CRYSTAL CARTRIDGES

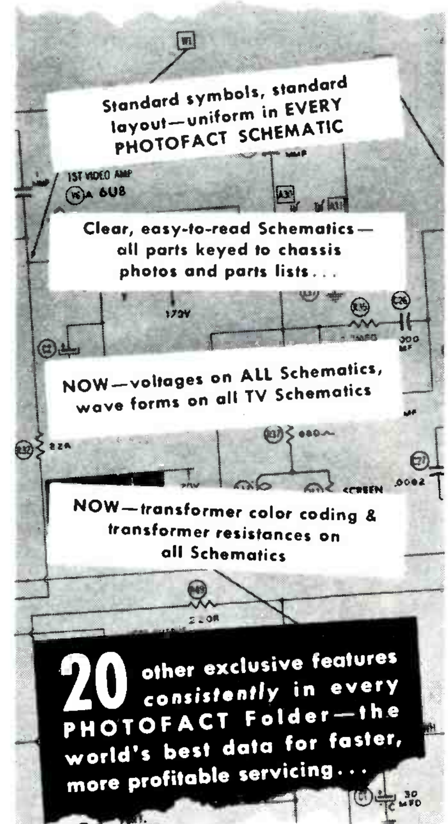


THERE ARE ADVANTAGES for everyone because jobbers dispense Astatic Crystal Cartridges from this handsome, rugged steel cabinet. No one — dealer, serviceman or record player owner — ever gets an Astatic Cartridge which has grown old from being accidently shunted back and forth on the shelf. This can't happen to Astatic Cartridges because new stock is put in the cabinet by feeding into the top of each bin . . . and the cabinet dispenses the oldest cartridge first, from the bottom of the bin. To make sure that everyone enjoys these advantages, the cabinets are given to Astatic Jobbers entirely free of charge, and without a single string attached or special purchase to be made. Attractively finished in light grey Hammerlin, this truly fine cabinet keeps all Astatic Cartridges together and permits taking accurate inventory in one glance. It is designed to stand solidly on the counter, on the shelf, hang on the wall, or even stack securely when two or more are used. Included is a handy Rollafax cartridge replacement chart, which attaches to the top of the cabinet and works like a miniature window blind. Note that the bottom cartridge in each bin always protrudes, for quick, easy grasping.

EXPORT REPRESENTATIVE
401 Broadway, New York, N. Y.
Cable Address: ASTATIC, New York

THE Astatic CORPORATION
CONNEAUT, OHIO
IN CANADA: CANADIAN ASTATIC LTD. TORONTO ONTARIO

you're on easy street with PHOTOFACT SCHEMATICS



NOW! GET THE PROOF FOR YOURSELF!

FREE We'll send you a Free Photofact TV Folder—just ask us for it!

Learn for yourself how PHOTOFACT pays for itself by earning bigger profits for you! We'll send you the proof—a FREE specimen PHOTOFACT TV Folder that shows all the features found *consistently* and *exclusively* ONLY in PHOTOFACT. Send for your FREE specimen TV Folder now. Examine it. Compare it. You'll see why PHOTOFACT belongs in your shop! And you'll want to ask your parts distributor about the pay-as-you-earn-plan. Only $25 down brings you the entire PHOTOFACT Library. Write for FREE specimen TV Folder—learn now how to earn more!

HOWARD W. SAMS & CO., INC.
2201 E. 46th St., Indianapolis 5, Ind.

HOWARD W. SAMS & CO., INC.

self. See Fig. 11A. This, too, is improper since it again leaves the receiver virtually unprotected. Any way you look at it, the best practice is to ground the antenna mast adequately and then install a lightning arrestor as close as possible to the point where the transmission line enters the building. The NFPA also approves the installation of a lightning arrestor just inside the exterior wall of a house. See Fig. 12. In this, an approved lightning arrestor is connected to and supported by a grounded water pipe by means of a metallic band.

Here are some of the more important provisions from the NEC code covering the grounding of antenna masts.

1. "The grounding conductor shall, unless otherwise specified, be of copper, aluminum, copper-clad steel, bronze, or other corrosion-resistant material."

2. "The grounding conductors may be uninsulated."

3. "The grounding conductor shall be run in as straight a line as possible from the antenna mast and/or lightning arrestor to the grounding electrode."

4. "The protective grounding conductor shall be not smaller than No. 14 copper or No. 12 aluminum or No. 17 copper-clad steel or bronze. . . ."

(Editor's Note: In regard to item 4, it should be pointed out that the wire sizes are the very minimum required to dissipate an accumulating static charge. Such wires are not selected to withstand the enormous current in a lightning bolt; even the heaviest of copper cables have been known to melt in the event of a direct strike by lightning.)

Fig. 14. A High Tower Close to Power Lines Can Cause Trouble. (Courtesy NFPA.)

Fig. 13 illustrates an improper method of running and connecting a grounding conductor. It should not follow the contours of the building and should not be connected to a downspout. NEC recommends a resistance to ground of not more than 25 ohms. High-resistance paths lead to stray currents that can cause unpredictable damage.

Indoor antennas do not require any grounding or lightning-arrestor protection. Outdoor antennas and lead-in lines should be kept at least two inches away from other wiring except where this other wiring is in metal armor or pipe. Where this cannot be done, then it is recommended that porcelain tubes or other suitable protection be used where spacings are not feasible.

Another hazard covered in Mr. Smith's article is the erection of tall towers for supporting antennas in the vicinity of power lines. See Fig. 14. This is a particularly dangerous practice, and the PF INDEX has carried accounts of men being electrocuted when the towers being installed fell across the power lines.

Where it is absolutely necessary to erect such towers in the vicinity of power lines, make certain that the structure receives substantial support. Figs. 15 and 16 illustrate more vividly than any written description what can happen when a poorly erected tower falls across a power line. In the final illustration, Fig. 16, the lady of the house was seriously burned on the face and arms as she was standing in front of the sink. Inadequate grounding of the mast led to the development of stray currents that finally reached ground through a path from the sanitary vent pipes to the water pipes.

By now the reader can well appreciate why there is far more to antenna installation than the suitable choice of a well-designed array. If a full report of this article is desired, it may be obtained by sending 25 cents to the National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts. The full title was given at the beginning of this review. Be sure to mention this and the author's name, Mr. Charles L. Smith.

Milton S. Kiver

Fig. 15. Antenna That Fell on Utility Wires. Note Fire-Blackened Spot on House. (Courtesy NFPA.)

Fig. 16. Sink Where Stray Currents Entered Via Sewer Pipes to Water Pipes. (Courtesy NFPA.)

Microvolts Per Meter

(Continued from page 31)

across the two sets of antenna terminals. Moreover, the attenuation of an antenna lead-in increases as the frequency increases. This makes greater field strength even more necessary at the higher frequencies.

The determination of service areas for television stations is often based on field intensities and does not consider the effects of receiving-antenna lengths and lead-ins. This condition tends to discriminate against the lower-channel stations by indicating that they have a smaller service area than a higher-channel station of the same power.

When the antenna and lead-in are considered in the estimation of a service area, a more accurate evaluation is obtained. This consideration together with certain propagational data results in a smaller service area for the higher-channel stations. In order to compensate for this difference in service areas, the maximum power allocation is 316 kilowatts for high-channel stations and 100 kilowatts for low-channel stations. High- and low-channel stations operating under these maximum-power limitations will therefore have more uniform service areas.

The "per meter" expression is often explained as referring to antenna height rather than antenna length. This is true for ground-based vertically polarized antennas in which case antenna height and antenna length become synonymous. This condition probably stemmed from the application of field-strength calculations to commercial AM radio broadcasting stations which employed vertical antennas. With the advent of television utilizing horizontal polarization, the term antenna height was no longer synonymous with antenna length. This point resulted in considerable confusion. For the purpose of calculation, the use of the antenna-length measurement is equally accurate for either of these two types of antenna and is therefore preferred.

An understanding of field intensity, expressed in microvolts per meter, will permit the service technician to evaluate more accurately television service areas based upon field intensity. Although the service technician will be concerned primarily with relative measurements, he may upon occasion employ absolute values in predicting installation problems. A clear concept of "microvolts per meter" is therefore beneficial.

Don R. Howe

UHF

(Continued from page 21)

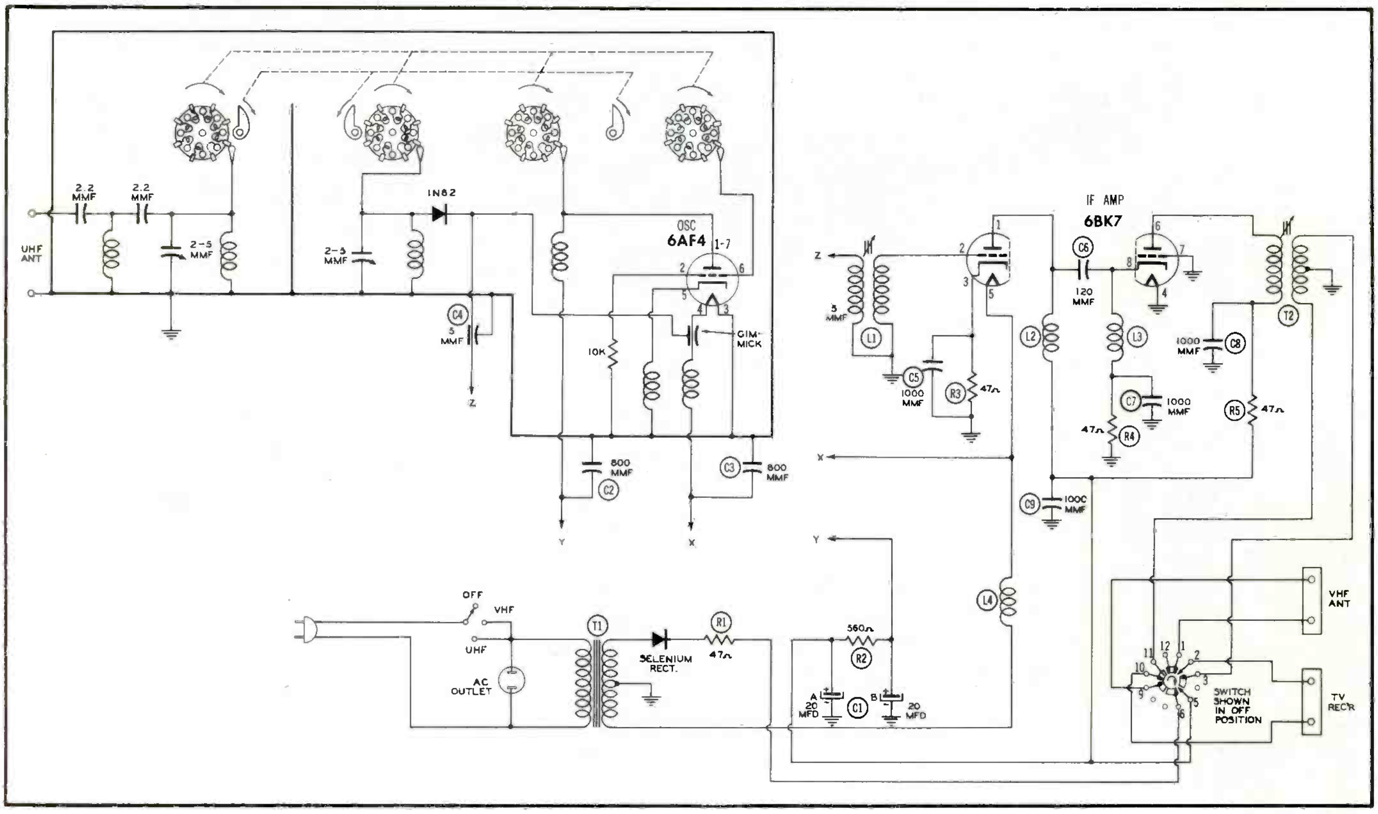


Fig. 4. Schematic of Walsco UHF Converter Model 2000.

function selector switch with three positions marked OFF, VHF, and UHF. In the VHF position of this switch, power is conveyed to the tube heaters in the converter and to the AC outlet on the back of the unit. When the television receiver is plugged into this outlet and its power switch is left ON, power to both converter and receiver can be controlled by the converter's function switch. In the VHF position of the switch, the receiver input is linked to the VHF antenna. In UHF position, the switch puts the converter into full operation and connects the receiver input to the output of the converter.

The center control on the front panel is a range switch for the turret type tuner. There are eight ranges which appear in the dial window as the switch is turned. The fine-tuning control at the lower right selects channels within each range. An indicating pointer in the dial window moves as the fine-tuning control is varied.

The schematic of the Walsco UHF Converter Model 2000 appears in Fig. 4. The UHF signal is fed through a high-pass filter to a double preselector section which is dielectrically tuned by two cam-like rotor plates. A third rotor plate, ganged with the others, tunes the oscillator stage. The oscillator, a 6AF4 tube, is coupled to the 1N82 crystal mixer by means of a "gimmick" at the filament of the oscillator. The output of the mixer is coupled to a cascode amplifier stage employing a 6BK7 duo-triode. The power supply of the converter uses a selenium unit as a half-wave rectifier.

Fig. 5. Sutco Metropolitan UHF Converter Model 37A.

Sutco Metropolitan UHF Converter Model 37A

Sutton Electronic Company, Inc., has produced a UHF converter unit primarily designed for use in strong signal areas. This unit is the Sutco Model 37A which is shown in Fig. 5. The front panel has only two controls on concentric shafts. The inner shaft operates a range-selector switch with twelve positions. Eleven of these are used for tuning portions of the 70-channel UHF band; the twelfth is the VHF position. The outer shaft operates a fine-tuning capacitor which serves to tune individual channels within a selected UHF range.

A schematic of the Sutco Model 37A is presented in Fig. 6. Notice the thermal switch in the primary circuit of the power transformer. This switch serves to turn on the converter when the television receiver draws power. The AC cord on the converter is plugged into a wall socket, and the line cord on the television set is plugged into the AC outlet on the back of the converter. When current flows in the television receiver, the thermal switch in the converter is actuated and delivers power to the converter.

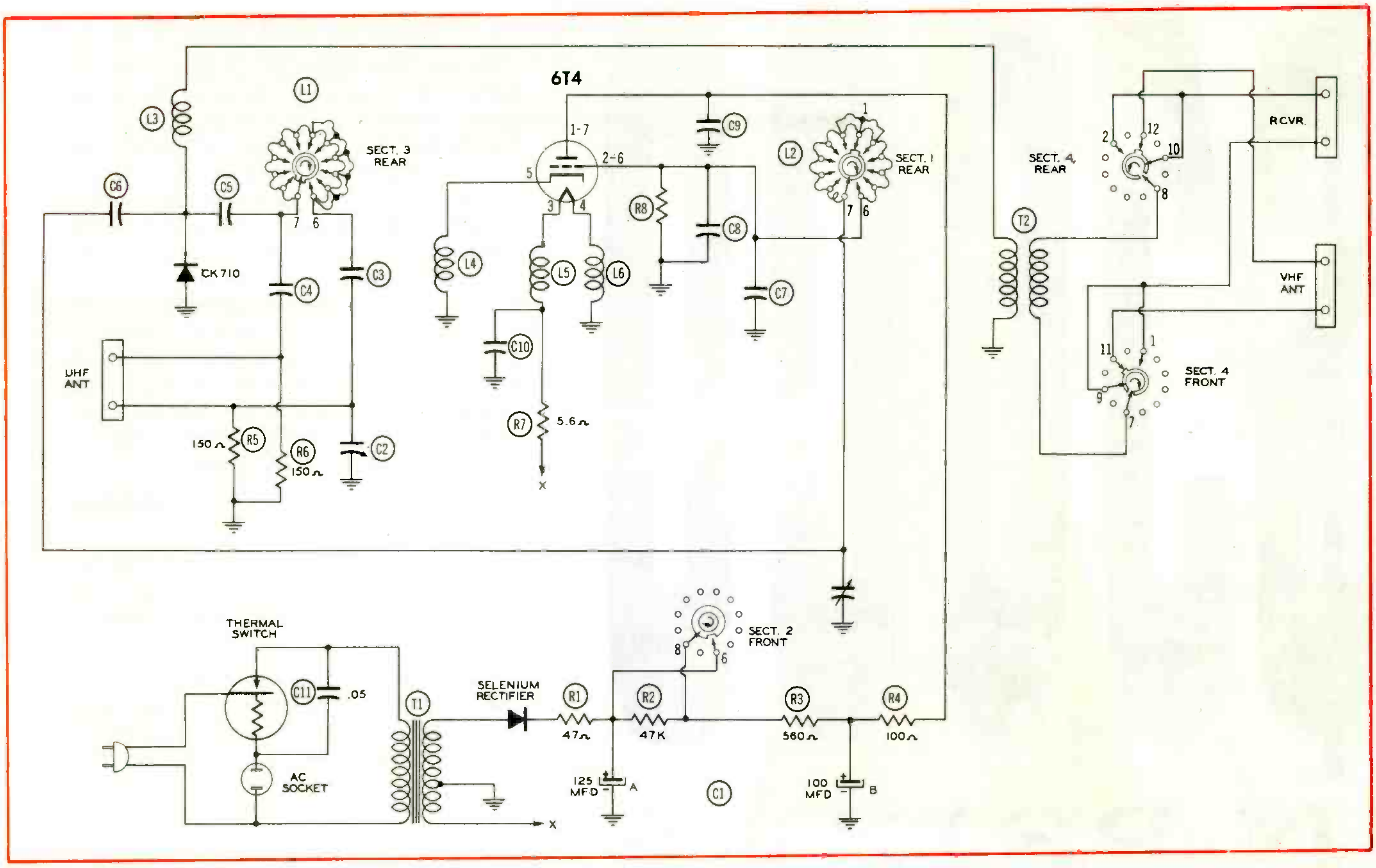


Fig. 6. Schematic of Sutco UHF Converter Model 37A.

A selenium rectifier is employed for half-wave rectification in the converter power supply. In the VHF position of the range switch a 47K-ohm resistor is placed in series with the power supply so that the B+ voltage drops to a value which effectively stops converter operation. At the same time the antenna input of the receiver is switched to the VHF antenna terminals on the converter.

The converter functions during UHF operation, and its output is delivered to the receiver. From the UHF antenna terminals the signal is fed to a preselector tuned circuit and from there to the crystal mixer CK710. A 6T4 tube functions as the local oscillator and delivers a signal to the crystal mixer in such a manner that the difference frequency falls within the range of channels 5 or 6. This intermediate-frequency signal is coupled through an output transformer to the television receiver. Since little or no amplification is given the signal in this conversion operation, it can be seen why this unit is recommended for strong signal areas only.

"PAL" Standoff Insulator

JFD Manufacturing Company, Inc., has added a new type of standoff insulator to its line of products and called it the "PAL" insulator. The new unit is designed so that it can be used with any of several different types of transmission line — ribbon twin lead, open wire, tubular twin lead, or oval line. Fig. 7 shows examples of the unit fitted with these various kinds of line.

The "PAL" is particularly useful in UHF areas where wide varieties of lead-in types are employed. Since there is no metal surrounding the line when it is clamped in place, losses due to the standing waves created from proximity to metal are minimized. Note from the illustration in Fig. 7 that the insulating portion of the standoff is hinged to the standoff frame and swings open to admit the line without the necessity for a threading operation. With the line placed in its proper position, the insulator can be closed by snapping the cam-like open notch into the standoff frame. The 7-inch length of the unit also makes it ideally suited for UHF installations which require spacing of this order for minimum signal attenuation.

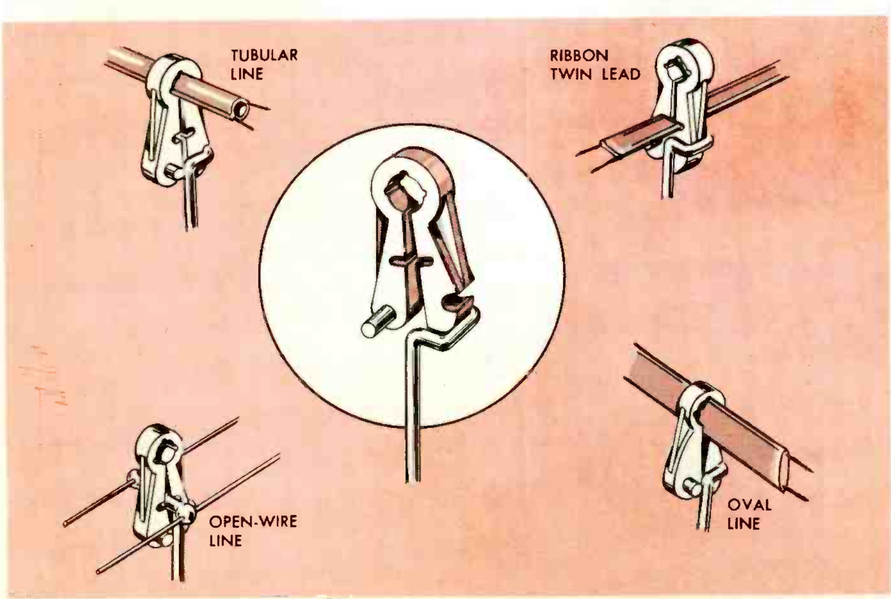


Fig. 7. JFD "PAL" TV Line Insulator Illustrating Its Use With Various Types of Transmission Line.

$5,600 IN PRIZES

. . . easy to win

503 PRIZES!

$2000 - 1st prize

$500 - 2nd prize, $100 - 3rd prize
100 - $10 prizes, 400 - $5 prizes

HOW TO WIN

To win one of these 503 prizes all you have to do is complete in 25 words or less "I like Pyramid capacitors because______" You fill in this statement on a Pyramid contest entry blank which can be obtained from any electronic parts jobber selling Pyramid capacitors. You have this entry blank countersigned by your jobber or one of his salesmen and forward it to us attached to a Pyramid Dry Electrolytic Capacitor box top—the top being the part which carries the description of the item. There is no limit to the number of entries which you may make in this contest but each entry must be accompanied by a box top. Full rules for the contest appear on the entry blank.

It's so easy. Here is the kind of statement that might win:

"I like Pyramid capacitors because the line is so complete that I can always get what I need and don't have to worry about an off-brand capacitor."

"I like Pyramid capacitors because they always check out perfectly and don't deteriorate and so I know I won't have to call back at my expense."

PYRAMID

PYRAMID FEATURES:

1. Only one quality—the best at no premium. All Pyramid capacitors are made of materials commanded by rigid military specifications.
2. All Pyramid capacitors are non-hygroscopic.
3. Highest quality insulator material used in all production results in low leakage factor.
4. Exclusive non-contamination technique guarantees close tolerances and no deterioration. Peak performances for life.
5. Pyramid capacitors operate unchanged at ambient temperature of 85° centigrade.
6. Designed by service technicians across the country for their requirements.
7. Individually packaged for protection.
8. Permanently legible, high visibility ratings on each item.
9. 100% absolute electronic inspection before shipment.

Pyramid is in its 10th year as a leading manufacturer of high-quality capacitors.

PYRAMID ELECTRIC COMPANY
1445 HUDSON BOULEVARD
NORTH BERGEN, N. J.

Burton browne advertising

There is one important precaution which must be stated concerning the use of the "PAL" standoff insulator. The reader will note that the unit seems to be made to order for installations having two transmission lines: ribbon twin lead for VHF and tubular for UHF. He may ask, "Can I use a single run of these standoffs to hold both lines?" The answer to this question is an emphatic "No." UHF transmission line must be widely separated not only from metal, wood, and other surfaces but also from other transmission lines. This spacing is essential for optimum transmission of the UHF signal. The "PAL" insulator is not intended to be used with two lines on single standoffs.

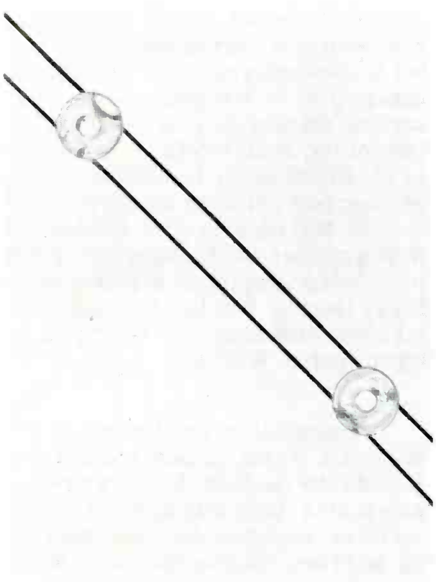


Fig. 8. Saucerline. (Photograph Courtesy of Fretco Inc.)

Saucerline

Fretco Incorporated has announced a new type of open-wire transmission line for use in both UHF and VHF areas. The line is pictured in Fig. 8. The way in which Saucerline gets its name is apparent from the novel shape of the red insulators which it employs. These insulators are made from a new type of low-loss material called polythemalyne. The characteristic impedance of Saucerline is 300 ohms.

The individual wires in Saucerline are made of No. 18 copper weld wire and are separated a distance of 3/8 inch from each other. The insulators measure 5/8 inch in diameter and are located at 6-inch intervals along the line.

The line is packaged on spools for convenience in handling.

Glen E. Slutz

Instrument Coupling Methods

(Continued from page 27)

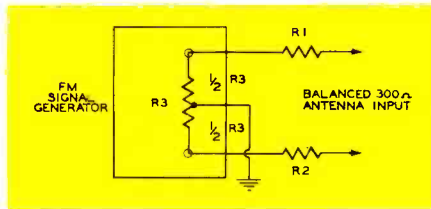


Fig. 3. Standard 300-Ohm FM Dummy Antenna.

In Fig. 4A, there is shown the response of the RF stage of a television tuner. The signal input was made to the receiver-antenna terminals through the output cable supplied by the manufacturer of the sweep generator. This cable had a built-in terminating network which is diagrammed in Fig. 4C. The generator sweep was set on channel 4, and the sweep was 12 mc wide with a 68-mc marker applied. When a shielded output cable with no terminating network was substituted for the first-mentioned cable, the response shown in Fig. 4B was obtained. Examples of a few sweep-attenuator pads recommended for use during alignment are shown in Fig. 5. They are designed to match three different generator-cable impedances to the 300-ohm balanced input of the receivers.

Other methods of generator coupling might be mentioned as being in common use among service technicians: the shield of a tube can be raised enough so that it is no longer grounded, and the hot lead of the generator can then be clipped directly to the shield; or the generator lead can be clipped to an insulated portion of the circuit wiring at a sensitive point. The amount of capacity involved in such a procedure is very small, consequently these methods have little detuning or loading effect in the circuits in question. At the higher frequencies, usually enough signal can be introduced in this way to be useful.

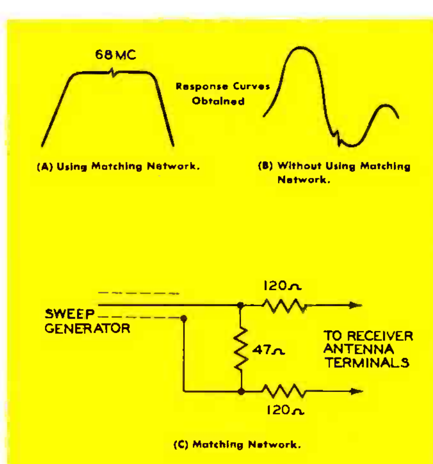


Fig. 4. Matching Network and Response Curves.

An extremely simple method of applying a marker signal to a receiver is to clip the hot lead of the generator to the receiver chassis. The point of application can be varied for best results. The ground lead of the generator is left floating.

When connecting VTVM's and oscilloscopes to circuits under test, the important consideration is to avoid excessive loading of the circuits. Most VTVM's have a built-in 1-megohm isolating resistor near the tip of the DC probe. Occasionally the application of a VTVM probe to a sensitive circuit will cause oscillation, and an additional resistance at the probe tip will be necessary with leads being kept as short as possible.

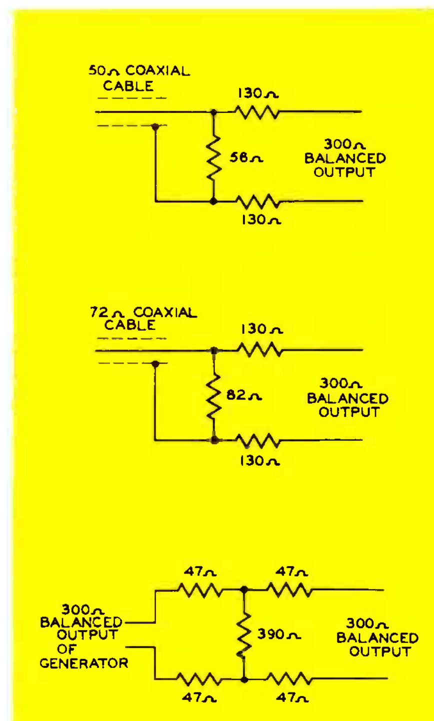


Fig. 5. Sweep Generator Attenuator Pads.

A resistance between 10,000 and 47,000 ohms will usually be very satisfactory for isolation of the input capacitance of a scope from the circuit to which it is applied. If too large a value is used, the resistance combined with the scope capacitance will act as an integrating network and the observed waveform may be distorted.

Paul C. Smith

The Williamson Amplifier

(Continued from page 15)

When David Hafler and Herbert I. Keroes developed the circuit[1] using an output transformer with taps on its primary to connect a portion of the load to the screens, they made it possible to increase the power output of the Williamson type of amplifier[2,3] easily and with little added demand on the power supply.

In the Williamson amplifier the beam-power output tubes are operated as triodes, since the screens are connected to the plates through 100-ohm suppressor resistors. This reduces internal plate impedance and results in very linear operation, but it does eliminate the high power capabilities of the tetrode. By connecting the screens to about 20 per cent of the load, a form of operation is obtained which is neither triode nor tetrode but is in between. Connecting the screens into the circuit in this manner has the effect of applying a large amount of negative feedback, thereby making it possible to maintain linearity of operation at higher output levels.

Since Hafler and Keroes developed this output circuit and a transformer to operate in it, several companies have brought out transformers designed for this service. In addition, some standard output transformers possessing tapped or multiple primary windings, while not exactly following the specifications set up for this circuit, do furnish improved operation when used in the correct manner.

Any such improvement in high-fidelity equipment is worth while, and we feel that the following details concerning the amplifier constructed in our laboratory and shown in the illustrations of Figs. 1 and 2 will be of interest to the reader.

In order to construct the improved unit, we selected the Stancor

---

[1] David Hafler and Herbert I. Keroes, "An Ultra-Linear Amplifier," Audio Engineering, Nov. 1951, p. 15, reprinted in The 2nd Audio Anthology, Radio Magazines, Inc., Mineola, N. Y., 1953.

[2] David Hafler and Herbert I. Keroes, "Ultra-Linear Operation of the Williamson Amplifier," Audio Engineering, June 1952, p. 26, reprinted in The 2nd Audio Anthology, Radio Magazines, Inc., Mineola, N. Y., 1953.

[3] David Sarser and Melvin C. Sprinkle, "Gilding the Lily," Audio Engineering, July 1952, p. 13, reprinted in The 2nd Audio Anthology, Radio Magazines, Inc., Mineola, N. Y., 1953.

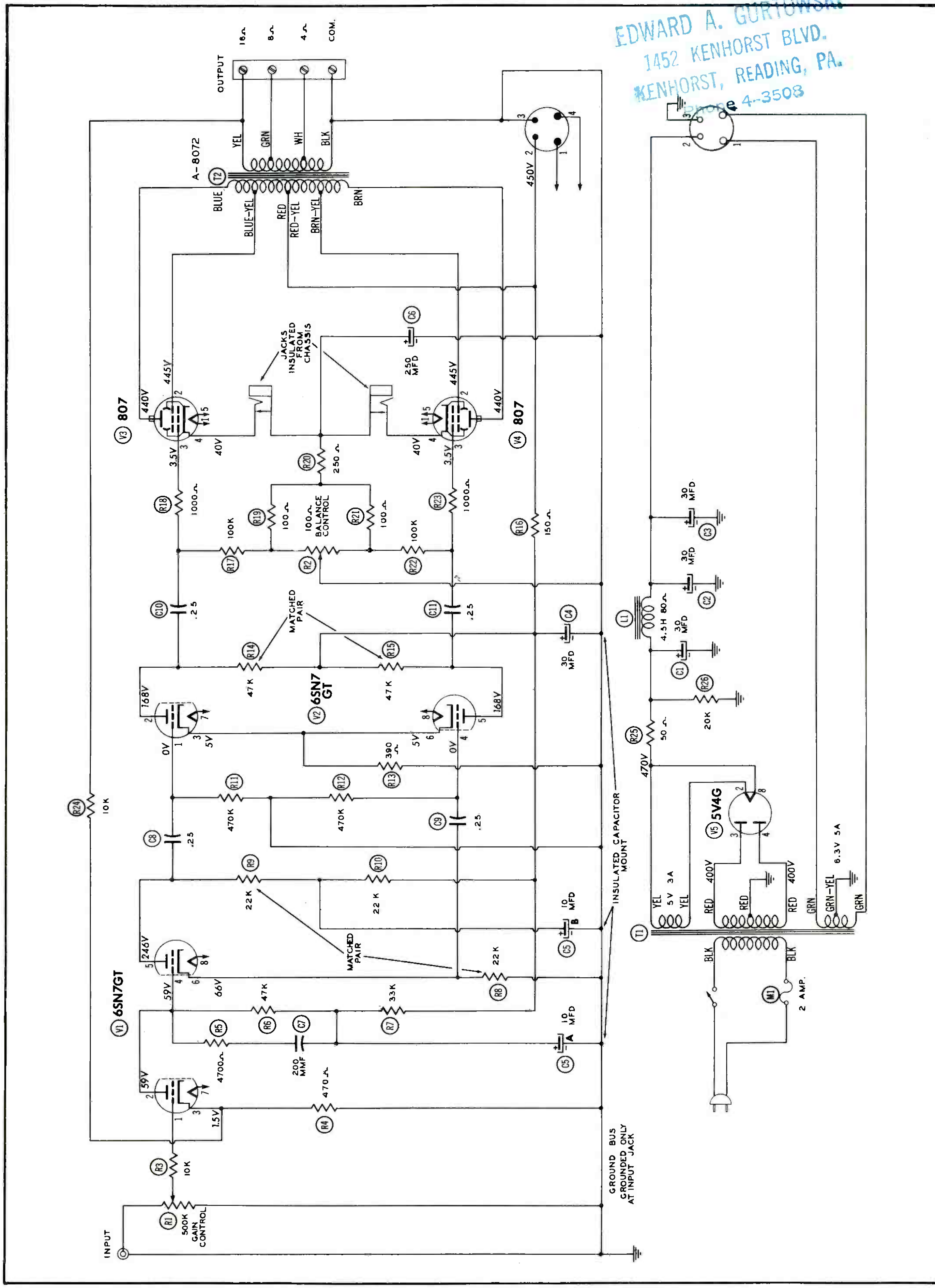


Fig. 3. Schematic of Modified Williamson Amplifier With Power Supply.

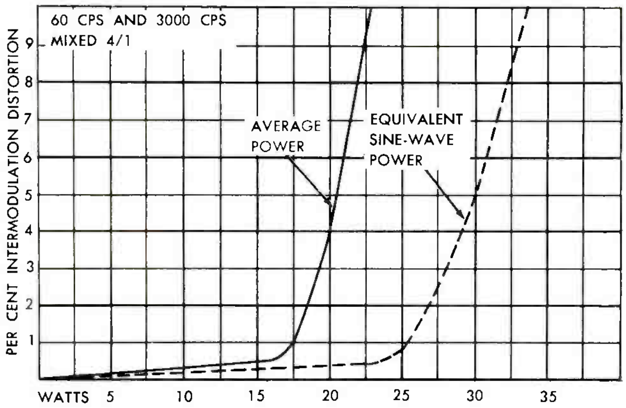


Fig. 4. Intermodulation Distortion Versus Power Output.

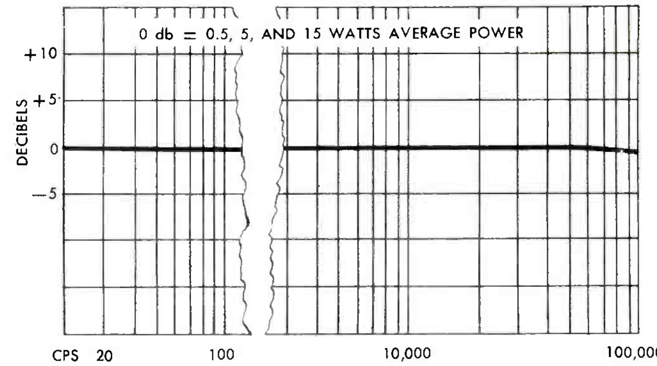


Fig. 5. Frequency Response at 0.5, 5, and 15 Watts Output.

A8072 high-fidelity output transformer (which was made by the Chicago Standard Transformer Corporation particularly for this type of service) and the power transformer, the filter choke, and two punched chassis (which were furnished by them for use in the Williamson amplifier).

The amplifier was assembled and wired according to the circuit shown in Fig. 3. A study of the schematic will reveal that very few modifications were actually made in the original circuit. After some discussion of these modifications we will then consider some of the things concerned with the construction and wiring.

Starting at the input R3, a 10,000-ohm resistor has been inserted in the grid circuit for increased stability when the input control is set at or very near maximum. R5 and C7 are connected across the plate load of the first stage to give a rolloff of the higher frequencies and minimize instability due to capacitive load effects. The values of C8 and C9 were increased from .05 mfd to .25 mfd in order to increase low-frequency stability.

C6, a 250-mfd 50-volt electrolytic capacitor, was connected from the cathodes of the output tubes to ground to reduce distortion, especially at the higher power levels. No suppressor resistors are employed in the screen circuits of the 807 type tube. The output transformer is connected directly to the screens and plates as shown in the schematic. The feedback resistor R24 has been increased in value to 10,000 ohms to maintain the 20 db of negative feedback to the input cathode.

No changes were made in the power supply, but it can be noted that a 5V4G has replaced the 5U4G. We have used a 5V4G in the Williamson for some time because it heats up to operating level in just about the same time required by the rest of the tubes. This eliminates the high-voltage surge present during the warm-up period when a filament type of tube, such as the 5U4G, is used. Also the increase in DC voltage available from the supply, because of the decreased drop across the 5V4G, improves operation. This is particularly helpful when line voltage is low.

The graph shown in Fig. 4, with the percentage of intermodulation distortion plotted against power output, clearly indicates the extended power output with low distortion. (Both average power and equivalent sine-wave power are shown to avoid confusion.) We have convinced ourselves that the listening qualities at low levels have also been improved.

It hardly seemed worth while to show the frequency-response curve (Fig. 5), since it is so flat at all power levels.

The amplifier chassis, as received, had a cutout for a three-terminal output strip as used with the Stancor A8054 transformer. Since the A8072 used has output taps for 4, 8 and 16 ohms, the cutout was enlarged to accommodate a four-terminal strip. We also installed a conventional phono jack in the hole punched for the microphone-cable connector originally used. This provided for the use of a phono plug and jack so commonly used in the sound systems.

All resistors and capacitors were mounted on terminal strips or on rigid mounts whenever possible, and some of the long leads were cabled. The cabling of these leads is not absolutely necessary; but knowing that this particular unit would receive considerable rough use, it was done to insure consistent, dependable service. The No. 14 solid wire ground bus also aids in this respect, besides preventing ground loops.

One- and two-watt resistors were used because of their ability to stand up under heat of soldering and also because they are less likely to change value or become noisy with hard usage as readily as lower-wattage resistors might.

All pairs of resistors and capacitors were carefully matched. Although R8 with R9 and R14 with R15 (as indicated on the schematic) are the most important ones, the matching of all pairs of coupling capacitors and grid resistors will do no harm;

H-4103

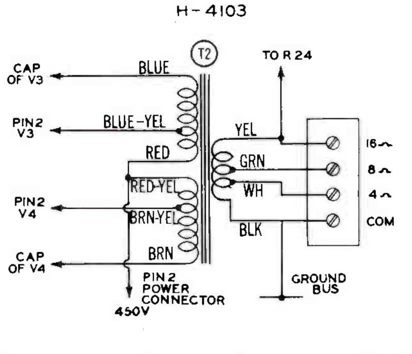


Fig. 6. Connections for Halldorson H4103 Output Transformer.

S-148A

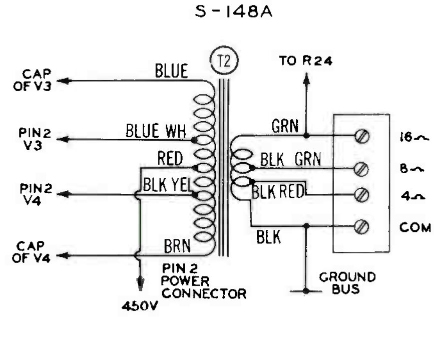


Fig. 7. Connections for Triad S-148A Output Transformer.

PARTS LIST

TUBES

V1	6SN7GT	V3	807	V5	5V4G
V2	6SN7GT	V4	807		

CAPACITORS

	Cap.	Volt.	Aerovox	Cornell-Dubilier	Mallory	Sprague	Note
C1	30	475	AFH1-56	A054	FP258 *	TVL-1810	*15-15/475 Parallel Sections
C2	30	475	AFH1-56	A054	FP258 *	TVL-1810	
C3	30	475	AFH1-56	A054	FP258 *	TVL-1810	
C4	30	475	AFH1-56	A054	FP258 *	TVL-1810	
C5A	10	450	AFH2-47	B037	FP231	TVL-2750	
C5B	10	450	AFH2-47	B037	FP231	TVL-2750	
C6	250	50	PRS50/250	BRH5025	TC50025	TVA-1312	
C7	200	500	14680002	5W5T2	MC237	1FM-32	
C8	.25	600	684-25	CUB6P25	PT6025	6TM-P25	
C9	.25	600	684-25	CUB6P25	PT6025	6TM-P25	
C10	.25	600	684-25	CUB6P25	PT6025	6TM-P25	
C11	.25	600	684-25	CUB6P25	PT6025	6TM-P25	

CONTROLS

	Resistance	Watts	IRC	Clarostat	Centralab	Mallory
R1	500K	1/2	Q13-133	AG-60-Z FS3	B60	
R2	100Ω	2	W100	43-100	V121	

RESISTORS

	Resistance	Watts	IRC	
R3	10KΩ	1	BTA-10000	
R4	470Ω	1	BTA-470	
R5	4700Ω	1	BTA-4700	
R6	47KΩ	1	BTA-47000	
R7	33KΩ	1	BTA-33000	
R8	22KΩ	1	BTA-22000	Matched Pair
R9	22KΩ	1	BTA-22000	Matched Pair
R10	22KΩ	1	BTA-22000	
R11	470KΩ	1	BTA-.47 Meg	
R12	470KΩ	1	BTA-.47 Meg	
R13	390Ω	1	BTA-390	
R14	47KΩ	2	BTB-47000	Matched Pair
R15	47KΩ	2	BTB-47000	Matched Pair
R16	150Ω	10	1 3/4 A150	
R17	100KΩ	1	BTA-.1 Meg	
R18	1000Ω	1	BTA-1000	
R19	100Ω	1	BTA-100	
R20	250Ω	10	1 3/4 A250	
R21	100Ω	1	BTA-100	
R22	100KΩ	1	BTA-.1 Meg	
R23	1000Ω	1	BTA-1000	
R24	10KΩ	1	BTA-10000	
R25	50Ω	10	1 3/4 A50	
R26	20KΩ	20	2D-20000	

POWER TRANSFORMER

			PRI	Section 1	Section 2	Section 3
T1	Stancor	PC-8412	117V AC	800V CT .2A	5V AC 3A	6.3V AC CT 5A
	Merit	P-3155				
	Triad	R-21A				
	Halldorson	P9404				
	Thordarson	TS-24R07-U				

OUTPUT TRANSFORMER

		Primary Impedance	Secondary Impedance
T2	Stancor A-8072	7600	4, 8 and 16Ω
	Merit A-3101	10000	4, 8 and 16Ω
	Triad HSM-189	10000	4, 8 and 16Ω
	Triad S-148A	10000	4, 8 and 16Ω
	Halldorson HA-4103	7400	4, 8 and 16Ω

FILTER CHOKE

		DC	DC Resistance	Inductance
L1	Stancor C-1411	200	80Ω	4.5
	Merit C-3196	200	80Ω	5
	Triad C-14A	200	150Ω	6
	Halldorson C-5031	200	80Ω	4.5
	Thordarson T20C55	200	75Ω	6

FUSES

	Type	Rating	Littelfuse Fuse	Littelfuse Holder	Buss Fuse	Buss Holder
M1	3AG	2A	312002	341001	AGC2	HKP

MISCELLANEOUS

1	WM-8 Set of Stancor Chassis or, Two Chassis 7in. x 9 in. x 2 in.	
1	Toggle Switch	
2	Closed-Circuit Jacks	
3	Octal Tube Sockets	
2	5-Prong Tube Sockets	
1	4-Prong Connector Socket	Amphenol 77-M1P4
1	4-Prong Connector	Amphenol 78-PF4
1	4-Prong Connector	Amphenol 86-PM4
1	4-Prong Connector	Amphenol 86-CP4
1	Phono Jack	
2	Plate Caps 3/8 in.	
	Output Terminal Strip, AC Line Cord, Miscellaneous Hardware, Etc.	

A STOCK GUIDE FOR TV TUBES

The figures in the chart below have been revised to include production of TV receivers since the compilation of the chart which appeared in PF INDEX and Technical Digest for September-October, 1953.

For an explanation of how this chart originated and for information on its recommended use, refer to PF INDEX and Technical Digest for May-June, 1953.

	46-53 Models	52 & 53 Models		46-53 Models	52 & 53 Models		46-53 Models	52 & 53 Models		46-53 Models	52 & 53 Models
1AX2#			6AT6	4	3	6BX7#			6W4GT	32	34
1B3GT	40	44	6AU5GT	4	4	6BZ7*	3	4	6W6GT	7	12
1V2	1		6AU6	135	125	6C4	10	10	6X5GT	1	1
1X2	6	2	6AV5GT	2	4	6CB6	94	138	6X8	3	5
1X2A	4	6	6AV6	14	16	6CD6G	7	9	6Y6G	3	1
5U4G	45	47	6AX4	3	2	6CL6	1	1	7C5	1	
5V4G	7		6AX5GT	2	3	6J5	3	3	7N7	2	1
5Y3GT	3	1	6BA6	16	11	6J5GT	2	1	12AT7	15	14
6AB4*	3	3	6BC5	11	7	6J6	34	31	12AU6	1	
6AC7	9	9	6BE6	5	6	6K6GT	17	10	12AU7	44	27
6AF4*	1	1	6BF5	1	1	6S4	8	10	12AV7	4	4
6AG5	37	11	6BG6G	15	7	6SH7	1		12AX4	2	4
6AG7	3	3	6BH6	8		6SL7GT	4	3	12AX7	4	5
6AH4GT	2	3	6BK5	1	2	6SN7GT	79	87	12AZ7	1	2
6AH6	8	10	6BK7*	4	7	6SN7GTA#			12BH7	8	12
6AK5	4	4	6BK7A*	1	1	6SQ7GT	3	3	12BX7#		
6AL5	77	79	6BL7GT	6	9	6T4*			12BY7	1	3
6AN4*			6BN6	3	3	6T8	14	15	12BZ7#		
6AQ5	12	13	6BQ6G#			6U4GT#			12SN7GT	7	5
6AQ7GT	2	2	6BQ6GT	16	26	6U8	4	7	25BQ6GT	3	5
6AS4*			6BQ7*	6	14	6V3	2	4	25L6GT	6	6
6AS5	2	2	6BQ7A*	1	1	6V6GT	22	20	25W4GT	2	2
									25Z6	1	
									5642	2	2

#New tubes recently introduced.

*A stock of these tubes should be maintained in UHF areas.

The Williamson Amplifier

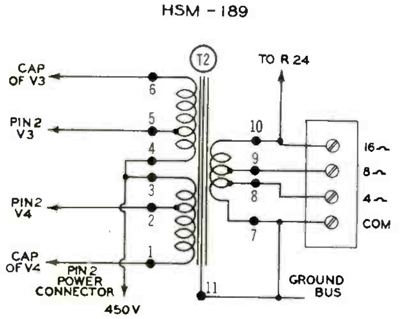


Fig. 8. Connections for Triad HSM-189 Output Transformer.

in fact, matching will aid greatly in achieving balance in the circuit and in obtaining satisfactory results under the most exacting requirements.

The 6SN7GT in the push-pull driver stage should be selected for equal output from its two sections in order to make possible the balancing of the complete circuit. A matched pair of 807's is just as important, if not even more so, for this same reason.

The Stancor A8072 transformer was used in this amplifier, but many others have been tested in this circuit with equally good results being obtained. This surely proves the merits of the circuit.

The Halldorson H4103 high-fidelity output transformer was also designed for use in this circuit. Excellent results were obtained when it was connected as shown in Fig. 6.

Triad output transformers S-148A and HSM189, designed for use in the original Williamson circuit, gave excellent results when used in this modified circuit as shown in Figs. 7 and 8 respectively.

Another output transformer, the Merit A3101, when connected as shown in Fig. 9, gave comparable results. Since the leads are not coded as to the start or finish of the windings, the plate and screen leads might be improperly connected in the first wiring. Such a connection provides a positive feedback resulting in violent oscillations. Trial will determine the correct connections.

As can be seen in the parts list included in these columns, these transformers vary as to primary

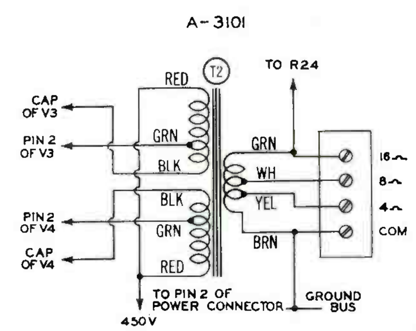


Fig. 9. Connections for Merit A-3101 Output Transformer.

impedance and placement of the taps. But improved operation, in comparison with that of the original Williamson, was obtained with every one when it was used in the modified circuit.

Results provided by an amplifier such as this further substantiate our feeling that it is no problem to find a good power amplifier to fill most any requirement.

Robert B. Dunham

Mathematics

(Continued from page 13)

$$f_1 = \frac{10^3}{2\pi\sqrt{L_1 C_1}} \qquad (20)$$

where

f_1 = resonant frequency, in megacycles per second,

L_1 = inductance, in microhenrys,

C_1 = capacitance, in micromicrofarads.

This completes the conversion of units in this particular formula.

We suggest that the reader try his hand at the following problem:

The formula for power states that

$$P = I^2 R \qquad (21)$$

where

P = power, in watts,

I = current, in amperes,

R = resistance, in ohms.

Restate this formula in terms of milliwatts P_1, milliamperes I_1, and megohms R_1. The correct answer is:

$$P_1 = I_1^2 R_1 \times 10^3 \qquad (22)$$

Interpolation

Certain pieces of test equipment have dials and scales which require the service technician to perform interpolation in order to set a control exactly on a desired value. The word "interpolation" in mathematics refers to the insertion of intermediate terms in a series. The best way to illustrate this process is by means of an example.

Let us assume that we have a frequency scale on a certain signal generator and that this scale is marked at 5-megacycle intervals over a 20-megacycle range. See Fig. 1A. The frequency needed for a particular test happens to be 58.5 megacycles, and it is not marked on the frequency scale. The fine-tuning knob on the generator has a skirt which is marked off in equal units, and every fifth mark is numbered without reference to frequency. See Fig. 1B. Rotating the fine-tuning knob causes the pointer to move across the frequency scale.

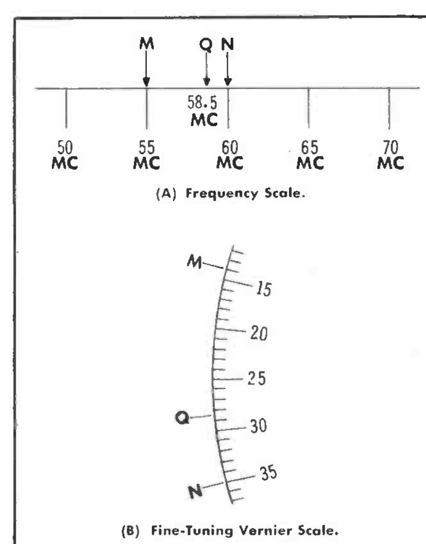


Fig. 1. Interpolation of Frequency Dial Settings.

The procedure for setting up a frequency of 58.5 megacycles on this instrument can be presented in steps as follows:

1. Since a 58.5-megacycle setting on the frequency scale falls between the 55-megacycle and 60-megacycle

marks, set the pointer at 55 megacycles (position M) by means of the fine-tuning knob. Record the reading of 14 which is indicated on the fine-tuning vernier scale at this setting.

2. Advance the pointer to 60 megacycles (position N), and record the setting of 35 on the vernier scale.

3. The movement of the pointer through the 5-megacycle interval between the 55-megacycle and 60-megacycle marks corresponds to a movement of the fine-tuning knob through 21 units on its vernier scale. This figure is found by subtracting.

$$35 - 14 = 21 \text{ units} \qquad (23)$$

4. The desired frequency is 3.5 megacycles above the lower known frequency of 55 megacycles. This separation is found by subtracting.

$$58.5 - 55 = 3.5 \text{ megacycles} \qquad (24)$$

5. A proportionality can now be set up such that the unknown number x of vernier-scale units between positions M and Q compares to 3.5 megacycles as 21 vernier units compare to 5 megacycles.

$$\frac{x}{3.5} = \frac{21}{5} \qquad (25)$$

Multiply both sides of this equation by 3.5.

$$x = \frac{21}{5} \times 3.5 \qquad (26)$$

$$x = 14.7 \text{ units}$$

6. By adding 14.7 units to the vernier-scale reading of 14 obtained at the M position, we arrive at an absolute setting on the fine-tuning knob for a frequency of 58.5 megacycles.

$$14 + 14.7 = 28.7 \qquad (27)$$

Let us assume now that we are faced with another situation. The generator is set at position Q which is 28.7 on the vernier scale, and we do not know the exact frequency which this position represents. Again we can use a series of steps to illustrate the procedure for finding this frequency.

1. Find the vernier-scale readings for positions M and N which are for 55 and 60 megacycles, respectively. These are found to be 14 and 35, as shown in Fig. 1.

2. The difference of the above readings is found to be

$$35 - 14 = 21 \text{ units} \qquad (28)$$

3. The difference between scale readings at positions M and Q is found by subtraction

$$28.7 - 14 = 14.7 \text{ units} \qquad (29)$$

4. A proportionality is established such that x, the unknown frequency difference between the M and Q positions, is to 14.7 units as 5 megacycles are to 21 units.

$$\frac{x}{14.7} = \frac{5}{21} \qquad (30)$$

Multiply both sides of the equation by 14.7.

$$x = \frac{5}{21} \times 14.7 \qquad (31)$$

$$x = 3.5 \text{ megacycles}$$

5. By adding 3.5 megacycles to the frequency of position M (55 megacycles), we can learn the frequency represented by the vernier-scale setting of 28.7.

$$55 + 3.5 = 58.5 \text{ megacycles} \qquad (32)$$

As a test of the reader's understanding of interpolation, it is suggested that the following problem be solved:

Fig. 2 is a drawing of the frequency scale and the vernier scale on a certain frequency meter. What is the frequency represented by position S of the pointer?

Prices and Discounts

Mathematics is employed constantly for the financial side of the service business. Matters of considerable concern to the service technician who manages his own shop are the costs, list prices, and discounts associated with the parts and materials which he buys and sells. The list price of an item is the price which the consumer is called upon to pay. The cost is the amount the service technician pays his supplier for the item. The discount is the percentage of the list price which constitutes the difference between list price and cost. Expressed mathematically,

$$D = 100\left(\frac{L - C}{L}\right) \qquad (33)$$

where
D = discount percentage,
L = list price,
C = cost.

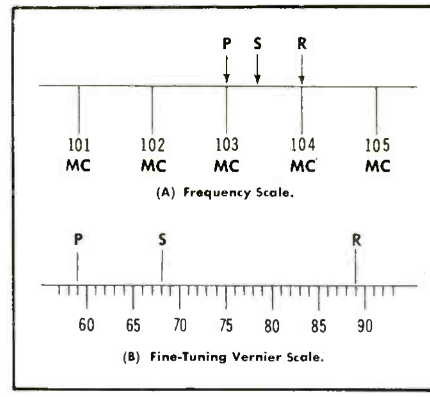


Fig. 2. Problem in Interpolation.

An example may be in order at this point. Suppose a certain transformer lists at \$15 and it costs the service technician \$10 when he orders it from his distributor. According to equation (33),

$$D = 100 \times \frac{15 - 10}{15} \qquad (34)$$

$$D = 100 \times \frac{5}{15} = 100 \times \frac{1}{3}$$

$$D = 33\tfrac{1}{3}\%$$

Equation (33) may be modified to suit a condition where either the list price or the cost is the unknown. Multiply both sides of equation (33) by L.

$$LD = 100\,(L - C) \qquad (35)$$

$$LD = 100\,L - 100\,C$$

Add 100 C to both sides of equation (35).

$$100\,C + LD = 100\,L \qquad (36)$$

Subtract LD from both sides of equation (36).

$$100\,C = 100\,L - LD \qquad (37)$$

Divide both sides of equation (37) by 100.

$$C = \frac{100\,L - LD}{100} \qquad (38)$$

Factor out L from the numerator of the fraction.

$$C = \frac{L\,(100 - D)}{100} \qquad (39)$$

Equation (39) makes possible the evaluation of cost C if the list price and discount percentage are known. If a discount of 40 per cent were given by a supplier on a picture tube which listed at \$55, what would its cost be? Substitute values in equation (39) to find the answer.

$$C = \frac{55\,(100 - 40)}{100} = \frac{55 \times 60}{100} \qquad (40)$$

$$C = \frac{3300}{100} = \$33.00$$

An equation for the list price in terms of cost and discount percent-

TABLE I Relationship Between Costs and List Prices for Three Discount Percentages		
Discount	Cost (When List Price Is Known)	List Price (When Cost Is Known)
40%	3/5 x List Price	1 2/3 x Cost
30%	7/10 x List Price	1 3/7 x Cost
25%	3/4 x List Price	1 1/3 x Cost

age can be obtained by methods similar to those used in finding equation (39).

$$L = \frac{100C}{100 - D} \qquad (41)$$

Suppose that a replacement part costs $3 and the discount percentage is 40 per cent. What would be the list price on this item? The answer can be found by substituting known values in equation (41).

$$L = \frac{100 \times 3}{100 - 40} = \frac{300}{60} \qquad (42)$$

$$L = \$5.00$$

In order to minimize the necessity for computing costs and list prices by means of equation substitution, Table I has been drawn up and presented. In this table are short-cut methods for figuring costs and list prices for three of the more common discount percentages. All figures in the table were derived by using equations (39) and (41) which have been presented in the text.

Many distributors, in order to avoid the use of odd percentage figures, offer discounts expressed with more than one number such as "40 and 10" or "50 and 5." A percentage discount of 40 and 10 is not the same as a discount of 50. Expressed by a single figure, its value would be between a 40 per cent and a 50 per cent discount.

Equations (39) and (41) can be used to compute cost and list price for multiple discount numbers as well as for the single discount; the difference in procedure lies in the number and order of the computations. Suppose that in the example of equation (40), the percentage discount were 40 and 10 instead of 40. Cost C for a list price of $55 may be found by the following procedure:

1. Find an initial value for C by substituting in equation (39) the list price of $55 for L. For D, use the first number in the multiple discount in this instance, 40.

2. Having found the initial value for C, which is $33 in this example, arrive at the final value for C by substituting in equation (39) a second time. For L, use the initial value for C computed in the previous step; and for D, substitute the second discount number, 10.

3. In case there are additional terms in the discount number, subsequent steps similar to step 2 must be made for each of the terms.

Equation (41) can be used to compute list price for multiple discount numbers. Substitution is made as many times as there are numbers in the discount. The last discount term is used in the first computation, the next to the last term is used in the second computation, and so on. Each list-price figure becomes the value for C in the succeeding computation.

Glen E. Slutz

Notes on Test Equipment (Continued from page 7)

2. Make coarse- and fine-frequency adjustments to synchronize the pattern as closely as possible without recourse to the sync-amplitude control. Choose a setting which results in a pattern of at least two cycles of the waveform being observed. This will minimize the possibility of multiple synchronization.

3. Advance the sync-amplitude control just the amount necessary for proper synchronization.

4. If necessary, reverse the polarity of the applied sync signal. If the scope does not have a polarity reversing switch or control, such reversal may be obtained by moving the vertical-signal take-off point (if the circuit allows) or by applying an external sync signal from a point of the desired polarity.

Fig. 2. Hickok Model 665 Oscilloscope.

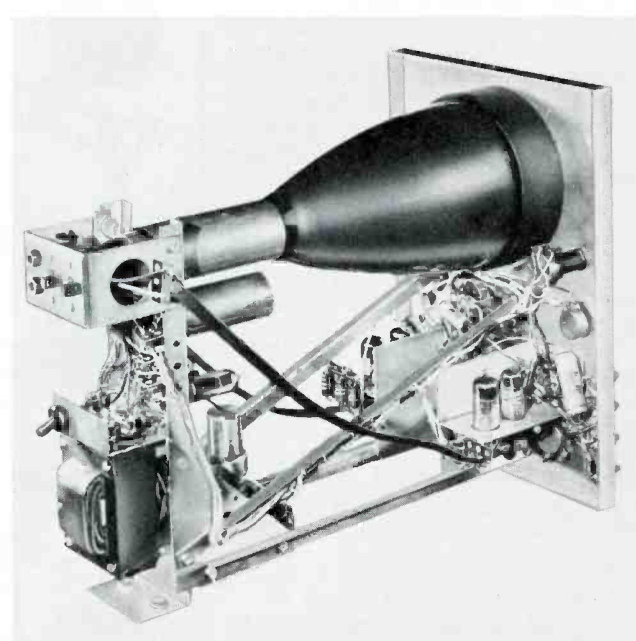


Fig. 3. Internal Construction of Hickok Model 665 Oscilloscope.

Following are discussions of several instruments which have been introduced recently and which we have had the opportunity of using. They include an oscilloscope, a volt-ohm-microammeter, a tube tester, and a UHF signal generator.

Model 665 Oscilloscope

The Hickok Electrical Instrument Company has recently made available a new item of test equipment for the radio and TV service technician. It is the Hickok Model 665 cathode-ray oscilloscope. This oscilloscope is portable because of its light weight (23 pounds). The instrument is housed in a steel case with a blue Hammertex finish. A photograph of the unit is shown in Fig. 2.

The Hickok Model 665 scope employs the following front-panel controls:

1. INTENSITY control for adjusting spot intensity. This control also incorporates the ON-OFF power switch.

2. FOCUS control for adjusting spot focus.

3. HOR. POS. control for horizontal positioning or centering of the beam.

4. VERT. POS. control for vertical positioning or centering of the beam.

5. HOR. SELECT. switch for selecting the desired type of horizontal sweep. Position 1, marked AMP, connects the SWEEP IN and HOR. IN binding posts to the input of the horizontal amplifier. Position 2, INT. SYNC, connects a portion of the amplified vertical-input signal to the LOCKING control. Position 3, EXT. SYNC, connects the LOCKING control to the EXT. SYNC binding post. Position 4, marked LINE, applies a 60-cycle voltage from the 6X4 filament winding of the power transformer to the input of the horizontal amplifier. This voltage is subject to the action of the PHASING CONTROL for proper phasing of the forward and return traces during visual alignment.

6. HOR. GAIN control for varying the amplitude of the signal applied to the horizontal amplifier.

7. VERT. GAIN control for varying the gain of the vertical amplifier section.

8. VERT. RANGE switch for selection of the proper range of input voltages. These positions are: position 1, 0 to 2 volts; position 2, 2 to 40 volts; and position 3, 40 to 600 volts.

9. SWEEP SELECT switch for selection of the proper horizontal sweep frequency to be applied to the horizontal amplifier.

10. VERNIER control for fine adjustment of the frequencies within the individual ranges of the sweep selector.

11. LOCKING control for controlling the amount of synchronizing signal applied to the sweep-circuit oscillator.

12. PHASING control for controlling the phase of the 60-cycle signal which is applied to the horizontal amplifier when the HOR. SELECT is in the LINE position.

The utility of the scope is further extended by the binding posts on the right and left of the front panel. These are designated as SWEEP IN, HOR. IN, GND., and 120 ∿. By setting the horizontal selector switch to EXT. SYNC position and connecting a jumper from the 120-cps binding post to the EXT. SYNC binding post, a 120-cps sync signal is applied to the LOCKING control. This makes possible the positive locking of the sweep oscillators at the 120-cycle rate when aligning FM discriminators or ratio detectors. The 120-cps signal is obtained from a point on the low-voltage supply filter.

The HOR. IN and SWEEP IN binding posts both connect to the horizontal amplifier section, as explained under item 5, with the difference that the SWEEP IN is connected internally through a high-impedance network to the HOR. IN terminal. This permits the SWEEP IN connection to be made to a sweep generator without reaction upon the phasing control of the generator.

Two switches are located at the rear of the oscilloscope case. One switch provides for blanking of the return trace when a 60-cycle sine-wave source is used as the horizontal sweep during alignment. This type of sweep would be obtained if the horizontal selector switch is set at the LINE position. The other switch on the rear of the case provides for direct connection to the vertical-deflection plates of the cathode-ray tube through pin jacks which are also located on the rear of the case.

The power supply employs two rectifiers. One is a 6X4 full-wave rectifier to supply the oscillator and the sweep amplifiers with power. The other rectifier is a 1V2 half-wave rectifier for supplying the high voltage to the cathode-ray tube. The primary and secondary windings of the power transformer are protected by a fuse in each winding. These fuses are mounted on a bracket above the power transformer on the rear of the chassis assembly.

The saw-tooth sweep for the internal horizontal sweep of the scope is generated by a cathode-coupled multivibrator employing a 6J6 dual triode type of tube. Horizontal sweep from 18 cps to 50 kc can be obtained from this oscillator in five ranges. Locking or synchronization of this oscillator can either be accomplished internally through application of a portion of the vertical amplifier signal or externally by introducing another signal into the circuit through the external sync connections.

The horizontal-amplifier section employs two tubes: a 6AB4 which functions as the input amplifier and a 12AT7 operating as a push-pull driver for the horizontal-deflection plates. The horizontal gain control is frequency compensated throughout its range.

The vertical amplifier circuit contains two 12AT7 dual triode type of tubes. The input section of the first tube is coupled to the second or output section of that tube through a cathode follower. The use of a cathode follower at this point results in a high input impedance and low input capacitance. The vertical-range switch is frequency compensated, allowing good frequency response at any setting.

The vertical-amplifier deflection factor (sensitivity) is .025 volt rms per inch. The frequency response of the vertical amplifier is stated as being ±1.5 db from .5 cycle to 500 kc. We have used the Model 665 for observing waveforms at various points normally used in checking a TV receiver. It was noted that there was very little difference between these waveforms and those which were obtained on a scope with a wider response. Stability of synchronization was very good, even when synchronized on the horizontal sync pulses of a video signal.

Fig. 3 shows the unique chassis construction of this scope. Each section of the circuit is wired on individual small chassis; and these chassis are assembled together by angle brackets, as can be seen in the photograph. This results in a very rugged and sturdy assembly while keeping the weight at a minimum.

Notes on Test Equipment

Simpson

Model 269 VOM

The Simpson Electric Company has introduced a new volt-ohm-microammeter designated as the Model 269. The principal feature of this unit is the high sensitivity of its meter movement, namely 10 microamperes for full-scale deflection. In DC-voltage measurements, therefore, the meter has a sensitivity of 100,000 ohms per volt. In measurements of AC voltages, a sensitivity of 5,000 ohms per volt is obtained.

The Model 269 is pictured in Fig. 4. Notice the large dial face of the meter with its several scales. The DC scale is marked in black, and the AC and ohm scales are marked in red. There are two front-panel controls. The one on the lower right is the function selector; the other adjusts the zero point on the ohm scale.

There are 24 positions available through two revolutions of the function switch. These positions are indicated in a circular pattern at the center of the meter face. Six resistance ranges are available. Six ranges of DC voltage are possible, together with a double use of the highest range if the 4-kilovolt multiplier assembly is employed. The AC voltage ranges are five in number, and the direct current ranges cover six positions of the selector. One of the latter ranges can be adapted to measure heavy currents up to 16 amperes. A separate tip jack having a series 0.1-microfarad blocking capacitor is used to measure audio-frequency output voltages which are read on the four lowest AC voltage ranges and on the db scale.

The test-lead pin jacks are four in number. The two on the left side of the instrument are marked "POS" for positive and "COM" for common.

Fig. 4. Simpson Model 269 VOM.

These are used for all functions except the 16-ampere current range and AF output measurements. For the latter functions, two jacks are available on the right side of the instrument. The test leads have the conventional needle type of prods; however, the shanks of these prods are threaded, and this permits threaded alligator clips (which are furnished with the instrument) to be firmly screwed over these prods if preferred.

The carrying handle for the Model 269 is constructed in such a way that when it is pushed over to the back of the instrument, it can be used as a tilted stand upon which to rest the meter at an angle for easy reading.

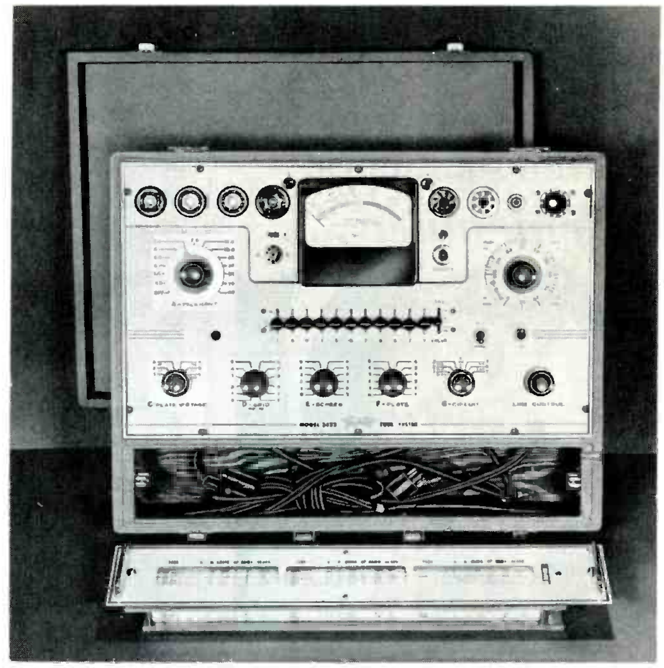


Fig. 5. Triplett Model 3423 Tube Tester With Roll Chart Removed.

Model 3423 Tube Tester

The new Triplett tube tester Model 3423, shown in Fig. 5, is a transconductance type of tester; this means that it duplicates as nearly as possible the normal operating voltages on the various elements in a tube, applies a signal to the grid of the tube, and measures the amplitude of the output signal. Under these conditions, the tube is given a dynamic or operating test as opposed to a static test.

In Fig. 5, notice the large clear markings on the various scales, a feature which facilitates operation. Another noteworthy feature of this instrument is the removable roll chart. One advantage of this chart arrangement is that it simplifies periodic replacement. It also leaves space for the accessory compartment where the line cord, the two cap leads, and any other accessories (such as the BV Adapter used to test picture tubes) can be stored.

The unit incorporates eleven different tube sockets, including special sockets for subminiature tubes and 8-pin acorn tubes. Provisions are available for testing pilot lights and flashlight bulbs. Lever switches are used to connect the pins of each socket into the testing circuit; the number on each lever corresponds to the number of the pin associated with that lever.

One of the electrical features of the Triplett Model 3423 is the 4-kilocycle oscillator, the output of which is used to drive the grid of the tube being tested. To illustrate the action of the circuits in the tube tester, let us consider the test setup for checking a 6AU6 tube. The schematic in Fig. 6 is greatly simplified in that it omits all components and switches not used in this particular test. A study of the schematic will show that the circuit can be divided into two sections, the oscillator section and the detector section which includes the meter.

The 117L7GT is a two-section tube containing a rectifier and a beam-power amplifier The only duty of the rectifier is to supply the DC voltage for operation of the oscillator. The beam-power section functions as the 4-kc oscillator which is used to drive the grid of the tube under test. There are two output voltages from the oscillator for application to the grid of the tube being tested. The one most often used is 1.2 volts. The other is 0.6 volt which is used for testing very high-gain tubes with a mutual conductance of over 18,000. The switching of these two voltages is provided by the SPECIAL/NORMAL switch on the front of the instrument.

The plate circuit of V2 in Fig. 6 warrants special consideration. By applying a 4-kc signal to the grid of V2 and detecting and measuring the output, it is possible to supply the plate and screen with 60-cycle voltages and still get an accurate measurement of the mutual conductance of the tube being tested. This is done in the following manner. L1 and C5 form a parallel circuit resonant at the 4-kc frequency, thereby offering very

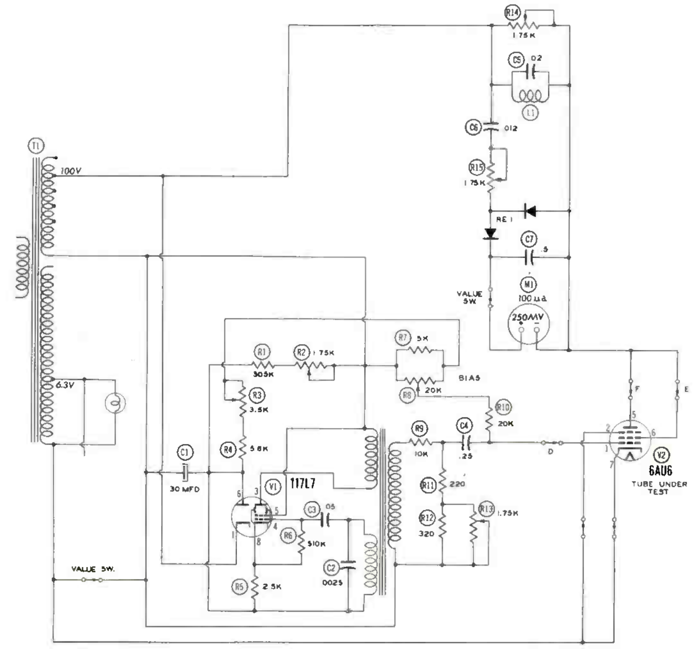


Fig. 6. Partial Schematic of Triplett Model 3423 Tube Tester Showing Circuit Used for Testing a 6AU6 Type of Tube.

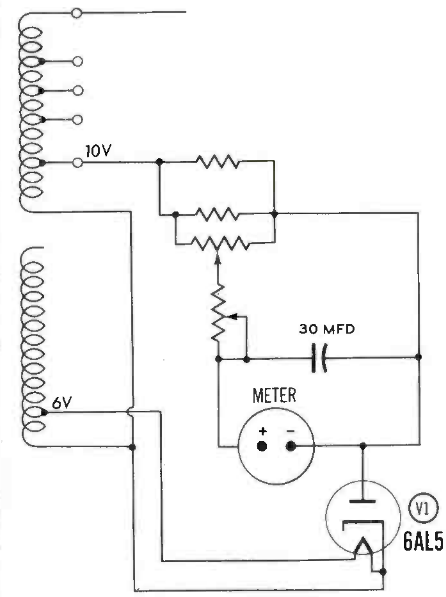


Fig. 7. Partial Schematic of Triplett Model 3423 Tube Tester Showing Circuit Used for Testing a 6AL5 Type of Tube.

little impedance to the 60-cycle signal and maximum impedance to the 4-kc signal; therefore, the only voltage actually appearing across the plate load is the 4-kc signal. The amplitude of the signal appearing across L1 and C5 is dependent upon the amplification characteristics of the tube under test. This 4-kc signal is then detected and measured by the meter and its rectifiers, RE1.

There are five plate voltages available in this tester; consequently, the voltage best suited to the particular tube under test can be selected.

Diodes are tested for emission only, since they provide no amplification. A typical setup for testing a 6AL5 diode may be seen in Fig. 7. Examination of this schematic will show that less than 10 volts are used

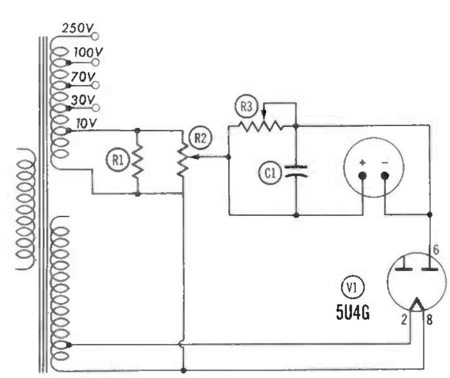


Fig. 8. Partial Schematic of Triplett Model 3423 Tube Tester Showing Circuit Used for Testing a 5U4G Type of Tube.

on the plate of the 6AL5 being tested. In measuring emission, this voltage level makes the circuit much more sensitive when a weak tube is encountered than would a larger voltage.

Fig. 8 is another simplified schematic showing a typical setup for testing a rectifier, which in this case is a 5U4G. It will be noted that here again a low voltage is employed. The reason is the same as for the 6AL5 diode. By using low voltages on the plates, a more positive indication of poor emission is possible.

In conducting a test for shorted elements using this tester, the following steps are required: (1) set line control adjustment according to meter indication, (2) set filament and bias controls to the values given on the chart, (3) place the tube to be tested in its proper socket, (4) set all levers in down position except those indicated by the chart as being in the up position, and (5) set the circuit control to the No. 1 position. With this setup completed, the grid control is rotated through all of its positions while the tube is tapped gently. If any of the elements are shorted, they will cause a steady lighting of the neon lamp. Indications of shorts on pin numbers listed in the chart with dark, bold type are normal and do not mean that the tested tube is defective.

The best time to make a gas test on a tube is after the tube has been tested for mutual conductance, because most of the controls are already set up. Reset the circuit control to the fourth position, which is the 1800-micromho range. While holding the value lever in the value position, the bias control is rotated until the meter reads 300 on the 1800-micromho range. Then, when the value lever is thrown to the gas position, the meter reading should not change more than one division on the 1800-micromho scale. If it does, the tube is gassy.

The Triplett Model 3423 may be used to test the actual striking or firing condition of thyratrons. To test a 2D21, for example, the bias control must be decreased steadily from 100 to the value shown on the chart. The tube should fire within these two limits. As soon as it fires, the meter should read in the good portion of the GOOD-BAD scale.

Eye tubes can be checked by setting all the controls according to the roll chart, holding the value lever in the value position and turning the bias control from the value on the chart for when the eye should be closed to the value for when the eye should be open.

Fig. 9. Triplett Model 3436 UHF Signal Generator.

For example, when testing a 6E5 eye tube, the bias control is first set at 60. The eye should be closed. Then change the control to zero, and note that the eye is then open. If these results are not obtained, it is an indication that the tube is defective.

TRIPLETT

Model 3436
UHF Signal Generator

The Triplett Model 3436 UHF Signal Generator, which is a new addition to the Triplett line of test instruments, features continuously variable tuning in one band through the UHF television range, channels 14 through 83. As shown in Fig. 9, the unit incorporates a large, easy-to-read dial scale. Calibration is from 470 mc to 900 mc in 5-mc divisions. A dial rotation of about 310 degrees gives a calibrated range equal to more than 12-1/2 inches of slide-rule dial.

A table of all UHF channel frequencies is divided into groups of eight channels each, and these groups are conveniently distributed about the inside circumference of the dial scale so that each group is close to its frequency coverage on the scale. Since there are 70 UHF channels in all, the last group contains only six channels. The upper and lower channel limits are listed in the table. The video carrier frequency for any channel can be obtained by adding 1.25 mc to the lower channel limit, and the sound carrier frequency can be obtained by subtracting .25 mc from the upper limit.

Front-panel controls are as follows: ON-OFF switch, OPERATE-STANDBY switch, TUNING control, MOD switch and control for turning on the audio modulation and for adjusting its level, and the ATTEN control which attenuates the UHF signal output.

There are provisions for a ground connection and for audio signal take-off at banana jacks on the front panel.

The UHF signal is fed through a balanced 300-ohm cable of the low-loss, shielded type to a small output box containing three pin jacks. The red leads from two of these jacks are terminated with spade lugs, and the black lead from the other jack is equipped with an alligator clip.

Tuning is accomplished by movement of a shorting bar on the quarter-wave transmission line in the oscillator circuit. The shorting bar is driven by a cam which is designed to give nearly straight-line frequency tuning throughout the range.

The attenuator is of the continuously variable type and varies the position of a pickup loop at the inner end of the generator output cable. Reference positions for the attenuator are marked 2, 4, 6, 8, and 10, with the No. 10 position giving greatest output level.

Tube complement consists of one of each of the following:

6X5GT rectifier,
OC3 voltage regulator,
6AF4 oscillator,
6J5 audio oscillator,
6K6GT audio output.

The service technician should find this a very convenient and easily operated instrument for servicing and aligning UHF receivers and for presetting UHF converters.

CURRENT RELEASES

The following data concerns equipment which will soon be available. As we receive reports of such equipment either in the developmental stage or near production, we shall use this column to pass the news along to the service industry.

Hickok

Model 690
VHF-UHF Marker Calibrator

Information on the new Hickok Model 690 VHF-UHF Marker Calibrator discloses several interesting features.

The use of a projection-dial system enables the user to set the marker with a high degree of accuracy. A light beam projects a greatly magnified shadow image of the dial upon a ground glass. This provides 45 inches of dial scale which can be read without parallax. A self-contained crystal calibrator provides for accurate dial calibration. Picture and sound settings for all channels are marked on the dial scale.

Marker ranges are on fundamentals from 4.25 mc to 11 mc, 19 mc to 50 mc, 54 mc to 108 mc, and 155 mc to 225 mc. Output level is 0.25 volt on all ranges. UHF channels 14 through 47 are covered by third harmonics, and channels 48 through 83 are covered by fourth harmonics. For calibration purposes, a 2.5-mc crystal is included with the generator. Provision is made for use of two alternate crystals.

Two markers may be viewed at one time on the response curve. This includes the main marker as selected by the dial plus a marker removed from the frequency of the main marker by a fixed amount determined by the crystal used. Thus, with a 4.5-mc crystal, two markers are available with a 4.5-mc separation throughout the dial range. This feature eliminates the need for constant resetting of the marker in order to judge response-curve width during alignment.

Other features include 400-cycle modulation for the marker, both visual and audible indications of zero beat during calibration (this is accomplished by means of an electronic-eye tube and a headphone jack), provision for crystal calibration of any other signal generator, and both step and continuous attenuation controls. The unit is double shielded to reduce leakage to a minimum. Dimensions are 16 1/4 in. high, 13 1/4 in. wide, and 8 in. deep. Weight is 24 lbs. net.

Model 691
Base-Line Marker Adapter

The Hickok Electrical Instrument Company has released information concerning their new Model 691 Base-Line Marker Adapter. Marker injection has been one operation where the alignment technician sometimes experiences difficulty. For example, if the maximum output is required from the sweep generator to produce a usable response on the scope, the marker amplitude may not be great enough to be visible on the response curve. On the other hand, when only a small sweep output will overload the circuit under test, great care must be used to prevent the marker from swamping or distorting the curve. Trap alignment also requires considerable ingenuity at times; if the marker is to be made effective, the technician may find it necessary to (1) use maximum marker strength, (2) use maximum scope gain (or lowest scale of VTVM if one is used), or (3) reduce the sweep width.

The manufacturer states that the Model 691 will provide a marker visible at all times, including trap points, and will not distort the response curve or change its amplitude. The marker is said to be visible even on the base line.

Other data furnished by the manufacturer concerning Model 691 includes output marker voltage up to 3 volts; variable attenuation of markers from 0 to 60 db; variable attenuation of response curve from 0 to 20 db; input impedance of 90 ohms; size of generator, 11 1/2 in. wide, 9 in. high, 6 in. deep; and weight, 14 lbs.

Model 697
UHF Sweep Generator

One of the outstanding features of the Hickok Model 697 UHF Sweep Generator is its all-electronic sweep. Excellent linearity of sweep is claimed throughout the entire sweep width, and the output level is said to be constant over the full range of sweep frequencies. The sweep generator operates on fundamentals on all channels from 14 through 83. In this manner the possibility of confusing indications from unwanted harmonics is avoided. Tuning is continuous throughout the range, and the unit is designed to present minimum loading on the UHF circuits to which it is coupled. Output impedance is 50 or 300 ohms.

The fundamental output is 0.5 volt RF on channels 14 through 83. The attenuator is of the piston type and allows an attenuation of more than 100 db. Triple shielding reduces RF leakage to a very low value. Several TV manufacturers state that this generator can be operated on top of a UHF receiver and yet cause no noticeable spurious interference with the receiver.

Sweep width is 0 to 25 mc at the low end of the band and 0 to 75 mc at the high end. Amplitude variation of the output signal is less than 0.1 db per mc.

A calibrated, variable DC bias voltage of 0 to 12 volts is available from jacks on the front panel. The service technician should find this feature very useful since it will eliminate the need for a separate bias supply during alignment procedures.

Other features include: (1) an oscillator blanking switch which permits the base line to be viewed and (2) a phasing control which provides for 170 degrees of phase shift in the deflection signal applied to the oscilloscope.

The generator is housed in a strong, steel, portable case with an appearance in keeping with other Hickok equipment. Dimensions are: 16 1/4 in. wide by 13 1/2 in. high by 10 in. deep; weight is 24 lbs. net.

As the new equipment, introduced as current releases, becomes available for use we will discuss in further detail their operation and servicing applications.

Paul C. Smith

Design Features (Continued from page 25)

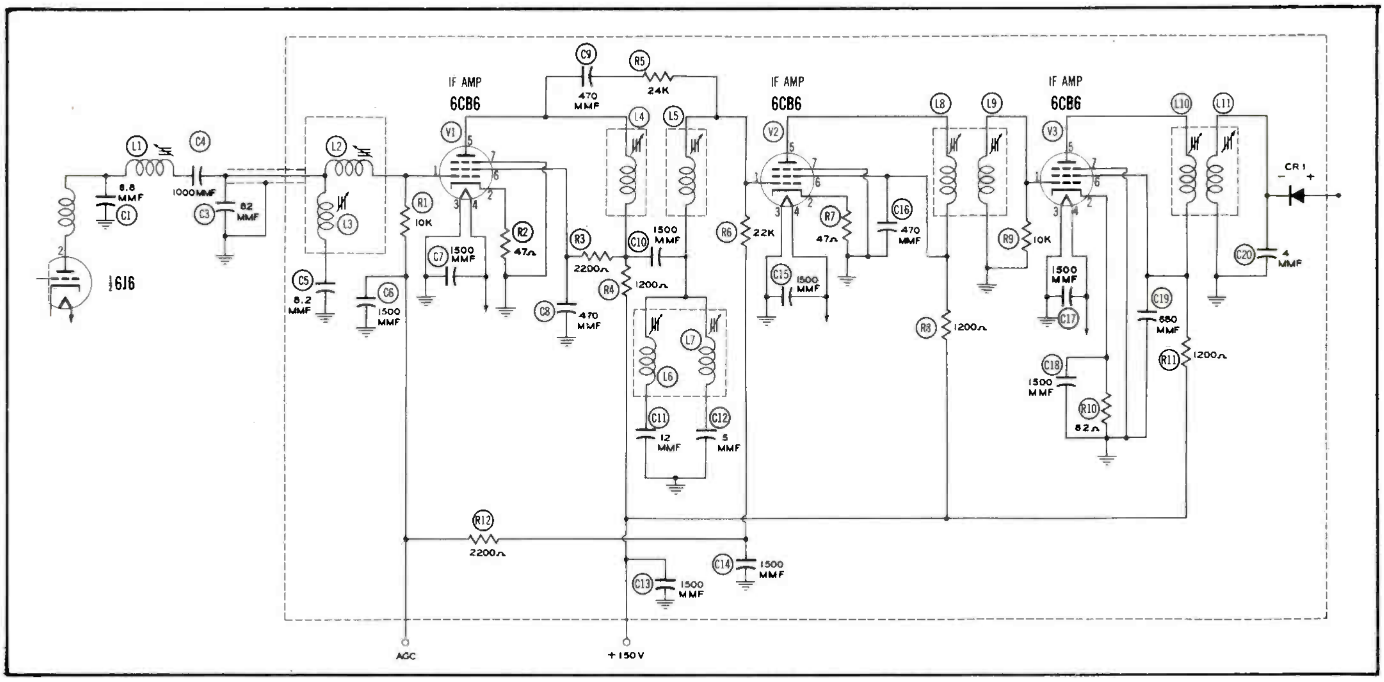


Fig. 4. Schematic Diagram of the RCA IF Strip.

Our attention is first focused on the cartridge used in this model. The cartridge is of the capacitive type. The portion of the needle inside the cartridge has a flat surface which is one plate of the capacitor. The flat end of the adjustable screw forms the other plate. The setting of this screw is made in the factory and adjustment should not be attempted by the service technician unless very precise instruments are available. This is readily understandable when it is realized that the spacing between screw and needle is between six and seven thousandths of an inch. Vibration of the needle changes the spacing between the two plates of the cartridge and therefore varies the capacitance. This varying capacitance is used by the radio portion for record reproduction. The cartridge contains a two mil needle which may be used on all records.

The schematic diagram in Fig. 5 will be of assistance in understanding how this varying capacitance is utilized by the receiver. When the phono-radio switch is placed in the phono position, preset capacitors are placed across the oscillator coil. As a result, the oscillator operates at a frequency of 455 kc which is the IF. The phonograph cartridge is connected from the high side of the primary winding on the IF transformer to the high side of the secondary winding. These windings are desinged to have low mutual inductance. The varying capacitance of the cartridge will then serve to vary the coupling between the primary and secondary. This effectively causes amplitude modulation of the 455-kc signal which is from the local oscillator. The AM signal is amplified by the IF amplifier and fed to the detector. After detection, the audio signal is amplified and reproduced by the speaker in the conventional manner.

The cartridge in this system is virtually unaffected by high humidity and will withstand temperatures of 200 degrees. (The construction results in a smaller and lighter cartridge.) It is possible to obtain practically 90 per cent modulation of the 455-kc carrier. Modulation of 5 to 10 per cent is all that is actually required for record reproduction because of the strong carrier present.

When the phono-radio switch is placed in the phono position, capacitor C6 is connected across the high side of the transformer windings. This capacitor is adjusted to almost cancel out the energy transferred by the

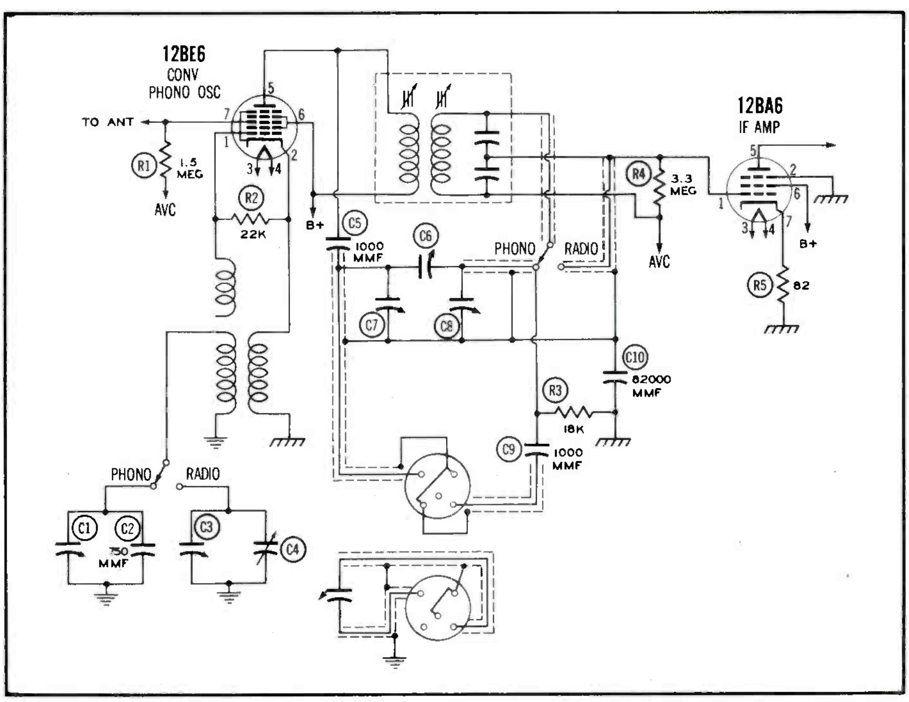


Fig. 5. Schematic Diagram of the Motorola Reproduction System.

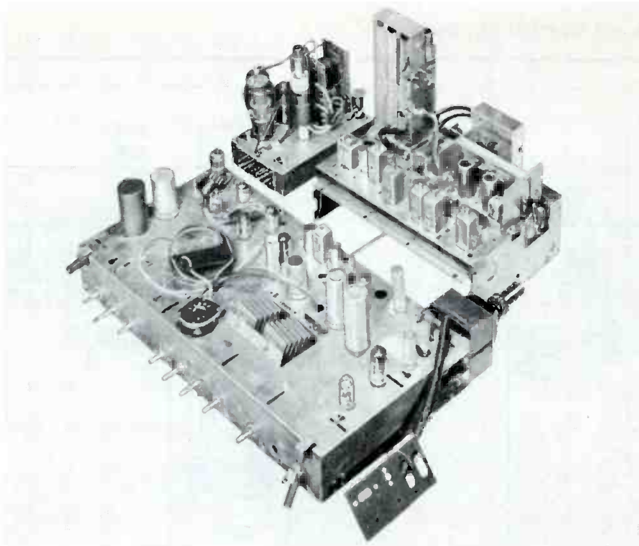


Fig. 6. Raytheon Chassis Showing the Sub-Chassis Construction.

mutual inductance of the transformer windings. This arrangement permits the linear portion of the IF-transformer response curve to be utilized in record reproduction.

Raytheon Subchassis Construction

A new trend in the production of television receivers is exhibited by the Raytheon 24T2. This receiver is constructed on three chassis which may be easily disassembled. All connections between the individual units are of the plug-in type which facilitates their removal. These three sections are shown disconnected from one another in Fig. 6.

One section contains the VHF-UHF tuner and the IF stages. The larger chassis contains the low-voltage power supply, audio stages, video amplifier, and sweep sections. The smallest of the three chassis contains the high-voltage power supply.

The weight and size of receivers has increased as the size of the picture tubes has increased. This tends to make the sets more difficult to handle. Constructing the receiver on several small chassis allows the service technician to inspect and handle the individual units more easily. The service technician specializing in Raytheon receivers could fabricate extension cables for the units and further increase the flexibility of the system.

This model also contains an additional feature which should assist in the servicing. Several test jacks have been incorporated in this receiver. These test jacks are standard throughout the set, permitting systematic checks to be made with a minimum expenditure of time.

Monitoradio Squelch Circuit

FM receivers capable of covering the communication frequencies of 30 to 50 mc and 152 to 174 mc have become increasingly prevalent. It is not unlikely that many service technicians will be called upon to repair

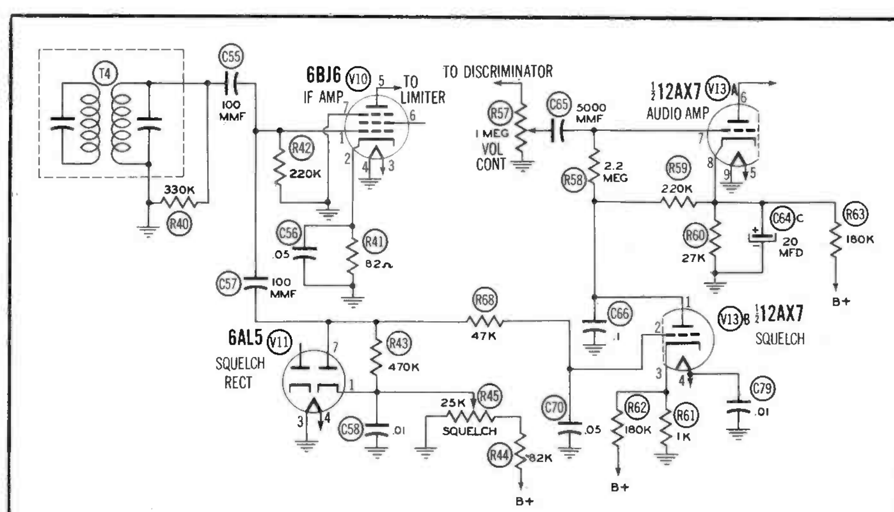


Fig. 7. Monitoradio Squelch Circuit.

these receivers. Although most of the circuits employed do not differ widely from those found in broadcast receivers, there is a circuit which may be new to many. This circuit is known as the "squelch." The purpose of the squelch circuit is to eliminate the background noise present during stand-by periods in which no signals are being received. An example of this system is found in the Monitoradio DR-200. A schematic of this circuit is presented in Fig. 7.

The squelch system employs a diode section of the 6AL5 and a triode section of a 12AX7. The input to this system is derived through capacity coupling from one of the IF stages. The squelch action is used to control operation of the audio amplifier.

We shall first investigate the action of the squelch circuit during periods of stand-by. Since no station is being received, there is no signal being coupled to the squelch rectifier V11, which is not conducting during such a period because of a positive voltage that is applied to the cathode. This voltage is taken from a voltage-divider network consisting of resistors R45 and R44. The level of this voltage is dependent upon the setting of the squelch control R45.

When the squelch rectifier is in a state of nonconduction, the voltage present on the grid of the squelch tube V13B is sufficiently positive to permit the tube to conduct. The plate load for the tube is in the audio amplifier circuit. Conduction of the squelch tube causes the grid voltage of the audio amplifier to become more negative. As a result, the audio amplifier tube is cut off and the background noise is prevented from proceeding further.

When a station is being received, a signal from one of the IF stages is coupled to the plate of the squelch rectifier. The positive excursions of this signal will cause the tube to conduct. The plate current flowing through resistor R43 results in a more negative voltage on the grid of the squelch tube. The tube is cut off, and plate current ceases to flow. This cessation of current flow permits the audio amplifier to return to normal operation, and the audio signals proceed through this stage in a normal manner.

It is well to remember that the setting of the squelch control determines the operating point of the squelch system. If it is set too high, weak signals will not cause the squelch rectifier to conduct; consequently, these signals will not be heard.

Don R. Howe

Audio Facts

(Continued from page 23)

just allow the stylus to track in band 16. If the weight of the pickup on the record is then measured and one half of the measured weight is added to the pickup end of the arm, the correct stylus force is obtained, providing the final weight is not more than 10 grams. A pickup weight of more than 10 grams should not be used on this nor on most other microgroove records because of the wear involved.

Bands 16 to 20 are used for tracking tests. These bands are recorded at 400 cps, and each is recorded at a level 3 db higher than the preceding one. Satisfactory tracking will result in a clear tone with no fuzziness. A record changer is to be considered normal if it will track bands 16, 17, and 18. Only very good professional arms and pickups will track band 20 because of the high modulation level. Never add weight above that found to be correct in the first test. A pickup or arm which will not track satisfactorily not only fails to provide good reproduction, it inflicts excessive wear.

Band 14 is provided for checking turntable rumble and therefore is not modulated. With the arm at rest (not on the record) and the turntable not moving, any hum or noise heard when the volume is turned up to slightly above normal listening level should be reduced or eliminated if best results are to be had. Then if the stylus is placed in a groove on the record (turntable still not turning) and there is an increase in the noise level, it is no doubt due to vibration picked up by the turntable mounting board. The effects of this vibration can be decreased by improved shock mounting. With the stylus in band 14 and the turntable turning, any heavy rumbling sound added to the output is turntable rumble. The mounting of the motor and condition of the idler wheels can have a great effect upon the amount of turntable rumble present in the output.

Band 15 is recorded at 3,000 cps and at a constant level. The frequency of 3,000 cps was selected for this band since the average ear is sensitive to any change in pitch at this frequency range. So, during the playing of band 15 if any defects such as those in idlers, turntable, and bearings have any effect they will be heard as wow or flutter. It is possible that a slight amount of wow may be heard because of a slightly off-center hole in the record, but this condition can be detected very easily by the eye and ear and can be ignored in this test.

Bands 1 through 13 are recorded at frequencies of 30, 50, 100, 250, 400, 700, 1000, 2000, 4000, 6000, 8000, 10,000 and 12,000 cps respectively; and these are recorded following the recording curve in the graph on the sleeve. These bands are useful in checking the frequency response of a sound system by simply listening or much more satisfactorily by measuring the output of the system with a suitable AC meter or oscilloscope. As suggested in the instructions, the use of these bands can be very helpful in locating the crossover frequency of a loudspeaker system.

The foregoing has been gone into in some detail as an example of what can be found on one side of a test record and to give some idea of what can be accomplished even when no other test equipment is used.

The Dubbings' D-101 test record is intended for "The Measure

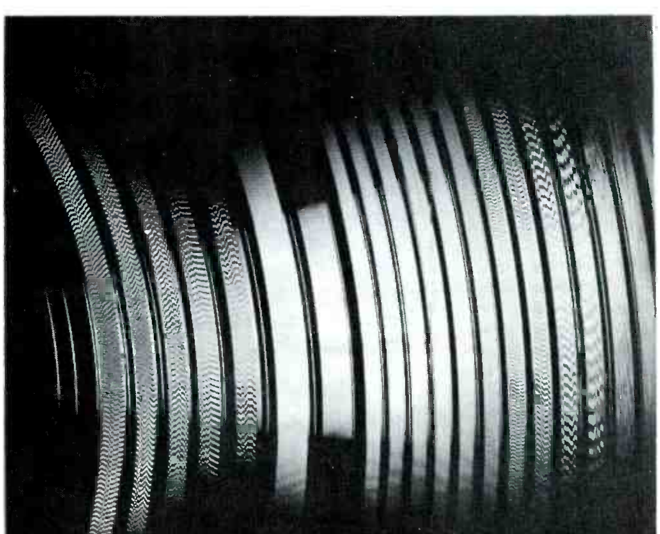


Fig. 1. Section of Dubbings D-100 Test Record.

of Your Phonograph's Equalization," to quote the front cover of the protective sleeve.

Complete information concerning the purpose of the record along with instructions on how to use it are given on the reverse side of the sleeve.

The D-101 is a 33 1/3-rpm microgroove record composed of four sections (two on a side), each recorded in thirteen bands of frequencies ranging from 30 cps to 12,000 cps. But each section is recorded on a different characteristic curve. A section is recorded according to the characteristics established for each of the following four curves: (1) AES, (2) NARTB, (3) LP, and (4) RCA's "New Orthophonic." This provides a means for checking the equalization of the sound system for any of these commonly used curves.

A suitable AC meter or oscilloscope is needed to measure the output of the system in order to check accurately the equalization of the system with this record. A suitable AC meter, mentioned before when discussing the D-100 record, is one that will accurately measure AC at the higher frequencies. The inexpensive and most of the rectifier types of meters will not read accurately, if at all, at the high frequencies encountered in such audio measurements.

Most oscilloscopes operate very accurately at these frequencies, and relative levels can be checked very easily; but a voltage calibrator is required if exact voltage readings are desired.

Dubbings furnishes a D-500 Test Level Indicator for use by the individual who does not possess high quality instruments for this purpose. This is an ingenious device made up of three small bulbs calibrated to light up in 3-db steps when connected across the output of an amplifier.

The Cook Series 10LP Frequency and Intermodulation Test Record and the Cook Series 50 "N-A" Beam Test Record have some unique and worth-while features. Something to be noted and marveled at when considering such records is the fact that such a wide range of frequencies is recorded so cleanly and with such low distortion.

Even though 20,000 cps cannot be heard by most people, a measure of how they are handled by the sound system is important.

Side A of the Cook Series 10LP, 33 1/3-rpm microgroove test record is intended for checking the frequency response of the sound system. Instructions furnished with this record explain how to make use of the frequencies ranging from 20 cps to 20,000 cps recorded on this side for that purpose. A suitable AC meter or oscilloscope is required.

A comparison of the output obtained when playing the 10,000-cps band near the outer edge of side A and of the output obtained when playing the 10,000-cps band near the inside edge will give the measure of the translation loss, and all of this aids in determining the condition of the stylus.

Side B contains three bands. The first one provides a spot check for LP characteristics.

The second band is intended for intermodulation checking with the frequencies of 100 cps and 7,000 cps recorded in this section.

The slow sweep from 1,000 cps to 20 cps crossing over at 500 cps (LP) and recorded in the third band gives a quick indication of the tracking ability of the pickup. Being recorded at a rather high level, any resonance or defect in tracking will be very evident.

The Cook Series 50 "N-A" Beam Test. Record is unique in that by only listening while it is being played, the sound system can be checked for intermodulation. As the signal sweeps down in a slow glide from 20,000 cps, a 1,000-cps tone will be heard. If it is heard as a series of A's (dot-dash), no intermodulation effects are present. But if nonlinearity in the system does introduce intermodulation, N's (dash-dot) will be heard. Since the A-signal is recorded at a 2-per-cent level it can be used as a reference level. If the N's are just as loud as the A's, approximately 2 per cent of intermodulation distortion is present.

Two identical bands are provided so that one can be used first with unknown pickups which may cause record damage.

A microgroove band recorded at 78 rpm is provided. When used according to instructions, it can be logically proved that the intermodulation is caused by the system and not by the record.

These three bands are on side A. Side B provides bands for checking a binaural system for the presence of intermodulation.

These examples give some idea of the very practical results that can be obtained with suitable test records. Of course, these are only four records selected from the large number available.

Some of the original test records of years back are now obsolete, but we have plenty of up-to-date ones. Made in speeds of 78, 45, and 33 1/3 rpm, they are designed for all types of testing, including all kinds of applications regarding record-changer adjustments.

Robert B. Dunham

Color TV (Continued from page 11)

The secret to obtaining wide bandpass in the video IF section is in the original design of the circuits, not in the ability of the service technician or in the capabilities of the test equipment. This can be demonstrated by considering two monochrome receivers. The manufacturer of one specifies a 3-mc bandpass in the IF system, while the manufacturer of the other set might specify a 4-mc bandpass. The service technician can align each of the receivers to conform to these specifications, but he can do this only because of the difference in design of the IF systems. The same equipment is used to align either receiver, and in each case the procedure set forth in the service manual must be followed to achieve the proper end result. By following the alignment instructions that will be provided in the service manuals, no particular troubles should be encountered. Of particular interest is the fact that the sweep alignment equipment which has been used for alignment of the monochrome receiver can be used for color-receiver alignment.

The sound IF section of the color receiver need be no different than that found in the monochrome receiver. The servicing procedures used in this section will follow those that have been employed in the past, thus there is no special test equipment required.

The video-amplifier portion of a color receiver must have a bandpass characteristic which will provide for amplification of the color burst as well as amplification of the transmitted color information. The attenuation of either of these signals will result in the loss of color detail or perhaps loss of color synchronization. The experimental color receivers which have been designed to date normally employ two stages for video amplification. The servicing of these stages is done in the same manner as those in the monochrome receiver.

Since the design of a video amplifier is different from that of a conventional audio amplifier (in that it incorporates peaking coils and low-value load resistors to extend its frequency range), the servicing of these stages has been somewhat of a problem. Fortunately, many difficulties can be readily detected through the use of a voltmeter. Any change in the value of the plate load will result in a change in plate voltage. Likewise, an open peaking coil will completely disable the stage; or in those cases where the coil is shunted by a resistor, the plate voltage will drop to a very low level. A change in screen voltage which might change the operating characteristics of the stage can also be detected through the use of a voltmeter. It would appear that these stages ought to be quite easy to service; but as the bandpass requirements are increased, there are several things which might appear in such a circuit to lessen its efficiency. For example, a video amplifier which is designed to have a flat response to 5 mc would be affected to a greater extent by a change in distributed capacitance of the wiring than would a 4-mc video amplifier with the same change in distributed capacitance. Since the video amplifier of the color receiver must pass the color information, these stages will be designed for a better bandpass characteristic than those used in the average monochrome receiver.

A poorly operating video amplifier in a black-and-white receiver might result in loss of fine detail or smearing of the picture. Such a condition is often tolerated by the user, since he has no way of making a comparison with a normally operating receiver. In the case of the color receiver, a defect in the video amplifier might result in the loss of color synchronization which would obviously be detected by the viewer. This brings up a point which must be considered while servicing the video amplifiers of a color receiver. Even though the correct voltages are present on the tube elements of these stages, the amplifier could still be operating in a defective manner.

The most effective instrument that can be used in the servicing of wide-band amplifiers is the oscilloscope. If this instrument is to display the color burst, it must be capable of passing the 3.579-mc signal with minimum attenuation. So far, our discussion has dealt with instruments upon which no special requirements have been placed when they are used to service the color receiver. Now we are placing specific requirements on the oscilloscope in that it must have a wider bandpass characteristic than a similar unit used to service the monochrome receiver.

There are many oscilloscopes which fulfill these characteristics and which are available at a reasonable cost. Several manufacturers have incorporated a dual function in the oscilloscope in that both a wide-band position and a high-sensitivity position are provided. Such an arrangement allows the viewing of low-amplitude signals when the scope is operating with medium bandpass characteristics. In the wide-band position, the scope is capable of producing with a minimum of distortion a waveform having high-frequency components. In the wide-band position the gain of the oscilloscope is reduced but the instrument can still be used for the servicing of video amplifiers, because the signal present in these stages is of sufficient amplitude to provide a usable pattern.

When the oscilloscope leads are connected to the video amplifier of a monochrome receiver, some degree of picture degradation can usually be noted. This is caused by the addition of capacitance contributed by the lead itself as well as by the input capacitance of the instrument. The latter is reduced considerably through the use of a cathode follower stage at the input of the vertical amplifier of the oscilloscope. Such a stage is usually employed in a wide-band oscilloscope. The input capacitance of such an instrument is only a few mmf, but capacitance of the lead is still present. This may be approximately 15 to 20 mmf which would produce a serious effect on the operation of the video amplifier. This added capacitance contributes to the degradation of the picture when the oscilloscope is connected to a video amplifier. Such an effect is particularly disadvantageous in the case of color receivers. The connection of an oscilloscope which adds considerable capacitance might disrupt the operation of the circuit so greatly that color synchronization is completely lost. If such is the case, the very instrument which should be of assistance in locating the trouble is actually contributing to improper operation.

It is impossible to set forth strict requirements for the specifications of an oscilloscope since the usefulness of a given instrument for color TV servicing is hard to establish. The average service technician will not be called upon to service a color receiver for many months. If a fairly wide-band scope is available in the service shop at the present time, it is very probable that this instrument can be used to great advantage when servicing color receivers. Only actual experiments at that time will reveal its capabilities or limitations. Most manufacturers of test equipment have two or more scopes currently available in various price brackets. The low-priced unit is intended primarily for general usage such as for sweep alignment, circuit tracing, or audio applications. The better units are designed for more accurate analysis of complex waveforms such as those found in many circuits in monochrome receivers. These instruments, which are capable of faithfully reproducing complex waveforms, will be very useful in analyzing the operation of a color receiver. Thus the service technician who now has a high quality oscilloscope should have no fear concerning the adaptability of his instrument to color TV applications.

Now let us consider some test instruments which might be specifically designed for use in servicing color receivers. One example would be an instrument which would produce a signal representative of small picture elements which are to be reproduced on the color picture tube. These small elements or dots might even be representative of a white signal since the operation of all three color guns is necessary to produce true white. Any deficiencies in the deflection system, adder circuits, or components mounted externally to the picture tube would show up in that the receiver would not be able to produce true white dots. The service technician could then make the necessary adjustments to produce the true color over the entire face of the picture tube. At this writing it is known that considerable work is being done to provide an instrument of this type.

Another instrument which will surely become available is some sort of a color-bar generator. This instrument would make possible the testing of each of the color guns as well as the associated circuits. By properly keying the multivibrators which are usually employed in this type of instrument, any desired combination of color bars can be produced since two or three of the guns can be caused to emit simultaneously. This would permit the checking of the ability of the receiver to produce any color in the spectrum without smearing or color contamination.

Generators for this purpose can range from a comparatively simple device to one of very elaborate design. The most simple one may provide an output which is intended to be connected directly to the driven elements of the three guns. Such an instrument will test the operation of the picture tube. The more elaborate units might provide for the insertion of the signal at a point in the receiver where the mixing action in the matrix can be tested. Actual servicing requirements will determine the practicability of these instruments.

One of the most critical functions of a color receiver is that of color synchronization. This section relies on the operation of a local oscillator which must operate at a given frequency and phase. The operation of such a critical circuit is usually disrupted when any attempt is made to connect test instruments. This makes it very difficult to carry on any servicing procedures. It is quite probable that an instrument can be designed to analyze the operation of the color synchronization section with a minimum of tests. Such a unit, however, could not be designed until a truer picture of the circuits that are to be employed in commercial receivers is obtained. Thus, it is very likely that an instrument for performing this function will not be available in the immediate future. Such a unit at first glance would seem to be out of the question from a price standpoint; but by comparing the instruments which are available now to those which were available during the early stages of TV, it can be seen that quite long strides have been taken in the development of special test equipment for TV work.

We hope that this review of the current requirements of color TV test equipment will be helpful to you in analyzing the future requirements of your service shop. Keep in mind that a very limited number of color receivers will require servicing within the next year because only a limited number will have been produced during that time. It is very probable that many of the early color receivers will be patterned after the developmental models which were demonstrated during the color hearings. The circuit design in these receivers undoubtedly will be changed as new techniques are developed.

Color TV is a new field. It will bring new servicing problems. It will require additional test equipment. The big question is how much. It is wise to look ahead to analyze future needs of your service shop. It is also wise to make sure that any new equipment obtained for color-receiver servicing will actually be required. Every service technician now has much equipment which can be used for servicing color receivers. Obtain additional equipment after an analysis of available equipment has been made, providing a need for such equipment has been established.

W. William Hensler

TV Rhombic Design

(Continued from page 29)

major factor in the design of the rhombic antenna. The same condition of lobe addition takes place with the signals in lobes 5 and 8. The signals in the remaining lobes combine in such a way as to cancel one another. The result is a very minimum of pickup at right angles to the desired direction. This not only reduces interference from unwanted stations, but also reduces the noise picked up by the antenna.

The leg length "ℓ" is a variable factor which must be chosen. The leg length will determine, within limits, the gain of the antenna as well as the directivity. This length will usually be from 2 to 8 wavelengths. The space available for the erection of the antenna will influence the length chosen. For leg lengths below 2 wavelengths the gain of the antenna falls off sharply. For leg lengths greater than 8 wavelengths, the directivity of the antenna is extremely sharp and orientation is very difficult. The effect of wavelength on gain is shown in the graph of Fig. 2.

The terminating resistor, as shown in Fig. 1, is a characteristic of the rhombic antenna. This resistor gives the antenna its unidirectional characteristic. The resistor also contributes to the broad frequency response of the antenna by reducing the resonant effects of the antenna. In order to match properly the impedance of the system, the termination should have a value between 700 and 800 ohms. When actually installing this resistance, it is advisable to use at least two resistors in series which will add to equal the desired value. By using two or more units in series, the capacitive effect of the resistors is reduced. It is important that these resistors be of the noninductive type. It is also suggested that some protection be afforded the resistors against the effects of moisture.

Another distinct advantage is offered by the use of two resistors. The junction of the resistors may be grounded by running a wire from the junction to a rod driven into the ground. This provides a path to ground for currents induced in the antenna by electrostatic charges in the atmosphere. No detrimental effects to the performance of the antenna results from this connection, because the rhombic antenna is a balanced system.

The wide bandwidth of this antenna is evidenced by the fact that excellent response is obtained over a frequency range of approximately 2 to 1. For example, if a rhombic antenna were designed for 100 mc, the frequency range would be from 100 mc to two times 100 mc, or 200 mc.

As the frequency of the received signal decreases below the design frequency, the number of wavelengths in each leg will correspondingly decrease. The result will be a lower gain and poorer directivity. If the original antenna were constructed with only two wavelengths per leg at the design frequency, the performance of the antenna at lower frequencies would be extremely poor. An increase in frequency up to a limit of approximately twice the design frequency results in more wavelengths per leg and consequently an improvement in gain and directivity. At frequencies beyond this limit, the extreme directivity of the antenna makes it impractical.

An antenna designed for channel 2 will perform well on channels 2 through 6. The high VHF channels 7 through 13 may be covered by an antenna constructed for channel 7. This is a distinct advantage when reception is desired from a distant city in which several TV stations are operating. For example, Chicago has stations operating on channels 2, 5, 7, and 9. Complete coverage of these stations would require two rhombics; one antenna for channels 2 and 5 and another one for channels 7 and 9.

In the actual design of a VHF rhombic antenna, it will be necessary to employ two formulas. It will also be necessary to know the frequency for which the antenna will be designed and the number of wavelengths desired in each leg.

The two formulas are:

$$\ell = \frac{492\ (n-0.05)}{f} \qquad (1)$$

and

$$\sin\theta = \frac{N - \frac{1}{2}}{N} \qquad (2)$$

where

f = the design frequency, in megacycles,

ℓ = the length of one leg, in feet,

n = the number of half wavelengths in one leg,

θ = the tilt angle,

N = the number of wavelengths in one leg.

The actual application of these formulas may be readily seen by considering a hypothetical case. We shall assume that an antenna is to be designed for channel 10 and is to be three wavelengths on a leg. The design frequency will be 195 mc in this case.

The length of each leg is determined in the following manner:

$$\ell = \frac{492\ (n-0.05)}{f}$$

$$\ell = \frac{492\ (6-0.05)}{195}$$

$$\ell = 15 \text{ feet}$$

The tilt angle may be calculated by use of the other formula:

$$\sin\theta = \frac{N - \frac{1}{2}}{N}$$

$$\sin\theta = \frac{3 - \frac{1}{2}}{3}$$

$$\sin\theta = 0.8333$$

A table of trigonometrical functions shows that the angle "θ" is 56.5 degrees.

This provides all of the information necessary for constructing the rhombic antenna for channel 10. These values have been substituted as dimensions for the antenna shown in Fig. 3.

An alternate method in which it is not necessary to find the angle "θ" may be used. An additional formula to determine the distance "L" is required. This distance is shown in Fig. 3. The new formula is used in

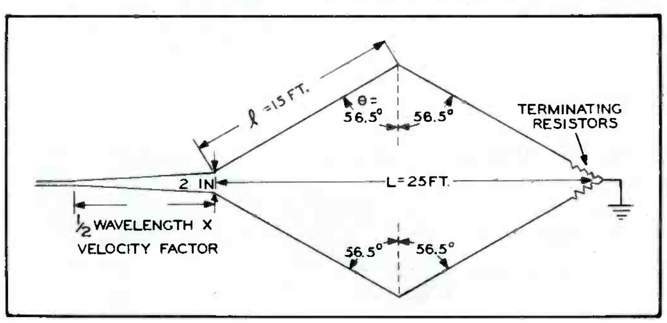


Fig. 3. A Rhombic Antenna for Channel 10.

place of formula (2) which may be eliminated.

$$L = 2\ell \frac{N - \frac{1}{2}}{N}$$

The distance "L" may be found for the channel 10 antenna in the following manner:

$$L = 2\ell \frac{N - \frac{1}{2}}{N}$$

$$L = 2 \times 15 \times \frac{3 - \frac{1}{2}}{3}$$

$$L = 25 \text{ feet}$$

Use of the distance "L" greatly simplifies the actual construction of the antenna, because the angle "0" is usually rather difficult to measure accurately.

The same considerations of height apply to the VHF rhombic as apply to other types of VHF antennas. This means that an increase in height will usually result in an increase in performance. Fifteen feet above ground should be considered a minimum. It is possible that an optimum height may exist where an increase in height will not improve the performance and may even result in a decrease of signal strength. If possible, the antenna should be tried at various heights; however, this is complicated by the size of the antenna.

As previously stated, the characteristic impedance of a rhombic antenna is 800 ohms. Since the input impedance of a television receiver is 300 ohms, a problem of matching arises. Any 300-ohm ribbon may be matched to the antenna by fanning the line for one-half wavelength. The lead-in is tapered from 2 inches at the antenna to the normal spacing one-half wavelength away. This half wavelength will be shorter than a half wavelength in space because of the velocity of the signal in the transmission line. For 300-ohm ribbon, the velocity factor is approximately 0.82. In order to find the proper length, the half wavelength in space is multiplied by the velocity factor. This fanning of a transmission line is illustrated in Fig. 3.

The large size of the rhombic antenna makes rotation impractical, therefore some method must be used to orient the antenna. There are two practical methods by which this may be done.

One method requires the use of a great-circle map such as an airways regional map. The bearing of the desired television station from the receiving location is taken from the map. The antenna is then oriented by use of an accurate compass. It is necessary that a great-circle map be used because of the accuracy required in determining the bearing. A few degrees of error will result in inferior performance of the antenna.

The second method requires the use of a rotatable television antenna and a field-strength meter. This method is only usable in locations where the test antenna will provide sufficient signal strength to be measured by the field-strength meter. The meter is connected to the test antenna, and the antenna is rotated until a maximum reading is obtained from the desired station. A reference line is then established which will be in line with the station. The rhombic antenna may then be constructed along this reference line.

When properly installed, the rhombic antenna should provide one of the best installations possible, particularly in areas far from television transmitters.

Don R. Howe

The Transistor Story

(Continued from page 5)

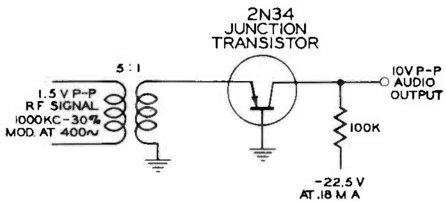


Fig. 3. Improved Detector Circuit Using Transistor.

the receiver in its orginal form, it must be separated from the carrier. This process of separation is called demodulation or detection. There are a number of circuits which have been used to accomplish detection, but only two bear any resemblance to a transistor detector. These are the crystal and the diode tube which are both used for the detection of AM transmissions. The theory behind the operation of each is the fact that they will conduct current in only one direction; that is, they are nonlinear devices. A transistor is also nonlinear in that it has two rectifying contacts either one of which could be used with the base to form a detector. Fig. 2A shows a detector circuit employing a transistor which is connected so that the emitter-base circuit is the rectifying section. The collector-base circuit of Fig. 2B was tested as a detector, and it was found to be very inefficient. The best detector was found to be the emitter collector connection of Fig. 2C. It produced approximately twice the output of the emitter-base circuit with the same input signal, and it was impossible to produce distortion in this circuit with input signals up to 1.5 volts peak to peak. The point-contact transistor was not effective in any of these circuits.

The circuits of Fig. 2 do not take full advantage of the latent possibilities of the transistor, for there is some amplification which can be gained merely by completing the collector circuit, as shown in Fig. 3. It should be noticed that the detector-load resistor has been removed and the audio signal is impressed directly on the transistor in the form of current bias. In this circuit, the transistor is operating with self-bias, resulting in a .1-volt positive potential being developed on the emitter by the signal current. This circuit produces an undistorted output audio voltage which is 20 times the value of the output produced by the circuit of Fig. 2A. It can be seen that it would not be economically practical to ignore the extra gain inherent in the transistor.

Amplification

There are three possible ways in which a transistor can be connected; namely, with a grounded base, grounded emitter, or grounded collector. These were illustrated in the first article of this series. A variety of possible amplifier circuits are thus made available, each with its own characteristics; and almost any desired characteristic can be produced.

The grounded-base circuit using a point-contact transistor is perhaps the most difficult to incorporate into an amplifier because of its inherent instability. The collector current flowing through the internal base resistance develops a regenerative voltage which predisposes the circuit toward oscillation. An amplifier constructed around this circuit would be very unstable and extremely critical with regard to transistor replacement unless it has been perfectly engineered.

The base resistance is high in the point-contact unit because this characteristic is determined by the size of the crystal and the resistivity of the germanium used in the manufacturing process. Both of these factors can be reduced, but the base resistance of the point-contact unit is still much larger than that of the junction unit.

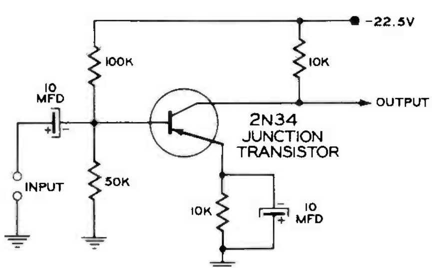


Fig. 4. Transistor Connected in Grounded-Emitter Amplifier Circuit.

To understand the reason for this, consider the base of the point-contact transistor. It consists of the entire crystal, except for the very small areas formed under the emitter and collector cat whiskers. In the junction transistor, the base is an extremely thin section or slice between the large emitter and the collector sections. In some junction units the base measures only .001 inch in thickness. Thus, even though both units may be made from the same germanium sample, the base resistance of the junction transistor is lower because the base presents greater surface areas to the emitter and collector. This lower base resistance allows the use of the junction transistor in grounded-base amplifiers having high gain and very good stability.

The grounded-emitter circuit of Fig. 4 provides an amplifier which is very stable and is not critical of variations between transistors of the same type. The series resistor in the emitter lead and the voltage divider which biases the base are both included in the circuit for stabilization of the operating point. This assures the designer that fluctuation in battery voltage and variation in ambient temperatures will have only a minor effect on the operation of the transistor over a wide range.

The circuit shown in Fig. 4 has a fairly low input impedance and poor high-frequency response. To correct these deficiencies, it is advantageous to drive the grounded-emitter stage from a low-impedance source. This can best be done by adding a grounded-collector stage as illustrated in Fig. 5. In this amplifier, the stabilizing network has been transferred to the grounded-collector stage. This stage operates at a lower current than the second stage, and thus the power loss in the bleeder network is reduced. The first stage stabilizes the second by presenting a constant-current source to the emitter of the second stage. In addition, the first stage provides an increase in power gain and voltage gain. The addition of the grounded-collector stage in this manner might be likened to the use of a vacuum-tube cathode follower, except that in the case of transistors a gain is realized.

The junction transistor is constantly proving to be the best of the two types for almost any amplifier application.

Oscillation

The basic components of a vacuum-tube oscillator are an amplifier, a feedback circuit, and a tank circuit. The complete oscillator circuit is arranged so that the feedback circuit subtracts a portion of the energy from the output and returns it in the proper phase relationship to the input. This bit of energy is then amplified, and a portion of the voltage it develops in the output is returned to the input. This cycle is continually repeated.

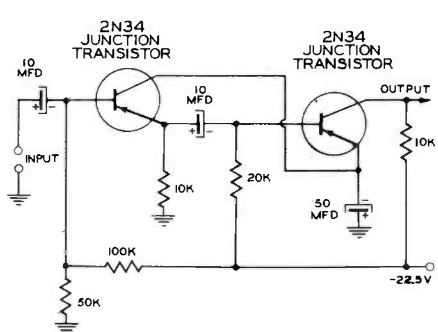


Fig. 5. Amplifier Circuit Illustrating Use of Grounded-Collector Circuit.

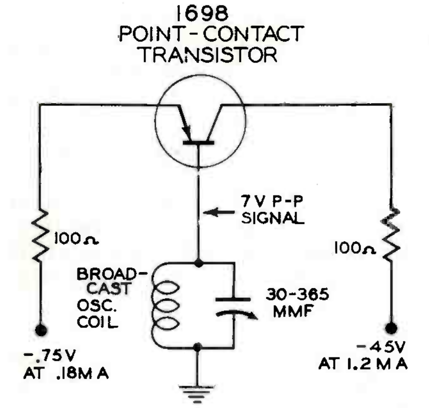


Fig. 6. Oscillator Circuit Utilizing the Principle of Increased Z_b.

A transistor can be utilized in the same manner if the same requirements are fulfilled. Since the point-contact transistor is basically a current amplifier, the circuits can be transposed by the use of the duality principle. The oscillator will then have current amplification, current feedback, and a tank circuit which will produce maximum current; and, by utilizing the negative resistance characteristic of the point-contact transistor, it will be effective as an oscillator. The formula stating the conditions required to make the point-contact transistor effective in an oscillator circuit contains many factors, but the only variables are the internal resistances of the transistor and the external circuit impedances. The internal resistances of any transistor are fixed values and cannot be altered. There are three external circuit impedances any one of which can be manipulated to bring about oscillation.

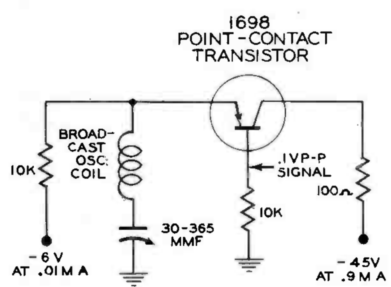


Fig. 7. Oscillator Circuit Using a Decrease in Z_e to Produce Oscillation.

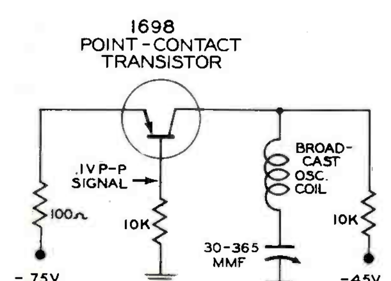


Fig. 8. Oscillator Circuit Using the Principle of Decreased Z_c.

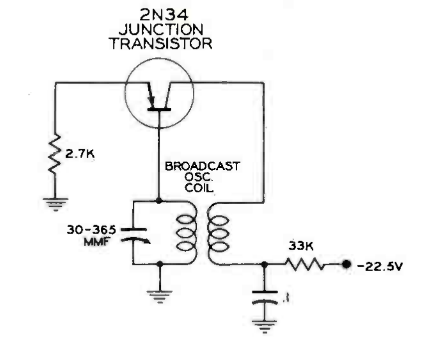


Fig. 9. Transistor Oscillator Incorporating Voltage Feedback in the Grounded-Base Circuit.

These are the base, emitter, and collector impedances. Oscillation can be initated by increasing the base impedance Z_b, decreasing the emitter impedance Z_e, or by decreasing the collector impedance Z_c.

An increase in Z_b can be achieved by inserting a parallel-resonant circuit in the base lead, as shown in Fig. 6. This provides a maximum of base impedance at resonance, and the circuit will oscillate at that frequency. The decrease in either Z_e or Z_c can be achieved by connecting a series-resonant circuit from the respective element to ground, as shown in Figs. 7 and 8. This will produce a minimum impedance and a condition of oscillation at resonance. The base resistor is required in Figs. 6, 7, and 8 to maintain the base impedance at a high value and makes it necessary to reverse the normal polarity of the emitter bias supply in order to maintain the emitter just slightly positive with respect to the base. It is interesting to note the great variation in the signal level developed by the circuit of Fig. 6 as compared to those of Figs. 7 and 8.

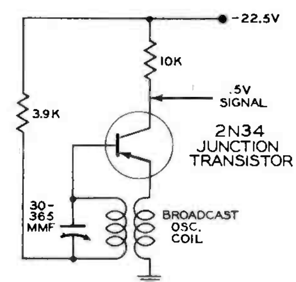


Fig. 10. Transistor Oscillator Utilizing the Gounded-Emitter Circuit and Voltage Feedback.

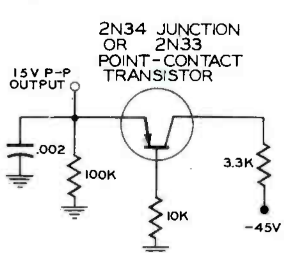


Fig. 11. Relaxation Oscillator Using Transistor.

The junction transistor will not oscillate in the circuits of Figs. 6, 7, and 8, for it is not a current amplifier; the maximum current gain of a junction transistor is always less than unity. Thus, it is necessary to employ this unit as a voltage amplifier and to use a voltage-feedback circuit similar to that used with vacuum tubes. This can usually be accomplished by inductive coupling.

The resulting circuits are somewhat similar to vacuum-tube oscillators, and some representative circuits are given in Figs. 9 and 10. A relaxation oscillator providing a saw-tooth voltage output is illustrated in Fig. 11. With the circuit constants as shown, the output frequency is about 10 kilocycles. A change in the time constant of the emitter circuit will alter this frequency.

The voltage-feedback type of oscillator is not limited solely to the use of the junction transistor; the point-contact unit can also be successfully employed in these oscillator circuits.

William E. Burke

Quicker Servicing

(Continued from page 19)

trouble-free service in properly operating circuits originally designed for 6BQ6GT tubes. The new tube is called 6CU6 and is being manufactured by CBS-Hytron. A photograph of this tube is shown in Fig. 2.

The 6CU6 is not a modified 6BQ6GT. It is an entirely new design having electrical characteristics almost identical to those of the 6BQ6GT. A chart showing these electrical characteristics is reproduced in Chart I, since this data is not yet available in most tube manuals. The big difference between the 6CU6 and the 6BQ6GT lies in their mechanical construction. Note the large envelope and plates which provide more surface area for greater heat dissipation. In addition to these features the tube employs specially designed micas and plate suspension, also visible in Fig. 2. This construction lessens the danger of arc-over in the tube. A solder of high temperature is used in the top cap; this lessens the probability of an intermittent connection developing between the cap and the internal plate lead.

It should be remembered that this tube is not intended to be used to overcome any deficiencies in the horizontal-output circuit. As is the case with any tube replacement, such deficiencies should be corrected before using the tube.

Replacing Picture Tubes

A little forethought when replacing picture tubes in TV receivers yields results. Too often the service technician finds that after installing a new tube and returning the chassis to the cabinet, either the face of the tube is too far forward or it is not far enough. The first situation leaves the front-panel control shafts too short so that the knobs are difficult to get on. When the picture tube is not far enough forward, on the other hand, there may be a gap between the tube face and dust seal.

The reason this problem comes up is because of the tolerance in bulb lengths on picture tubes even though they have identical type numbers; this tolerance is ±3/16 inch on many tubes. As a result, the distance between the face and the start of the bulb flare on these tubes may vary as much as 3/8 inch. Since the deflection yoke establishes the position of the flared part of the tube relative to the chassis, the position of the tube face will vary according to bulb length.

The first thing to do after determining that a picture tube requires replacement is either to mark or to measure the exact location of the tube

CHART I

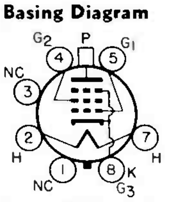
CHARACTERISTIC CHARTS FOR 6CU6 HORIZONTAL-DEFLECTION TUBE

MECHANICAL DATA

Coated unipotential cathode

Bulb	T-12
Base	Intermediate Shell 7-Pin Octal
Top-Cap	C1-3 Skirted Miniature
Maximum diameter	1 23/32 inches
Maximum over-all length	4 1/2 inches
Maximum seated height	4 inches
Mounting position	Any

Basing Diagram



Pin 1: No connection
Pin 2: Heater
Pin 3: No connection
Pin 4: Grid No. 2
Pin 5: Grid No. 1
Pin 7: Heater
Pin 8: Cathode
Top-Cap: Plate

JETEC Basing Designation 6AM

ELECTRICAL DATA

Direct Interelectrode Capacitances¶

Grid to plate: (g1 to p)	0.55	micromicrofarads
Input: g1 to (h+K+g2+b.p.)	15.0	micromicrofarads
Output: p to (h+K+g2+b.p.)	7.0	micromicrofarads

Heater Characteristics

Heater voltage	6.3	volts
Heater current	1.2	amperes
Maximum heater-cathode voltage:		
Heater negative with respect to cathode: Total d-c & peak	200	volts
Heater positive with respect to cathode: D-c	100	volts
Heater positive with respect to cathode: Total d-c & peak	200	volts

Ratings — Horizontal Deflection Amplifier†**

Maximum d-c plate-supply voltage (boost+d-c power supply)	550	volts
Maximum peak positive plate voltage (absolute maximum)	6000	volts
Maximum peak negative plate voltage	1250	volts
Maximum plate dissipation‡	11	watts
Maximum peak negative grid-No. 1 voltage	300	volts
Maximum d-c grid-No. 2 voltage	175	volts
Maximum grid-No. 2 dissipation	2.5	watts
Maximum average cathode current	110	milliamperes
Maximum peak cathode current	400	milliamperes
Maximum grid-No. 1-circuit resistance	0.47	megohm
Maximum bulb temperature (at hottest point)	220°	C

Typical Operating Characteristics — Horizontal Deflection Amplifier†

D-c plate-supply voltage (boost+d-c power supply)	465	volts
D-c grid-No. 1 (control-grid) voltage	–28	volts
D-c grid-No. 2 (screen) voltage	140	volts
Grid-No. 1 input voltage:		
Peak-to-peak sawtooth component	74	volts
Negative peaking component	18	volts
Peak positive plate voltage	3440	volts
Picture-tube anode voltage	14,000	volts
D-c plate current	83	milliamperes
D-c grid-No. 2 (screen) current	12.3	milliamperes
Plate dissipation	5.1	watts
Control-grid resistance	0.33	megohm
Sweep width (21FP4 picture tube)§	19 1/8	inches

¶No external shield.

**All values are evaluated on design-center system except where absolute maximum is stated.

†For operation in a 525-line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse must not exceed 15% (10 microseconds) of a scanning cycle.

‡In stages operating with grid-leak bias, an adequate cathode-bias resistor or other suitable means is required to protect the tube in the absence of excitation.

§For normal, synchronized picture.

face before removing the old tube from the chassis. A good method for accomplishing this is to measure from the front of the chassis to the front of the picture tube, as shown in Fig. 3. When the new replacement is in position with its flare against the yoke cushion, this measurement should be checked. If there proves to be a marked difference, the mounting position of the yoke must be changed to compensate for the difference. The service technician who spends the minute or two necessary to make this check will be assured of an easier job returning the chassis to its cabinet.

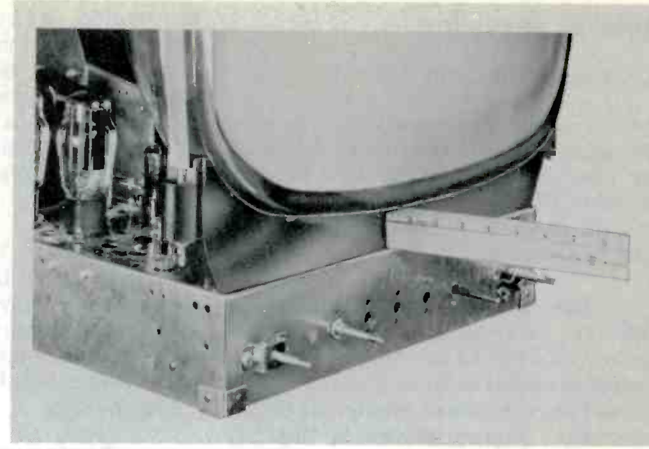


Fig. 3. Method of Recording Location of Picture Tube Before Removing.

Another service suggestion that is particularly useful when replacing rectangular metal picture tubes is to note the position of the base-locating key on the old tube and to place the new tube with its key in the same position. Quite often the leads for the picture-tube socket are so short that the socket cannot be made to reach the tube base when the key position is other than it was originally.

Dolly for Truck or Station Wagon

Sliding a TV receiver into a station wagon or panel truck presents a problem. Many cabinets have rubber feet which make it difficult to slide them. Moreover, the inside height of a station wagon or panel truck is quite limited so that it becomes difficult to achieve lifting leverage on a bulky TV receiver.

One service technician has designed a dolly which contributes much to making this job easier. This dolly is shown in use in Fig. 4. The unit is made of two sections of 3/4-inch plywood; the sections are joined together by hinges. One section has two axles and the other has only one. Heavy-duty rubber casters are used as wheels, and one section is made slightly shorter than the other so that the wheels at the extreme ends do not hit when the unit is folded.

The hinged feature provides several advantages. Should it be necessary to remove the dolly from the station wagon or truck, it can be folded for convenient handling and storage. When the unit is used in a station wagon, it can be folded, and this will allow room for the rear seat of the station wagon to be installed in front of the dolly. The hinges also permit the rear section to drop to the tail gate when the unit is pulled out sufficiently to let the wheels pass the end of the tail gate. Fig. 4 shows the dolly in this position. When in the position shown, the dolly is anchored and kept from rolling.

After a receiver is placed on the dolly, both can be rolled forward into the bed of the truck or station wagon. First, lift the back edge of the dolly so that the wheels are on the tail gate or platform, then push the dolly forward. Fig. 5 shows the dolly and receiver in final position.

Some method of preventing the dolly from moving about during transit should be incorporated. This may be in the form of a latch or blocking device placed on the bed of the truck or station wagon. The originator of this idea designed his dolly so that its length allowed just enough room for his tool kit to fit between the rear edge of the dolly and the elevated tail gate.

Notice in Figs. 4 and 5 that a mat is cemented to the top surface of the dolly. This mat improved the appearance of the unit and serves as a cushion for receivers during transit. The rubber wheels also provide a cushioning effect.

We wish to express our thanks for this idea to Roy Shepherd, owner of Shepherd Radio and Television in Anderson, Indiana.

Fig. 4. Dolly in Loading Position.

Fig. 5. Dolly in Position for Traveling.

Soldering Twin Lead

Certain precautions in soldering the ends of wires in twin lead should be observed in order to perform a neat-looking job. The chief reason that this task requires careful handling lies in the softening effect of heat on twin-lead insulation. If the wires are under any strain when the softening occurs, they have a tendency to pull right through the insulation. Hence, there are two goals to strive for: (1) to relieve all strain from the wires during soldering and (2) to keep as much of the heat as possible from reaching the insulation.

There are procedures which will help toward the achievement of these goals. Whenever the soldering iron is applied, hold the lead-in wire with long-nosed pliers between the soldering point and the insulation; this will shunt much of the heat away from the insulation. Prior to making connection, tin the ends of the lead-in wires; in this way, less heat will be required to make the final connection. Make a mechanical connection by means of a loop or hook in the wire before attempting a soldered connection; this will take some of the strain off the wire while heat is being applied.

Henry A. Carter

Dollar and Sense Servicing

(Continued from page 33)

NEEDLING. For square dancing in a two-car garage refurnished as a recreation room, our neighbor made himself a record player by mounting a turntable, motor, and tone arm on a box. Didn't sound bad at all, but just didn't look right somehow. Glancing at it off and on while catching our breath in between dances, we blinked twice and gasped—he was putting down the tone arm at the wrong side of the record, so that the needle was diving point-on into those grooves like a snowplow. Sure was glad those were his own records. A tactful explanation that records prefer dragging to digging got things fixed—and the band played on.

SECOND SET. Spot checking in one community reveals that only 4 1/2 per cent of homes have two TV sets, and these are chiefly because the customer hung onto the old small-screen set when buying a new one. Here are other figures from the Cunningham and Walsh survey of their viewer-habit guinea pig, New Brunswick, N. J. Almost 20 per cent of set owners have never had their sets repaired; of sets purchased before 1951, some 4 per cent have never been repaired; average annual TV repair bill is $11 except for those few requiring new picture tubes. We'll take these figures with a grain of salt; spot-sampling surveys, like questionnaires and Gallup polls, can really get off base at times.

TUBE TESTING. It actually costs you about 13 cents per tube for testing those bags and bushel baskets full of tubes brought in by certain customers for free testing, says NATESA president Frank J. Moch. This takes into account the value of 2 1/2 minutes minimum time per tube plus depreciation on the tester, but no overhead. The markup on possible sale of a few tubes won't cover it, because that is pretty well eaten up by normal costs of keeping the tube in stock, handling it, guaranteeing it, and replacing it when the customer accidentally plugs it into the wrong socket. He also points out that a "Tubes Tested Free" sign can't be considered as advertising, because the type of people who bring in tubes for testing are rarely good customers for service. Solution, he recommends, is charging 15 or 20 cents per tube for testing by the bagful.

TURRETS. Our old home town of St. Paul had it good when just channels 4 and 5 were on the air; people could click back and forth in a jiffy to see which program was the better. But channel 11 sort of spoiled this when it came on, by being so far away from 5. Service technician Derril Hundley makes an excellent suggestion for this situation in GE Techni-talk: on sets having turret-type "head ends," interchange the channel strips for 6 and 11. The idea is good in any locality where there are two or more VHF stations; customers really appreciate it.

OLDIES. Dick Counter of Minneapolis has his own unique way of playing the old Edison hill-and-dale diamond-disc records through a modern high-fidelity audio system. From the pivoted original diamond-needle shank he runs string to a toothpick inserted in place of a needle in an old Wurlitzer magnetic pickup that's mounted on its side. Springs in the pickup mounting absorb shock. The old tungsten-steel magnet in the pickup was replaced with an Alnico slug. With string tension adjusted just right, the words of that popular oldie, "Margie," rang out loud and clear from the woofer-tweeter combination in the next room.

A disc cut from Celotex was used under the record on the turntable to cut down rumble from the electric phonograph motor he installed in place of the original spring-wound job.

Same results should be possible with a GE variable-reluctance pickup on its side. It would seem desirable to have a spring to bias the needle above center so the hill-and-dale grooves would move it equally far above and below center between the pole pieces, though no such spring was necessary on the Wurlitzer pickup. Now we're wondering what a GE pickup would do for the still older cylinder records.

GROUNDING. For grounding a chassis quickly on your bench, fasten a small permanent magnet to the end of your ground lead, says Moe Schleicher in the December issue of Electrical Merchandising. The wire can be cleaned and wrapped around the magnet a few times, across its face, so that the magnet then presses the wire against the chassis. Use a rubber band or speaker cement to anchor the wire.

Other good ideas in his article: in the nozzle of the shop vacuum cleaner, put a heater coil for locating intermittents with a hot air blast. Devise a yoke arrangement that will permit hooking up any TV chassis to a picture tube permanently mounted on the bench. This saves the risk of work of taking out tubes that are mounted on the cabinet instead of on the chassis.

In this service shop (Schleicher Radio & Television Shop, White Plains, New York), they figure that each TV-owning customer is worth about $40 a year in service when averaged over 4 years. They get list price on set sales, despite New York City cut-throat competition, by giving three free service calls during the first year of ownership and by charging only for parts that are out of warranty.

RACKET. Answering a $64 question correctly over the phone cost a California housewife exactly $64, according to a UP story in the New York Times. On the phone, a man identified himself as master of ceremonies for a quiz show then asked a fairly easy question. If she answered correctly, she would win twice the amount of money she had in the house.

"Absolutely right," the man yelled in the phone. She had $64. A messenger appeared soon after with checks for $128 and $64; he gave her the $128 check; then he asked for the $64 in cash in exchange for the other check, "to prove to the studio how much you had." Becoming suspicious after parting with her money, the lady called the studio and discovered there was no such program. Both checks bounced.

SEEING. Handy for dark corners in a cabinet or deep chassis is an Ungar soldering pencil with a 7-watt candelabra bulb in place of the soldering tip. Stephen Goch gets credit for this idea in a recent issue of Sylvania News.

THE WORKS. It isn't too far back to the days when radio customers said, "Give it the works." This usually meant wiping off the dust and installing a whole new set of tubes in the radio. Some had this done regularly once a year. Service technicians cheerfully obliged, because in those days the markup on the sale of a tube looked pretty good.

The customer's reasoning was a combination of preventive maintenance and general pep-up of the set — the same two things that make people buy entire new sets of spark plugs for their car once a year even today, when cleaning and gapping of the points would usually give the same result.

In both cases, ordering the works means satisfaction and peace of mind for the customer. This alone is worth many times the cost of the plugs or tubes, so both parties come out ahead on such deals.

Are peace-of-mind sales being overlooked today? True, they're not for many-tubed TV receivers, but there are around a hundred million radios in homes and cars now. Why not try out the idea on a sampling of calls — say the next hundred that you make. Keep tabs on how many customers accept your suggestion to give a radio the works, and decide for yourself if it pays off. Use the peace-of-mind slogan —putting the set back in like-new condition so there's no worry about a tube failing during an important program and no worry about whether it is going to distort.

WINDOWSHOPPING. With the aid of industrial underwater television, scientists and archeologists seated comfortably on board ship watch while divers aim the camera at various pieces of submerged cargo from a Greek galleon that sank off Marseilles, and indicate by telephone the relics that they feel should be recovered. To us, the equivalent would be a television-equipped mole that went through Indian burial mounds in Minnesota and let us see where lay the buried tomahawks, peacepipes, arrowheads and skeletons. We dug into one for a solid day just to get two tiny arrowheads and a few pieces of Indian skull, so no more of that until someone comes up with underground industrial TV.

HEADACHE. Service technicians aren't the only ones who get headaches. In designing their model 462 and 463 TV sets, Sentinel engineers spotted an idle open pin at No. 5 on the 1B3GT, in just the right location for anchoring a filament current-limiting resistor. They used it, and patted themselves on the back for saving the cost of a separate insulated terminal. Out went the sets, and then they discovered that GE was making 1B3GT's with pin 5 internally connected to 7. This shorted out the resistor and greatly shortened the life of said tube. So next, GE announced it wouldn't short 5 to 7 any more. All of which makes the subject of an interesting Sentinel Service Bulletin which concludes with the recommendation to clip pin 5 off all GE 1B3GT tubes used as replacements in these sets.

On second thought, this is also a service technician's headache.

John Markus

TV SUPPLEMENTARY SHEET NO. 8

MODEL & CHASSIS	PART #	CATALOG #	FUNCTION	DESCRIPTION	LIST PRICE
TELE-KING					
K21 K72 K73L KC21 KC71 KD21M KD22B KD71 KD72B	P-2-D	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	P-5-D	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	P-12-D	AG-6-S FKS-1/4	AM Rejection	1000 Ω carbon	$1.25
	P-13	AG-61-S KSS-3	Vert. Hold	1 Meg. Ω carbon	$1.25
CHASSIS TVJ	P-14	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
	P-15	AG-49-S KSS-3	Bright.	100K Ω carbon	$1.25
	PD-9	RTV-347	Contrast/ Vol./Sw.	2000 Tap 1400/500K Ω Conc. Dual carbon SPST	$4.30
TRAD					
C-2020 C-2420 CD-2020 T-1720	131-0001	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	131-0002	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	131-0003	RTV-1	Contrast/ Vol./Sw.	10K/1 Meg. Tap 200K Ω Conc. Dual carbon SPST	$3.70
	131-0012	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
	131-0012	AG-44-S KSS-3	Bright.	50K Ω carbon	$1.25
	131-0013	AG-61-S KSS-3	Vert. Hold	1 Meg. Ω carbon	$1.25
	131-0014	RTV-10	Focus	5000 Ω 4W-W.W.	$1.85
		A43-3000 FKS-1/4	Threshold	3000 Ω 2W-W.W.	$1.25
TRAV-LER					
217-10,11-12-14 217-15 217-16 220-9,A,B,	TV-VC-28	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	TV-VC-28	AG-84-S FKS-1/4	Focus	2.5 Meg. carbon	$1.25
	TV-VC-29	A43-5000 FKS-1/4	Vert. Lin.	5000 Ω 2W-W.W.	$1.25
	TV-VC-30	AG-61-S FKS-1/4	Vert. Hold	1 Meg. Ω carbon	$1.25
CHASSIS 33A2 34A2	TV-VC-31	AG-44-S FKS-1/4	Hor. Hold	50K Ω carbon	$1.25
	TV-VC-32	AG-49-S FKS-1/4	Bright.	100K Ω carbon	$1.25
	TV-VC-32	AG-49-S FKS-1/4	Contrast Range Control	100K Ω carbon	$1.25
	TV-VC-36	RTV-292	Contrast/ Vol./Sw.	1000/250K Ω 2W-W.W./ carbon Conc. Dual SPST	$3.70
VIDEO PRODUCTS					
630DXC DX24C 630K3C K24C	EP-101	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	EP-104	RTV-98	Hor. Cent.	20 Ω C.T. 2W-W.W.	$1.85
	EP-104	RTV-98	Vert. Cent.	20 Ω C.T. 2W-W.W.	$1.85
	EP-105	RTV-65	Vert./Hor. Hold	1 Meg./50K Ω Conc. Dual carbon	$3.10
	EP-106	AM-44-S FS-3/SW-A5	Bright./ Sw.	50K Ω carbon--SPST	$1.25 .75
	EP-107	RTV-1	Contrast/ Vol./Sw.	10K/1 Meg. Tap 200K Ω Conc. Dual carbon SPST	$3.70
	EP-108	RTV-10	Focus	5000 Ω 4W-W.W.	$1.85
	EP-111	A43-5000 FKS-1/4	Vert. Lin.	5000 Ω 2W-W.W.	$1.25
WESTERN AUTO (Truetone)					
2D2149A	10A-18441	RTV-218	Contrast/ Vol./Sw.	5000/1 Meg. Tap 100K Ω Conc. Dual carbon DPST	$4.50
	10B-17275	AG-49-S KSS-3	Vert. Hold	100K Ω carbon	$1.25
	10B-17764	AG-44-S KSS-3	Bright	50K Ω carbon	$1.25
	10B-19218	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	10B-19220	AG-61-S FKS-1/4	Height.	1 Meg. Ω carbon	$1.25
2D2219A	A10A-18441	RTV-218	Contrast/ Vol./Sw.	5000/1 Meg. Tap 100K Ω Conc. Dual carbon DPST	$4.50
	A10B-17275	AG-49-S KSS-3	Vert. Hold	100K Ω carbon	$1.25
	A10B-17764	AG-44-S KSS-3	Bright.	50K Ω carbon	$1.25
	A10B-19218	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	A10B-19220	AG-61-S FKS-1/4	Height	750K Ω carbon	$1.25
	* A10B-19542	AG-63-Z KSS-3	Tone	1 Meg. Ω carbon	$1.25
	* Not Used In All Models.				
WESTINGHOUSE					
H-688K24	V-6463	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	V-9813-3	AG-58-S FKS-1/4	Height	500K Ω carbon	$1.25
CHASSIS V-2219-1	V-9894-1	AG-58-S KSS-3	Vert. Hold	500K Ω carbon	$1.25
	V-10130-4	AG-63-Z FS-3	Tone	1 Meg. Ω carbon	$1.25
	V-10854-2	RTV-317	Contrast/ Vol./Sw.	1500/500K Tap 50K Ω Conc. Dual carbon SPST	$4.30
	V-10914-1	AG-44-S KSS-3	Bright.	50K Ω carbon	$1.25
	V-10915-1	AG-52-S KSS-3	Hor. Hold	125K Ω carbon	$1.25
	V-11214-1	RTV-326	Dual Focus	800/800 Ω 4W-W.W./ 4W-W.W. Dual	$4.30

Form No. 751962010-5M-12/52

PF INDEX

+ More or Less —

The articles starting on Pages 6, 11, 17, and 27, in this issue of the PF INDEX, represent our first concentrated effort in the direction of test equipment application coverage. With your indulgence, we would like to review a little of the background responsible for this material.

Those of you who recall the early history of this publication, will remember that we have frequently sought advice from our readership as to what subjects were most desired for coverage in our editorial content. Test equipment — then and now — ranks as one of the major ones.

Our objective, originating as a result of these requests, has been to furnish the most helpful and accurate application and maintenance information on test equipment that we could provide. Our approach to this objective has been to adopt the same philosophy which is applied to the origination and preparation of PHOTOFACT Folders; i.e., to furnish data resulting from actual use and knowledge of the equipment which is covered.

Lest there be a misunderstanding, we want to make it clear that we do not process the various items of test equipment, as we do radio and television receivers in our PHOTOFACT analysis operation. We do, however, have the availability of individual test equipment units which have been, or are to be, used in conjunction with service requirements outlined in PF INDEX content. The experience and knowledge resulting from their actual use can, therefore, be employed as a basis for article preparation.

To furnish additional grounding in this field, we, about a year ago, sent out a test equipment application questionnaire, and the tabulated results of this have been tied in with our planning so that we may attempt to reflect the greatest effort on the greatest need.

As these articles appear in the Index, please bear in mind that our efforts are not unlimited — we must observe space limitations within our publication as well as the natural requirement of an impartial attention on items which you would have us cover.

We feel that the program which we have developed, and which we will continue to implement, will be mutually beneficial to the service technician, to the test equipment manufacturer, and, of course, to the final consumer — your service customer.

One additional thought about our planning. We intend to provide data on specific models with which we have had experience . . we are neither going to guess nor predict. Obviously, such an operation will require time to cover not only the various makes of test equipment, but, additionally, the many categories of types of service equipment currently in use. We must take adequate time in preparation to avoid improper emphasis (or lack of it) in either the direction of make, or classification of units.

The appearance or mention of any make and model of test equipment in this activity does not constitute a recommendation, or promotion, by this Company or this publication. Similarly, the absence of specific mention on any make and model cannot be interpreted as either condemnation or indifference. We presently have the whole-hearted cooperation of a number of test equipment manufacturers in furnishing us with representative constructions of their lines; and we expect to have even more just as soon as our time and our staff can be suitably expanded.

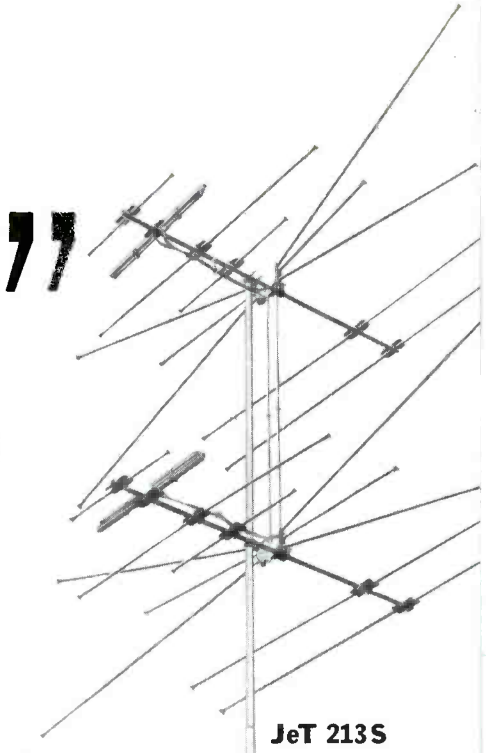
In conclusion, may I say that, as in the past, we solicit, and will respect, your advice and understanding.

J.R.R.

INDEX TO ADVERTISERS
February - 1954

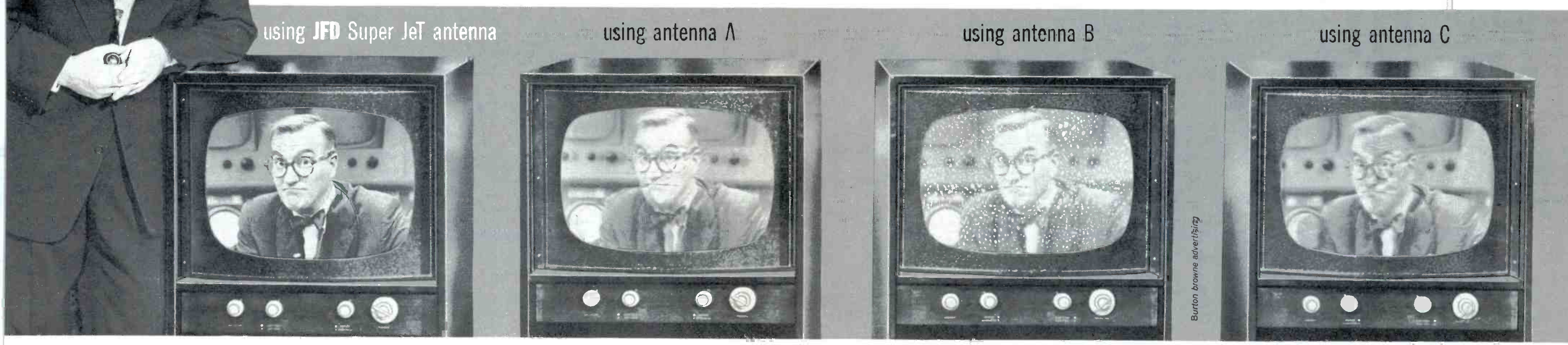
Before you install another antenna

take this "look-test"



Irving Rose, prominent Chicago designer and president of Voice and Vision, noted television and high fidelity center, takes the **"look test"** of fringe reception from Milwaukee.

Here is your clinical proof that only the **JFD Super JeT TV antenna Out-Performs** all others on all channels



1. Four TV receivers of one brand, same model, same production run were set up. Technicians went over these sets to make sure they were identically aligned.

2. Three other leading high gain TV antennas were installed—each oriented for maximum performance. Each antenna was connected to a set by identical type lead-in.

3. Each receiver was tuned with infinite care to the same channel to make certain the reception was as good as possible. The picture is the proof—the result can be immediately seen—the JFD Super JeT outperformed all others.

4. The chart shows why the "Look-test" is your proof positive of sharper, clearer, more brilliant pictures . . . in Black and White or Color on all channels present and future.

JeT 213 (single Bay) $20.75
JeT 213S* (2-Bay) $42.50
*complete with stacking transformer

ANTENNA LIST		CHANNELS 2	3	4	5	6	7	8	9	10	11	12	13
Competitor A Radar Screen with 3 dipoles (2-bay) Partly Pre-Assembled	$42.36	4.5	4.3	7.3	7.0	7.0	10.00	10.75	11.5	11.7	11.0	11.5	11.6
Competitor B Radar Screen with 2 dipoles (2-bay) Not Assembled	$34.95	0.75	3.25	4.5	3.5	3.5	6.0	7.0	6.5	7.75	8.0	7.5	6.0
Competitor C Bedspring (4-bay) Pre-Assembled	$55.00	4.0	5.0	7.0	6.25	5.0	5.25	6.0	5.25	7.25	9.25	6.5	7.0
JFD Superjet Model JeT 213 S (2-bay) Pre-Assembled	$42.50	6.5	7.5	9.5	8.5	8.5	11.0	11.0	12.0	12.0	11.25	11.75	12.0

DB GAIN

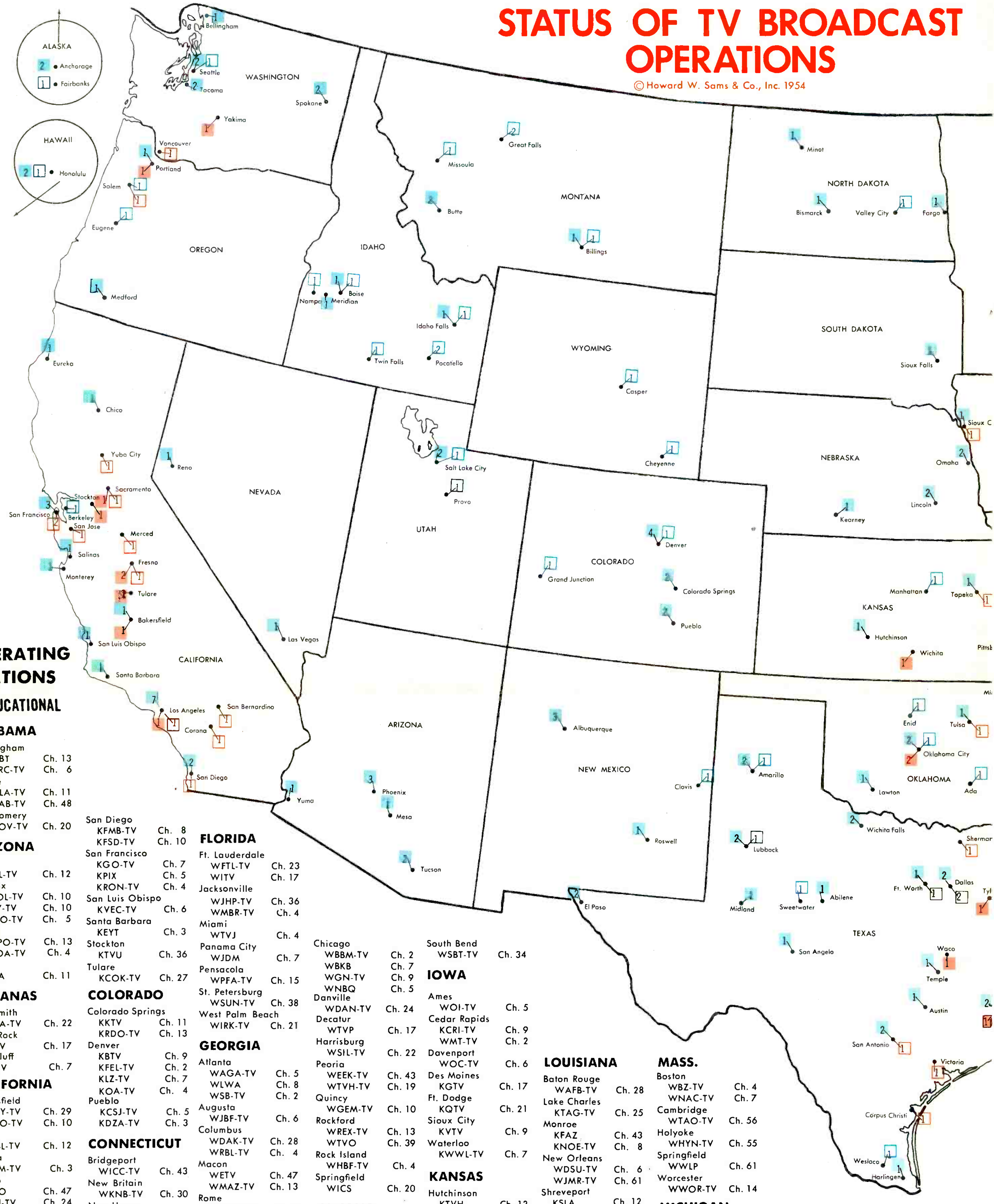
World's largest manufacturers of TV antennas and accessories

Write for Bulletin #230

JFD Electronics

JFD Manufacturing Company,
Brooklyn 4, N.Y.

STATUS OF TV BROADCAST OPERATIONS



OPERATING STATIONS

* EDUCATIONAL

ALABAMA

Birmingham
WABT Ch. 13
WBRC-TV Ch. 6
Mobile
WALA-TV Ch. 11
WKAB-TV Ch. 48
Montgomery
WCOV-TV Ch. 20

ARIZONA

Mesa
KTYL-TV Ch. 12
Phoenix
KOOL-TV Ch. 10
KOY-TV Ch. 10
KPHO-TV Ch. 5
Tucson
KOPO-TV Ch. 13
KVOA-TV Ch. 4
Yuma
KIVA Ch. 11

ARKANSAS

Fort Smith
KFSA-TV Ch. 22
Little Rock
KRTV Ch. 17
Pine Bluff
KATV Ch. 7

CALIFORNIA

Bakersfield
KAFY-TV Ch. 29
KERO-TV Ch. 10
Chico
KHSL-TV Ch. 12
Eureka
KIEM-TV Ch. 3
Fresno
KJEO Ch. 47
KMJ-TV Ch. 24
Los Angeles
KABC-TV Ch. 7
KHJ-TV Ch. 9
KLAC-TV Ch. 13
KNBH Ch. 4
KNXT Ch. 2
*KTHE Ch. 28
KTLA Ch. 5
KTTV Ch. 11
Monterey
KMBY-TV Ch. 8
Sacramento
KCCC-TV Ch. 40
Salinas
KSBW-TV Ch. 8
San Diego
KFMB-TV Ch. 8
KFSD-TV Ch. 10
San Francisco
KGO-TV Ch. 7
KPIX Ch. 5
KRON-TV Ch. 4
San Luis Obispo
KVEC-TV Ch. 6
Santa Barbara
KEYT Ch. 3
Stockton
KTVU Ch. 36
Tulare
KCOK-TV Ch. 27

COLORADO

Colorado Springs
KKTV Ch. 11
KRDO-TV Ch. 13
Denver
KBTV Ch. 9
KFEL-TV Ch. 2
KLZ-TV Ch. 7
KOA-TV Ch. 4
Pueblo
KCSJ-TV Ch. 5
KDZA-TV Ch. 3

CONNECTICUT

Bridgeport
WICC-TV Ch. 43
New Britain
WKNB-TV Ch. 30
New Haven
WNHC-TV Ch. 8
Waterbury
WATR-TV Ch. 53

DELAWARE

Wilmington
WDEL-TV Ch. 12

DIST. OF COLUMBIA

Washington
WMAL-TV Ch. 7
WNBW Ch. 4
WTOP-TV Ch. 9
WTTG Ch. 5

FLORIDA

Ft. Lauderdale
WFTL-TV Ch. 23
WITV Ch. 17
Jacksonville
WJHP-TV Ch. 36
WMBR-TV Ch. 4
Miami
WTVJ Ch. 4
Panama City
WJDM Ch. 7
Pensacola
WPFA-TV Ch. 15
St. Petersburg
WSUN-TV Ch. 38
West Palm Beach
WIRK-TV Ch. 21

GEORGIA

Atlanta
WAGA-TV Ch. 5
WLWA Ch. 8
WSB-TV Ch. 2
Augusta
WJBF-TV Ch. 6
Columbus
WDAK-TV Ch. 28
WRBL-TV Ch. 4
Macon
WETV Ch. 47
WMAZ-TV Ch. 13
Rome
WROM-TV Ch. 9

IDAHO

Boise
KIDO-TV Ch. 7
Idaho Falls
KID-TV Ch. 3
Meridian-Boise
KBOI Ch. 2

ILLINOIS

Bloomington
WBLN Ch. 15
Champaign
WCIA Ch. 3
Chicago
WBBM-TV Ch. 2
WBKB Ch. 7
WGN-TV Ch. 9
WNBQ Ch. 5
Danville
WDAN-TV Ch. 24
Decatur
WTVP Ch. 17
Harrisburg
WSIL-TV Ch. 22
Peoria
WEEK-TV Ch. 43
WTVH-TV Ch. 19
Quincy
WGEM-TV Ch. 10
Rockford
WREX-TV Ch. 13
WTVO Ch. 39
Rock Island
WHBF-TV Ch. 4
Springfield
WICS Ch. 20

INDIANA

Bloomington
WTTV Ch. 10
Evansville
WFIE Ch. 62
Ft. Wayne
WKJG-TV Ch. 33
Indianapolis
WFBM-TV Ch. 6
Lafayette
WFAM-TV Ch. 59
Muncie
WLBC-TV Ch. 49
Princeton
WRAY-TV Ch. 52
South Bend
WSBT-TV Ch. 34

IOWA

Ames
WOI-TV Ch. 5
Cedar Rapids
KCRI-TV Ch. 9
WMT-TV Ch. 2
Davenport
WOC-TV Ch. 6
Des Moines
KGTV Ch. 17
Ft. Dodge
KQTV Ch. 21
Sioux City
KVTV Ch. 9
Waterloo
KWWL-TV Ch. 7

KANSAS

Hutchinson
KTVH Ch. 12
Pittsburg
KOAM-TV Ch. 7
Topeka
WIBW-TV Ch. 13
Wichita
KEDD Ch. 16

KENTUCKY

Henderson
WEHT Ch. 50
Louisville
WAVE-TV Ch. 3
WHAS-TV Ch. 11
WKLO-TV Ch. 21

LOUISIANA

Baton Rouge
WAFB-TV Ch. 28
Lake Charles
KTAG-TV Ch. 25
Monroe
KFAZ Ch. 43
KNOE-TV Ch. 8
New Orleans
WDSU-TV Ch. 6
WJMR-TV Ch. 61
Shreveport
KSLA Ch. 12

MAINE

Bangor
WABI-TV Ch. 5
Lewiston
WLAM-TV Ch. 17
Portland
WPMT Ch. 53
WCSH-TV Ch. 6

MARYLAND

Baltimore
WAAM Ch. 13
WBAL-TV Ch. 11
WMAR-TV Ch. 2

MASS.

Boston
WBZ-TV Ch. 4
WNAC-TV Ch. 7
Cambridge
WTAO-TV Ch. 56
Holyoke
WHYN-TV Ch. 55
Springfield
WWLP Ch. 61
Worcester
WWOR-TV Ch. 14

MICHIGAN

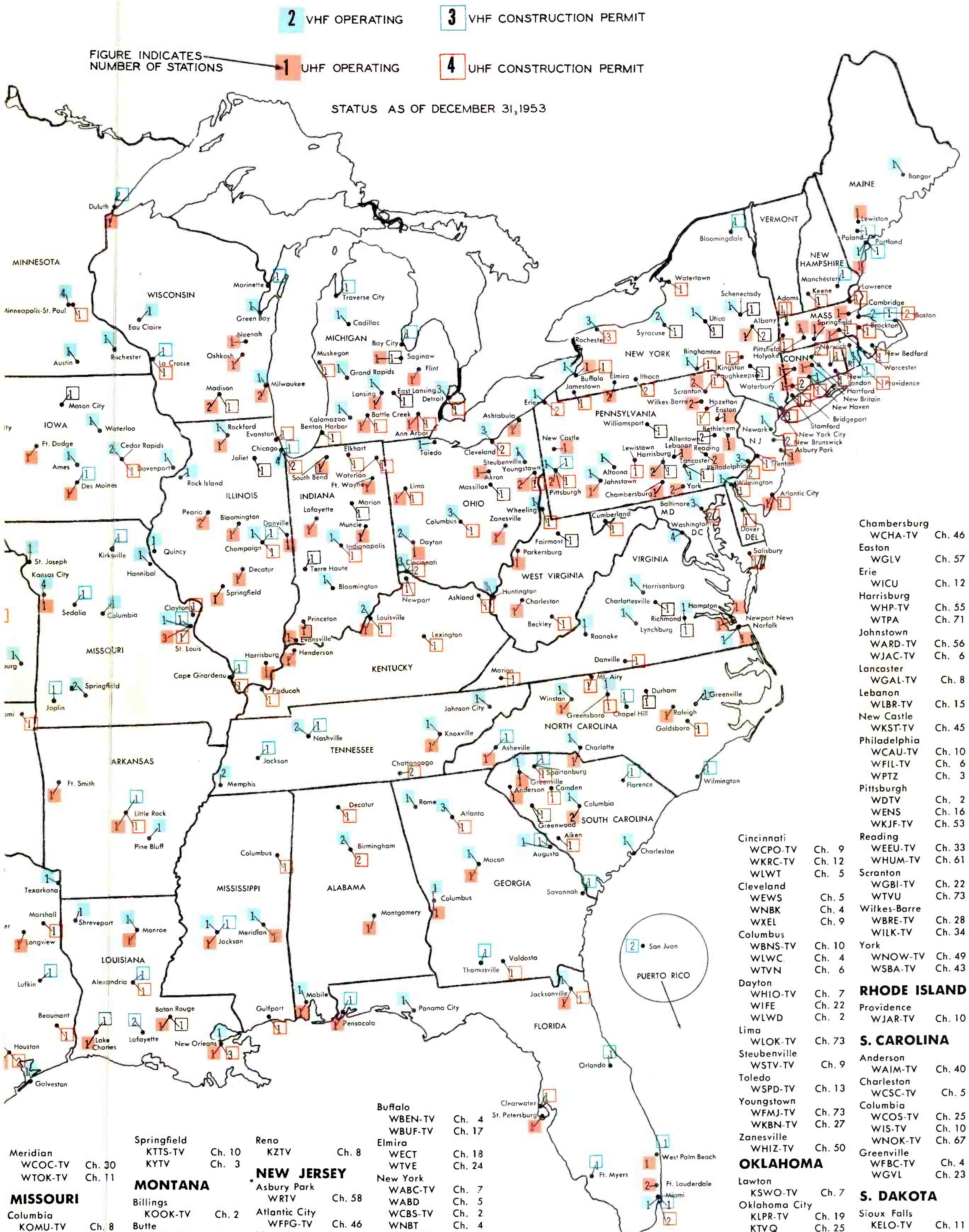
Ann Arbor
WPAG-TV Ch. 20
Battle Creek
WBKZ-TV Ch. 64
Cadillac
WWTV Ch. 13
Detroit
WJBK-TV Ch. 2
WWJ-TV Ch. 4
WXYZ-TV Ch. 7
Flint
WTAC-TV Ch. 16
Grand Rapids
WOOD-TV Ch. 7
Kalamazoo
WKZO-TV Ch. 3
Lansing
WILS-TV Ch. 54
WJIM-TV Ch. 6
Saginaw
WKNX-TV Ch. 57

MINNESOTA

Austin
KMMT Ch. 6
Duluth
WFTV Ch. 38
Minneapolis-St. Paul
WCCO-TV Ch. 4
WTCN-TV Ch. 11
Rochester
KROC-TV Ch. 10
St. Paul-Minneapolis
KSTP-TV Ch. 5
WMIN-TV Ch. 11

MISSISSIPPI

Jackson
WJTV Ch. 25
WLBT Ch. 3



Meridian
WCOC-TV Ch. 30
WTOK-TV Ch. 11

MISSOURI

Columbia
KOMU-TV Ch. 8
Hannibal
KHQA-TV Ch. 7
Kansas City
KCMO-TV Ch. 5
KCTY Ch. 25
KMBC-TV Ch. 9
WDAF-TV Ch. 4
WHB-TV Ch. 9
St. Joseph
KFEQ-TV Ch. 2
St. Louis
KSD-TV Ch. 5
KSTM-TV Ch. 36
St. Louis-Belleville, Ill.
WTVI Ch 54
St. Louis-Festus
KACY Ch. 14
Springfield
KTTS-TV Ch. 10
KYTV Ch. 3

MONTANA

Billings
KOOK-TV Ch. 2
Butte
KOPR-TV Ch. 4
KXLF-TV Ch. 6

NEBRASKA

Kearney-Holdredge
KHOL-TV Ch. 13
Lincoln
KFOR-TV Ch. 10
KOLN-TV Ch. 12
Omaha
KMTV Ch. 3
WOW-TV Ch. 6

NEVADA

Las Vegas
KLAS-TV Ch. 8
Reno
KZTV Ch. 8

NEW JERSEY

Asbury Park
WRTV Ch. 58
Atlantic City
WFPG-TV Ch. 46
Newark
WATV Ch. 13

NEW MEXICO

Albuquerque
KGGM-TV Ch. 13
KOAT-TV Ch. 7
KOB-TV Ch. 4
Roswell
KSWS-TV Ch. 8

NEW YORK

Albany
WROW-TV Ch. 41
Binghamton
WNBF-TV Ch. 12
Buffalo
WBEN-TV Ch. 4
WBUF-TV Ch. 17
Elmira
WECT Ch. 18
WTVE Ch. 24
New York
WABC-TV Ch. 7
WABD Ch. 5
WCBS-TV Ch. 2
WNBT Ch. 4
WOR-TV Ch. 9
WPIX Ch. 11
Rochester
WHAM-TV Ch. 6
WHEC-TV Ch. 10
WVET-TV Ch. 10
Schenectady
WRGB Ch. 4
Syracuse
WHEN Ch. 8
WSYR-TV Ch. 3
Utica
WKTV Ch. 13

N. CAROLINA

Asheville
WISE-TV Ch. 62
Charlotte
WAYS-TV Ch. 36
WBTV Ch. 3
Greensboro
WFMY-TV Ch. 2
Greenville
WNCT Ch. 9
Raleigh
WNAO-TV Ch. 28
Winston-Salem
WSJS-TV Ch. 12
WTOB-TV Ch. 26

N. DAKOTA

Bismarck
KFYR-TV Ch. 5
Fargo
WDAY-TV Ch. 6
Minot
KCJB-TV Ch. 13

OHIO

Akron
WAKR-TV Ch. 49
Ashtabula
WICA-TV Ch. 15
Cincinnati
WCPO-TV Ch. 9
WKRC-TV Ch. 12
WLWT Ch. 5
Cleveland
WEWS Ch. 5
WNBK Ch. 4
WXEL Ch. 9
Columbus
WBNS-TV Ch. 10
WLWC Ch. 4
WTVN Ch. 6
Dayton
WHIO-TV Ch. 7
WIFE Ch. 22
WLWD Ch. 2
Lima
WLOK-TV Ch. 73
Steubenville
WSTV-TV Ch. 9
Toledo
WSPD-TV Ch. 13
Youngstown
WFMJ-TV Ch. 73
WKBN-TV Ch. 27
Zanesville
WHIZ-TV Ch. 50

OKLAHOMA

Lawton
KSWO-TV Ch. 7
Oklahoma City
KLPR-TV Ch. 19
KTVQ Ch. 25
KWTV Ch. 9
WKY-TV Ch. 4
Tulsa
KOTV Ch. 6

OREGON

Medford
KBES-TV Ch. 5
Portland
KOIN-TV Ch. 6
KPTV Ch. 27

PENN.

Altoona
WFBG-TV Ch. 10
Bethlehem
WLEV-TV Ch. 51
Chambersburg
WCHA-TV Ch. 46
Easton
WGLV Ch. 57
Erie
WICU Ch. 12
Harrisburg
WHP-TV Ch. 55
WTPA Ch. 71
Johnstown
WARD-TV Ch. 56
WJAC-TV Ch. 6
Lancaster
WGAL-TV Ch. 8
Lebanon
WLBR-TV Ch. 15
New Castle
WKST-TV Ch. 45
Philadelphia
WCAU-TV Ch. 10
WFIL-TV Ch. 6
WPTZ Ch. 3
Pittsburgh
WDTV Ch. 2
WENS Ch. 16
WKJF-TV Ch. 53
Reading
WEEU-TV Ch. 33
WHUM-TV Ch. 61
Scranton
WGBI-TV Ch. 22
WTVU Ch. 73
Wilkes-Barre
WBRE-TV Ch. 28
WILK-TV Ch. 34
York
WNOW-TV Ch. 49
WSBA-TV Ch. 43

RHODE ISLAND

Providence
WJAR-TV Ch. 10

S. CAROLINA

Anderson
WAIM-TV Ch. 40
Charleston
WCSC-TV Ch. 5
Columbia
WCOS-TV Ch. 25
WIS-TV Ch. 10
WNOK-TV Ch. 67
Greenville
WFBC-TV Ch. 4
WGVL Ch. 23

S. DAKOTA

Sioux Falls
KELO-TV Ch. 11

TENNESSEE

Johnson City
WJHL-TV Ch. 11
Knoxville
WROL-TV Ch. 6
WTSK-TV Ch. 26
Memphis
WHBQ-TV Ch. 13
WMCT Ch. 5
Nashville
WSIX-TV Ch. 8
WSM-TV Ch. 4

TEXAS

Abilene
KRBC-TV Ch. 9
Amarillo
KFDA-TV Ch. 10
KGNC-TV Ch. 4
Austin
KTBC-TV Ch. 7
Dallas
KRLD-TV Ch. 4
WFAA-TV Ch. 8
El Paso
KROD-TV Ch. 4
KTSM-TV Ch. 9
Fort Worth
WBAP-TV Ch. 5
Galveston
KGUL-TV Ch. 11
Harlingen
KGBT-TV Ch. 4
Houston
KNUZ-TV Ch. 39
KPRC-TV Ch. 2
*KUHT Ch. 8
Longview
KTVE Ch. 32
Lubbock
KCBD-TV Ch. 11
KDUB-TV Ch. 13
Midland
KMID-TV Ch. 2
San Angelo
KTXL-TV Ch. 8
San Antonio
KGBS-TV Ch. 5
WOAI-TV Ch. 4
Temple
KCEN-TV Ch. 6
Texarkana
KCMC-TV Ch. 6
Tyler
KETX Ch. 19
Waco
KANG-TV Ch. 34
Wichita Falls
KFDX-TV Ch. 3
KWFT-TV Ch. 6

UTAH

Salt Lake City
KDYL-TV Ch. 4
KSL-TV Ch. 5

VIRGINIA

Hampton-Norfolk
WVEC-TV Ch. 15
Harrisonburg
WSVA-TV Ch. 3
Lynchburg
WLVA-TV Ch. 13
Newport News
WACH Ch. 33
Norfolk
WTAR-TV Ch. 4
WTOV-TV Ch. 27
Richmond
WTVR Ch. 6
Roanoke
WSLS-TV Ch. 10

WASHINGTON

Bellingham
KVOS-TV Ch. 12
Seattle
KING-TV Ch. 5
KOMO-TV Ch. 4
Spokane
KHQ-TV Ch. 6
KXLY-TV Ch. 4
Tacoma
KMO-TV Ch. 13
KTNT-TV Ch. 11
Yakima
KIMA-TV Ch. 29

WEST VIRGINIA

Charleston
WKNA-TV Ch. 49
Huntington
WSAZ-TV Ch. 3
Parkersburg
WTAP Ch. 15
Wheeling
WTRF-TV Ch. 7

WISCONSIN

Eau Claire
WEAU-TV Ch. 13
Green Bay
WBAY-TV Ch. 2
Madison
WKOW-TV Ch. 27
WMTV Ch. 33
Milwaukee
WCAN-TV Ch. 25
WOKY-TV Ch. 19
WTMJ-TV Ch. 4
Neenah
WNAM-TV Ch. 42
Oshkosh
WOSH-TV Ch. 48

ALASKA

Anchorage
KFIA Ch. 2
KTVA Ch. 11

HAWAII

Honolulu
KGMB-TV Ch. 9
KONA Ch. 11

Additional copies of this map may be obtained from JFD Manufacturing Co., Inc. Brooklyn 4, N. Y.

STATUS OF TV BROADCAST OPERATIONS

CONSTRUCTION PERMITS

ALABAMA
Birmingham
- WJLN-TV Ch. 48
- WSGN-TV Ch. 42

Decatur
- WMSL-TV Ch. 23

ARKANSAS
Little Rock
- KARK-TV Ch. 4
- KETV Ch. 23

CALIFORNIA
Berkeley
- *KQED Ch. 9

Corona
- KCOA Ch. 52

Fresno
- KBID Ch. 53

Los Angeles
- KBIC-TV Ch. 22

Merced
- KMER Ch. 34

Sacramento
- KBIK-TV Ch. 46

San Bernardino
- KITO-TV Ch. 18

San Diego
- Ch. 21

San Francisco
- KBAY-TV Ch. 20
- KSAN-TV Ch. 32

San Jose
- KVIE Ch. 48

Yuba City
- KAGR-TV Ch. 52

COLORADO
Denver
- *KRMA-TV Ch. 6

Grand Junction
- KFXJ-TV Ch. 5

CONNECTICUT
Bridgeport
- *WCBE Ch. 71
- WSJL Ch. 49

Hartford
- *WCHF Ch. 24
- WGTH-TV Ch. 18

New Haven
- WELI-TV Ch. 59

New London
- WNLC-TV Ch. 26

Norwich
- *WCNE Ch. 63

Stamford
- WSTF Ch. 27

DELAWARE
Dover
- WHRN Ch. 40

Wilmington
- WILM-TV Ch. 83

FLORIDA
Clearwater
- Ch. 32

Fort Myers
- WINK-TV Ch. 11

Jacksonville
- WOBS-TV Ch. 30

Miami
- Ch. 33
- WMIE-TV Ch. 27
- *WTHS-TV Ch. 2

Orlando
- WDBO-TV Ch. 6

Pensacola
- WEAR-TV Ch. 3

West Palm Beach
- WJNO-TV Ch. 5

GEORGIA
Atlanta
- WQXI-TV Ch. 36

Augusta
- WRDW-TV Ch. 12

Savannah
- WTOC-TV Ch. 11

Thomasville
- Ch. 6

Valdosta
- WGOV-TV Ch. 37

IDAHO
Boise
- KTVI Ch. 9

Idaho Falls
- KIFT Ch. 8

Nampa
- KFXD-TV Ch. 6

Pocatello
- KISJ Ch. 6
- KWIK-TV Ch. 10

Twin Falls
- KLIX-TV Ch. 11

ILLINOIS
Champaign
- WCUI Ch. 21

Champaign-Urbana
- *WTLC Ch. 12

Chicago
- WHFC-TV Ch. 26
- WIND-TV Ch. 20
- * Ch. 11

Evanston
- WTLE Ch. 32

Joliet
- WJOL-TV Ch. 48

INDIANA
Elkhart
- WSJV Ch. 52

Indianapolis
- WJRE Ch. 26

Marion
- WMRI-TV Ch. 29

Terre Haute
- WTHI-TV Ch. 10

Waterloo
- WINT Ch. 15

IOWA
Cedar Rapids
- KEYC Ch. 20

Des Moines
- WHO-TV Ch. 13

Mason City
- KGLO-TV Ch. 3

Sioux City
- KCTV Ch. 36

KANSAS
Manhattan
- *KSAC-TV Ch. 8

Topeka
- KTKA Ch. 42

KENTUCKY
Ashland
- WPTV Ch. 59

Lexington
- WLAP-TV Ch. 27

Louisville
- WLOU-TV Ch. 41

Newport
- WNOP-TV Ch. 74

Paducah
- WTLK Ch. 43

LOUISIANA
Alexandria
- KSPJ Ch. 62
- Ch. 5

Baton Rouge
- KHTV Ch. 40

Lafayette
- KLFY-TV Ch. 10
- KVOL-TV Ch. 10

Lake Charles
- KPLC-TV Ch. 7

New Orleans
- WCKG Ch. 26
- WCNO-TV Ch. 32
- WTLO Ch. 20

MAINE
Poland
- WMTW Ch. 8

Portland
- WGAN-TV Ch. 13

MARYLAND
Baltimore
- WSID-TV Ch. 18
- WITH-TV Ch. 60

Cumberland
- WTBO-TV Ch. 17

Salisbury
- WBOC-TV Ch. 16

MASS.
Adams
- WMGT Ch. 74

Boston
- WBOS-TV Ch. 50
- *WGBH-TV Ch. 2
- WJDW Ch. 44

Brockton
- WHEF-TV Ch. 62

Lawrence
- WGLM Ch. 72

New Bedford
- WTEV Ch. 28

Pittsfield
- WBEC-TV Ch. 64

Worcester
- WAAB-TV Ch. 20

MICHIGAN
Ann Arbor
- *WUOM-TV Ch. 26

Battle Creek
- WBCK-TV Ch. 58

Bay City
- WNEM-TV Ch. 5

Benton Harbor
- WHFB-TV Ch. 42

Detroit
- Ch. 62

East Lansing
- WKAR-TV Ch. 60

Muskegon
- WTVM Ch. 35

Saginaw
- WSBM-TV Ch. 51

Traverse City
- WPBN-TV Ch. 7

MINNESOTA
Duluth-Superior
- WDSM-TV Ch. 6

Duluth
- KDAL-TV Ch. 3

St. Paul
- WCOW-TV Ch. 17

MISSISSIPPI
Columbus
- WCBI-TV Ch. 28

Gulfport
- WGCM-TV Ch. 56

Jackson
- WSLI-TV Ch. 12

MISSOURI
Cape Girardeau
- KFVS-TV Ch. 12
- KGMO-TV Ch. 18

Clayton
- KFUO-TV Ch. 30

Joplin
- KSWM-TV Ch. 12

Kirksville
- KBIZ-TV Ch. 3

St. Louis
- *KETC Ch. 9
- WIL-TV Ch. 42

Sedalia
- KDRO-TV Ch. 6

MONTANA
Billings
- KRHT Ch. 8

Great Falls
- KFBB-TV Ch. 5
- KMON-TV Ch. 3

Missoula
- KGVO-TV Ch. 13

N. HAMPSHIRE
Keene
- WKNE-TV Ch. 45

Manchester
- WMUR-TV Ch. 9

NEW JERSEY
Atlantic City
- WOCN Ch. 52

New Brunswick
- WDHN Ch. 47
- *WTLV Ch. 19

Trenton
- WTTM-TV Ch. 41

NEW MEXICO
Clovis
- KNEH Ch. 12

NEW YORK
Albany
- WPTR-TV Ch. 23
- *WTVZ Ch. 17

Binghamton
- *WQTV Ch. 46

Bloomingdale
- WIRY-TV Ch. 5

Buffalo
- *WTVF Ch. 23

Ithaca
- WHCU-TV Ch. 20
- *WIET Ch. 14

Jamestown
- WJTN-TV Ch. 58

Kingston
- WKNY-TV Ch. 66

New York
- *WGTV Ch. 25

Poughkeepsie
- WEOK-TV Ch. 21

Rochester
- WCBF-TV Ch. 15
- WRNY-TV Ch. 27
- *WROH Ch. 21

Schenectady
- WTRI Ch. 35

Syracuse
- *WHTV Ch. 43

Utica
- WFRB Ch. 19

Watertown
- WWNY-TV Ch. 48

N. CAROLINA
Asheville
- WLOS-TV Ch. 13

Chapel Hill
- *WUNC-TV Ch. 4

Durham
- WCIG-TV Ch. 46

Goldsboro
- WTVX Ch. 34

Greensboro
- WCOG-TV Ch. 57

Mt. Airy
- WPAQ-TV Ch. 55

Wilmington
- WMFD-TV Ch. 6

N. DAKOTA
Valley City
- KXJB-TV Ch. 4

OHIO
Cincinnati
- *WCET Ch. 48
- WCIN-TV Ch. 54

Cleveland
- WERE-TV Ch. 65
- WHK-TV Ch. 19

Columbus
- *WOSU-TV Ch. 34

Lima
- WIMA-TV Ch. 35

Massillon
- WMAC-TV Ch. 23

Youngstown
- WUTV Ch. 21

OKLAHOMA
Ada
- KEOK Ch. 10

Enid
- Ch. 5

Miami
- KMIV Ch. 58

Oklahoma City
- * Ch. 13

Tulsa
- KCEB Ch. 23

OREGON
Eugene
- KVAL-TV Ch. 13

Salem
- KPIC Ch. 24
- KSLM-TV Ch. 3

PENN.
Allentown
- WFMZ-TV Ch. 67
- WQCY Ch. 39

Erie
- WSEE Ch. 35
- Ch. 66

Harrisburg
- WCMB-TV Ch. 27

Hazelton
- WAZL-TV Ch. 63

Lancaster
- WWLA Ch. 21

Lewistown
- WMRF-TV Ch. 38

Philadelphia
- WIBG-TV Ch. 23
- WIP-TV Ch. 29

Pittsburgh
- *WQED Ch. 13
- WTVQ Ch. 47

Scranton
- WARM-TV Ch. 16

Williamsport
- WRAK-TV Ch. 36

RHODE ISLAND
Providence
- WNET Ch. 16
- WPRO-TV Ch. 12

S. CAROLINA
Aiken
- WAKN-TV Ch. 54

Camden
- WACA-TV Ch. 14

Florence
- WPDV Ch. 8

Greenwood
- WCRS-TV Ch. 21

Spartanburg
- WORD-TV Ch. 7
- WSCV Ch. 17

TENNESSEE
Chattanooga
- WOUC Ch. 49
- WTVT Ch. 43

Jackson
- WDXI-TV Ch. 9

Nashville
- WLAC-TV Ch. 5

TEXAS
Amarillo
- KLYN-TV Ch. 7

Beaumont
- KBMT Ch. 31

Corpus Christi
- Ch. 43

Dallas
- KDTX Ch. 23
- KLIF-TV Ch. 29

Fort Worth
- KTCO Ch. 20

Houston
- KTVP Ch. 23
- KXYZ-TV Ch. 29

Lubbock
- KFYO-TV Ch. 5

Lufkin
- KTRE-TV Ch. 9

Marshall
- KMSL Ch. 16

San Antonio
- KALA Ch. 35

Sherman
- KSHM Ch. 46

Sweetwater
- KPAR-TV Ch. 12

Victoria
- KNAL-TV Ch. 19

Weslaco
- KRGV-TV Ch. 5

UTAH
Provo
- KOVO-TV Ch. 11

Salt Lake City
- KUTV Ch. 2

VIRGINIA
Charlottesville
- WCHV-TV Ch. 64

Danville
- WBTM-TV Ch. 24

Marion
- WMEV-TV Ch. 50

Richmond
- Ch. 29

WASHINGTON
Seattle
- *KUOW Ch. 9

Vancouver
- KVAN-TV Ch. 21

W. VIRGINIA
Beckley
- WBEY Ch. 21

Fairmont
- WJPB-TV Ch. 35

Wheeling
- WLTV Ch. 51

WISCONSIN
LaCrosse
- WKBT Ch. 8
- Ch. 38

Madison
- *WHA-TV Ch. 21

Marinette
- WMAM-TV Ch. 11

WYOMING
Casper
- KSPR-TV Ch. 2

Cheyenne
- KFBC-TV Ch. 5

ALASKA
Fairbanks
- KFIF Ch. 2

HAWAII
Honolulu
- KULA-TV Ch. 4

PUERTO RICO
San Juan
- WAPA-TV Ch. 4
- WKAQ-TV Ch. 2

For log of OPERATING STATIONS and TV MAP, see reverse side. * EDUCATIONAL

Here it is! DRAMATIC DEVELOPMENT IN TV INSTALLATIONS! LESS METAL ...LOWEST LOSS IN AN ALL-PURPOSE STAND-OFF INSULATOR

JFD Electronics

PAL* Stand-off Insulator

*Pivot-Action-Lock

PAL* stand-off insulator is the serviceman's PAL for all UHF and VHF installations—takes tubular, open and flat transmission lines more quickly and simply.

No metal surrounds the PAL insulator. PAL eliminates standing waves and voltage losses on UHF or VHF. Produces sharper, clearer pictures.

PAL* is easy to work with—even in the open position PAL* is always in one piece because of the exclusive JFD hinge design. No threading of insert. No crimping.

The PAL* positive lock—pressure button exerts extra locking tension when insulator is in closed position.

PAL* is plated to a special military spec which safeguards against rust. Exclusive BRONZIDITE plating.

PAL* cam type latch is for quicker, easier, better installations.

Write for PAL Brochure No. 243
JFD MANUFACTURING CO., INC.
Brooklyn 4, N. Y.
World's largest manufacturers of TV Antennas and Accessories

AVAILABLE IN ALL TYPES AND SIZES

Wood Screw Stand-Offs
PAL 213 .... 3½"
PAL 215 .... 5½"
PAL 217 .... 7½"
PAL 2112 .... 12½"

Wood Screw Inline Stand-Offs
PAL 2177 .... 7½"

"NUT" Universal Stand-Offs
(with electro-galvanized straps)
PAL 323 .... 3½"
PAL 325 .... 5½"
PAL 327 .... 7½"
PAL 3212 .... 12½"

Inline "NUT" Screw Eye Stand-Off
PAL 3277 .... 7½"

"NUT" Universal Stand-Offs
(with stainless steep straps)
PAL 433 .... 3½"
PAL 435 .... 5½"
PAL 437 .... 7½"
PAL 4312 .... 12½"
PAL 4377 .... 7½"
(with stainless steep strap)

Clip-On Stands-Offs (7½")
PAL 100 .... 1" od
PAL 116 .... 1" e.m.t. od
PAL 125 .... 1¼" od

Inline Clip-On Stand-Off
PAL 1255 .... 7½"

Machine Screw PAL
PAL 713 .... 3½"
PAL 715 .... 5½"
PAL 717 .... 7½"
PAL 7112 .... 12½"

Inline Machine Screw PAL
PAL 7177 .... 7½"

Drive-In Stand-Off
PAL 500 .... 4½"
PAL 517 .... 7½"

Double Drive-In Stand-Off
PAL 510 .... 4½"
PAL 517 .... 7½"

Gutter Stand-Offs
PAL 547 .... 7½"

Inline Gutter Stand-Offs
PAL 5477 .... 7½"

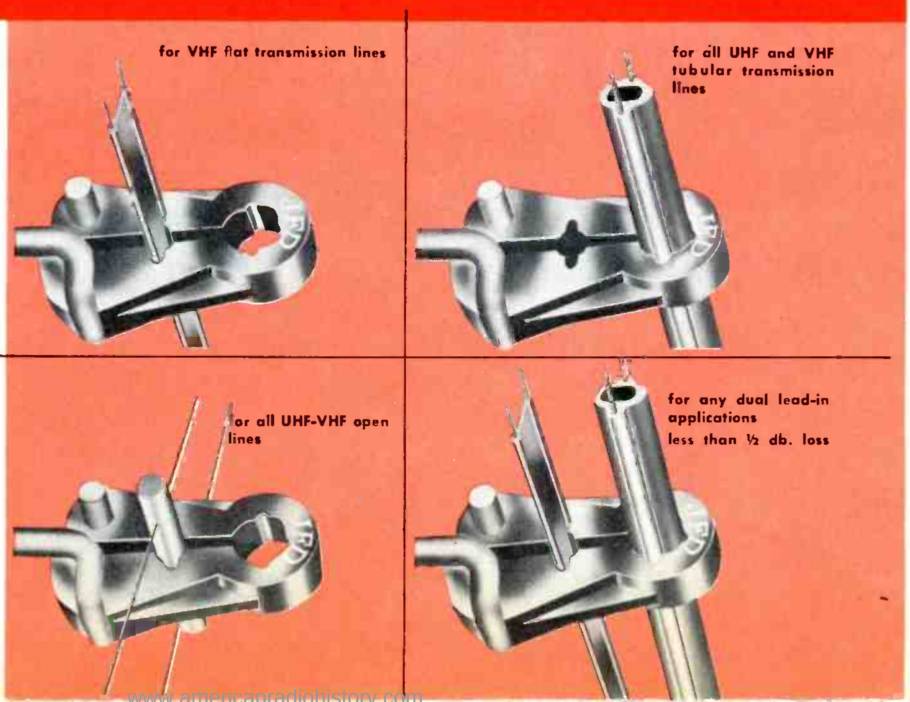
Hot Nail Stand-Off
PAL 600 .... 3½"

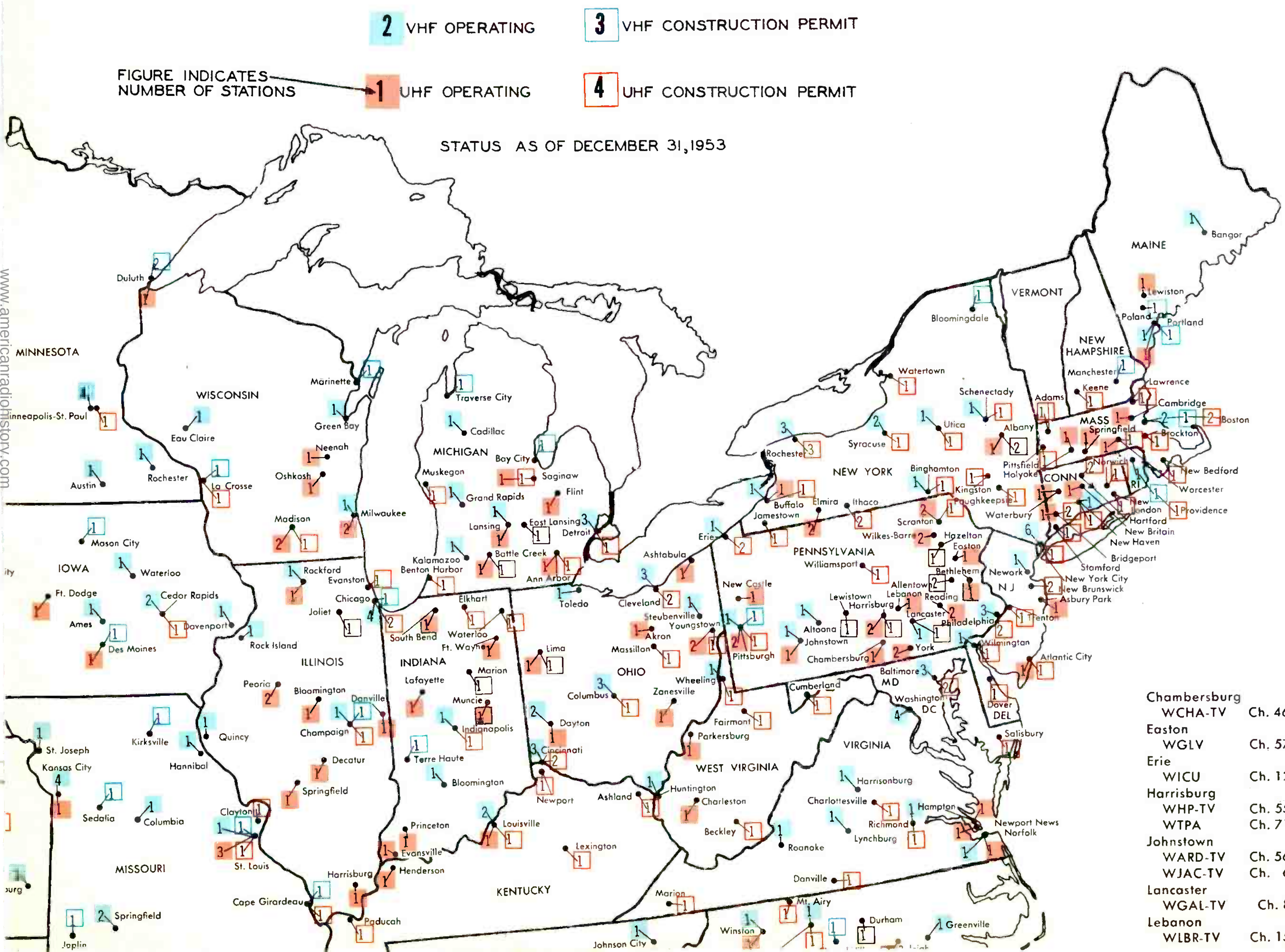
PAL Insulator (only)
PAL 800

Burton browne advertising

1. Simply hinge insulator—slip lead-in into place—(any type fits tightly inside insulator).

2. Swing polyethylene insulator into place—click that's it.





Amarillo
KFDA-TV Ch. 10
KGNC-TV Ch. 4
Austin
KTBC-TV Ch. 7
Dallas
KRLD-TV Ch. 4
WFAA-TV Ch. 8
El Paso
KROD-TV Ch. 4
KTSM-TV Ch. 9
Fort Worth
WBAP-TV Ch. 5
Galveston
KGUL-TV Ch. 11
Harlingen
KGBT-TV Ch. 4
Houston
KNUZ-TV Ch. 39
KPRC-TV Ch. 2
*KUHT Ch. 8
Longview
KTVE Ch. 32
Lubbock
KCBD-TV Ch. 11
KDUB-TV Ch. 13
Midland
KMID-TV Ch. 2
San Angelo
KTXL-TV Ch. 8
San Antonio
KGBS-TV Ch. 5
WOAI-TV Ch. 4
Temple
KCEN-TV Ch. 6
Texarkana
KCMC-TV Ch. 6
Tyler
KETX Ch. 19
Waco
KANG-TV Ch. 34
Wichita Falls
KFDX-TV Ch. 3
KWFT-TV Ch. 6

Chambersburg
WCHA-TV Ch. 46
Easton
WGLV Ch. 57
Erie
WICU Ch. 12
Harrisburg
WHP-TV Ch. 55
WTPA Ch. 71
Johnstown
WARD-TV Ch. 56
WJAC-TV Ch. 6
Lancaster
WGAL-TV Ch. 8
Lebanon
WLBR-TV Ch. 15

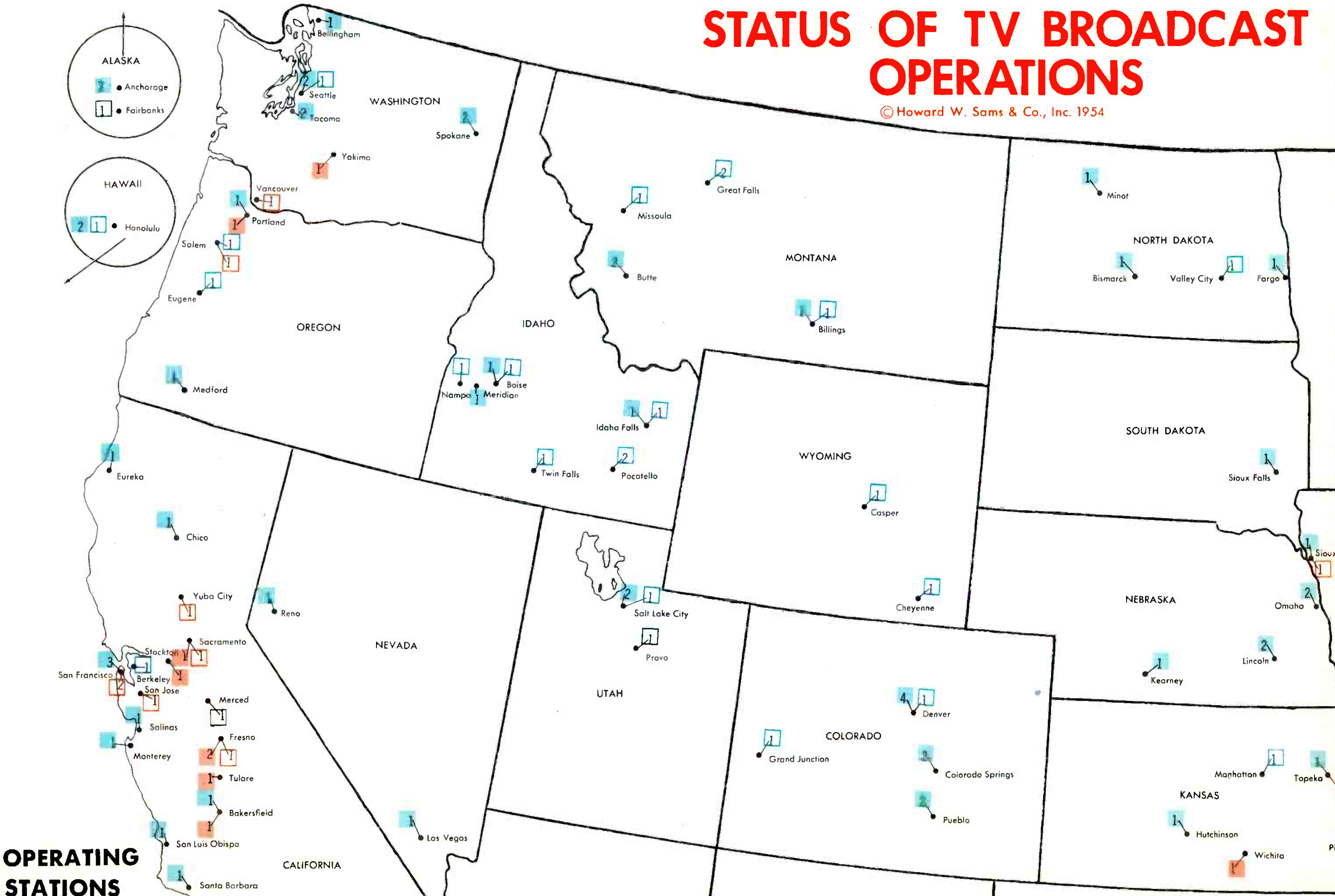
UTAH

Salt Lake City
KDYL-TV Ch. 4
KSL-TV Ch. 5

VIRGINIA

Hampton-Norfolk
WVEC-TV Ch. 15
Harrisonburg
WSVA-TV Ch. 3
Lynchburg
WLVA-TV Ch. 13
Newport News
WACH Ch. 33

STATUS OF TV BROADCAST OPERATIONS

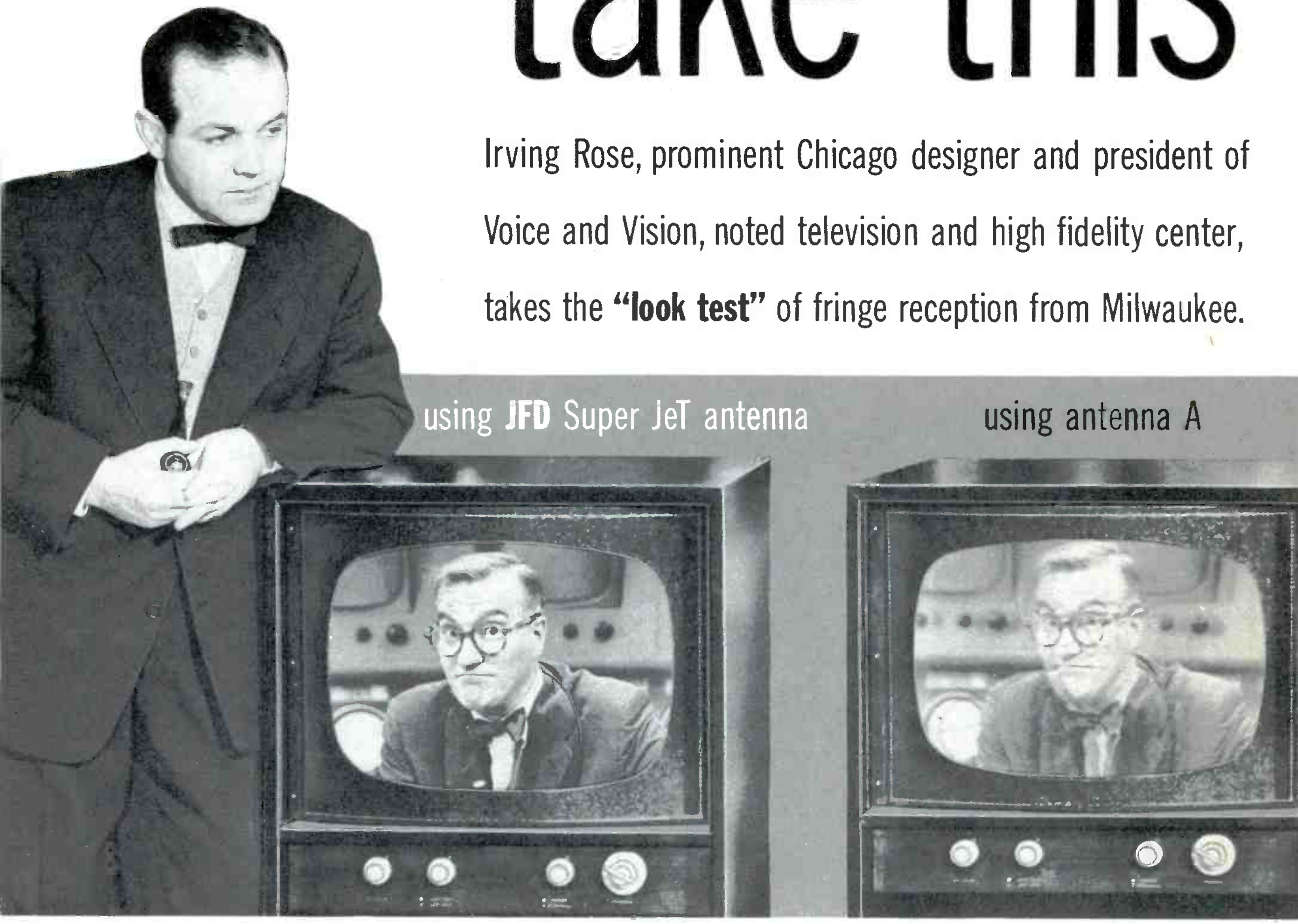


OPERATING STATIONS

Before you install another antenna

take this

Irving Rose, prominent Chicago designer and president of Voice and Vision, noted television and high fidelity center, takes the **"look test"** of fringe reception from Milwaukee.



1. Four TV receivers of one brand, same model, same production run were set up. Technicians went over these sets to make sure they were identically aligned.

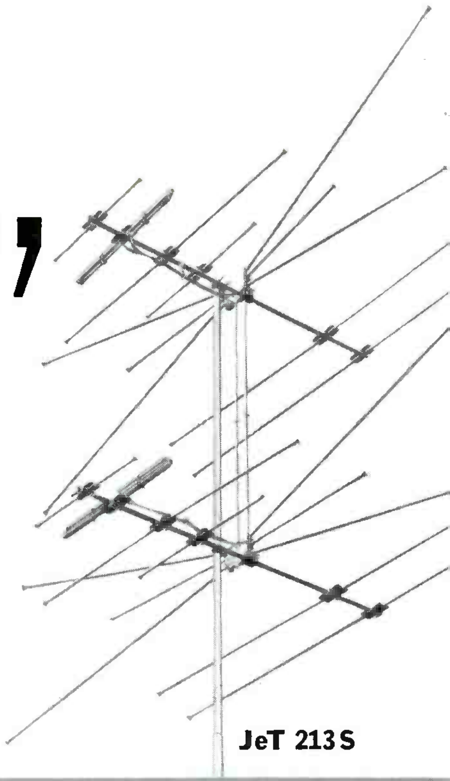
2. Three other leading high gain TV antennas were installed—each oriented for maximum performance. Each antenna was connected to a set by identical type lead-in.

3. Each receiver was tuned with infinite care to the same channel to make certain the reception was as good as possible. The picture is the proof—the result can be immediately seen—the JFD Super JeT outperformed all others.

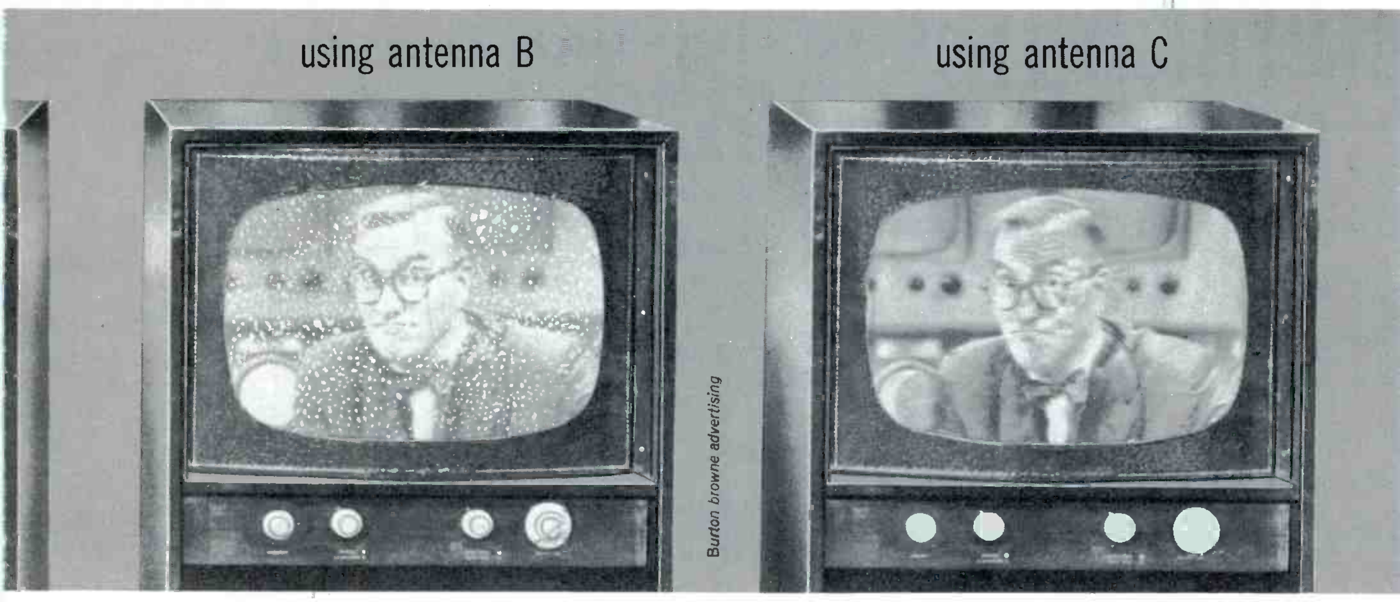
4. The chart shows why the "Look-test" is your proof positive of sharper, clearer, more brilliant pictures . . . in Black and White or Color on all channels present and future.

JeT 213 (single Bay) $20.75
JeT 213S* (2-Bay) $42.50
***complete with stacking transformer**

"look-test"



Here is your clinical proof that only the **JFD Super JeT TV antenna Out-Performs** all others on all channels



ANTENNA	LIST	CHANNELS 2	3	4	5	6	7	8	9	10	11	12	13
Competitor A Radar Screen with 3 dipoles (2-bay) Partly Pre-Assembled	$42.36	4.5	4.3	7.3	7.0	7.0	10.00	10.75	11.5	11.7	11.0	11.5	11.6
Competitor B Radar Screen with 2 dipoles (2-bay) Not Assembled	$34.95	0.75	3.25	4.5	3.5	3.5	6.0	7.0	6.5	7.75	8.0	7.5	6.0
Competitor C Bedspring (4-bay) Pre-Assembled	$55.00	4.0	5.0	7.0	6.25	5.0	5.25	6.0	5.25	7.25	9.25	6.5	7.0
JFD Superjet Model JeT 213 S (2-bay) Pre-Assembled	$42.50	6.5	7.5	9.5	8.5	8.5	11.0	11.0	12.0	12.0	11.25	11.75	12.0

DB GAIN

World's largest manufacturers of TV antennas and accessories

Write for Bulletin #230

JFD Electronics

JFD Manufacturing Company,
Brooklyn 4, N.Y.

* **EDUCATIONAL**

ALABAMA

Birmingham
- WABT Ch. 13
- WBRC-TV Ch. 6

Mobile
- WALA-TV Ch. 11
- WKAB-TV Ch. 48

Montgomery
- WCOV-TV Ch. 20

ARIZONA

Mesa
- KTYL-TV Ch. 12

Phoenix
- KOOL-TV Ch. 10
- KOY-TV Ch. 10
- KPHO-TV Ch. 5

Tucson
- KOPO-TV Ch. 13
- KVOA-TV Ch. 4

Yuma
- KIVA Ch. 11

ARKANAS

Fort Smith
- KFSA-TV Ch. 22

Little Rock
- KRTV Ch. 17

Pine Bluff
- KATV Ch. 7

CALIFORNIA

Bakersfield
- KAFY-TV Ch. 29
- KERO-TV Ch. 10

Chico
- KHSL-TV Ch. 12

Eureka
- KIEM-TV Ch. 3

Fresno
- KJEO Ch. 47
- KMJ-TV Ch. 24

Los Angeles
- KABC-TV Ch. 7
- KHJ-TV Ch. 9
- KLAC-TV Ch. 13
- KNBH Ch. 4
- KNXT Ch. 2
- *KTHE Ch. 28
- KTLA Ch. 5
- KTTV Ch. 11

Monterey
- KMBY-TV Ch. 8

Sacramento
- KCCC-TV Ch. 40

Salinas
- KSBW-TV Ch. 8

San Diego
- KFMB-TV Ch. 8
- KFSD-TV Ch. 10

San Francisco
- KGO-TV Ch. 7
- KPIX Ch. 5
- KRON-TV Ch. 4

San Luis Obispo
- KVEC-TV Ch. 6

Santa Barbara
- KEYT Ch. 3

Stockton
- KTVU Ch. 36

Tulare
- KCOK-TV Ch. 27

COLORADO

Colorado Springs
- KKTV Ch. 11
- KRDO-TV Ch. 13

Denver
- KBTV Ch. 9
- KFEL-TV Ch. 2
- KLZ-TV Ch. 7
- KOA-TV Ch. 4

Pueblo
- KCSJ-TV Ch. 5
- KDZA-TV Ch. 3

CONNECTICUT

Bridgeport
- WICC-TV Ch. 43

New Britain
- WKNB-TV Ch. 30

New Haven
- WNHC-TV Ch. 8

Waterbury
- WATR-TV Ch. 53

DELAWARE

Wilmington
- WDEL-TV Ch. 12

DIST. OF COLUMBIA

Washington
- WMAL-TV Ch. 7
- WNBW Ch. 4
- WTOP-TV Ch. 9
- WTTG Ch. 5

FLORIDA

Ft. Lauderdale
- WFTL-TV Ch. 23
- WITV Ch. 17

Jacksonville
- WJHP-TV Ch. 36
- WMBR-TV Ch. 4

Miami
- WTVJ Ch. 4

Panama City
- WJDM Ch. 7

Pensacola
- WPFA-TV Ch. 15

St. Petersburg
- WSUN-TV Ch. 38

West Palm Beach
- WIRK-TV Ch. 21

GEORGIA

Atlanta
- WAGA-TV Ch. 5
- WLWA Ch. 8
- WSB-TV Ch. 2

Augusta
- WJBF-TV Ch. 6

Columbus
- WDAK-TV Ch. 28
- WRBL-TV Ch. 4

Macon
- WETV Ch. 47
- WMAZ-TV Ch. 13

Rome
- WROM-TV Ch. 9

IDAHO

Boise
- KIDO-TV Ch. 7

Idaho Falls
- KID-TV Ch. 3

Meridian-Boise
- KBOI Ch. 2

ILLINOIS

Bloomington
- WBLN Ch. 15

Champaign
- WCIA Ch. 3

Chicago
- WBBM-TV Ch. 2
- WBKB Ch. 7
- WGN-TV Ch. 9
- WNBQ Ch. 5

Danville
- WDAN-TV Ch. 24

Decatur
- WTVP Ch. 17

Harrisburg
- WSIL-TV Ch. 22

Peoria
- WEEK-TV Ch. 43
- WTVH-TV Ch. 19

Quincy
- WGEM-TV Ch. 10

Rockford
- WREX-TV Ch. 13
- WTVO Ch. 39

Rock Island
- WHBF-TV Ch. 4

Springfield
- WICS Ch. 20

INDIANA

Bloomington
- WTTV Ch. 10

Evansville
- WFIE Ch. 62

Ft. Wayne
- WKJG-TV Ch. 33

Indianapolis
- WFBM-TV Ch. 6

Lafayette
- WFAM-TV Ch. 59

Muncie
- WLBC-TV Ch. 49

Princeton
- WRAY-TV Ch. 52

South Bend
- WSBT-TV Ch. 34

IOWA

Ames
- WOI-TV Ch. 5

Cedar Rapids
- KCRI-TV Ch. 9
- WMT-TV Ch. 2

Davenport
- WOC-TV Ch. 6

Des Moines
- KGTV Ch. 17

Ft. Dodge
- KQTV Ch. 21

Sioux City
- KVTV Ch. 9

Waterloo
- KWWL-TV Ch. 7

KANSAS

Hutchinson
- KTVH Ch. 12

Pittsburg
- KOAM-TV Ch. 7

Topeka
- WIBW-TV Ch. 13

Wichita
- KEDD Ch. 16

KENTUCKY

Henderson
- WEHT Ch. 50

Louisville
- WAVE-TV Ch. 3
- WHAS-TV Ch. 11
- WKLO-TV Ch. 21

LOUISIANA

Baton Rouge
- WAFB-TV Ch. 28

Lake Charles
- KTAG-TV Ch. 25

Monroe
- KFAZ Ch. 43
- KNOE-TV Ch. 8

New Orleans
- WDSU-TV Ch. 6
- WJMR-TV Ch. 61

Shreveport
- KSLA Ch. 12

MAINE

Bangor
- WABI-TV Ch. 5

Lewiston
- WLAM-TV Ch. 17

Portland
- WPMT Ch. 53
- WCSH-TV Ch. 6

MARYLAND

Baltimore
- WAAM Ch. 13
- WBAL-TV Ch. 11
- WMAR-TV Ch. 2

MASS.

Boston
- WBZ-TV Ch. 4
- WNAC-TV Ch. 7

Cambridge
- WTAO-TV Ch. 56

Holyoke
- WHYN-TV Ch. 55

Springfield
- WWLP Ch. 61

Worcester
- WWOR-TV Ch. 14

MICHIGAN

Ann Arbor
- WPAG-TV Ch. 20

Battle Creek
- WBKZ-TV Ch. 64

Cadillac
- WWTV Ch. 13

Detroit
- WJBK-TV Ch. 2
- WWJ-TV Ch. 4
- WXYZ-TV Ch. 7

Flint
- WTAC-TV Ch. 16

Grand Rapids
- WOOD-TV Ch. 7

Kalamazoo
- WKZO-TV Ch. 3

Lansing
- WILS-TV Ch. 54
- WJIM-TV Ch. 6

Saginaw
- WKNX-TV Ch. 57

MINNESOTA

Austin
- KMMT Ch. 6

Duluth
- WFTV Ch. 38

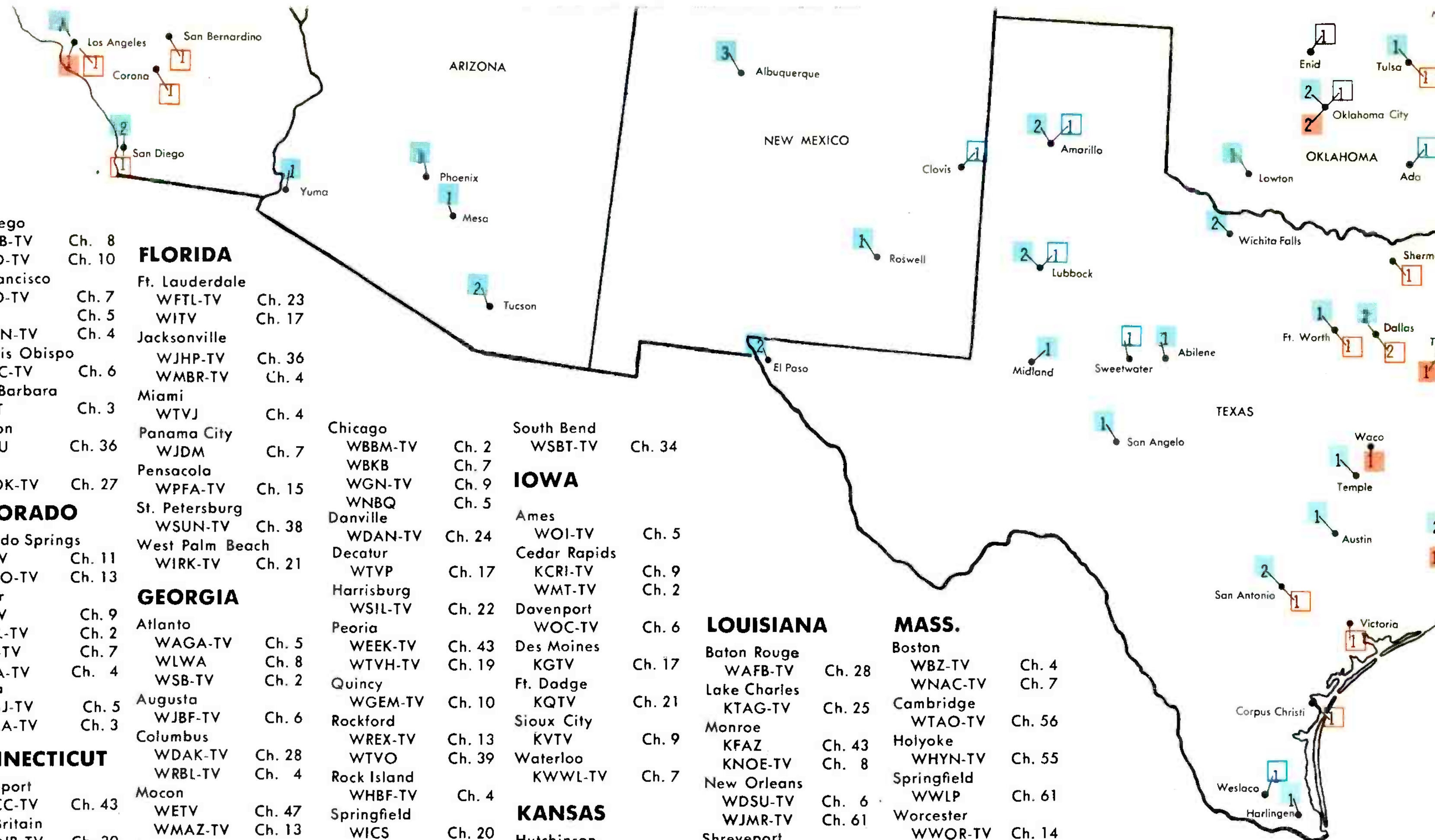
Minneapolis-St. Paul
- WCCO-TV Ch. 4
- WTCN-TV Ch. 11

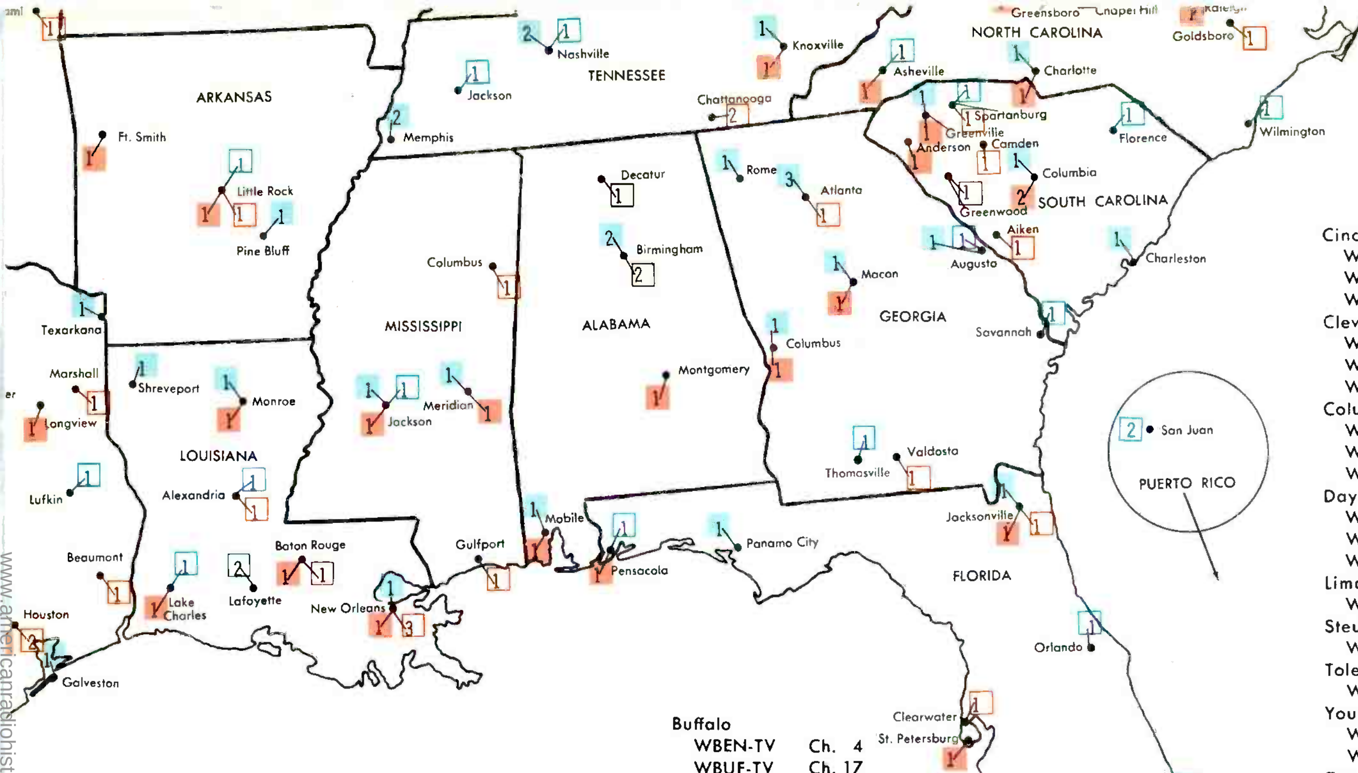
Rochester
- KROC-TV Ch. 10

St. Paul-Minneapolis
- KSTP-TV Ch. 5
- WMIN-TV Ch. 11

MISSISSIPPI

Jackson
- WJTV Ch. 25
- WLBT Ch. 3





Meridian
WCOC-TV Ch. 30
WTOK-TV Ch. 11

MISSOURI

Columbia
KOMU-TV Ch. 8
Hannibal
KHQA-TV Ch. 7
Kansas City
KCMO-TV Ch. 5
KCTY Ch. 25
KMBC-TV Ch. 9
WDAF-TV Ch. 4
WHB-TV Ch. 9
St. Joseph
KFEQ-TV Ch. 2
St. Louis
KSD-TV Ch. 5
KSTM-TV Ch. 36
St. Louis-Belleville, Ill.
WTVI Ch. 54
St. Louis-Festus
KACY Ch. 14

Springfield
KTTS-TV Ch. 10
KYTV Ch. 3

MONTANA

Billings
KOOK-TV Ch. 2
Butte
KOPR-TV Ch. 4
KXLF-TV Ch. 6

NEBRASKA

Kearney-Holdredge
KHOL-TV Ch. 13
Lincoln
KFOR-TV Ch. 10
KOLN-TV Ch. 12
Omaha
KMTV Ch. 3
WOW-TV Ch. 6

NEVADA

Las Vegas
KLAS-TV Ch. 8

Reno
KZTV Ch. 8

NEW JERSEY

Asbury Park
WRTV Ch. 58
Atlantic City
WFPG-TV Ch. 46
Newark
WATV Ch. 13

NEW MEXICO

Albuquerque
KGGM-TV Ch. 13
KOAT-TV Ch. 7
KOB-TV Ch. 4
Roswell
KSWS-TV Ch. 8

NEW YORK

Albany
WROW-TV Ch. 41
Binghamton
WNBF-TV Ch. 12

Buffalo
WBEN-TV Ch. 4
WBUF-TV Ch. 17
Elmira
WECT Ch. 18
WTVE Ch. 24
New York
WABC-TV Ch. 7
WABD Ch. 5
WCBS-TV Ch. 2
WNBT Ch. 4
WOR-TV Ch. 9
WPIX Ch. 11
Rochester
WHAM-TV Ch. 6
WHEC-TV Ch. 10
WVET-TV Ch. 10
Schenectady
WRGB Ch. 4
Syracuse
WHEN Ch. 8
WSYR-TV Ch. 3
Utica
WKTV Ch. 13

N. CAROLINA

Asheville
WISE-TV Ch. 62

Charlotte
WAYS-TV Ch. 36
WBTV Ch. 3
Greensboro
WFMY-TV Ch. 2
Greenville
WNCT Ch. 9
Raleigh
WNAO-TV Ch. 28
Winston-Salem
WSJS-TV Ch. 12
WTOB-TV Ch. 26

N. DAKOTA

Bismarck
KFYR-TV Ch. 5
Fargo
WDAY-TV Ch. 6
Minot
KCJB-TV Ch. 13

OHIO

Akron
WAKR-TV Ch. 49
Ashtabula
WICA-TV Ch. 15

Cincinnati
WCPO-TV Ch. 9
WKRC-TV Ch. 12
WLWT Ch. 5
Cleveland
WEWS Ch. 5
WNBK Ch. 4
WXEL Ch. 9
Columbus
WBNS-TV Ch. 10
WLWC Ch. 4
WTVN Ch. 6
Dayton
WHIO-TV Ch. 7
WIFE Ch. 22
WLWD Ch. 2
Lima
WLOK-TV Ch. 73
Steubenville
WSTV-TV Ch. 9
Toledo
WSPD-TV Ch. 13
Youngstown
WFMJ-TV Ch. 73
WKBN-TV Ch. 27
Zanesville
WHIZ-TV Ch. 50

OKLAHOMA

Lowton
KSWO-TV Ch. 7
Oklahoma City
KLPR-TV Ch. 19
KTVQ Ch. 25
KWTV Ch. 9
WKY-TV Ch. 4
Tulsa
KOTV Ch. 6

OREGON

Medford
KBES-TV Ch. 5
Portland
KOIN-TV Ch. 6
KPTV Ch. 27

PENN.

Altoona
WFBG-TV Ch. 10
Bethlehem
WLEV-TV Ch. 51

New Castle
WKST-TV Ch. 45
Philadelphia
WCAU-TV Ch. 10
WFIL-TV Ch. 6
WPTZ Ch. 3
Pittsburgh
WDTV Ch. 2
WENS Ch. 16
WKJF-TV Ch. 53
Reading
WEEU-TV Ch. 33
WHUM-TV Ch. 61
Scranton
WGBI-TV Ch. 22
WTVU Ch. 73
Wilkes-Barre
WBRE-TV Ch. 28
WILK-TV Ch. 34
York
WNOW-TV Ch. 49
WSBA-TV Ch. 43

RHODE ISLAND

Providence
WJAR-TV Ch. 10

S. CAROLINA

Anderson
WAIM-TV Ch. 40
Charleston
WCSC-TV Ch. 5
Columbia
WCOS-TV Ch. 25
WIS-TV Ch. 10
WNOK-TV Ch. 67
Greenville
WFBC-TV Ch. 4
WGVL Ch. 23

S. DAKOTA

Sioux Falls
KELO-TV Ch. 11

TENNESSEE

Johnson City
WJHL-TV Ch. 11
Knoxville
WROL-TV Ch. 6
WTSK-TV Ch. 26
Memphis
WHBQ-TV Ch. 13
WMCT Ch. 5
Nashville
WSIX-TV Ch. 8
WSM-TV Ch. 4

TEXAS

Abilene
KRBC-TV Ch. 9

Norfolk
WTAR-TV Ch. 4
WTOV-TV Ch. 27
Richmond
WTVR Ch. 6
Roanoke
WSLS-TV Ch. 10

WASHINGTON

Bellingham
KVOS-TV Ch. 12
Seattle
KING-TV Ch. 5
KOMO-TV Ch. 4
Spokane
KHQ-TV Ch. 6
KXLY-TV Ch. 4
Tacoma
KMO-TV Ch. 13
KTNT-TV Ch. 11
Yakima
KIMA-TV Ch. 29

WEST VIRGINIA

Charleston
WKNA-TV Ch. 49
Huntington
WSAZ-TV Ch. 3
Parkersburg
WTAP Ch. 15
Wheeling
WTRF-TV Ch. 7

WISCONSIN

Eau Claire
WEAU-TV Ch. 13
Green Bay
WBAY-TV Ch. 2
Madison
WKOW-TV Ch. 27
WMTV Ch. 33
Milwaukee
WCAN-TV Ch. 25
WOKY-TV Ch. 19
WTMJ-TV Ch. 4
Neenah
WNAM-TV Ch. 42
Oshkosh
WOSH-TV Ch. 48

ALASKA

Anchorage
KFIA Ch. 2
KTVA Ch. 11

HAWAII

Honolulu
KGMB-TV Ch. 9
KONA Ch. 11

Additional copies of this map may be obtained from JFD Manufacturing Co., Inc. Brooklyn 4, N. Y.

STATUS OF TV BROADCAST OPERATIONS

CONSTRUCTION PERMITS

ALABAMA
Birmingham
- WJLN-TV Ch. 48
- WSGN-TV Ch. 42

Decatur
- WMSL-TV Ch. 23

ARKANSAS
Little Rock
- KARK-TV Ch. 4
- KETV Ch. 23

CALIFORNIA
Berkeley
- *KQED Ch. 9

Corona
- KCOA Ch. 52

Fresno
- KBID Ch. 53

Los Angeles
- KBIC-TV Ch. 22

Merced
- KMER Ch. 34

Sacramento
- KBIK-TV Ch. 46

San Bernardino
- KITO-TV Ch. 18

San Diego
- Ch. 21

San Francisco
- KBAY-TV Ch. 20
- KSAN-TV Ch. 32

San Jose
- KVIE Ch. 48

Yuba City
- KAGR-TV Ch. 52

COLORADO
Denver
- *KRMA-TV Ch. 6

Grand Junction
- KFXJ-TV Ch. 5

CONNECTICUT
Bridgeport
- *WCBE Ch. 71
- WSJL Ch. 49

Hartford
- *WCHF Ch. 24
- WGTH-TV Ch. 18

New Haven
- WELI-TV Ch. 59

New London
- WNLC-TV Ch. 26

Norwich
- *WCNE Ch. 63

Stamford
- WSTF Ch. 27

DELAWARE
Dover
- WHRN Ch. 40

Wilmington
- WILM-TV Ch. 83

FLORIDA
Clearwater
- Ch. 32

Fort Myers
- WINK-TV Ch. 11

Jacksonville
- WOBS-TV Ch. 30

Miami
- Ch. 33
- WMIE-TV Ch. 27
- *WTHS-TV Ch. 2

Orlando
- WDBO-TV Ch. 6

Pensacola
- WEAR-TV Ch. 3

West Palm Beach
- WJNO-TV Ch. 5

GEORGIA
Atlanta
- WQXI-TV Ch. 36

Augusta
- WRDW-TV Ch. 12

Savannah
- WTOC-TV Ch. 11

Thomasville
- Ch. 6

Valdosta
- WGOV-TV Ch. 37

IDAHO
Boise
- KTVI Ch. 9

Idaho Falls
- KIFT Ch. 8

Nampa
- KFXD-TV Ch. 6

Pocatello
- KISJ Ch. 6
- KWIK-TV Ch. 10

Twin Falls
- KLIX-TV Ch. 11

ILLINOIS
Champaign
- WCUI Ch. 21

Champaign-Urbana
- *WTLC Ch. 12

Chicago
- WHFC-TV Ch. 26
- WIND-TV Ch. 20
- * Ch. 11

Evanston
- WTLE Ch. 32

Joliet
- WJOL-TV Ch. 48

INDIANA
Elkhart
- WSJV Ch. 52

Indianapolis
- WJRE Ch. 26

Marion
- WMRI-TV Ch. 29

Terre Haute
- WTHI-TV Ch. 10

Waterloo
- WINT Ch. 15

IOWA
Cedar Rapids
- KEYC Ch. 20

Des Moines
- WHO-TV Ch. 13

Mason City
- KGLO-TV Ch. 3

Sioux City
- KCTV Ch. 36

KANSAS
Manhattan
- *KSAC-TV Ch. 8

Topeka
- KTKA Ch. 42

KENTUCKY
Ashland
- WPTV Ch. 59

Lexington
- WLAP-TV Ch. 27

Louisville
- WLOU-TV Ch. 41

Newport
- WNOP-TV Ch. 74

Paducah
- WTLK Ch. 43

LOUISIANA
Alexandria
- KSPJ Ch. 62
- Ch. 5

Baton Rouge
- KHTV Ch. 40

Lafayette
- KLFY-TV Ch. 10
- KVOL-TV Ch. 10

Lake Charles
- KPLC-TV Ch. 7

New Orleans
- WCKG Ch. 26
- WCNO-TV Ch. 32
- WTLO Ch. 20

MAINE
Poland
- WMTW Ch. 8

Portland
- WGAN-TV Ch. 13

MARYLAND
Baltimore
- WSID-TV Ch. 18
- WITH-TV Ch. 60

Cumberland
- WTBO-TV Ch. 17

Salisbury
- WBOC-TV Ch. 16

MASS.
Adams
- WMGT Ch. 74

Boston
- WBOS-TV Ch. 50
- *WGBH-TV Ch. 2
- WJDW Ch. 44

Brockton
- WHEF-TV Ch. 62

Lawrence
- WGLM Ch. 72

New Bedford
- WTEV Ch. 28

Pittsfield
- WBEC-TV Ch. 64

Worcester
- WAAB-TV Ch. 20

MICHIGAN
Ann Arbor
- *WUOM-TV Ch. 26

Battle Creek
- WBCK-TV Ch. 58

Bay City
- WNEM-TV Ch. 5

Benton Harbor
- WHFB-TV Ch. 42

Detroit
- Ch. 62

East Lansing
- WKAR-TV Ch. 60

Muskegon
- WTVM Ch. 35

Saginaw
- WSBM-TV Ch. 51

Traverse City
- WPBN-TV Ch. 7

MINNESOTA
Duluth-Superior
- WDSM-TV Ch. 6

Duluth
- KDAL-TV Ch. 3

St. Paul
- WCOW-TV Ch. 17

MISSISSIPPI
Columbus
- WCBI-TV Ch. 28

Gulfport
- WGCM-TV Ch. 56

Jackson
- WSLI-TV Ch. 12

MISSOURI
Cape Girardeau
- KFVS-TV Ch. 12
- KGMO-TV Ch. 18

Clayton
- KFUO-TV Ch. 30

Joplin
- KSWM-TV Ch. 12

Kirksville
- KBIZ-TV Ch. 3

St. Louis
- *KETC Ch. 9
- WIL-TV Ch. 42

Sedalia
- KDRO-TV Ch. 6

MONTANA
Billings
- KRHT Ch. 8

Great Falls
- KFBB-TV Ch. 5
- KMON-TV Ch. 3

Missoula
- KGVO-TV Ch. 13

N. HAMPSHIRE
Keene
- WKNE-TV Ch. 45

Manchester
- WMUR-TV Ch. 9

NEW JERSEY
Atlantic City
- WOCN Ch. 52

New Brunswick
- WDHN Ch. 47
- *WTLV Ch. 19

Trenton
- WTTM-TV Ch. 41

NEW MEXICO
Clovis
- KNEH Ch. 12

NEW YORK
Albany
- WPTR-TV Ch. 23
- *WTVZ Ch. 17

Binghamton
- *WQTV Ch. 46

Bloomingdale
- WIRY-TV Ch. 5

Buffalo
- *WTVF Ch. 23

Ithaca
- WHCU-TV Ch. 20
- *WIET Ch. 14

Jamestown
- WJTN-TV Ch. 58

Kingston
- WKNY-TV Ch. 66

New York
- *WGTV Ch. 25

Poughkeepsie
- WEOK-TV Ch. 21

Rochester
- WCBF-TV Ch. 15
- WRNY-TV Ch. 27
- *WROH Ch. 21

Schenectody
- WTRI Ch. 35

Syracuse
- *WHTV Ch. 43

Utica
- WFRB Ch. 19

Watertown
- WWNY-TV Ch. 48

N. CAROLINA
Asheville
- WLOS-TV Ch. 13

Chapel Hill
- *WUNC-TV Ch. 4

Durham
- WCIG-TV Ch. 46

Goldsboro
- WTVX Ch. 34

Greensboro
- WCOG-TV Ch. 57

Mt. Airy
- WPAQ-TV Ch. 55

Wilmington
- WMFD-TV Ch. 6

N. DAKOTA
Valley City
- KXJB-TV Ch. 4

OHIO
Cincinnati
- *WCET Ch. 48
- WCIN-TV Ch. 54

Cleveland
- WERE-TV Ch. 65
- WHK-TV Ch. 19

Columbus
- *WOSU-TV Ch. 34

Lima
- WIMA-TV Ch. 35

Massillon
- WMAC-TV Ch. 23

Youngstown
- WUTV Ch. 21

OKLAHOMA
Ada
- KEOK Ch. 10

Enid
- Ch. 5

Miami
- KMIV Ch. 58

Oklahoma City
- * Ch. 13

Tulsa
- KCEB Ch. 23

OREGON
Eugene
- KVAL-TV Ch. 13

Salem
- KPIC Ch. 24
- KSLM-TV Ch. 3

PENN.
Allentown
- WFMZ-TV Ch. 67
- WQCY Ch. 39

Erie
- WSEE Ch. 35
- Ch. 66

Harrisburg
- WCMB-TV Ch. 27

Hazelton
- WAZL-TV Ch. 63

Lancaster
- WWLA Ch. 21

Lewistown
- WMRF-TV Ch. 38

Philadelphia
- WIBG-TV Ch. 23
- WIP-TV Ch. 29

Pittsburgh
- *WQED Ch. 13
- WTVQ Ch. 47

Scranton
- WARM-TV Ch. 16

Williamsport
- WRAK-TV Ch. 36

RHODE ISLAND
Providence
- WNET Ch. 16
- WPRO-TV Ch. 12

S. CAROLINA
Aiken
- WAKN-TV Ch. 54

Camden
- WACA-TV Ch. 14

Florence
- WPDV Ch. 8

Greenwood
- WCRS-TV Ch. 21

Spartanburg
- WORD-TV Ch. 7
- WSCV Ch. 17

TENNESSEE
Chattanooga
- WOUC Ch. 49
- WTVT Ch. 43

Jackson
- WDXI-TV Ch. 9

Nashville
- WLAC-TV Ch. 5

TEXAS
Amarillo
- KLYN-TV Ch. 7

Beaumont
- KBMT Ch. 31

Corpus Christi
- Ch. 43

Dallas
- KDTX Ch. 23
- KLIF-TV Ch. 29

Fort Worth
- KTCO Ch. 20

Houston
- KTVP Ch. 23
- KXYZ-TV Ch. 29

Lubbock
- KFYO-TV Ch. 5

Lufkin
- KTRE-TV Ch. 9

Marshall
- KMSL Ch. 16

San Antonio
- KALA Ch. 35

Sherman
- KSHM Ch. 46

Sweetwater
- KPAR-TV Ch. 12

Victoria
- KNAL-TV Ch. 19

Weslaco
- KRGV-TV Ch. 5

UTAH
Provo
- KOVO-TV Ch. 11

Salt Lake City
- KUTV Ch. 2

VIRGINIA
Charlottesville
- WCHV-TV Ch. 64

Danville
- WBTM-TV Ch. 24

Marion
- WMEV-TV Ch. 50

Richmond
- Ch. 29

WASHINGTON
Seattle
- *KUOW Ch. 9

Vancouver
- KVAN-TV Ch. 21

W. VIRGINIA
Beckley
- WBEY Ch. 21

Fairmont
- WJPB-TV Ch. 35

Wheeling
- WLTV Ch. 51

WISCONSIN
LaCrosse
- WKBT Ch. 8
- Ch. 38

Madison
- *WHA-TV Ch. 21

Marinette
- WMAM-TV Ch. 11

WYOMING
Casper
- KSPR-TV Ch. 2

Cheyenne
- KFBC-TV Ch. 5

ALASKA
Fairbanks
- KFIF Ch. 2

HAWAII
Honolulu
- KULA-TV Ch. 4

PUERTO RICO
San Juan
- WAPA-TV Ch. 4
- WKAQ-TV Ch. 2

For log of OPERATING STATIONS and TV MAP, see reverse side. * EDUCATIONAL

PF INDEX LITERATURE SERVICE

Valuable Manufacturers' Data Available to Our Readers

Many of the advertisers in PF INDEX have prepared useful, informative literature and aids covering their products. Much of this data is of great help to the TV-Radio Service Technician. You can obtain this valuable material quickly and conveniently by using the handy order form below. Simply check the items you want to receive. Then fill in your name and address (see other side) and mail this form back to us. We'll do the rest—as another PHOTOFACT service to you. There's no CHARGE, of course.

(CUT ALONG DOTTED LINE TO REMOVE)

CHECK THE LITERATURE YOU WANT — SIGN AND RETURN THIS FORM TO HOWARD W. SAMS & CO., INC.

ALL CHANNEL (All Channel Antenna Corp.)

☐ Catalog. *See advertisement page* 65.

ALLIANCE (The Alliance Manufacturing Co.)

☐ Replacement Parts and Price Lists for Alliance Tenna-Rotors. *See advertisement page* 46.

ASTATIC (The Astatic Corporation)

☐ UHF Converter Literature Forms No. S-243 and No. S-244. *See advertisements pages* 48 & 64.

BLONDER-TONGUE (Blonder-Tongue Labs., Inc.)

☐ How to Install Master TV Systems and UHF Converters, including TV Calculator. *See advertisement page* 50.

BUSS (Bussmann Manufacturing Co.)

☐ 1953 TV Fuse List. *See advertisement page* 8.

CBS-HYTRON (CBS-Hytron, a Division of Columbia Broadcasting System, Inc.)

☐ CBS-Hytron Business Builders. (A Complete Illustrated Catalog of Sales Promotional Material, Technical Literature, Service Tools, etc.) *See advertisement page* 10.

C-D (Cornell-Dubilier Electric Corp.)

☐ C-D Capacitor Service Replacement Guide, 200-D. *See advertisement page* 63.

CENTRALAB (A Division of Globe-Union, Inc.)

☐ Printed Electronic Circuit Guide No. 3, plus 32 page index to complete line of ceramic capacitors, controls, switches, and printed electronic circuits. *See advertisement page* 4.

CHICAGO STANDARD (Chicago Standard Transformer Corp.)

☐ 1954 TV Transformer Replacement Guide and Reference Library. *See advertisement page* 20.

CLAROSTAT (Clarostat Mfg. Co., Inc.)

☐ New 1954 General Catalog. *See advertisement page* 87.

ELECTRO PRODUCTS (Electro Products Labs., Inc.)

☐ New Model D-612 Low Cost 6 & 12 Volt D.C. Power Supply.

ELECTRO-VOICE (Electro-Voice, Inc.)

☐ Revised Electro-Voice Bulletin 170-A Phono-Cartridge Replacement Chart. Complete Cross-Reference of Cartridge Interchangeability, Including Specification Table. *See advertisement page* 72.

EQUIPTO (Equipto Div. Aurora Equip. Co.)

☐ Electronic Part Storage Catalog.

ERIE (Erie Resistor Corporation)

☐ New Switch Catalog, Detailing General Purpose Single and Multi-Section and Lever Action Switches.

FEDERAL (Federal Telephone and Radio Co., Divison of IT&T)

☐ Portfolio Selenium Rectifiers, Descriptive Material, Technical Data and Application, Form F-535, Federal's Quality Controlled Cable. *See advertisement page* 26.

G-C (General Cement Mfg. Co.)

☐ New G-C No. 156 Catalog.

GRANCO (Granco Products, Inc.)

☐ Brochure Describing All-Channel UHF Converters Models LCU, MTU and HT-5.

HALLDORSON (Halldorson Transformer Co.)

☐ Transformer Catalog and Latest TV Release Bulletins.

HICKOK (The Hickok Electrical Instrument Co.)

☐ New Radio-TV Test Instrument Catalog No. 29, Covering Complete Line of Radio-TV, AM-FM, VHF, UHF, Test Equipment. *See advertisement page* 14.

IRC (International Resistance Co.)

☐ Form S-057D-DC1D. *See advertisement 2nd Cover.*

ITI (Industrial Television, Inc.)

☐ UHF Autobooster & Accessories Specification Sheet.

JENSEN (Jensen Industries, Inc.)

☐ Jenselector. *See advertisement page* 82.

JFD (JFD Manufacturing Co.)

☐ JFD PAL Stand-off Insulator plus 1954 42-Page Television Antenna, Mast, Mount, Wire and Accessory Handbook. *See advertisements, Map Insert.*

KNIGHTS (James Knights Co.)

☐ Catalog Quartz Crystals.

KWIKHEAT (Kwikheat Mfg. Co.)

☐ Catalog Kwikheat Thermostatically Controlled Soldering Irons.

OVER

MALLORY (P. R. Mallory & Co., Inc.)

☐ Guide to Auto Radio Replacement Controls. *See advertisement page* 18.

MILLER (J. W. Miller Co.)

☐ No. 154 Television Coil Replacement Guide.

OXFORD (Oxford Electric Corp.)

☐ Catalog Listing Complete Standard Replacement Line of Oxford Speakers. *See advertisement page* 76.

PYRAMID (Pyramid Electric Company)

☐ New Catalog DE. Lists 272 New Dry Electric Capacitors. *See advertisement page* 54.

QUAM (Quam-Nichols Co.)

☐ Quam Speaker and Output Transformer Catalog. *See advertisement page* 62.

RADIART (The Radiart Corporation)

☐ CDR Rotor Catalog. *See advertisement pages* 40 & 41.

RADIO'S MASTER (United Catalog Publishers, Inc.)

☐ Handy "Little Master" Containing Catalog Data on Hundreds of Popular Products Sold by the Leading Manufacturers. *See advertisement page* 76.

RCA (Radio Corporation of America)

☐ How to Trouble-Shoot TV and Radio Sets with an RF Signal Generator, plus "Tell and Sell" Brochure No. 3F171, plus Speaker Catalog No. 3F687. *See advertisements pages* 22 & 70.

REGENCY (Division I.D.E.A., Inc.)

☐ All Products Folder. *See advertisement page* 1.

ROHN (Rohn Manufacturing Company)

☐ Catalog of Complete Line of Rohn TV and Communication Towers, Fold-over Towers, Telescoping Masts, and Installation Accessories.

SAMS (Howard W. Sams & Co., Inc.)

☐ Complete Information on How to Own PHOTOFACT Folders in a 4-Drawer Steel File or DeLuxe Binders on a Time-Payment Basis. *See advertisement page* 74.

SHURE (Shure Bros., Inc.)

☐ General Catalog 44A.

SPRAGUE (Sprague Products Co.)

☐ Bulletin M-600 Describing New Kwik-Test Capacitor Checker for Determining Opens, Shorts and Intermittents without Unsoldering Capacitors from Circuit. *See advertisement page* 2.

STANDARD (Standard Coil Products Co.)

☐ Brochure Providing Complete Technical Information and Schematic Diagrams for Installation of Standard Tuners and Strips. *See advertisement page* 32.

TELE-BEAM (Tele-Beam Industries)

☐ Latest Catalog on Saber Comet All-Channel Antenna.

TELEMATIC (Telematic Industries, Inc.)

☐ TVI Interference Booklet.

TITONE (Sonotone Corporation)

☐ Titone Ceramic Pickup Descriptive Folder SA-84, plus Titone Pickup Replacement Chart SA-91. *See advertisement page* 56.

TODD (Todd-Tran Corp.)

☐ Television Components Catalog and Replacement Guide.

TRIAD (Triad Transformer Corp.)

☐ TR-54 Transformer Catalog.

TRIPLETT (Triplett Electrical Instrument Co.)

☐ Brochure Describing Model 3436 UHF Marker and Signal Generator.

V-M (V-M Corporation)

☐ V-M Tri-o-matic Record Changers and Changer Attachments. *See advertisement page* 66.

WARD (The Ward Products Corp.)

☐ Televanes—54-245, Tower Jack—54-248, Indoor Can-Can—54-247. *See advertisement page* 30.

WEBSTER (Webster Electric Co.)

☐ Featheride Replacement Chart YF-2, plus Details of Special Dispenser Offer. *See advertisement page* 36.

XCELITE (Xcelite, Incorporated)

☐ Complete Catalog of Screwdrivers, Nut Drivers, Pliers, Tool Kits. *See advertisement page* 80.

(CUT ALONG DOTTED LINE TO REMOVE)

MAIL TO

HOWARD W. SAMS & CO., INC.
2201 East 46th Street, Indianapolis 5, Indiana

☐ I have previously requested literature from your earlier Free Literature Offers.

☐ This is my first request for Free Literature.

PLEASE PRINT OR TYPE

Name ....

Company ....

Address ....

City .... Zone .... State ....

Has your address changed since you last wrote us?
If so, write in old address here ....

You can't do without...

SYLVANIA'S SEE-WELL TOOL KIT

A NEW, TIME-SAVING TOOL-SENSATION!

YOUR 3 MOST NEEDED TOOLS IN 1 KIT—MAGNETIC PHILLIPS AND FLATHEAD SCREWDRIVERS, NYLON ALIGNMENT TOOL—**PLUS** POWERFUL FLASHLIGHT!

This **$7.95 VALUE** for only 15 Sylvania Premium Tokens.

NO MORE FUMBLING inside dark radio and TV cabinets. At the flick of a switch, a bright light automatically focuses right at the spot you're seeking. Saves your time . . . improves your work.

3 Handy Tools in 1. Magnetized Phillips and Flathead screwdrivers, nylon alignment tool—all 3 built into break-resistant lucite shafts perfectly fitted to flashlight handle.

Without doubt, this SEE-WELL Tool Kit is one of the slickest, quickest service tools ever built!

See your Sylvania Distributor Today! He has this remarkable tool kit for you now—you need only 15 Sylvania Premium Tokens. The time to get this valuable Sylvania See-Well Tool Kit is NOW—so don't delay, order high quality Sylvania tubes TODAY.

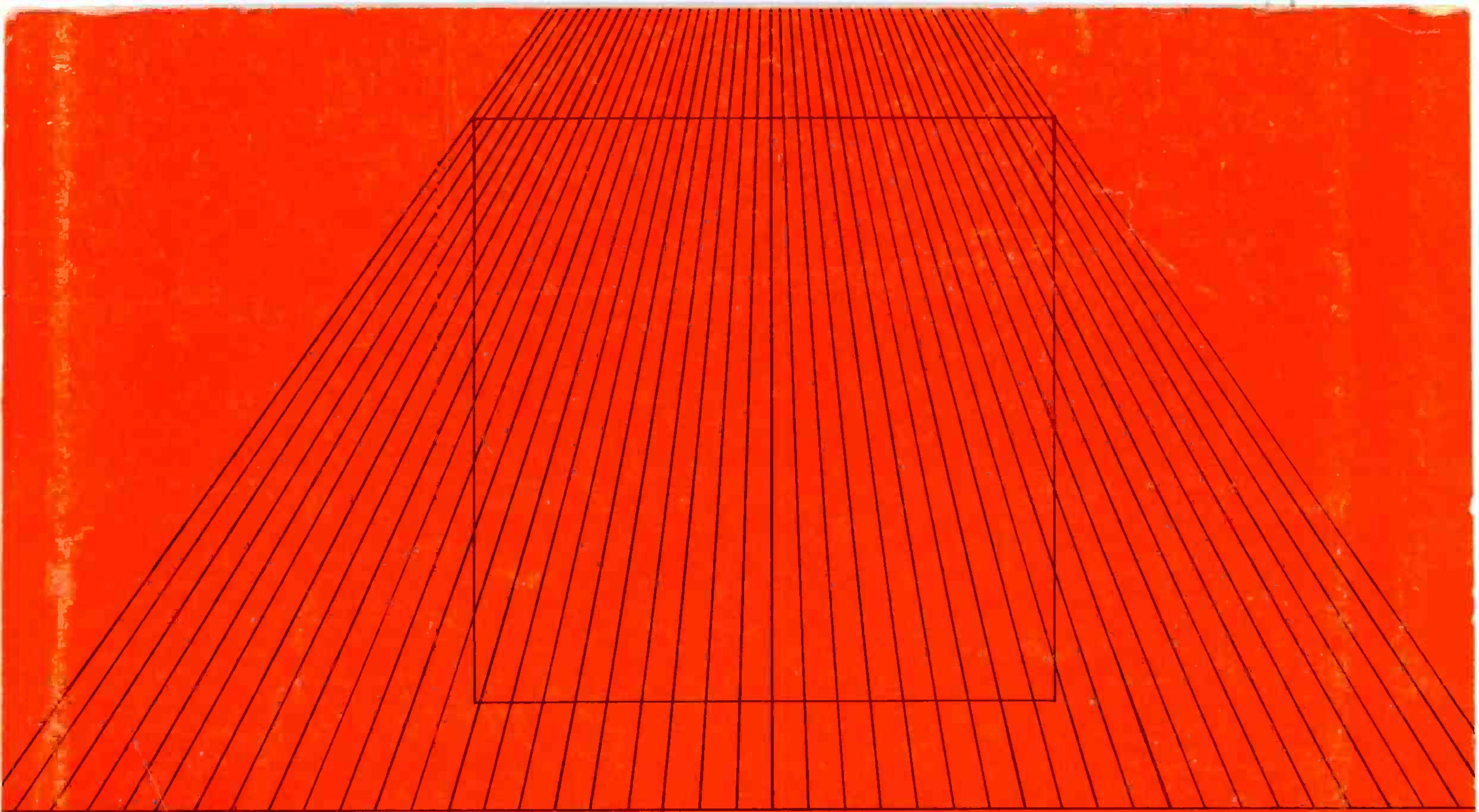
Remember, you get 1 token with every 25 Sylvania Receiving Tubes or every Sylvania TV Picture Tube you buy.

SYLVANIA

Sylvania Electric Products Inc., Dept. 4R-2902, 1740 Broadway, New York 19, N. Y.

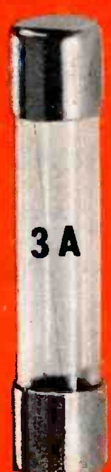
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION



THINGS ARE NOT AS THEY SEEM...

This *is* a perfect square.
It is an optical illusion that the sides bend.



3 amps fuse will not blow at 3 amps.

Fuses are not rated by the current at which they blow. Fuses are rated by the maximum current they should carry indefinitely.

Each type of fuse blows according to the requirements of the equipment it was designed to protect.

Littelfuse has cooperated with NEC, Underwriters, Armed Forces MIL Specs Committees in establishing the characteristics of the various fuse types.

Littelfuse holds more design patents on fuses than all other manufacturers combined.

3 AG "SLO-BLO"

3 AB

8 AG U/L

1 AG

4 AG ANTI-VIBRATION

LITTELFUSE

DES PLAINES, ILLINOIS